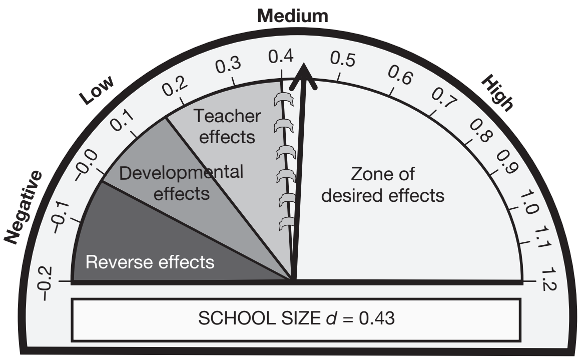


KEY	
Standard error	na
Rank	59th
Number of meta-analyses	1
Number of studies	21
Number of effects	120
Number of people (0)	na

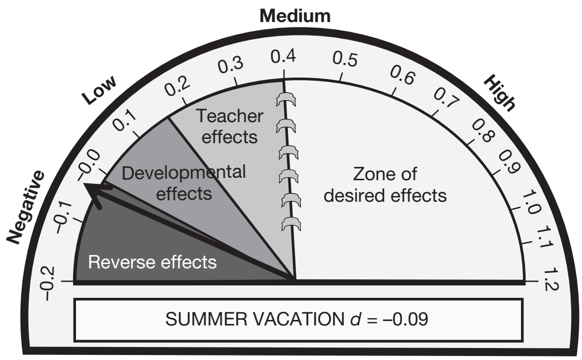
appears that increasing enrollment correlates positively with higher test scores. Consolidating very small (high schools) may be more important than consolidating large ones" (Stekelenburg, 1991, p. 111).

There is thus a message about an "optimal" size, and too small or too large may reduce effectiveness. Ready, Lee, and Welner (2004) explored the effects of school size across more than 800 schools and concluded that achievement gains in mathematics and reading over the course of high school were largest in middle-sized high schools (600–900 students). Similarly, Lee and Smith (1997) found that achievement gains in mathematics and reading over the course of high school were largest in middle-sized high schools (600–800 students). There is an important moderator to this conclusion about optimal school size; the more affluent a school's student cohort then the larger the optimal size, and the higher the proportion of minority students then the smaller the optimal size (Howley & Bickel, 1999; Lee & Smith, 1997). In other organizations there also appears to be a curvilinear relation between size and outcomes: Gooding and Wagner (1985) conducted a meta-analysis of 31 studies of the relationship between organizational size and economic efficacy. After a certain size, they found that increasing the size of a business increased total output but the ratio of output to input typically remained the same, particularly in organizations that depended primarily on human effort, such as schools. A major reason was the increased coordination costs with no return in extra benefits.

Newman *et al.* (2006) reported that teachers and students at smaller schools are more likely to have positive perceptions of their school environment, although costs per student decrease as school size increases. Lee and Smith (1993; 1997) found that in high schools of between 600 to 900 students, there was more teacher collaboration and team teaching, and teachers had more input into decisions affecting their work. Bryk, Easton, Kerbow, Rollow, and Sebring (1993) added other reasons such as better personal social interactions among students and faculty, more leadership experience for students, and a feeling by students that teachers are more interested in them. Perhaps among the more important reasons are that schools with 600 to 900 students typically offer strong core curriculum to all students and there is less likelihood of using electives to stream and dilute the curriculum (cf. Walberg & Walberg, 1994).

Summer vacation

In the early years of formal schooling in America, the school calendar (including the long summer break) was designed to meet the needs of agricultural communities (Cooper, Nye,



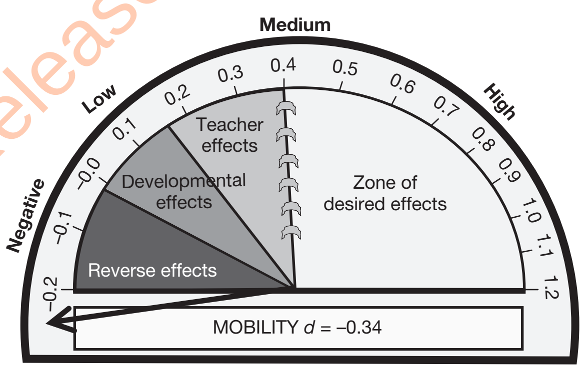
KEY	
Standard error	na
Rank	134th
Number of meta-analyses	1
Number of studies	39
Number of effects	62
Number of people (0)	na

Charlton, Lindsay, & Greathouse, 1996). Today with only about three percent of American's livelihood being linked to agricultural cycles, there have been calls for change to lessen the effect of the long break on learning and on the retention and acquisition of knowledge. Supporters of change consider a three-month break too long as children learn best when learning is continuous, and the break means significant time needs to be spent reviewing previous material in order for learning to commence again (Cooper *et al.*, 1996).

On average, this meta-analysis showed students lost some achievement gains over the summer ($d = -0.09$), and the effects were slightly larger in mathematics ($d = -0.14$) than in reading and language ($d = -0.05$, Cooper *et al.*, 1996). Compared to all other effects, these are minor indeed. Middle class students appeared to gain on grade-level equivalent reading recognition tests over summer ($d = 0.13$) compared to lower class students ($d = -0.14$). There were no moderating effects for gender or race but the negative effect of summer did increase with grade level (see also Burkam, Ready, Lee, & LoGerfo, 2004). It may be that if teachers were more attuned to the proficiencies that students bring into their classrooms, then the first month of the school year could be used to recapture the losses from the summer break reasonably quickly.

Mobility

The effect of student mobility between schools a quite marked. Transience, or mobility across schools, has become a major trend in recent decades. In New Zealand, for example, 40 percent of all students change schools each year (including moving from elementary to



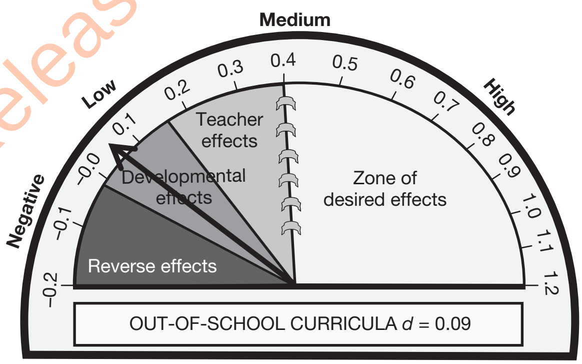
KEY	
Standard error	0.005 (Low)
Rank	138th
Number of meta-analyses	3
Number of studies	181
Number of effects	540
Number of people (1)	185,635

middle, from middle to high and more recently from junior to senior high schools), and in the United States, 20 percent change residence each year. The effects of such mobility on reading and mathematics are negative (Mehana, 1997, $d = -0.27$ vs. $d = -0.22$). Jones (1989), who found similar effects, argued that it was *any* changing of schools that made the negative effect, as mobility was not negatively related to the total number of moves, nor to socioeconomic status or ethnicity.

The reasons for this decline may be many, but a most important cause relates to peer effects. Galton and Willcocks (1983) followed students longitudinally and every change of school caused negative effects. They noted that typically there were adjustment issues, including problems with friendship patterns, particularly friendships to support learning. Whenever there is a major transition in schools, then the key success factor is whether a child makes a friend in the first month (cf., Galton, 1995; Pratt & George, 2005). It is incumbent, therefore, for schools to attend to student friendships and ensure the class makes newcomers welcomed, if this marked decline from mobility is to be reduced.

Out-of-school curriculum experiences

Children have more discretionary time outside school hours than ever before. Some parents worry that out-of-school experiences can involve harm (such as participation in drugs and other non-social activities) or can be non-productive (watching television, playing computer games). Other parents make their children attend private tutor courses, and there has been a remarkable increase in the prevalence of tutor programs over the past decades. It seems surprising that there is not more systematic research on after-school programs, particularly tutoring programs, which are becoming abundant (Bray, 1999). Schools are also offering these out-of-regular class time courses. Lauer *et al.* (2006) found small gains from these out-of-school courses, with similar effects on reading ($d = 0.05$) and mathematics ($d = 0.09$). The more successful programs were shorter rather than longer programs ($d = 0.23$ compared to $d = 0.05$ in reading, and $d = 0.15$ compared to $d = 0.16$ in mathematics), involved one-on-one tutoring ($d = 0.50$ in reading, and $d = 0.22$ in mathematics), were for students from lower elementary (K-2, $d = 0.22$ in reading and $d = 0.22$ in mathematics) and high school ($d = 0.25$ in reading and $d = 0.44$ in mathematics). While it is the case that students at most risk may be in many of these more structured after-school programs, the overall effects are still negligible ($d = 0.09$) compared to what effective teachers can attain in regular classrooms using many other methods of instruction.



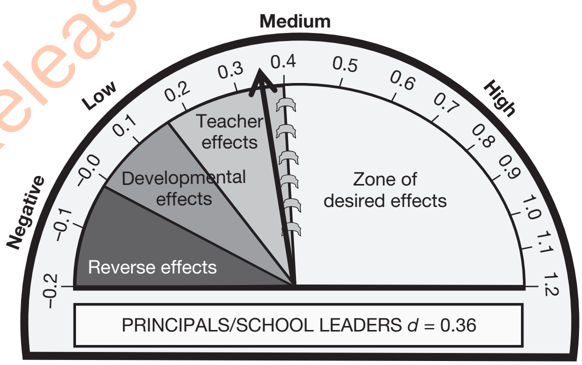
KEY	
Standard error	na
Rank	127th
Number of meta-analyses	2
Number of studies	52
Number of effects	50
Number of people (2)	30,554

Principals and school leaders

There is so much written about leadership: the seven habits of successful leaders, the personality attributes of leaders, and case studies of inspired leaders of lighthouse schools. But the fundamental issue of interest in this book is the influence of principals on students in their school. In the meta-analyses on the effects of principals, there is an important moderator, relating the type of principal leadership.

There are at least two major forms of leadership: instructional leadership and transformational leadership. Instructional leadership refers to those principals who have their major focus on creating a learning climate free of disruption, a system of clear teaching objectives, and high teacher expectations for teachers and students. Transformational leadership refers to those principals who engage with their teaching staff in ways that inspire them to new levels of energy, commitment, and moral purpose such that they work collaboratively to overcome challenges and reach ambitious goals. The evidence from the meta-analyses supports the power of the former over the latter in terms of the effects on student outcomes. It is school leaders who promote challenging goals, and then establish safe environments for teachers to critique, question, and support other teachers to reach these goals together that have most effect on student outcomes. School leaders who focus on students' achievement and instructional strategies are the most effective (Connell, 1996; Henchey, 2001; Teddlie & Springfield, 1993). It is leaders who place more attention on teaching and focused achievement domains (Hallinger & Murphy, 1986) who have the higher effects.

As an example of this differential effect, Brown (2001) found a mean effect of $d = 0.57$ of leadership influences on student achievement (and $d = 0.54$ on affective outcomes). The effects gained by principals were greater on instructional leadership dimensions (e.g., organization, $d = 0.66$) than from transformational leadership dimensions (consideration $d = 0.36$, inspiration $d = 0.40$). The effects were much higher at the elementary ($d = 0.76$) than for the middle ($d = 0.36$) and high school levels ($d = 0.44$). Similarly, Robinson, Lloyd, and Rowe (in press) reported a similar pattern, in that the effects of instructional leadership on student outcomes ($d = 0.55$) were much greater than the effects of transformational leadership ($d = 0.09$). Specific dimensions of instructional leadership that had greatest effects on student outcomes were promoting and participating in teacher learning and development ($d = 0.91$); planning, coordinating, and evaluating teaching and the curriculum (e.g., direct involvement in the support and evaluation of teaching through regular classroom visits and provision of formative and summative feedback to



PRINCIPALS/SCHOOL LEADERS $d = 0.36$

KEY	
Standard error	0.031 (Low)
Rank	74th
Number of meta-analyses	11
Number of studies	491
Number of effects	1,257
Number of people (4)	1,133,657

teachers, d = 0.74); strategic resourcing (aligning resource selection and allocation to priority teaching goals, d = 0.60); establishing goals and expectations (d = 0.54); and ensuring an orderly and supportive environment such as protecting time for teaching and learning by reducing external pressures and interruptions and establishing an orderly and supportive environment both inside and outside classrooms (d = 0.49). Robinson *et al.* noted that the more generic nature of transformational leadership theory and its focus on leader–follower relations, rather than on the work of improving learning and teaching, may be responsible for its weaker effect on student outcomes. "The more leaders focus their influence, their learning, and their relationships with teachers on the core business of teaching and learning, the greater their likely influence on student outcomes" (Robinson *et al.*, in press, p. 23).

Two meta-analyses specifically investigated the effects of transformational leadership. In Chin's (2007) meta-analysis, it is not clear if instructional leadership studies were therefore excluded. For example, she defined transformational leadership as including shaping and elevating goals and abilities to achieve significant improvements. The effects on teacher job satisfaction are very high (r = 0.71), and while lower, the effects on student achievement are also high (r = 0.48). Gasper (1992) was more concerned with contrasting transformational and transactional leadership (leaders engaging "in simple exchanges with followers to cause performance contributing to goal attainment", p. 19) and showing the differences on teacher job satisfaction. Clearly, teachers prefer transformational leadership, which is not too surprising given its purpose is to encourage teacher growth and participation through common interests and cooperative actions.

Although Waters, Marzano, and McNulty (2003) did not use the distinction between instructional and transformational leadership in their meta-analysis, the results show a similar pattern. The more important dimensions of leadership that influenced student outcomes related to teachers creating a conversation challenging the status quo of achievement in the school, ensuring that there were current and diverse ways to address these concerns, involving teachers in designing and implementing strategies to enhance achievement, establishing challenging goals of enhanced student achievement, and monitoring use of feedback information to the teachers and school leaders about student progress and effectiveness of teaching. Again, instructional leadership attributes are highlighted.

Another way to evaluate the effects of principals is to review the various leadership competencies derived from the many assessment centers for principals and the resultant effects on student achievement. For the past few decades in the United States, assessment centers have played a key role in assessing thousands of school personnel for selection and placement in principal positions. Pantili, Williams, and Fortune (1991) looked at the effectiveness of assessment by the National Association of Secondary Schools principals (NASSP) in evaluating desirable criteria for the principalship. The strongest correlation with enhanced student outcomes was with organizational ability and leadership (r = 0.25) and written communication skills (r = 0.24). Transformational criteria such as sensitivity, range of interests, and personal motivation had almost no effect on job performance. Also of interest was that neither gender nor ethnicity has any significant effect on the assessment center scores of principals, on any dimension.

Other correlates with achievement included the extent to which the principals were aware of the goals in the school that needed addressing (r = 0.66), the way they ensured that teachers were intellectually stimulated about current theories and practices (r = 0.64), whether they were willing to actively challenge the status quo (r = 0.60), whether they monitored the effectiveness of school practices and their impact on student learning ($r = 0.56$), the extent to which they communicated and operated from strong ideals and belief about schooling ($r = 0.50$), and whether the principals were knowledgeable about current curriculum, instruction, and assessment practices ($r = 0.48$). The attributes least related to effectiveness were the recognition and rewarding of individual accomplishments ($r = 0.30$), visibility in establishing quality contact and interactions with teachers and students ($r = 0.32$), demonstration of an awareness of the personal aspects of teachers ($r = 0.38$), and adaptation of leadership behavior to the needs of the current situation ($r = 0.44$). Again, a distinction can be drawn between instructional leadership and transformational leadership.

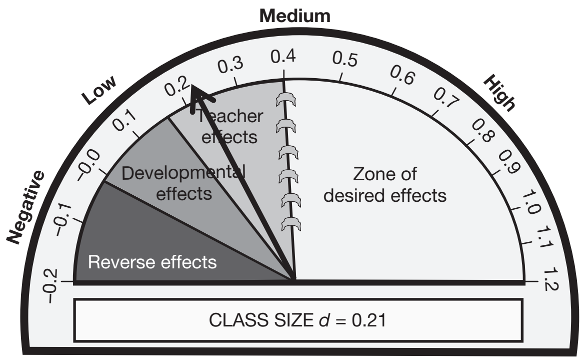
Conclusions from the more general management literature (with some inclusion of effects on students' achievement in school) show similar positive effects on student outcomes for more instructional and purposeful leadership, compared with transformational leadership (where the latter effect is more on the satisfaction and teacher outcomes). For example, Neuman, Edwards, and Raju (1989) investigated the effects of organizational development interventions on satisfaction and other attitudes. Organizational development involves "an effort which is planned, organization wide and managed from the top to increase organization effectiveness and health through planned interventions in the organization's processes, using behavioral science knowledge" (Beckhard, 1969, p. 20). The more successful interventions were goal setting ($d = 0.22$) and team building ($d = 0.30$), and the least successful were what Neuman *et al.* termed "technostructural interventions"; that is those interventions aimed to affect the work content, work method, and relationships among the participants (e.g., job redesign, job enrichment). In one of the few studies on the effects of management methods on student achievement, Miller and Rowan (2006) questioned the value of "organic management" which is a shift from the more hierarchical forms of management to what has "been referred to as a network pattern of control, that is, a pattern of control in which line employees are actively involved in organizational decision making, staff cooperation, and collegiality as a means of coordinating work and resolving technical uncertainties" (p. 220). They found that these organic methods were not especially powerful determinants of student achievement: there was "almost no evidence that organic design features have positive effects on student achievement in general" (p. 242).

Classroom compositional effects

This section includes reviews of class size, open versus traditional classes, ability grouping, multi-age classes, within-class grouping, small group learning, mainstreaming of special education students, single-sex classes, and retention of students (making them repeat a year).

Class size

It is not difficult to find claims for both sides of the argument about whether or not reducing class sizes leads to enhancements in learning outcomes. One side argues that reducing class size leads to more individualized instruction, higher quality instruction, greater scope for innovation and student-centered teaching, increased teacher morale, fewer disruptions, less student misbehavior, and greater ease in engaging students in academic activities. On the



KEY	
Standard error	na
Rank	106th
Number of meta-analyses	3
Number of studies	96
Number of effects	785
Number of people (x)	550,339

other side, there is a voluminous literature that does not support the claim that learning outcomes are enhanced when class sizes are reduced.

Based on a more detailed analysis of the evidence on class size from meta-analyses and other studies, I concluded (Hattie, 2006) that the evidence overall suggests that the results are systematically small; there is much difficulty in reconciling the small effects with the rhetoric about the positive and, for many, obvious profound effects; the effects of those studies supporting lower class sizes are more related to teacher and student work-related conditions, and the effects of those not supporting lower class sizes are more related to the small effects on student learning. It appears that the effects of reducing class size *may* be higher on teacher and student work-related conditions, which then *may* or *may not* translate into effects on student learning.

Table 6.2 summarizes many of the synthesizing studies. Across these meta-analyses, summaries of major initiatives, and newer studies, the average effect size is d = 0.13. Thus, the typical effect of reducing class sizes from 25 to 15 is about d = 0.10–0.20. Perhaps as interesting as the typical value, is that there is not a lot of variance in these estimates; the mean is a reasonable summary of the effects of reducing class size.

These studies represent a variety of designs including meta-analysis, longitudinal studies, cross-cohort studies; are from many countries (the United States, the United Kingdom, Israel, Bolivia); from across all grades; and use some of the most sophisticated statistical methods available. There is remarkable consistency across the effect sizes from these many diverse studies. This typical effect size of about d = 0.10–0.20 could be considered small especially in relation to many other possible interventions—and certainly not worth the billions of dollars that is required to reduce the number of children per classroom. The more important question, therefore, is "Why are the effect sizes from reducing class size so small?"

One reason for these small effect sizes relates to teachers of smaller classes adopting the same teaching methods as they were using in larger classes and thus not optimizing the opportunities presented by having fewer students (Finn, 2002). It is difficult, however, to find studies that investigate or that demonstrate whether the nature of classroom experiences are different in the smaller than in the larger classes. Further, there is a different concept of excellent teaching in larger classes than when teaching smaller classes of 25–30 (see Hattie, 2006 for more details). For classes of 80 or more students, it is probably necessary to assume that individual students are already self-regulated to learn and the major tasks for teachers are to provide content; interpretation of this content; and to assess students on the facility to absorb, and (slightly) transform this content into their words and beliefs (via

Table 6.2 Synthesis of meta-analyses and major studies reducing class size from 25 to 15

Authors	*Year*	*No. of studies*	*No. of effects*	*No. of classes*	*No. of students*	*d*	*Outcome*
Glass & Smith	1997	77	725	14,358	520,899	0.09	Achievement
Smith & Glass	1980	59	371	—	—	0.24	Non-achievement outcomes
Finn	1988	1	1	79	6,500	0.22	Achievement
	—	1	1	79	6,500	0.12	Achievement (grades 4–6)
	—	1	1	79	6,500	0.02	Self-concept, Motivation
McGiverin *et al.*	1989	10	24	—	—	0.34	Achievement
Molnar *et al.*	1999	1	1	411	9,790	0.21	Achievement
Hoxby	2000	1	1	14,593	306,453	0.03	Achievement
Blatchford	2005	1	1	368	9,330	0.23	Achievement
Goldstein *et al.*	2000	9	36	1,178*	29,440	0.20	Achievement
Dustmann, Rajah, & van Soest	2003	1	1	224	3,811	– 0.04	Achievement
Akerhielm	1995	1	1	1,052*	24,000	0.15	Achievement
Rice	1999	1	1	8,760	24,599	– 0.04	Achievement
Johnson *et al.*	2003	1	1	168*	3700	0.00	Achievement
Angrist & Lavy	1999	1	1	1,327	46,455*	0.15	Achievement
Urquiola	2000	1	1	608	10,018	0.20	Achievement
Average	—	164	1,165	40,728+	948,540+	0.13	—

* = estimated

structured essays or multiple choice exams). A perusal of student evaluations of teaching of such classes (most evident at the university level) shows the high desirability of organized lectures and lecturers, clear expectations of the examination system, provision of notes and resources, and a well signposted, guided tour through text books, syllabi, and assessments.

When classes move to the 30–80 size, the concept of excellent teaching is the close following of scripts, and chalk or whiteboard lessons, no toleration of deviant behavior in the class, over-learning the rules of classroom behavior, more rigid forms of discipline that allow for little deviance, copying, and high amounts of rote learning, straight rows, all walking through the lessons at the same pace (see Cortazzi & Jin, 2001). In classes of 20–30, grouping becomes possible. There is more opportunity to group students according to ability (or behavior), to encourage peer interactions, to allow for different proficiencies of self-regulation, and some tailoring of curriculum to students (either in topic or pace). There is already a wealth of literature as to the profile of excellent teachers and how they differ from experienced teachers in classes of 20–30 students (e.g., Berliner, 1987, 1988; Borko & Livingston, 1989; Chi, Glaser, & Farr, 1988; Hattie & Clinton, 2008; Housner & Griffey, 1985; Krabbe, 1989; Leinhardt, 1983; Ropo, 1987; Shanteau, 1992; Smith, Baker, Hattie, & Bond, 2008; Sternberg & Horvath, 1995; Strahan, 1989; Swanson, O'Connor, & Cooney, 1990; Tudor, 1992; van der Mars, Vogler, Darst, & Cusimano, 1995; Westerman, 1991; Yekovich, Thompson, & Walker, 1991). It is not convincing, however, to suggest that these attributes necessarily apply to classes of other than this size.

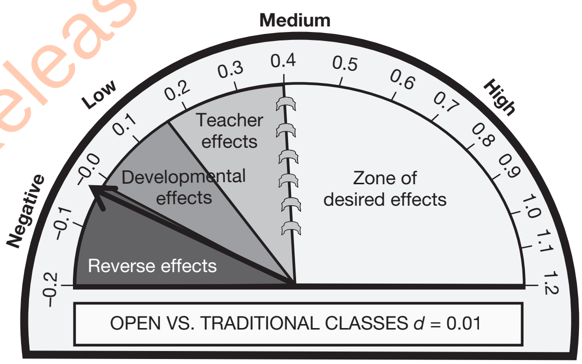
The argument is that moving from one level of class size to another requires a shift in the concept of excellence of teaching—a move from direct (most often transmission) teaching of students (at 80 or more) through attending to teaching and learning (at 20–80), to co-working with a cohort of individual students teaching and learning together (Chan, 2005). The shift required by teachers is not merely to adapt their methods as they move across the levels, but a major re-conceptualization of what it means to be excellent as a teacher at the various levels of class size.

A typical response to this lower than expected effect of reducing class size is to note that many of the more powerful influences identified in this book could be more effective if the class size was lower. With smaller classes, goes the plea, there could be more feedback, more interaction with students and between peers, more diagnosis, and so on. This may indeed be the case, but the evidence so far indicates that when class sizes are smaller, if these influences are implemented, there is still no great difference in student outcomes. Therein is the intriguing question. As noted above, this lack of outcome difference is most likely because teachers do not change their current teaching strategies. The message could be that if teachers were retrained to work with smaller class sizes then indeed many of these optimal strategies may take effect; but merely reducing the number of students in front of teachers appears to change little—in teaching and in outcomes. The reader is reminded that meta-analysis is a method of literature review—the lack of effects from lowering class size summarizes the experiences of past reductions in class size and these experiences indicate that reducing class sizes has not been a powerful moderator on outcomes (although the positive sign of the average effect size suggests that increasing class size is poor policy).

Open vs. traditional

While open education programs are based on underlying philosophical assumptions about the nature, development, and learning of students, they can range widely in type and number of features included in their organization. Some emphasize open space as an essential feature of good practice, others teaching practices (e.g., individual or small-group instruction and a high use of manipulative teaching materials) and the role of the student, and others a combination of features. Although open education had its heyday in the 1970s and 1980s, there are still many of these programs in action (including the one my own boys attended in North Carolina). As was noted in many of these studies, too often classroom architecture may be open but that is no guarantee that the principles of open teaching are present.

Open classrooms make little difference to student learning outcomes. Hetzel, Rasher, Butcher and Walberg (1980) found that while, overall, open education has slightly higher



KEY	
Standard error	0.032 (Low)
Rank	133rd
Number of meta-analyses	4
Number of studies	315
Number of effects	333
Number of people (0)	na

outcomes than traditional education, the differences were not great. Peterson (1980) showed that students performed slightly better on achievement tests in traditional compared to open teaching, but did worse on tests of creativity and had slightly less positive attitudes and self-concepts. Madamba (1980) examined the effects of open and traditional schooling structures on aspects of student development and found that open and traditional structures were equally effective in the development of reading comprehension, vocabulary, language, self-concept, and attitude toward school.

Giaconia and Hedges (1982) aimed to identify the features of effective open education. Their findings reinforced Peterson's in that they found that open education programs can aid in producing greater self-concept, creativity, and a positive attitude toward school. Programs effective in producing these non-achievement outcomes were characterized by four features:

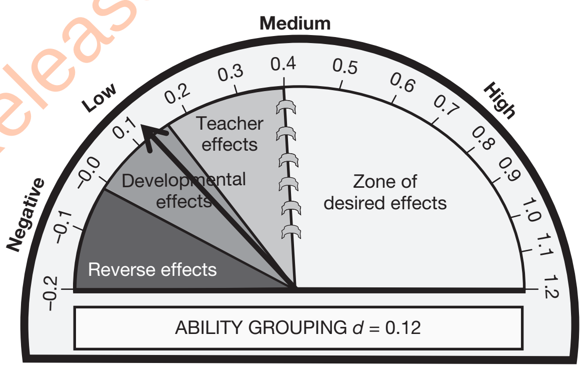
1 the emphasis on the role of the child in learning;
2 diagnostic evaluation;
3 use of manipulative materials;
4 individualized instruction.

Multi-age grouping, open space, and team teaching are not factors in distinguishing the more effective from the less effective open education programs. Furthermore, programs that were very effective for non-achievement outcomes produced smaller than average effects on academic achievement.

Ability grouping

In the United States, it is often claimed that about 20 to 40 percent of middle schools assign students to all classes on the basis of ability, and a further 40 percent use some between-class tracking, primarily in reading and mathematics (Epstein & Mac Iver, 1990; Lounsbury & Clark, 1990; Wheelock, 1992). Data from the National Educational Longitudinal Study (NELS) of 25,000 students in nearly 1,000 schools show that about 86 percent of public school students in American middle and high schools are placed in tracked classes.

The fundamental concern relates to whether classes are heterogeneous or homogeneous in ability or achievement. Tracking in the upper high school often involves students



KEY	
Standard error	0.045 (Medium)
Rank	121st
Number of meta-analyses	14
Number of studies	500
Number of effects	1,369
Number of people (0)	na

undertaking different courses, whereas in the earlier grades it typically involves students taking the same subjects but the orientation or pacing of the instruction is intended to differ to match the differing ability levels. At the middle school level, it is more likely that students are tracked in some subjects (e.g., English and/or mathematics) and are in untracked classes for other subjects.

The outcomes can be broadly grouped into achievement effects and equity effects. The latter address the question of whether the gains or losses from tracking are uniformly distributed across various subgroups (e.g., minority versus majority students). Many of the studies also address concerns about whether there are differences in instructional pace and teaching methods moderated by subgroups and whether there is differential access into the tracks on variables other than the avowed tracking variable (e.g., if social class influences access over and above achievement level).

The meta-analysis studies have summarized more than 300 studies of tracking, covering a wide variety of schooling cultures and experiences, in most curriculum subjects, across all age ranges, and across most major educational outcomes. The average effect is a small d = 0.11 (see Hattie, 2002; Jaeger & Hattie, 1996; Wilkinson, Parr, Fung, Hattie, & Townsend, 2002 for more detail). The results show that tracking has minimal effects on learning outcomes and profound negative equity effects. The overall effects on mathematics and reading were similarly low (reading d = 0.00, mathematics d = 0.02), the effects on self-concept were close to zero, and effects on attitudes towards subject matter slightly higher (d = 0.10). The overall effects for the three major ability levels across the studies were d = 0.14 for high-tracked, d = –0.03 for middle-tracked, and d = 0.09 for low-tracked students—no one profits.

The effects on equity outcomes are more profound and negative. The most influential in-depth study of teaching and learning in tracked classes is Oakes' (2005) *Keeping track: How schools structure inequality*. Her study was based on an intensive qualitative analysis of 25 junior and senior high schools. The major finding was that many low-track classes are deadening, non-educational environments. Oakes (1992) concluded that "the best evidence suggests that, in most cases, tracking fails to foster the outcomes schools value" (p. 13). Ability grouping fosters friendship networks linked to students' group membership, and these peer groups may contribute to polarized track-related attitudes among high school students, with high-track students becoming more enthusiastic and low-track students more alienated (Oakes, Gamoran, & Page, 1992). In subsequent evaluations, Oakes *et al.* (1993) commented that tracking limits "students' schooling opportunities, achievements, and life chances. Students not in the highest tracks have fewer intellectual challenges, less engaging and supportive classrooms, and fewer well-trained teachers" (p. 20). Shanker (1993), then president of the American Federation of Teachers, in a commentary of Oakes' research, was more earthy: "Kids in these [lower] tracks often get little worthwhile work to do; they spend a lot of time filling in the blanks in workbooks or ditto sheets. And because we expect almost nothing of them, they learn very little" (p. 24). In a similar qualitative design, Page (1991) provided a detailed account of daily activities of eight low-track classes and found that teachers and students came to understandings about how to not push each other too hard so that they could cope, that low tracks were used as "holding tanks" for students with the most severe behavior problems, and that teachers focused on remediation through dull, repetitious seatwork (see also Camarena, 1990; Gamoran, 1993).

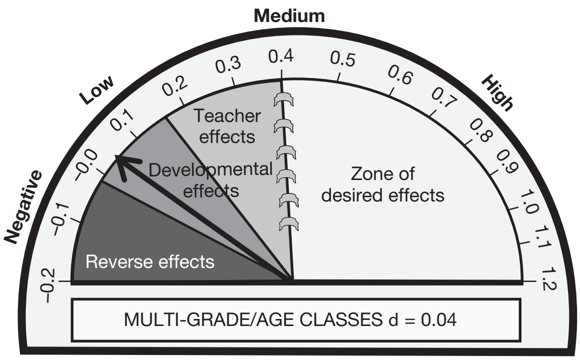
Oakes and Wells (1996) claimed that tracking exists to guarantee the unfair distribution of privilege in that white and wealthy students benefit from access to high-status knowledge that low-income students and students of color are denied. Oakes, Ormseth, Bell, and Camp (1990) analyzed 1,200 public and private elementary and high schools in the United States, and found that minority students were seven times more likely to be identified as low-ability than as high-ability students. Those schools that track often explain this ethnic subdivision by reference to past achievement, and thereby argue that tracking can maximize opportunities to alter this. If tracking leads to proportionally more students from lower socioeconomic backgrounds or from particular ethnic groups being placed in lower tracks, then the use of tracking may serve to increase divisions along class, race, and ethnic lines (Haller & Davis, 1980; Rosenbaum, 1980). In his survey of tracking policy in California and Massachusetts, Loveless (1999) concluded that there are massive contradictions in that detracking is taking place in low-achievement schools, in poor schools, and in urban areas; whereas suburban schools, schools in wealthy communities, and high-achieving schools are staying with tracking—indeed, they are embracing it. "This runs counter to the notion of elites imposing a counterproductive policy on society's downtrodden. If tracking is bad policy, society's elites are irrationally reserving it for their own children" (Loveless, 1999, p. 154). Braddock (1990) found that schools with more than 20 percent of their rolls from minority groups were more likely to track than those with fewer minority students.

Oakes, Gamoran and Page (1992) found that Asian students were more likely to be assigned to advanced courses than were Hispanic students with whom their test scores were equivalent. A disproportionate number of low socioeconomic status and disadvantaged minority students occupy the lower tracks and non-college tracks (National Centre for Educational Statistics, 1985; Oakes *et al.*, 1992; Persell, 1979; Vanfossen, Jones, & Spade, 1987). Students of average ability from advantaged families are more likely to be assigned to higher tracks because of actions by their parents, who are often effective managers of their children's schooling (Alexander, Cook, & McDill, 1978; Baker & Stevenson, 1986; Dornbusch, 1994; Lareau, 1987; Useem, 1991, 1992). Further, schools with a larger proportion of minority and lower socioeconomic students are less likely to have sufficient higher-level courses, which effects the probability of students entering higher classes. Moreover, the higher-track programs in these schools are often less rigorous than higher-track classes in schools with fewer minorities and higher socioeconomic students (Oakes *et al.*, 1992).

There is a final conundrum in this research. The empirical evidence leads to a conclusion that there is a close to zero effect from tracking, but the qualitative literature indicates that there may be quite different teaching and interactions in the low versus high tracked classes. The qualitative evidence indicates that low track classes are more fragmented, less engaging, and taught by fewer well-trained teachers. Clearly, if these lower tracked classrooms were more stimulating, challenging, and taught by well-trained teachers there may be gains from tracking for these students: there are not. It seems that the quality of teaching and the nature of the student interactions are the key issues, rather than the compositional structure of the classes.

Multi-grade/multi-age classes

Multi-age classes include students from more than one year level who are taught in the same classroom by the same teacher (also called multi-grade, multi-age, combination, split-grade, vertically grouped, mixed-aged, family group, and non-graded). These are common in very small schools, in many developing nations, and where there are uneven numbers of students at different year levels. Schools also use combination classes because



KEY	
Standard error	na
Rank	131st
Number of meta-analyses	3
Number of studies	94
Number of effects	72
Number of people (0)	na

they are believed to have certain pedagogical advantages over single-level classes, as "they allow for more flexible grouping and learning styles, they encourage children to help each other and work together cooperatively and collaboratively, and they present more of a "family" or "community" atmosphere" (Trussell-Cullen, 1994, p. 30).

Kim (1996) used 98 studies of non-graded and graded classes and found low effects (d = 0.17) in favor of non-graded classes—and this was consistent across most school subjects: reading d = 0.16, language d = 0.13, vocabulary d = 0.17, mathematics d = 0.10. More studies favored non-graded to graded programs. He also compared non-graded with multi-grade and multi-age classes and the overall effect was similarly small. Veenman (1995) conducted a meta-analysis of the cognitive and affective outcomes of multi-grade and multi-age classes in primary schools across a variety of English-speaking and non-English-speaking countries. In reviewing 34 studies comparing multi-grade and single-grade classes and eight studies comparing multi-age and single-age classes, Veenman found no differences in achievement (d = 0.00 and d = –0.03 for multi-grade and multi-age classes, respectively), and in 13 studies of multi-grade classes and eight studies of multi-age classes, he found small effects on students' attitudes towards school, self-concept, and personal adjustment favoring these classes (d = 0.10 and d = 0.15, respectively). There was little variation in outcomes by grade or academic area (reading, mathematics, language). As a consequence, Veenman concluded "parents, teachers, and administrators need not worry about the academic progress or social-emotional adjustment of students in multi-grade or multi-age classes. These classes are simply no worse, and simply no better, than single-grade or single-age classes" (Veenman, 1995, p. 367). Veenman also noted that, although few studies provided information on the instructional practices used in the classes, those that did suggested that teachers rarely capitalized on the multi-grade or multi-age arrangement to promote learning from peers (e.g., by using cooperative learning or reciprocal teaching). Nor did teachers group students within the classes across grade or age lines in order to tailor instruction to more homogeneous classes.

Mason and Burns (1996) criticized Veenman's conclusion, arguing that his null finding for multi-grade classes is an artifact of selection bias favoring these classes, combined with lower quality instruction, which counteracts the benefits of selection. They argued that multi-grade classes generally have better students and perhaps better teachers and that these selection factors mask a small negative effect resulting from the increased demands on teachers due to the greater diversity of students (Burns & Mason, 1995; Mason & Burns, 1995, 1996; Mason & Doepner, 1998). Mason and Burns (1996) hypothesized that, when student and teacher selection factors are controlled, comparative studies of achievement in multi-grade and single-grade classes should show a small negative effect in the order of –0.10 of a standard deviation. Mason and Burns also argued that, because of the additional time demands placed on teachers in multi-grade classes, teachers might neglect non-core subjects such as science and social studies.

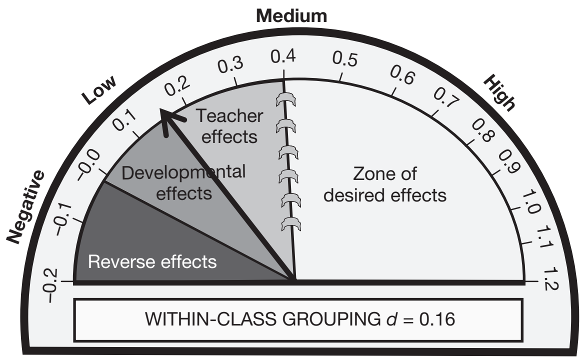
In a reply to this criticism, Veenman (1995) reported results of a reanalysis, using meta-analytic procedures, on a slightly larger sample of studies. Overall, the results again showed no significant differences in either cognitive or affective outcomes between multi-grade/multi-age classes and single-grade/single-age classes. The effect sizes were essentially zero for cognitive outcomes and slightly positive, but still close to zero, for affective outcomes. The reanalysis showed a small positive effect of multi-grade classes for students in grades 1 to 3 (mean effect size $d = 0.06$), a near-zero effect for grades 4 to 5 ($d = 0.01$), and a small negative effect for grades 6 to 7 ($d = -0.08$). There was some support for the possibility that student achievement may suffer in subjects such as science (mean effects size $d = -0.19$) and mathematics ($d = -0.25$), but there was no support for the notion that there might be small negative effects in schools where selection factors would not be operative (e.g., in rural schools the mean effect size was $d = 0.10$).

There seems to be some agreement between Veenman and Mason and Burns as both noted that teachers rarely capitalize on multi-grade or multi-age arrangements to promote learning from peers. Instead, teachers tend to teach distinctly different curricula, maintain grade levels, and deliver separate lessons to each grade-level group. In a study of mathematics achievement, Mason and Burns (1996) compared the curriculum, instruction, and organizational formats used by primary school teachers in six multi-grade classes with those used by teachers in 18 single-grade classes—six who used whole-class teaching and 12 who used two within-class ability groups. They coded 153 lessons taught by these teachers according to classroom type, the manner in which the teachers organized students for mathematics, and the nature of teacher-directed and independent-group activities. Teachers of multi-grade classes organized their students into two groups for almost all lessons. Moreover, in independent group activities, students in the multi-grade classes were less productive than were those in the single-grade classes, even compared to those that used a similar two-group structure. Students in the multi-grade classes seldom worked cooperatively to solve problems and seldom helped others who were in need of assistance. Mason and Burns noted that, whereas multi-grade classes might provide opportunities for teachers to use more innovative, developmental approaches, these data provide little support for this notion. There was no evidence of increased opportunities for social growth, peer tutoring, and independent learning for students in the multi-grade classes.

Overall, the effects from multi-grade classes compared to single-age classes are not compelling enough to argue for the effectiveness of one over the other. It is likely that teachers teach in a similar way regardless of the distribution of age range in the class, and the multi-grade classes are often split by age for grouping. There is a deeply embedded grammar of teaching that appears to remain the same regardless of these structural changes in classes. Hence, it is not surprising that there are close to zero findings.

Within-class grouping

Within-class grouping can be defined as "a teacher's practice of forming groups of students of similar ability within an individual class" (Hollifield, 1987, p. 1). This is a very common



KEY	
Standard error	na
Rank	116th
Number of meta-analyses	2
Number of studies	129
Number of effects	181
Number of people (1)	16,073

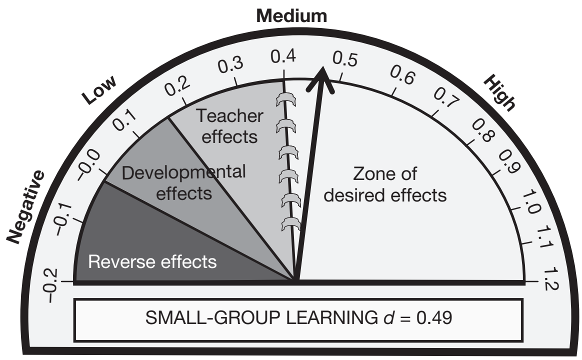
practice in New Zealand, for example in reading, 94 percent and in mathematics almost all teachers of Year 5 students in New Zealand reported dividing their classes into groups for instruction (Wagemaker, 1993). There are two major forms of this within-class grouping—ability/achievement grouping and small group learning, with the former being groups formed on a somewhat semi-permanent basis over weeks of instruction and the latter being more spontaneous and usually for specific tasks over a shorter time period.

Kulik and Kulik (1992) conducted a meta-analysis of 19 studies of within-class grouping in the United States. Overall, the mean effect size in favor of within-class grouping (excluding the classes specifically for gifted) was d = 0.17. The effect sizes were similar with respect to the abilities of the students in the groups: d = 0.29 for high-ability students, d = 0.17 for medium-ability students, and d = 0.21 for low-ability students. Kulik and Kulik (1992) followed up this review by conducting a further meta-analysis that included 11 studies of within-class grouping, using different criteria for study inclusion. The mean effect size in favor of within-class grouping was d = 0.25, but there were slightly higher effects for higher ability (d = 0.30) than medium (d = 0.18) and lower ability students (d = 0.16).

Results from one meta-analysis of ability/achievement grouping (Lou *et al.*, 1996) show a slight advantage of within-class grouping compared to no grouping in promoting student learning (mean effect size d = 0.17). Moreover, this analysis shows that the effect of grouping depends on class size. In large classes (more than 35 students) the mean effect of grouping is d = 0.35, whereas in small classes (less than 26) the mean effect is d = 0.22, and in medium-sized classes (26–35) it is d = 0.06. Small-group instruction is also more beneficial when it is compared to traditional whole-class teaching (mean effect size d = 0.24) than when it is compared to individualized mastery learning (mean effect size d = 0.15), and small groups using cooperative learning perform better (mean effect size d = 0.28) than other small groups (mean effect size d = 0.15). Low-, medium-, and high-ability students all seem to benefit from being taught in small groups (mean effects size d = 0.37, d = 0.19, and d = 0.28, respectively).

Small-group learning

Small-group learning differs from within-class grouping in that it typically involves assigning a task to a small group and then expecting them to complete this task—and the only meta-analyses on this topic have been conducted at the tertiary level. Lou, Abrami, and d'Apollonia (2001) found that small-group learning had significantly more positive



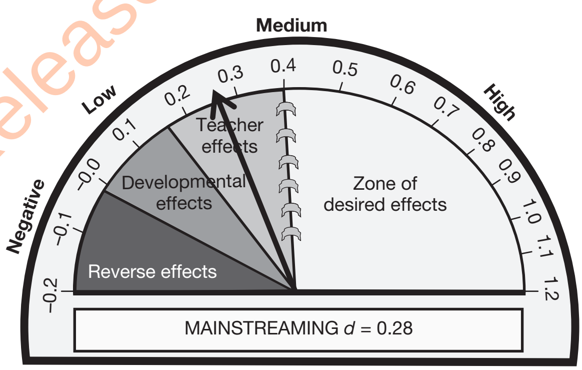
KEY	
Standard error	na
Rank	48th
Number of meta-analyses	2
Number of studies	78
Number of effects	155
Number of people (1)	3,472

effects than individual learning with computer technology on student achievement, group task performance, and several process and affective outcomes. The effects of small group learning were significantly enhanced when students had group work experience or instruction, where specific cooperative learning strategies were employed, and when group size was small. Springer, Stanne, and Donovan (1999) also found there was a similar 0.5 effect on achievement, attitude, and persistence for college students. Small-group learning also led to greater self-esteem among undergraduate students.

A consistent message from studies of the effectiveness of grouping and mixing students within classes by ability or for small groups is that instructional materials and the nature of instruction must be adapted for these specific groups. Simply placing students in small or more homogenous groups is not enough. For grouping to be maximally effective materials and teaching must be varied and made appropriately challenging to accommodate the needs of students at their different levels of ability.

Mainstreaming

The notion of the least restrictive environment for special students has often lead to these students being mainstreamed—that is, placed in regular school classes. Mainstreaming is the concept that students with disabilities should be integrated with their non-disabled peers to the maximum extent possible, and certainly placed in the least restrictive environment. Mainstreaming is often argued more on equity and social justice reasons than in terms of optimal effects on the learning for these students. In specific terms, least restrictive



KEY	
Standard error	na
Rank	92nd
Number of meta-analyses	5
Number of studies	150
Number of effects	370
Number of people (2)	29,532

environment does not mean mainstreaming (or as some have termed it, maindumping: Chapman, 1988), but refers to modification of content, materials, classroom management, instructional techniques, and strategies. Full inclusion means that special needs students can and should be educated, with appropriate support, in the same settings as their other peers. This, claim the advocates, leads to increased expectations by teachers, more peer interaction, more learning, and greater self-esteem.

Carlberg and Kavale (1980) found small but positive advantages for mainstream over special classes (d = 0.12), and more specifically, d = 0.15 for achievement, and d = 0.11 for social/personality outcomes. It is important to note that these effect sizes are between students in these special classes and similar students in mainstreamed classes, so the differences are not a measure of non-equivalence between groups. Baker (1994) reported similar effects (d = 0.08) in favor of mainstreamed students, with more positive outcomes for mathematics (d = 0.22) than for reading (d = 0.12). He also found similar effects for those classified mentally retarded (d = 0.47) than learning disabled (d = 0.13). Wang and Baker (1985) found similar effects across various grades.

Single-sex classes

There is from time to time a resurgence of interest in tracking students by sex within coeducational schools. Much of the interest comes from writers exhorting the advantages that would accrue from these classes for girls (Milligan & Thomson, 1992; Parker, 1985; Willis & Kenway, 1986) citing the differential nature of teacher interactions, intimidation of girls by boys, marking and assessment bias, and the content and presentation of subjects. Gillibrand, Robinson, Brawn, and Osborn (1999) investigated the reasons why 47 of a class of 58 girls chose to enter a single-sex class for physics (taught entirely by males). The major reasons were expectations of better results, avoidance of disruption from boys, wish to be with friends, and desire to experience the novelty. The major reasons for girls choosing mixed-sex classes, on the other hand, were that all-girl classes were demeaning and that in all-girl classes boys could not help them with their work. Kruse, in an extensive series of studies in Denmark (Kruse, 1987, 1989, 1990, 1992, 1994, 1996a, 1996b), reported that solidarity can be strengthened within girls' classes, while the competitive element which often worked in favor of boys was diminished. Parker and Rennie (1997) found that teachers perceived that single-sex classes benefited those girls who were experiencing a great deal of harassment from boys in mixed-sex classes, although there was least benefit for the higher-achieving girls and boys. Their overall conclusion was that any effects were more dependent on the teacher and teacher expectations than whether the class was mixed- or single-sex.

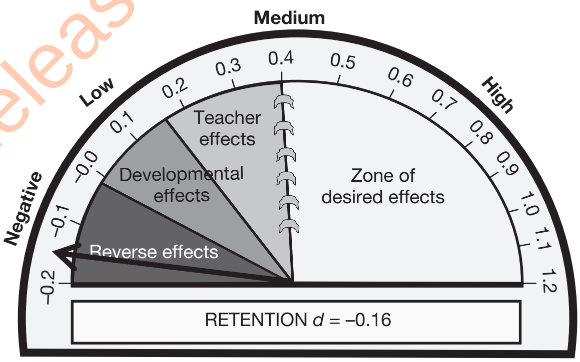
One of the major difficulties in addressing the effect on student learning from comparing students in single-sex compared with coeducational classes has been the problem associated with the non-equivalent group comparisons. Single-sex classes tend to be more selective both in students and teachers, and it is not clear whether it is these selection factors rather than the gender of the student that accounts for any differences (Steedman, 1983). Rowe (Marsh & Rowe, 1996; Rowe, 1988) has conducted the most powerful study of single- compared with mixed-sex classes, as he was able randomize the students and teachers to six single-sex or two mixed-sex classes for mathematics. Across all measures, there were no instances of gains for girls in girls-only classes (or boys in boy-only classes) being significantly more positive than gains for girls (or boys) in mixed-sex classes. Hence, there was "no support for the advantages of single-sex mathematics classes for either boys or girls" (Marsh & Rowe, 1996, p. 153), nor were there effects from the choice of class on subsequent mathematics choices. Similarly, Signorella, Frieze, and Hershey (1996) completed a 10-year longitudinal study of single- and mixed-sex classes within one private school, and concluded that there was "no consistent tendency for students in single-sex classrooms to display less gender stereotyping … [and there was] no consistent advantage to girls in single-sex as compared to mixed-sex classes" (p. 606). Marsh and Rowe did find that brighter students benefited more from being in mixed-sex classes.

Overall, there is very little compelling evidence of a compositional effect related to whether a class is single- or mixed-sex. It needs to be noted that most studies have been conducted on high school students and there is minimal research on these classes at the elementary school level; although there is little reason to suspect that there would be meaningful differences at this level. There are more powerful effects due to the quality of teaching and teacher expectations than to whether a class is all one sex or mixed.

Retention

Retention is the practice of not promoting students up a grade level in school (that is, the student repeats the level) and it is based on the belief that children learn more academically by repeating a grade (Fait, 1982). This is one of the few areas in education where it is difficult to find any studies with a positive ($d > 0.0$) effect, and the few that do exist still hover close to a zero effect. Overall, there are negative effects for students who are retained, and there are more positive effects in the long term for promoted students than for retained students—even when matched for achievement at the time of decision to retain or promote.

Retention has been found to have a negative effect on academic achievement in language arts, reading, mathematics, work-study skills, social studies, and grade point average. Promoted students score better than retained students on social and emotional adjustment, and behavior, self concept, and attitude towards school. Jimerson (2001), in the most recent study on retention, based on 169 achievement effects, found a mean effect of $d = -0.39$, and this negative effect was mirrored across many subjects: language arts ($d = -0.36$), reading ($d = -0.54$), and mathematics ($d = -0.49$). A further 246 effect sizes related to socio-emotional and behavioral outcomes and these also were systematically negative ($d = -0.22$); as was attendance, which was lower for the retained students ($d = -0.65$).



KEY	
Standard error	na
Rank	136th
Number of meta-analyses	7
Number of studies	207
Number of effects	2,675
Number of people (2)	13,938

Holmes (1983; 1989) synthesized the results from 63 studies on the effects of retention and reported an overall effect of $d = -0.15$. Thus the groups of non-promoted or retained students scored $d = 0.15$ standard deviation units lower than the promoted comparison groups on the various outcome measures, over most academic and personal educational outcomes and at every age level. This negative effect increases over time, such that after one year the retained groups were scoring 0.45 standard deviation units lower than the comparison groups who had gone on to the next grade and in many cases were being tested on more advanced material. This difference became larger each subsequent year, with the difference reaching 0.83 standard deviation units for measures taken four or more years after the time of retention. Moreover, being retained one year almost doubled a student's likelihood of dropping out, while failing twice almost guaranteed it. These negative effects are partly caused by schools and teachers not providing special interventions for the retained students, and thereby the students are retained in programs that were not beneficial to them in the previous year. Another possible effect is the negative influence of peer groups on the beliefs of the retained student, and the effects of being forced to interact with students of different ages. Holmes (1989) concluded that it would be difficult to find another educational practice on which the evidence is so unequivocally negative (see also Byrnes, 1989; Cosden, Zimmer, & Tuss, 1993; Dauber, Alexander, & Entwisle, 1993; Foster, 1993; Grissom & Shepard, 1989; House, 1989; Kaczala, 1991; Mantzicopoulos & Morrison, 1992; Meisels & Liaw, 1993; Morris, 1993; Peterson, DeGracie, & Ayabe, 1987; Shepard, 1989; Shepard & Smith, 1989; Tomchin & Impara, 1992).

The effects are bad enough for achievement, but when the negative equity effects are added, the situation is dire for retention. Consider two students of the same achievement, and it is four times more likely that the student of color (African American, Hispanic) will be retained and the other (white) student promoted (Cosden *et al.*, 1993; Meisels & Liaw, 1993). The only question of interest relating to retention is why it persists in the face of this damning evidence.

To cite some typical conclusions: long-term follow-up studies, especially, found no difference in achievement between retained and promoted participants. On teacher ratings of reading and mathematics achievement, there were no differences between the groups. The extra year had produced no benefit for retained children over controls on teacher ratings of social maturity, learner self-concept, or attention at the end of first grade (Shepard & Smith, 1989).

The research indicates that the threat of non-promotion is not a motivating force for students; grade retention does not generally improve achievement or adjustment for developmentally immature students; economically, grade retention is a poor use of the education dollar, because it increases the cost of education (the retained child spends an additional year in the public school system) without any benefits for the vast majority of retained children; characteristics such as low socioeconomic status and peer classroom conduct affect the likelihood that a child will be retained (Byrnes, 1989).

Perhaps one of the most frightening and costly effects of retention is the increased risk of dropping out of school. Although one of its goals is to provide children with the opportunity to be more successful, and therefore stay in school longer, retention clearly has the opposite effect. Being retained one year almost doubled a student's likelihood of dropping out, while failing twice almost guaranteed it. In fact, retention is the second greatest predictor of school drop-out (Foster, 1993).

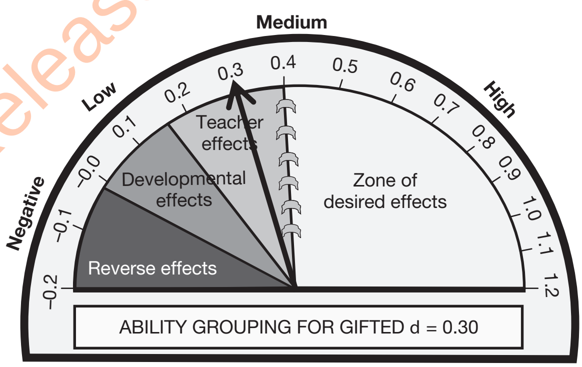
Students are retained in rather arbitrary and inconsistent ways, and those flunked are more likely to be poor, male and from a minority, although holding students back is practiced to some degree in rich and poor schools alike. The effects of flunking are immediately traumatic to the children and the retained children do worse academically in the future, with many of them dropping out of school altogether. Incredibly, being retained has as much to do with children dropping out as does their academic achievement. It would be difficult to find another educational practice on which the evidence is so unequivocally negative (House, 1989).

School curricula effects for gifted students

The school curricula effects discussed in this section relate to structuring differential curricula experiences for gifted and talented students within schools, such as ability grouping for gifted students, acceleration, and enrichment. Each of these is considered in turn below. In comparing results for the three methods overall, the most effective for influencing the outcomes of gifted students was acceleration ($d = 0.84$). This compares to $d = 0.39$ or enrichment and $d = 0.30$ for ability grouping—which leads to the question of why acceleration is the least implemented of the three.

Ability grouping for gifted students

It is important to separate gifted programs from high-ability tracks. The latter typically receive a faster pace of instruction and more challenging tasks within the same curriculum frameworks as medium- and low-ability students, whereas the former often have different curricula. Herein lies a key distinction. Where there are specific curricula aimed at challenging students at the appropriate level then there is more likelihood of success in engagement and learning. For example, Kulik and Kulik (1984) found that ability grouping had a positive effect on the achievement of gifted and talented elementary school students ($d = 0.49$). Goldring (1990) found that gifted students, when placed in special, homogeneous classes with challenging curricula, achieved more than gifted counterparts in regular classes. For students in special classes, the greatest advantages were in science and social science tests and the smallest were in reading and writing. There was no evidence of negative or differential social effects: there were no differences in general self-concept or creativity for students in special classes and those in regular classes. Vaughn,



KEY	
Standard error	0.064 (Medium)
Rank	87th
Number of meta-analyses	5
Number of studies	125
Number of effects	202
Number of people (0)	na

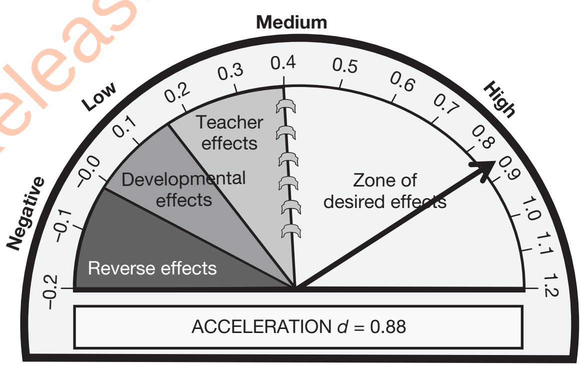
Feldhusen, and Asher (1991) found positive effects from various creativity programs on self-concept (d = 0.11), achievement (reading and vocabulary; d = 0.65), and creative thinking (d = 0.44).

Acceleration

An alternative to special classes for gifted children is to accelerate students through the curricula: "Accelerated instruction enables bright students to work with their mental peers on learning tasks that match their abilities" (Kulik & Kulik, 1984b, p. 84). It typically involves progress through an educational program at rates faster or ages younger than is conventional (Pressey, 1949), although there are many options, such as curriculum compacting or telescoping, and advanced placement. Kulik and Kulik in their meta-analyses on the effects of accelerated instruction on students (Kulik & Kulik, 1984a, 1984b) found that accelerated students surpassed the performance of non-accelerated students of an equivalent age and intelligence by nearly one grade level (d = 0.88). Kulik (2004) revisited those studies that had some form of controlled design. Those that compared accelerated students with same-age controls had much greater effects (d = 0.80) than those that compared accelerated students with older control groups (d = –0.04). Again, he concluded that accelerated students did just as well as the bright students in the grades into which they moved. He also noted that accelerated students had higher educational ambitions, and were no different in rates of participation in school activities.

George, Cohn, and Stanley (1979) reviewed the acceleration and enrichment research and concluded that there were no studies which have shown enrichment to provide superior results over accelerative methods; at best, enrichment may only defer boredom. The major question is why there is so much resistance to acceleration, and their claim is that it is usually preconceived and irrational claims about social and emotional acceptability of accelerated students, or some timetabling barriers. Kulik and Kulik (1984a) found that students' attitudes towards schools seemed largely unaffected by instruction in accelerated programs.

If acceleration is so successful then why is it one of least used methods for gifted students? The typical claim is that acceleration is not beneficial from social and interpersonal perspectives. In a meta-analysis directed at this question of the social effects, Kent (1992) found an average effect of only d = 0.13, in favor of gifted students in accelerated programs—if anything, there were positive social effects of acceleration and negative



KEY	
Standard error	0.183 (High)
Rank	5th
Number of meta-analyses	2
Number of studies	37
Number of effects	24
Number of people (1)	4,340

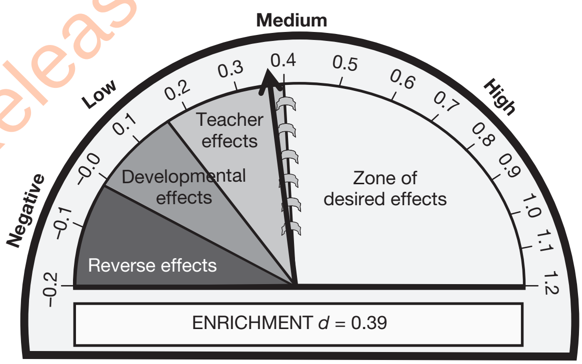
effects if *not* accelerated. There were few differences between methods of acceleration (telescoping was the highest effect, d = 0.15), or by sex (boys d = 0.21, girls d = 0.15). Instead, we may need to question the negative social impact on gifted students if they are not accelerated!

Levin (1988) asked, if acceleration is so beneficial for gifted students, why could it not also be used with non-gifted students? Hence, his Accelerated Learning program aims to accelerate the learning of at-risk students so that they are able to perform at grade level by the end of elementary school. These programs involve high expectations, specified deadlines for meeting educational requirements, stimulating instructional programs, planning by all staff, and using all available community resources. The evidence, however, is limited from a meta-analysis standpoint: Borman and D'Agostino (1995) claimed Accelerated Learning had "highly promising evidence of effectiveness" although the overall effect size was only d = 0.09.

Enrichment

Enrichment involves activities meant to broaden the educational lives of some group of students (George *et al.*, 1979). Wallace (1989) reported that enrichment was stronger in mathematics (d = 1.10) and science (d = 1.23) than in reading (d = 0.59) or social studies (d = 0.23). Programs in which students mastered more mature ideas had higher effects than those with a broader investigation of the regular curriculum. Teachers with more years of teaching gifted students had greater (d = 0.88) effects than those with no or limited experience (d = –0.06).

There are many forms of enrichment and one of the more common is Feuerstein's Instrumental Enrichment program (Feuerstein, 1980). These programs aim to teach critical thinking skills via a series of 13 to 15 instruments to be completed in one-hour lessons three to five times a week for two to three years. Each instrument concerns a specific cognitive deficiency such as blurred and sweeping perceptions, unplanned impulsive exploratory behavior, lack of receptive verbal tools, lack or impaired conservation of constancy such as size, shape or quantity, deficient need for precision and accuracy, impaired capacity for considering two or more sources of information at once, inadequacy in experiencing the existence of an actual problem and then defining it, inability to select relevant as opposed to irrelevant cues, lack of or impaired need for pursuing logical evidence, and so on. Shiell (2002) reviewed the effects of Feuerstein's



KEY	
Standard error	0.018 (Low)
Rank	68th
Number of meta-analyses	3
Number of studies	214
Number of effects	543
Number of people (2)	36,336

programs and the overall effect on achievement was *d* = 0.26. Romney and Samuels' (2001) meta-analysis found a *d* = 0.35 effect on achievement.

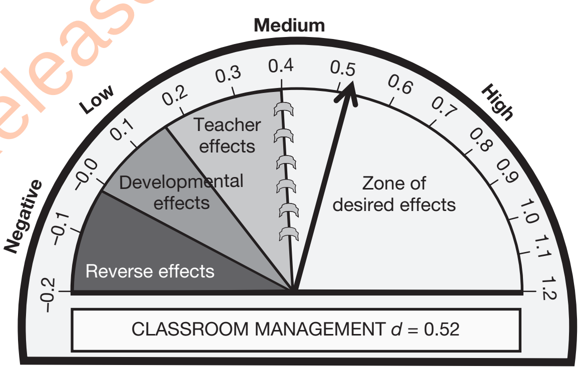
Classroom influences

The final section in this chapter concerns various influences within the class, such as climate of the class, the presence of disruptive students and decreasing this disruptive effect on all students, and peer influences.

Climate of the classroom: classroom management

Marzano (2000) investigated the effects of various classroom management processes on a number of outcomes, including achievement. The effect on achievement from well-managed classrooms was *d* = 0.52 and on heightened engagement was *d* = 0.62. The attributes of teachers that had the greatest influence on ensuring well-managed classrooms and reducing disruption came from having an appropriate mental set (*d* = 1.29) or "with-it-ness" (*d* = 1.42) by the teacher; that is, the teacher had the ability to identify and quickly act on potential behavioral problems, and retained an emotional objectivity (*d* = 0.71). These factors are related to what Langer (1989) called situational awareness or mindfulness. The next most effective methods were disciplinary interventions (*d* = 0.91), which included verbal and physical behaviors of teachers that indicated to students that their behavior was appropriate or inappropriate (*d* = 1.00); group contingency strategies, which required a specific set of students to reach a certain criterion level of appropriate behavior (*d* = 0.98); tangible recognition, which included those strategies in which students were provided with some symbol or token for appropriate behavior (*d* = 0.82); and interventions that involved a direct and concrete consequence for misbehavior (*d* = 0.57).

Teacher–student relationships were powerful moderators of classroom management (*d* = 0.87, see also Cornelius-White, 2007). The major factors included what Marzano (2000) termed 'high dominance' (clarity of purpose and strong guidance) and 'high cooperation' (concern for the needs and opinions of others and a desire to function as a member of a team). Rules and procedures (*d* = 0.76) involved stated expectations regarding behavior and well articulated rules and procedures that were negotiated with students.



KEY	
Standard error	Na
Rank	42nd
Number of meta-analyses	1
Number of studies	100
Number of effects	5
Number of people (0)	na

Climate of the classroom: group cohesion

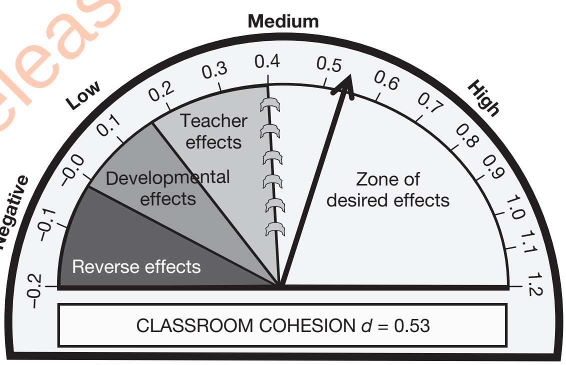
Classroom behavior is any behavior taking place in a classroom that either supports or interferes with the capability and capacity of students to learn the tasks and skills required to achieve educationally. The major effect identified by the meta-analyses and a key factor in positive classroom climate is classroom cohesion—the sense that all (teachers and students) are working towards positive learning gains.

Over all the studies in these meta-analyses of classroom climate, there are common attributes that optimize student learning—goal directedness, positive interpersonal relations, and social support. For example, Haertel and Walberg (1980) found that learning outcomes were positively associated with cohesiveness, satisfaction, task difficulty, formality, goal direction, and the material environment. They were negatively associated with friction, cliquishness, apathy, and disorganization. Johnson and Johnson (1987) found that cooperation among adults promoted achievement, positive interpersonal relationships, social support, and self esteem. These findings were consistent across decades with no differences for individual or group rewards, in laboratory or field settings, by study duration, types of tasks involved, or quality of the study.

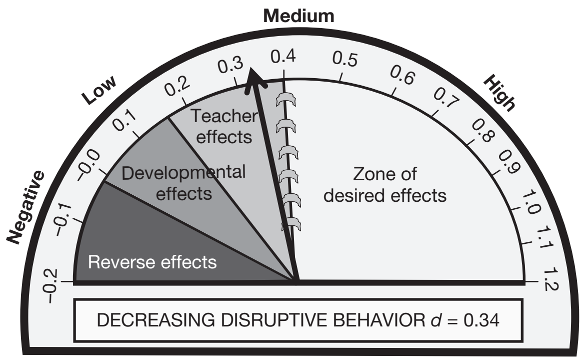
Evans and Dion (1991) concluded that the relationship between cohesion and performance was both stable and positive. Mullen and Copper (1994) argued that this important relationship—group cohesion—was stronger in smaller rather than larger classroom groups; and they attributed it to commitment to task rather than interpersonal attraction or group pride. In situations with greater cohesiveness it is more likely that there is co-peer learning, tolerance and welcoming of error and thus increased feedback, and more discussion of goals, success criteria, and positive teacher-student and student-student relationships.

Decreasing disruptive behavior

The presence of disruptive students can have negative effects on their own and all other students' achievement outcomes. Thus, reducing disruptive behaviors needs to be a core competency of any successful teacher. The argument here is *not* that these students should be removed, as often the same students in a different class are less disruptive. Rather, it is that teachers need skills to ensure that no student unnecessarily disrupts their own or the learning of any other students in the class. There have been many meta-analyses of the effects of various programs to decrease disruptive behaviors (although these are



KEY	
Standard error	0.016 (Low)
Rank	39th
Number of meta-analyses	3
Number of studies	88
Number of effects	841
Number of people (2)	26,507



KEY	
Standard error	0.037 (Low)
Rank	80th
Number of meta-analyses	3
Number of studies	165
Number of effects	416
Number of people (3)	8,426

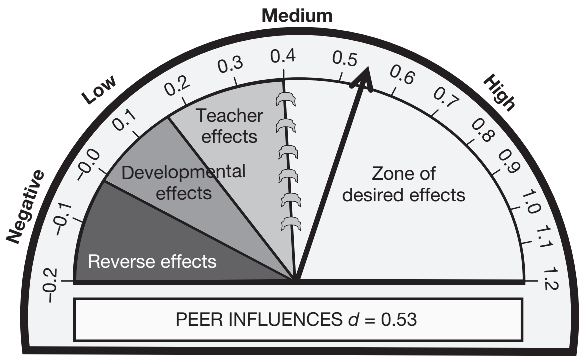
not included in Appendix A as they do not report on achievement effects). For example, Weisz, Weiss, Alicke, and Klotz (1987) found an average effect of d = 0.79 from psychotherapy studies conducted with school age children, Kazdin, Bass, Ayers, and Rodgers (1990) in a larger set of studies found d = 0.77, and in particular that behavioral interventions (d = 0.76) were much more effective than non-behavioral interventions (d = 0.35). The effects were highest for self-control (d = 0.87), then treatment of delinquent behaviors (d = 0.42), noncompliant behaviors (d = 0.42), and aggressive behaviors (d = 0.34) (see also Prout & DeMartino, 1986).

Stage and Quiroz (1997) examined interventions aimed at decreasing disruptive behavior in public education classrooms and found they were successful for 78 percent of students treated. Results indicate that these interventions yield comparable results to other meta-analytic studies investigating the effectiveness of psychotherapy for children and adolescents. Studies using teacher rating scales were less likely to show evidence of reductions in disruptive classroom behavior than those using behavioral observation methods. In addition, students treated in classrooms specifically established for disruptive students were more likely to show less disruptive behavior than students treated in regular classrooms. Similarly, Reid, Gonzalez, Nordness, Trout, and Epstein (2004) found a d = 0.69 effect from programs to provide treatments for emotionally disturbed students. Ghafoori (2000) synthesized 20 studies on the success of cognitive-behavioral therapy in reducing disruptive behaviors in school settings. The overall effect size was d = 0.29; the effects were greater for the lowest socioeconomic students, but similar whether administered by a teacher or not, across ethnicities, and for ADHD and conduct disorder students.

Skiba and Casey (1985) found an effect of 0.91 for interventions for disruptive students. Programs targeting academic outcomes had the greatest effect, then those targeting classroom behavior and social interactions. The most successful programs included social or token reinforcement (d = 1.38), cooperation (d = 1.05), behavioral consultation (d = 1.09), and cognitive behavior modification (d = 1.0); the least successful involved social skills training (d = 0.44). These results indicate that targeting classroom disruptions via a behavioral approach is the most efficacious.

Peer influences

The effects of peers can be considerable, although it is noted how infrequently peers are involved in the teaching and learning process. In our own work we have identified a



KEY	
Standard error	na
Rank	41st
Number of meta-analyses	1
Number of studies	12
Number of effects	122
Number of people (0)	na

myriad of ways in which peers can influence learning, such as helping, tutoring, providing friendship, giving feedback, and making class/school a place students want to come each day (Wilkinson & Fung, 2002). Peers can assist in providing social comparisons, emotional support, social facilitation, cognitive restructuring, and rehearsal or deliberative practice.

Friendships can play an important part in the classroom environment, as they often involve higher levels of caring, support and help, can ease conflict resolution, and thus lead to more learning opportunities, thence enhancing academic achievement (Anderman & Anderman, 1999). This is particularly the case from early adolescence, where social relationships become particularly important. Levy-Tossman, Kaplan, and Assor (2007) also demonstrated that for many performance-oriented students (i.e., those who focus more on the product or outcome of learning and proving their achievement relative to others), friendship is not often characterized by intimacy, and thus the concerns with social comparison and impression management may lead to them taking on less challenging tasks to ensure demonstrations of competence; whereas many achievement-oriented students (i.e., those who focus more on learning as something valuable and meaningful in itself, aiming to master the learning) had more concern for their personal academic development and growth. The higher the quality of the friendships, the greater the magnification of the influence of the friend—and among adolescents this can lead to gaining a reputation as a learner, a social misfit, an athlete, and so on; some of these reputations can be beneficial or harmful to an individual's academic achievement (Berndt, 2004).

Buhs, Ladd, and Herald (2006) showed how low classroom peer acceptance can be consistently linked with student disengagement (Ladd, 1990; Ladd, Kochenderfer, & Coleman, 1997) and academic achievement (Buhs & Ladd, 2001). These students receive negative behavioral treatment, and become marginalized from classroom peer activities. Exclusion is a process that restricts access to the social and instrumental resources that may be found in class peer activities.

Concluding comments

We all like to think that our school is different; that somehow the culture, people, neighborhood, or special status of our school are unique. Any such differences however, relate to concerns that have little effect on achievement. In most western countries, take two students of the same ability, and it matters not which school they attend. That does not seem to stop the search for the point of difference for schools, and a lot of time spent debating school structural issues: the size of school, the class sizes, the tracking, and the finances—which are among the least influences on student achievement. Many of these matters concern teachers' working conditions, and while I am not suggesting that we should cease to strive for excellent working conditions, focusing our concerns on these matters can be to the detriment of debating more critical matters that affect student achievement outcomes.

Take a common debate in schools: whether there should be a school uniform or not. Since the United States' President Clinton announced that "our public schools should be able to require students to wear school uniforms", many schools (about a quarter of American public schools) have adopted this policy—usually in the name of increased attendance, greater safety, enhanced self-esteem, and improved achievement. Such panaceas abound in our business. It is an easy solution that appeals to the hearts of parents—"Don't they look nice in those uniforms; they must be so proud". Brunsma (2004) completed a synthesis of data using two large American databases to assess the effects of those United States public schools that had or had not implemented school uniform policies. He concluded that "school uniform policies do not significantly alter eighth-grade students' perceptions of their schools' safety climate" (p. 109), and indeed had a negative effect on principals' perceptions of the safety climate of the school. At middle school, both students and principals had stronger negative views about school safety after the introduction of school uniforms.

More importantly, school uniform policies had no effect on academic achievement in elementary school but a significant negative effect in high school. Brunsma concluded that "uniform policies negatively affect all aspects of academic achievement when analysed at the school level" and when such policies are implemented in largely minority high schools, then they are "likely to further exacerbate the academic achievement problems witnessed in these schools" (Brunsma, 2004, p. 132). Further, they had no effect on pro-school or pro-peer attitudes, on attendance, on self-esteem, locus of control, coping skills, level of drug use, or behavior incidents.

Policies on uniforms typically stipulate what a student must wear, whereas dress codes typically say what they cannot wear. The same conclusions as were drawn for school uniform policies seem to be the case for dress codes—no effects.

> There is no evidence from this set of analyses that dress codes or uniforms positively affect the school or its students in discernible ways, nor do they influence the very processes that do affect schools and students (i.e., climate, pro-school attitudes, etc.).
>
> (Brunsma, 2004, p. 142)

And "in some cases, they be more harmful than previously thought" (Brunsma, 2004, p. 154).

One of the fascinating outcomes of this research on school effects is the number of such issues in education where the achievement evidence is close to zero but the heat is as high as it would be if the policy were obviously effective. Why do such issues as class size, tracking, retention, summer schools, and school uniforms command such heat and strong claims? The discourse of schooling is often more in terms of such notions, which, while highly visible, can often have zero effect or the opposite effect to the one intended on achievement. Such cosmetic or "coat of paint" reforms are too common.

These structural claims involve the parents, lead to more rules (and therefore more rule breakers), have hints of cultural imperatives, include appeals to common sense, and aim to reduce diversity.

The most powerful effects of the school relate to features within schools, such as the climate of the classroom, peer influences, and the lack of disruptive students in the classroom. Other powerful effects include adapting curricula to be more appropriately challenging (e.g., through acceleration or differential curricula for gifted students), and having principals who see themselves as instructional leaders at the helm of schools. The influences that are close to zero include mainstreaming, ability grouping, class size, open versus traditional classrooms, multi-grade or age classes, and summer vacation courses. Among the more negative influences are retention, and student mobility across schools.

Chapter 7

The contributions from the teacher

As noted in Chapter 3, the current mantra, that *teachers make the difference,* is misleading. Not all teachers are effective, not all teachers are experts, and not all teachers have powerful effects on students (this is what is meant when it is claimed that the "variance due to teachers" makes the difference! It is teachers' variability in effect and impact that is critical). But there is no doubt that nearly all teachers are effective (that is, if we mean having positive achievement effects, $d > 0.00$) and many can have an effect above the hinge-point in the "zone of desired effects" ($d > 0.40$). The important consideration is the ways that teachers differ in their influence on student achievement—what it is that makes the most difference?

As a mind experiment, recall the teachers who truly made a difference to you when you were at school. I have posed this question to large groups on many occasions and the modal answer is always two to three teachers. During your elementary, middle, and high schools you would have experienced between 40 and 60 teachers. Hence, four to six percent of teachers have left their mark. The research on the reasons we choose these teachers identifies teachers who turn students on to the love and challenge of their subject. When students were asked about their *best* teachers, the common attributes were teachers who built relationships with students (Batten & Girling-Butcher, 1981), teachers who helped students to have different and better strategies or processes to learn the subject (Pehkonen, 1992), and teachers who demonstrated a willingness to explain material and help students with their work (Sizemore, 1981).

As noted at the start of the previous chapter, *within*-school factors, in particular teacher quality, account for a much larger proportion of variance than *between*-school factors. On the basis of 18 studies investigating the magnitude of teacher effects, Nye, Konstantopoulos, and Hedges (2004) reported that somewhere between seven and 21 percent of the variance in achievement gains was associated with variations in teacher effectiveness. This corresponds to an average effect of $d = 0.32$, which means that a one standard deviation increase in teacher effectiveness should increase student achievement gains by about one-third of a standard deviation. The variation in teacher effectiveness is much greater for mathematics than reading outcomes (11 percent on average for mathematics compared to seven percent for reading). Neither teacher experience nor teacher education explained much variance in the teacher effects (never more than five percent). The teacher effects are much larger in low socioeconomic schools, which suggests that the distribution of teacher effectiveness is much more uneven in low socioeconomic schools than in high socioeconomic schools, or as they commented "in low-SES schools, it matters more *which* teacher a child receives than it does in high-SES schools" (Nye *et al.*, 2004, p. 254).

To begin the story about the effects of teachers, let's start with a brief review of who our teachers are. The typical American teacher is a white, Anglo-Saxon or middle class female who has grown up in a suburban or rural area. She is monolingual in English, has traveled very little beyond a 100-mile radius of her home, and hopes to teach in a school similar to those where she grew up. She enters teacher education thinking teaching is a craft, knowing how to teach (but seeking a few strategies to get started and some advice about class management), and aims to become more skilful at defending the perspective she already possesses (Wideen, Mayer-Smith, & Moon, 1998). Cochran-Smith and Zeichner (2005) reported that new teachers were predominantly female, white, monolingual, and taught in hard-to-staff, lower performing, rural, and/or central city schools. They were much older on average than in previous decades (e.g., see Brookhart & Freeman, 1992). Across all teachers, about a fifth were not qualified to teach in their subject area: 23 percent of English, 27 percent of mathematics, 18 percent of science, 61 percent of primary chemistry, 45 percent of biology, 63 percent of physics, and 24 percent of social studies high school teachers were not certified in their field (Ingersoll, 2003; Seastrom, Gruber, Hanke, McGrath, & Cohen, 2002).

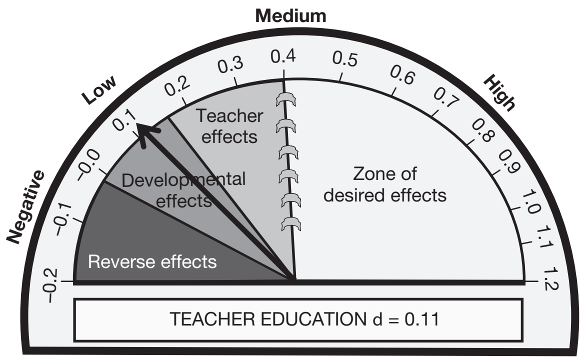
This chapter reviews the contributions of the teacher education programs, teacher subject matter knowledge, the importance of the quality of teaching, the quality of the teacher-student relationships, professional development, and teacher expectations.

Teacher training programs

Arthur Levine (2006, p. 109) described teacher education as "the Dodge City of the education world. Like the fabled Wild West town, it is unruly and disordered." There is no standard approach to where and how teachers should be prepared". Walsh (2006, p. 1) also claimed that "the nation's leading teacher educators … concede that there is presently very little empirical evidence to support the methods used to prepare the nation's teachers". For those working in many teacher education institutions, there is the strong claim that there is a "standard' approach, there is order, and there is core knowledge and understandings that all future teachers should have. I have sat through many meetings where colleagues have decided on the essential core knowledge and experiences that should be taught to

Table 7.1 Summary information from the meta-analyses on the contributions from the teacher

School	*No. metas*	*No. studies*	*No. people*	*No. effects*	*d*	*SE*	*CLE*	*Rank*
Teacher effects	1	18	—	18	0.32	0.020	23%	85
Teacher training	3	53	—	286	0.11	0.044	8%	124
Microteaching	4	402	—	439	0.88	—	62%	4
Teacher subject matter knowledge	2	92	—	424	0.09	0.016	6%	125
Quality of teaching	5	141	—	195	0.44	0.060	31%	56
Teacher-student relationships	1	229	355,325	1,450	0.72	0.011	51%	11
Professional development	5	537	47,000	1,884	0.62	0.034	44%	19
Expectations	8	674	—	784	0.43	0.081	31%	58
Not labeling students	1	79	—	79	0.61	—	43%	21
Teacher clarity	1	na	—	na	0.75	—	53%	8
Total	31	2,225	402,325	5,559	0.49	0.049	35%	—



KEY	
Standard error	0.044 (Low)
Rank	124th
Number of meta-analyses	3
Number of studies	53
Number of effects	286
Number of people (0)	na

teacher education students. In every place this has been a long and often vexed discussion, and every time the 'core' knowledge decided on by the group has been different. There is no set of essential experiences that must be taught, let alone a "correct" order for teaching students to become teachers. Moreover, it seems surprising that the education of new teachers seems so data-free; maybe this is where future teachers learn how to ignore evidence, emphasize craft, and look for positive evidence that they are making a difference (somewhere, somehow, with someone!). Spending three to four years in training seems to lead to teachers who are reproducers, teachers who teach like the teacher they liked most when they were at school, and teachers who too often see little value in other than practice-based learning on the job. The common refrain that "the best part of college was practice teaching" or that the real learning occurs *in situ* points to the lack of effect of the college experience (a refrain often advocated by teacher educators who do not seem to realize how ineffectual it makes them sound).

Many of our students come straight from school themselves, and they need to be de-educated from seeing classrooms through their eyes as students and begin to see classrooms through their eyes as a teacher—which means seeing learning through the eyes of the students in front of them. Mary Kennedy (1997) claimed that:

> [The] unusual nature of teacher learning is such that students entering teacher education already 'know' a great deal about their chosen field. Moreover, they will use what they already know to interpret any new skills or new theories they acquire during the formal study of teaching. This fact means that the simple acquisition of new skills or theories is not adequate to alter teaching practices. Therefore, the central task of teacher learning must be to change these conceptions.
>
> (Kennedy, 1997, p. 13)

They need to be persuaded that school subjects consist of more than the facts and rules they themselves learned as students, that there is much to be learned about the complexities and ambiguities in teaching, that teaching is more than snippets of personal craft techniques and common sense, that there are multiple conceptions of teaching which they may never have experienced, and that developing a strong desire to control student behavior can be inconsistent with implementing many conceptual approaches to teaching. Understanding the lens through which teachers view their criteria of success, and their role in learning as well as teaching, is critical to then asking about their effects.

Teachers enter classrooms with these conceptions of teaching, learning, assessment, and curriculum, and these influence how they see classrooms working, students' progression, and themselves as teaching. Teacher education programs can do much to build lenses and conceptions that can lead to teachers being prepared for the rigors of the classroom, with classes of 25 or more students and detailed and busy curricula, and being prepared to question their own expectations, appreciating the need to talk with other teachers about teaching, and, most importantly, seeing learning through students' eyes. Such "Apprenticeship of Observation", as Dan Lortie (2002) refers to this issue, is a significant challenge for student teachers as they move from seeing classrooms as students to seeing classrooms as teachers of students.

The task should be to ask about evidence of what works best in teacher education and subject it to the same scrutiny found in other research studies about teachers and schools. In accreditation exercises, it could be worthwhile to ask about the evidence that teacher education institutions can provide showing they are having an effect on their student teachers; such that these student teachers will have an effect on their own students. Indeed, in my days as psychometric advisor to the National Council for Accreditation of Teacher Education (NCATE), this was the criterion that was uppermost. It was clear that the model of accreditation based on horses and courses—does the college have the right staff and right time on tasks—was a bankrupt model. Instead, the new NCATE model (National Council on the Accreditation of Teacher Education, 2000) was based on asking colleges to articulate their graduating standards and then provide evidence that all graduates were reaching these standards; this was a major shift. No longer could rooms of paper work, bound folders of brilliance, and counting the time spent in class suffice. Instead, colleges needed to change and be transparent about their learning and assessment methods; they had to provide evidence that demonstrated their concept of their standards of graduation; and any or all students could be evaluated as to how well they met these standards.

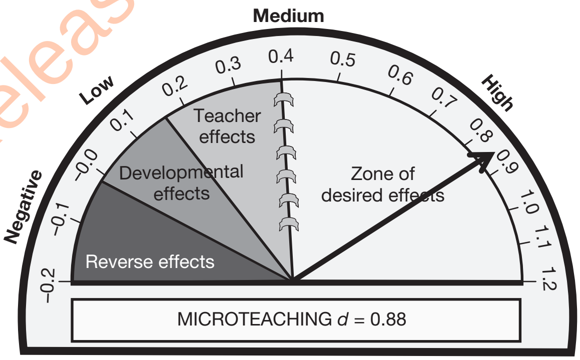
The meta-analyses relating to teacher education show that the effect size of teacher education on subsequent student outcomes is negligible (about 0.10), although the effect on specific skills is quite high. Qu and Becker (2003) reported a very small effect from only 24 studies—not a lot of studies considering how important this topic should be (and they acknowledged the difficulties in finding even these studies). The effects of four-year college training compared with the effects of alternative certification is $d = -0.01$, and, compared with emergency licenses, $d = 0.14$. The effect for those training in one subject but teaching out of field is $d = 0.09$, but when compared to teachers with full certification who have several years of teaching experience as opposed to emergency teachers, the effect rises to $d = 0.39$—probably reflecting the influences of teaching experience (pedagogical subject matter) and not subject matter knowledge *per se*. Similarly Sparks (2004) commented about how little is known about such an important and well discussed and advocated topic. She reported that fully certified teachers had slightly more effect on student achievement than those with probationary or emergency licenses (across mathematics, science, and reading; $d = 0.12$); and that teachers trained in the field they are teaching in were more effective than those not so trained ($d = 0.38$). While not a meta-analysis, one of the rare random controlled studies involved assigning students to 44 teachers with emergency licenses and 56 trained teachers (Glazerman, Mayer, & Decker, 2006). They found no differences in reading and $d = 0.15$ in mathematics. They concluded that "Teach for America" teachers were "an appealing pool of candidates" (p. 95) particularly as they serve low-income and often difficult-to-staff schools. At best, it was concluded that teacher education programs appear to make some difference compared to emergency licenses. So much more is needed on this topic.

Microteaching

There are larger effects for more specific aspects of the teacher education preparation. Metcalf (1995), for example, carried out a meta-analytic review of studies of on-campus clinical experience for teacher education and found that laboratory experiences produced moderate to strongly positive results for teacher effect, knowledge, and instructional behavior ($d = 0.70$). Such experiences included microteaching, with analysis, reflective teaching, and videotaped role play with debriefing. Microteaching typically involves student-teachers conducting (mini-) lessons to a small group of students (often in a laboratory setting) and then engaging in post-discussions about the lessons. They are usually videotaped for this later analysis, and allow an often intense under-the-microscope view of their teaching. In contrast to conclusions drawn by earlier reviews, Metcalf (1995) argued that laboratory experiences appeared to have a strong effect on teacher behavior and this effect did not significantly decrease over time. Laboratory experiences are effective for in-service teachers. But these methods are far less frequent today.

Bennett (1987) reviewed the effects of various teaching methods within teacher education programs, and reported higher effects for demonstration ($d = 1.65$) and information ($d = 0.63$) than for theory ($d = 0.15$) on trainee teachers' knowledge. He found a similar pattern for attitude outcomes ($d = 0.48, 0.15, -0.08$, respectively), but the reverse for effects on skills: theory ($d = 0.97$), information ($d = 0.35$), and then demonstration ($d = 0.26$). The conclusion was that all components should be included: theory, demonstration, and practice, as well as feedback and coaching, preferably in a distributed rather than condensed manner across many sessions. It was noted, however, that most teacher programs focused on training of low-level skills, reinforcing the skills that were already part of the training teacher's repertoire. It seems that there is too little exposure or teaching of new conceptions of teaching and new ways of teaching.

Overall, the evidence in support of teacher education in general is wanting—both in terms of the number of studies and in the limited evidence of effectiveness from those few studies that do exist. It may be that the effects of teacher education are less on the students of these prospective teachers and greater on the conceptions of what teaching



KEY	
Standard error	na
Rank	4th
Number of meta-analyses	4
Number of studies	402
Number of effects	439
Number of people (0)	na

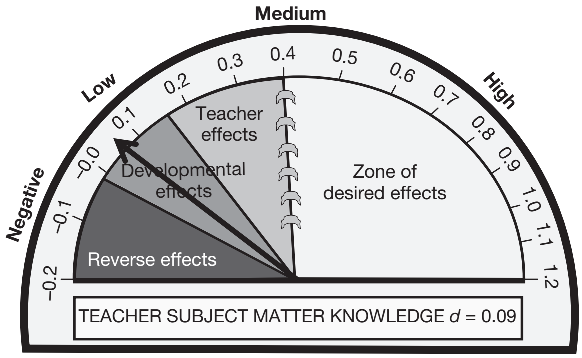
involves. Brookhart and Freeman (1992) reported that beginning teachers' conceptions of teaching, while positive, emphasize the value of interpersonal aspects and minimize the importance of academic goals of schooling. Their conception is that teaching is more about telling, and the role of the teacher is to construct lesson sequences to help students work through complex ideas. This is concerning if the model promoted in this book is worth pursuing. The conception of teaching needs to be more related to choosing appropriately challenging learning intentions and success criteria, then *enabling* the students to attain these goals by monitoring and evaluating the effectiveness of their teaching, while constantly aiming to see learning through the eyes of the students, and creating a safe and cooperative climate to make and learn from errors, from each other (teacher, student and peers), and optimize the feedback to the student about what they are learning. The current model seems more related to an extended view of parenting than becoming a behavior change agent!

What may be needed is more study of the best programs. Darling-Hammond (2006) studied exemplary teacher education programs and identified seven features of these programs:

1. coherence based on a common, clear vision of good teaching that permeates all coursework and clinical experiences;
2. well-defined standards of practice and performance that guide and evaluate coursework and clinical work;
3. curriculum grounded in knowledge of child and adolescent development, learning, social contexts, and subject matter pedagogy;
4. extended clinical experiences carefully developed to support the ideas and practices presented in simultaneous closely interwoven coursework;
5. explicit strategies to help student teachers to confront their own deep-seated beliefs and assumptions about learning;
6. strong relationships, common knowledge, and shared beliefs that link all who are teaching these prospective teachers;
7. assessment based on professional standards that evaluates teaching through demonstrations of critical skills and abilities using performance assessments and portfolios.

Teacher subject matter knowledge

There has been a long debate about the importance of teacher subject matter knowledge, with the seemingly obvious claim that teachers need to know their subject to teach it! Shulman (1987) clearly articulated the importance of "pedagogical content knowledge that is the basis of effective teaching". Teaching, according to Shulman, "begins with a teacher's understanding of what is to be learned and how it is to be taught" (p. 7). Despite the plausibility of this claim, there is not a large corpus of evidence to defend it. If there were a large and consistent set of studies showing the power of teacher subject matter knowledge/pedagogical knowledge on subsequent student outcomes, it would seem that it should be well-cited and not elusive to find. The only meta-analysis on the topic, by Ahn and Choi (2004), found a very low effect size of $d = 0.12$ between knowing mathematics and student outcomes. Further, these effects were similarly small at both the elementary and high school level. Darling-Hammond (2006) has argued that it is likely that subject



KEY	
Standard error	0.016 (Low)
Rank	125th
Number of meta-analyses	2
Number of studies	92
Number of effects	424
Number of people (0)	na

matter knowledge influences teaching effectiveness up to some level of basic competence but less so thereafter (see also Monk, 1994).

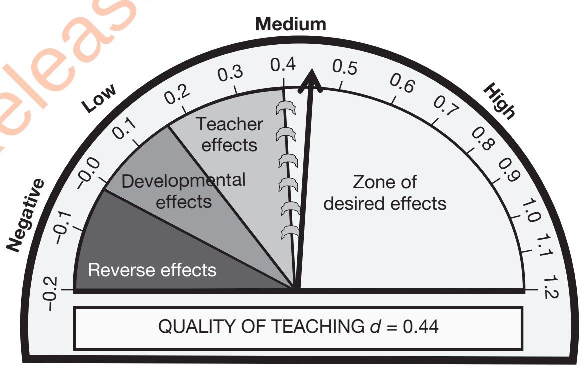
Druva and Anderson (1983), in their meta-analysis on the characteristics of science teachers that affected student outcomes, did find a relation between teaching effectiveness and the number of education courses taken (d = 0.37), student teaching grade (d = 0.34), and the number of years of teaching experience (d = 0.33). Other correlates to student outcomes were teachers with a more intellectual orientation and this suggests that there may be a more underlying general ability that is more critical. For example, Greenwald, Hedges and Laine (1996) found that teachers' academic skills have a positive relationship to student achievement in 50 percent of the studies they analyzed; and thus they suggested that intellectual ability may be more powerful than teacher training. Ferguson and Ladd (1996) found more positive relationships between aggregate teacher scores on the American College test and literacy examinations than on states' teacher licensure examinations and aggregate student performance on standardized tests. Ehrenberg and Brewer (1995) re-examined the Coleman (1966) data and found a significant positive association between teachers' verbal ability and student outcomes. As Hanushek (1989) wrote "Perhaps the closest thing to a consistent conclusion across studies is the finding that teachers who perform well on verbal ability tests do better in the classroom" (p. 48). There is a need for care here, as it could be that verbal ability is a correlate of many important attributes (usually not measured in these studies) such as flexibility, empathy and content knowledge, and such correlates should not be confused with causes. The suggestion, however, is that more generalized verbal proficiency is a key determinant in the later success; when combined with subject knowledge and the teaching skills identified in this book (visible teaching), this may make for excellent effects on achievement.

The importance of teachers having skills in developing interpersonal relationships with students is also important. Colosimo (1984) examined attitude changes with initial teaching experience and found that increases in positive attitudes and self-concepts of new teachers could be expected where teachers were involved in pre-service programs which included interpersonal skills training. The effect on attitudes of the teachers was quite substantial (d = 0.30), compared to the effects on achievement. Positive self-attitudes, however, decreased after teachers left colleges and began teaching, particularly for those teaching in inner city rather than suburban schools, possibly because they were less prepared for the inner-city schools. Colosimo suggested that the inclusion of interpersonal skill development and psychological preparation training in traditional teacher education programs was necessary to increase positive attitudes and self-concepts of new teachers. It seems that knowledge, empathy and verbal ability all need to be present. They are greater than the sum of the parts and if one is missing the effectiveness is reduced by more than a third.

Quality of teaching

All the meta-analyses on the relation of the quality of teaching to learning come from student ratings of teachers by college and university students. It appears that student rating of the quality of teachers and teaching is related to learning outcomes, although the feedback that is provided to teachers rarely leads to improvements in their teaching or the effectiveness of the courses. This is despite Irving (2004) finding a high relation between his student evaluation of secondary National Board Certified and non-certified mathematics teachers. The student evaluations could correctly categorize the National Board Certified teachers (NBCTs) over 70 percent of the time, and the non-National Board Certified teachers (non-NBCTs) approximately 60 percent of the time. The effect size between these two groups of teachers on his five student evaluation factors was d = 0.41 for student evaluation of the quality of the mathematics teaching, d = 0.32 for perceived teachers' commitment to student learning, d = 0.31 for engagement with the curriculum, and lower (d = 0.14) for relating mathematics to the real world, and for involvement with family and community (d = 0.07). The highest correlations involved items relating to:

1 teachers challenging students (encouraging them to think through and solve problems, either by themselves or together as a group r =0.64);
2 high expectations (encouraging students to place a high value on math r = 0.53);
3 monitoring and evaluation (getting students to think about the nature and quality of their work r = 0.46; encouraging them to test mathematical ideas and discover mathematical principles r = 0.40);
4 teaching the language, love, and details of mathematics (helping students construct an understanding of the language and processes of mathematics r = 0.47; developing their ability to think and reason mathematically, and have a mathematical point of view r = 0.41).



KEY	
Standard error	0.060 (Medium)
Rank	56th
Number of meta-analyses	5
Number of studies	141
Number of effects	195
Number of people (0)	na

Quality teachers, as rated by students, are those who challenge, who have high expectations, who encourage the study of their subject, and who value surface and deep aspects of their subject.

The use of student rating has been hotly contested, although the majority of studies show that they are reliable, trustworthy, and valid (Marsh, 2007). Some have argued that they are merely popularity contests. Abrami, Leventhal, and Perry (1982) conducted a meta-analysis of studies on the influence of an instructor's personality on student ratings of instruction. They found that instructor expressiveness had a substantial effect on student ratings but a small effect on student achievement. In contrast, lecture content had a substantial effect on student achievement but a small effect on student ratings.

Cohen (1981) found an average correlation of $r = 0.43$ between overall teacher rating and student achievement. The relations were highest for perceived teaching skill and knowledge of the subject ($r = 0.50$), planning and organizing the course ($r = 0.47$), rapport with students ($r = 0.31$), and feedback ($r = 0.31$), but the rating was not correlated to the difficulty of the course ($r = -0.02$). As noted earlier, students were reasonable accurate in evaluating their own progress in the course ($r = 0.47$), which also attests to the accuracy of student evaluations of their own learning and probably of the influences of the teacher. Given the value of student evaluations as an index of teaching and their own learning, it is therefore discouraging to note that teachers do not seem to learn much from this important source of information. Cohen (1980; 1981) found that feedback from student ratings has a medium contribution to the improvement of teaching at college level ($d = 0.38$). The effects were amplified when feedback was extended through such processes as consultation (see also Hampton & Reiser, 2004; Lang & Kersting, 2007).

The lack of use of student evaluations in elementary and high schools should be a major concern. The stakes are too high to depend on beliefs that quality is high, or that the students are too immature to have meaningful judgments about the effects of teachers on their learning. A key is not whether teachers are excellent, or even seen to be excellent by colleagues, but whether they are excellent as seen by students—the students sit in the classes, they know whether the teacher sees learning through their eyes, and they know the quality of the relationship. The visibility of learning from the students' perspective needs to be known by teachers so that they can have a better understanding of what learning looks and feels like for the students. Of course, the quality of student evaluation instruments is critical, although the meta-analysis shows little difference in the findings, regardless of the student evaluation questionnaire used.

Another set of studies that have a bearing on the quality of teaching are those investigating the National Board for Professional Teaching Standards (www.nbpts.org). This model involves teachers opting to sit a series of assessments (over six months or more) and then being adjudged certified as an accomplished teacher (in a particular teaching domain such as early childhood, middle grade generalist, early adolescent English language arts, secondary mathematics, and so on (Ingvarson & Hattie, 2008). There are conflicting accounts of the impact of NBCTs on student achievement. Goldhaber and Anthony (2004) compared the growth increases of NBCTs and non-NBCTs on over 600,000 students in North Carolina. They found that NBCTs had growth increases of $d = 0.04$ for reading and $d = 0.05$ for mathematics outcomes. Lustick and Sykes (2006) were more interested in the effects of the National Board Certification process on teacher learning, and reported an effect of $d = 0.47$ in the promotion of learning in teachers, and in particular quite substantial effects in advancing student learning ($d = 0.48$), supporting teaching and student learning

(d = 0.52), and establishing favorable contexts for student learning (d = 0.44). Vandevoort, Amrein-Beardsley and Berliner (2004) compared 35 NBCTs performance to Arizona state averages on achievement over four years. The effect sizes on the gains in achievement were d = 0.12 overall, and specifically d = 0.14 in reading, d = 0.43 in mathematics, and d = 0.09 in language. Sanders, Ashton, and Wright (2005) reported effect sizes of d = 0.09 and d = 0.04 for mathematics and reading from NBCTs compared to non-NBCTs (see also Cavalluzzo, 2004; Goldhaber & Anthony, 2004).

In our own work on NBPTS, we compared NBC teachers who had passed (i.e., were above the cut score) with those just below the cut score (Hattie & Clinton, 2008; Smith, Baker, Hattie, & Bond, 2008). We spent many hours in these teachers' classes and collected a large array of information from the teachers and students (including lesson transcripts, observations, teacher and student interviews, surveys, assignments, and student work). This evidence was independently evaluated and there were differences across all 13 indicators of teaching quality, but the most powerful related to the degree the teachers set appropriately challenging goals for the students: the NBC teachers compared to the non-NBC teachers were more likely, in a systematic and consistent way, to challenge students to think; they regularly promoted varied and appropriate assignments that were demanding and engaging (d = 1.37). Other discriminators included:

1 teachers tested hypotheses about the effects of their teaching (d = 1.09);
2 had a deeper understanding of their teaching and its effects on student learning (d = 1.02);
3 had a sense of control (d = 0.90);
4 had high levels of passion for teaching and learning (d = 0.90);
5 had deep understanding of their subject d = 0.87);
6 were adept at improvisation (d = 0.84);
7 had a problem solving disposition to teaching (d = 0.82);
8 had a positive classroom climate that fostered learning (d = 0.67);
9 had respect for their students (d = 0.61).

While the effects on the writing achievement of their students was far less substantial (d = 0.13), the key difference in the outcomes was that 74 percent of the student work samples in the classes of NBC teachers were judged to reflect a level of deeper understanding (i.e., relational or extended abstract), and 26 percent reflected a more surface understanding. This compares with 29 percent of the work samples of non-NBC teachers so classified as deep and 71 percent as surface. It appears that the quality of teachers (at least as measured by the National Board methods) has important effects on the nature of what teachers do and think, but lower effect on the actual achievement on state tests. They do emphasize and enhance the deeper outcomes to a far greater extent that do non-NBC teachers—and it may be that many state tests are more focused on the surface features of the curricula domains.

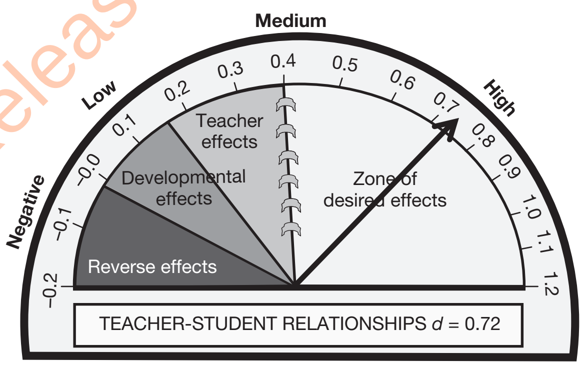
On the other side of this equation, having poor teachers can be devastating. Sanders and Rivers (1996) found that the least effective teachers elicited average student gains of roughly 14 percentile points a year, whereas the most effective teachers elicited an average gain of 52 percentile points a year. But more importantly, "the residual effects of relatively ineffectual teachers from prior years can be measured in subsequent student achievement scores" (p. 4). Ineffective teachers were so for all students in that teacher's class, and there was "little evidence of compensatory effect of more effective teachers in later grades" (p. 6). The effects of poor teacher quality tend to persist for years after a student has had such a teacher (Sanders & Rivers, 1996). "If anyone is serious about improving the academic achievement levels for all students, then this improvement will be obtained only by reducing the likelihood that students will be assigned to relatively ineffective teachers." (Sanders, 2000, p. 335).

The final meta-analysis under quality of teacher relates to the effects of the sameness of ethnicity of teacher and students. Clotfelter, Ladd, and Vigdor (2007) found that when a student and a teacher are the same race, the effects on student achievement are no different than when the teachers are from a different background—about d = 0.02 for reading and d = 0.03 for mathematics. They also found that teachers with more experience are more effective than those with less experience (d = 0.12 after 21 to 29 years' experience) with more than half this gain occurring during the first few years of teaching.

Teacher–student relationships

In the first chapter, the work of Russell Bishop and colleagues with Māori students in New Zealand mainstream classes was noted. When students, parents, principals, and teachers were asked about what influences students' achievement, all but the teachers emphasized the relationships between the teachers and the students. The teachers saw the major influence on achievement as a function of the child's attitudes and dispositions, their home, or the working conditions of the school—it is the students who are not learning who are somehow deficient. Building relations with students implies agency, efficacy, respect by the teacher for what the child brings to the class (from home, culture, peers), and allowing the experiences of the child to be recognized in the classroom. Further, developing relationships requires skill by the teacher—such as the skills of listening, empathy, caring, and having positive regard for others.

Cornelius-White (2007) located 119 studies and 1,450 effects, based on 355,325 students, 14,851 teachers, and 2,439 schools. He found a correlation of 0.34 (d = 0.72) across all person-centered teacher variables and all student outcomes (achievement and attitudes). The highest relations between person-centered teacher variables and achievement outcomes were for critical/creative thinking (r = 0.45), math (r = 0.36), verbal (r = 0.34), grades (r = 0.25). The effect sizes between the eight affective outcomes are depicted in Figure 7.6.



KEY	
Standard error	0.011 (Low)
Rank	11th
Number of meta-analyses	1
Number of studies	229
Number of effects	1,450
Number of people (1)	355,325

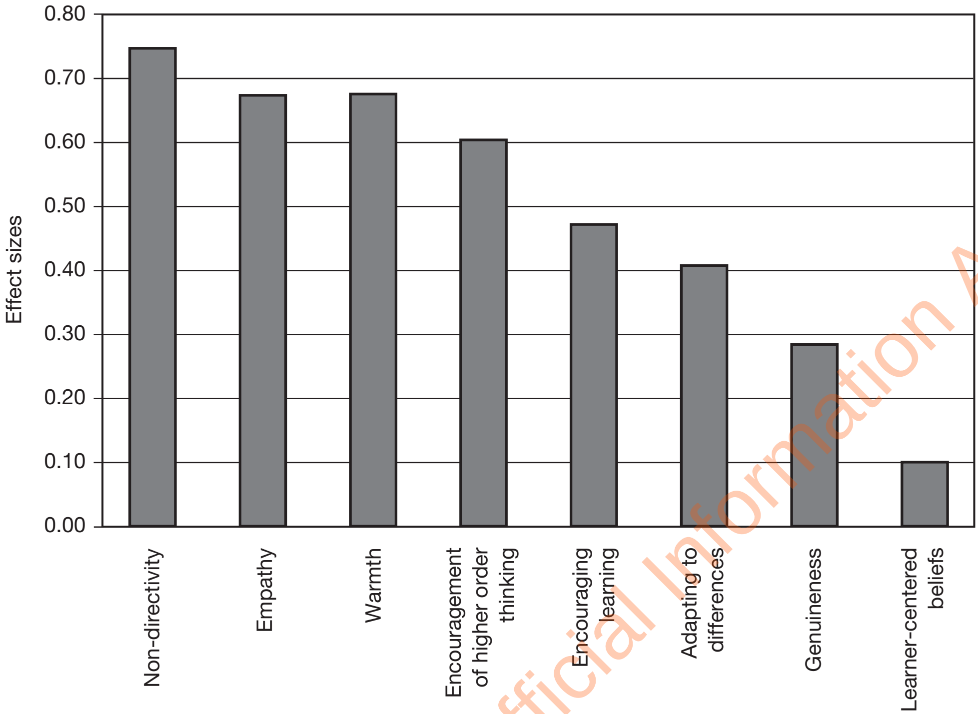


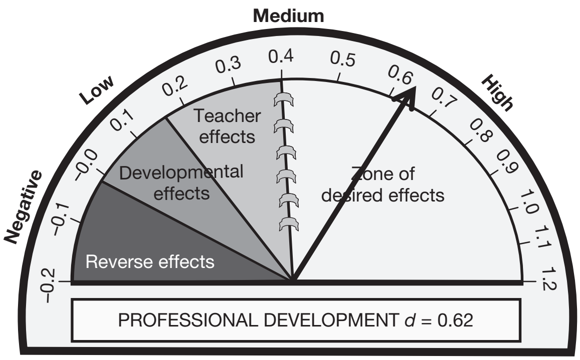
Figure 7.6 Effect sizes for nine teacher–student relationship variables

In classes with person-centered teachers, there is more engagement, more respect of self and others, there are fewer resistant behaviors, there is greater non-directivity (student-initiated and student-regulated activities), and there are higher achievement outcomes. Cornelius-White notes that most students who do not wish to come to school or who dislike school do so primarily because they dislike their teacher. His claim is that to "improve teacher-student relationships and reap their benefits, teachers should learn to facilitate students' development" by demonstrating that they care for the learning of each student as a person (which sends a powerful message about purpose and priority), and empathizing with students—"see their perspective, communicate it back to them so that they have valuable feedback to self-assess, feel safe, and learn to understand others and the content with the same interest and concern." (p. 23).

Professional development

One of the difficulties with reviews of professional development is that the outcomes seem to be more about changes in the teachers, and not the impact of professional development on student outcomes. Wade (1985) for example, divided the outcomes into four groups:

1 reaction—how the teachers felt about the professional development;
2 learning—the amount of learning the teachers accrued;



KEY	
Standard error	0.034 (Low)
Rank	19th
Number of meta-analyses	5
Number of studies	537
Number of effects	1,884
Number of people (1)	47,000

3 behavior—whether teachers changed their behavior as a result of the professional development;
4 student outcomes—impact on students.

Professional development is more likely to change teacher learning (*d* = 0.90), but these learnings have less effect on teachers' actual behavior (*d* = 0.60) and teachers' reactions to the professional development (*d* = 0.42), and even less influence on student learning (*d* = 0.37). The four types of instruction found to be most effective on teacher knowledge and behavior were: observation of actual classroom methods; microteaching; video/audio feedback; and practice. Lowest effects were from discussion, lectures, games/simulations, and guided field trips. Coaching, modeling, and production of printed or instructional materials also had lower effects. Higher effect sizes were found in studies where: training groups involved both high school and elementary school teachers rather than only high or only elementary teachers; training programs were initiated, funded or developed by federal, state, government or university rather than by schools or teachers; participants were selected for training; and where training was practical rather than theoretical (Wade, 1985).

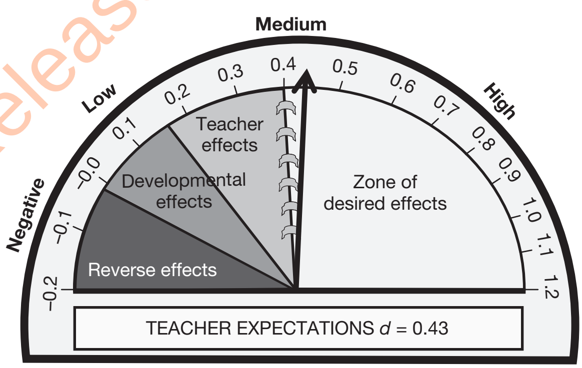
Joslin (1980) found that in-service programs were effective in changing teacher achievement, skills, and attitudes, although it was questionable as to whether professional development was effective in attempts to change students through teacher participation in these programs. Harrison (1980) also found that professional development was an effective way in which to improve job performance and satisfaction. The effects were highest for increasing the teacher's knowledge (*d* = 1.11) and affective feelings and satisfaction (*d* = 0.85), and lower but still positive for the effects on student outcomes (*d* = 0.47).

Timperley, Wilson, Barrar, and Fung (2007) found 72 studies that assessed the effects of professional development on student outcomes. The overall effect on academic outcomes was *d* = 0.66, and the effects were highest for science (*d* = 0.94), writing (*d* = 0.88), mathematics (*d* = 0.50), and then reading (*d* = 0.34). The effects did not relate to the size of the cohort in the professional development (<100 *d* = 0.84; 100–999 *d* = 0.69; > 1000 *d* = 0.69), but the effects were greater on low-achieving or special education students (*d* = 0.43) and gifted (*d* = 0.31) than on regular students (*d* = 0.18). More important, Timperley and colleagues used the effect sizes to ascertain seven themes about what works best in professional development. First, the learning opportunities for teachers occurred over an extended period of time—except when powerful ideas formed the basis of new practice and had a high impact on student outcomes (e.g., teaching how to screen students for auditory processing problems). Second, the involvement of external experts was more related to success than within-schools initiatives. Third, it was important to engage the teachers sufficiently during the learning process to deepen their knowledge and extend their skills in ways that improved student outcomes. Fourth, and most critical, effects on student learning were very much a function of professional development that challenged the teachers' prevailing discourse and conceptions about learning (when this discourse was problematic, it was usually based on the assumption that some groups of students could not or would not learn as well as others), or challenging teachers how to teach particular curricula more effectively. Fifth, teachers talking to teachers about teaching (involvement in a professional community of practice) was necessary but not sufficient by itself. This was because teachers were more listened to when challenging problematic beliefs and testing the efficacy of competing ideas, and when discussions were grounded in artifacts representing student learning. Sixth, professional development was more effective when the school leadership supported opportunities to learn, where there was access to relevant expertise, and when opportunities were provided to meet to process new information. Seventh, funding, release time, and whether the involvement was voluntary or compulsory were unrelated to influences on student outcomes.

Expectations

In the education system, it is now widely accepted that teachers do form expectations about student ability and skills and that expectations affect student achievement (Dusek and Joseph, 1985). The question is not "Do teachers have expectations?" but "Do they have false and misleading expectations that lead to decrements in learning or learning gains—and for which students?"

Perhaps the most famous (or infamous) book in education in the past 50 years has been *Pygmalion in the Classroom*. In this book, Rosenthal and Jacobsen (1968) argued that teachers' expectations were powerful influences on the success of student learning. The students they randomly labeled as "bloomers" ("they will show a more significant inflection or spurt in their learning within the next year than will the remaining 80 percent of the children"; p. 66) did indeed increase in achievement by the end of the year. The book, and its reviews, created its share of those inspired, insulted, and infuriated. There were many failures to replicate the results, and there was much attention paid to the methodological problems of this study (Spitz, 1999), but there was the constant



KEY	
Standard error	0.081 (High)
Rank	58th
Number of meta-analyses	8
Number of sudies	674
Number of effects	784
Number of people (0)	na

niggle that expectations were powerful. Some sought to find expectations that led to the disempowerment of various groups (girls, minorities, students sitting at the back of the room), while others noted the power of feedback to correct false expectations. Raudenbush (1984), in his meta-analysis, argued that the less teachers knew their students prior to receiving the false information, then the stronger the effect on learning. The research on expectations is not now as prevalent as it was in the 1970s and 1980s, but there has been a recent resurgence due to the work of Weinstein (2002) and colleagues.

The first set of meta-analyses discussed in this section relate to the more general issue of interpersonal expectancies (which is that the experimenter tends to obtain the results she or he expects). Rosenthal and Rubin (1978) summarized the results of 345 experiments looking at interpersonal expectancy effects, and found a mean size of d = 0.70 over eight different areas of research. This is a large effect. Depending on the type of study examined, the mean size of the effect varied from small for studies of reaction time and laboratory interviews to very large for studies of psychophysical judgments and animal learning. They found that the effect of interpersonal expectations or self-fulfilling prophecies was as great, on average, in everyday life situations as it was in laboratory experiments. The implication for teachers is that teachers (as human beings) are more likely to have their students reach their "expected" outcomes, regardless of the veracity of the expectations.

Harris and Rosenthal (1985) examined 135 studies on the effects of expectations on various behaviors. They claimed that input factors (student sex, age, ethnicity) are the most important mediators in the transmission of expectancies (d = 0.26), followed by output (asks questions, frequency of interaction: d = 0.19), climate (d = 0.20), and feedback (which they considered as praise and criticism: d = 0.13). All four combined factors are of higher importance than any individual factor. They did note the low effects of praise, and noted that it may be more important to study the content of the feedback than its frequency, timing, or simple positive versus negative nature.

> In most situations, praise and criticism may refer to routine, almost mechanized, pronouncements of 'Good' or 'No, you're wrong.' This kind of feedback is not informative to the student; consequently, it may have no impact on the child beyond the realization that he or she got the answer right or wrong.
>
> (Harris & Rosenthal, 1985, p. 377)

Smith (1980) found that when labeling information on pupil ability is given to teachers, they reliably rate student ability, achievement, and behavior according to the information provided. Teacher expectations affected their behavior to a modest degree; in particular, more teaching opportunities were given to students for whom there was a favorable expectation. Raudenbush (1984) reported that prior teacher–student contact (of at least two weeks) reduced any negative outcomes, and expectation effects were larger for young students in grade levels 1 and 2, than for students in grade levels 3 and 4.

There has been a long search for which particular students are differentially affected by teacher expectations. Dusek and Joseph (1983) found that student attractiveness (d = 0.30), student prior conduct in class, cumulative folder information (d = 0.85), and social class (d = 0.47 for high and middle compared to low) were related significantly and positively to teacher expectancies. Factors not related included number of parents at home, student gender (d = 0.20), previously-taught siblings, name stereotypes, and student ethnicity. But when teachers were given more pertinent information (such as academic information) then factors such as attractiveness became less important. It was also noted that too many of the studies that led to these effects asked teachers to make judgments about unfamiliar students. Jackson, Hunter, and Hodge (1995) derived various reasons why physical attractiveness would be related to achievement. Their meta-analysis supported the notion that attractive people are *perceived* as more intellectually competent than their less attractive peers. These effects were stronger for males than females, and markedly reduced, but not absent, when explicit evidence about competence was present. There were no relations between attractiveness and achievement for adults (d = 0.02) but there were for children (d = 0.41). It seems that there is an attractiveness bias that benefits these students.

Dusek and Joseph (1983) also cautioned that the effects of expectancies on social versus achievement effects can be quite different and these two should not be confused. It may be the case, for example, that attractive children tend to have better relations than unattractive children with peers—so that the teachers' expectations about these social outcomes is not a bias but a reflection of teachers' experiences. Ritts, Patterson and Tubbs (1992) found that physically attractive students are judged more favorably by teachers on social skills (d = 0.48) than on intelligence or academic grades (d = 0.36). But it was also the case that more attractive students do receive higher grades on standardized tests and parents also show biases in many actions to attractive children; the key question raised in the study is when and where do attractiveness effects begin and how do they change over time?

The label *learning difficulties* can also have negative effects. Fuchs, Fuchs, Mathes, Lipsey, and Roberts (2002) found 79 studies that compared students with lower reading achievement with those labeled as having learning difficulties. The effect of d = 0.61 indicated that the reading scores of 73 percent of low achievers without the label were above the average reading score of low achievers with the label—clearly, labeling leads to differential performance and it is difficult to understand why this is so when there was no evidence that these labeled students have a qualitatively different set of learner characteristics than those not so labeled. At what point does low achievement become so extreme that it represents a real disorder, requiring a different educational response?

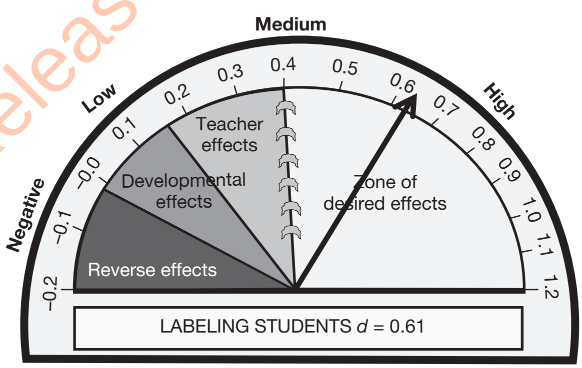
It was noted above that Dusek and Joseph (1985) found small effects of race on teacher expectations (d = 0.11). Wherever the race advantage is found, however, it favors white and Asian students. Tenenbaum and Ruck (2007) reported that teachers had more positive expectations for European Americans than for minority students (d = 0.23; Hispanic d = 0.46, African American d = 0.25, Asian d = –0.17), the effects were greatest in elementary (d = 0.28) and high school (d = 0.26) and less so for college students (d = 0.12). Further, teachers were more likely to make negative assignments (e.g., special education, disciplinary action) for ethnic minorities (d = 0.31) and direct more positive or neutral speech to whites (d = 0.21), but there was no evidence of more negative speech (d = 0.02) to white compared to African Americans or Hispanics. Cooper and Allen (1997) investigated the interactive effects of race on the classroom experiences of white and minority students. The average effect was d = –0.18 thus indicating that minority students have different types of interactions with teachers. In particular, there were more negative statements by teachers to non-white students (d = –0.15), white students received more positive praise (d = 0.09), and overall minority students had fewer interactions with teachers than white students (d = 0.15).

So how to make sense of these moderating effects of teacher expectations on student achievement? Two recent sets of research bring some meaning to this domain. First, Weinstein (2002) has provided a new direction for expectancy effects. She has shown that students *know* they are treated differentially in the classroom due to expectations held by teachers, and are quite accurate in informing on how teachers differ in the degree to which they favor some children over others with higher expectations. There are differences in classrooms where teachers aim to select talent for different educational pathways (such as schools with tracking) compared with those where achievement cultures aim to develop talent in each child. There are differences in classes where teachers believe that achievement is difficult to change because it is fixed and innate compared to teachers who believe achievement is changeable (Dweck, 2006). Weinstein also demonstrated that many institutional practices (such as tracking) can lead to beliefs that preclude many opportunities to learn: "Expectancy processes do not reside solely 'in the minds of teachers' but instead are built into the very fabric of our institutions and our society" (Weinstein, 2002, p. 290).

Second, Rubie-Davis and her colleagues (Rubie, 2003, 2006, 2007; Rubie-Davies, Hattie, & Hamilton, 2006) added another concerning dimension to this expectation research with the finding that when teachers hold lower expectations, they do so for *all* the students in the class—it is certainly a teacher effect. Based on this evidence, teachers must stop overemphasizing ability and start emphasizing progress (steep learning curves are the right of all students regardless of where they start), stop seeking evidence to confirm prior expectations but seek evidence to surprise themselves, find ways to raise the achievement of all, stop creating schools that attempt to lock in prior achievement and experiences, and be evidence-informed about the talents and growth of *all* students by welcoming diversity and being accountable for all (regardless of the teachers' and schools' expectations). "Be prepared to be surprised" seems to be the mantra to avoid negative expectation effects. If teachers and schools are going to have expectations, make them challenging, appropriate, and checkable such that all students are achieving what is deemed valuable. To this we can add the potentially negative effects of students setting their own low expectations (recall the power of self-reported grades) and not being provided with high levels of confidence that they can exceed these expectations and not only attain but enjoy challenging learning intentions.

Labeling students

Many of the meta-analyses reviewed in this section do not have achievement as an outcome, but do relate to how teachers (and parents) differentiate between special and regular students (and many other labels). The controversy in distinguishing between mentally disabled and non-disabled children is often couched between the developmental



KEY	
Standard error	na
Rank	21st
Number of meta-analyses	1
Number of studies	79
Number of effects	79
Number of people (0)	na

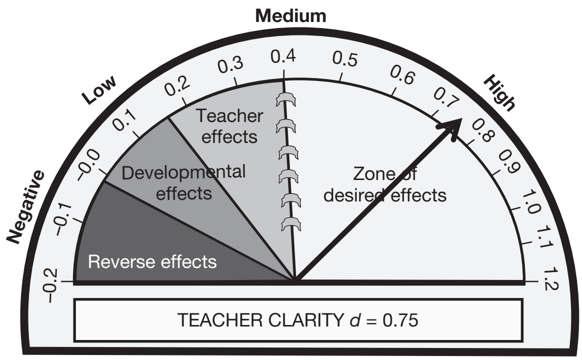
and cognitive processing claims. The developmental position is that disabled children pass through cognitive developmental stages in an identical manner but differ in rate and the upper limit of development (Inhelder & Piaget, 1964; Piaget, 1970). The information-processing claim is that they differ in the cognitive processes they use in reasoning. Weiss, Weisz, and Bromfield (1986) examined information-processing studies based on the hypotheses that "retarded" and non-"retarded" people pass through Piagetian cognitive developmental stages in an identical order but at a different rate. They noted, however, that differences were not found across all learning areas, with differences in some areas such as discrimination learning (verbal, picture, and three-dimensional object discrimination), but not in others such as conservation and incidental learning. For "retarded" students, there was found to be a strong deficit specific to certain aspects of memory: serial and non-serial auditory; short-term memory; visual-iconic memory; visual short-term memory; cross-modal short-term memory; and visual paired-associate learning. Swanson and Jerman (2006) reviewed the differences between students categorized with mathematics disabilities with age-matched average-achieving peers. From their 28 studies, the mathematics disability students performed much lower on verbal problem solving ($d = -0.58$), naming speed ($d = -0.70$), and verbal word memory ($d = -0.70$), indicating the power of verbal skills in learning mathematics. Swanson and Jerman concluded that their results were "consistent with previous syntheses of the literature that have attributed math disability to working memory deficits" (Swanson & Jerman, 2006, p. 265), particularly verbal working memory.

In reading, Hoskyn and Swanson (2000) found no differences between low achievers and reading disabled students in automaticity (rapid naming, $d = -0.06$) or real-world reading words ($d = 0.02$), but major differences in lexical knowledge ($d = 0.55$), syntactical knowledge ($d = 0.87$), visual-spatial processing ($d = 0.36$) and in phonological processing ($d = 0.25$). The results from their regression of many of these variables led them to conclude that both low achievers and reading-disabled students shared a common problem in phonological processing (although reading difficulty students exhibited an advantage in cognitive processing for other reading measures). It is thus not surprising that Swanson, Carson, and Sachse-Lee (1996) concluded that phonics training has a direct influence on reading achievement (especially spelling and word recognition performance) for these students.

The differences across many *labels*, however, are not always so marked. Kavale and Nye (1985) compared learning-disabled and normal students and found that about 75 percent of learning-disabled students could be clearly differentiated from normal students across all dimensions, displaying deficits that would interfere with their academic ability. Kavale and Forness (1983) reviewed the difference in achievements related to those students classified as brain injured and those with difficulties more related to familial-cultural factors. The 26 studies yielded 241 effect sizes and an average of $d = 0.10$ between the two groups—with differences related to perceptual-motor ($d = 0.11$), cognition ($d = 0.14$), language ($d = 0.10$), behavior ($d = 0.09$), and intelligence $d = 0.05$—so little difference was established. Very often the labels help "classify" these students and can lead to extra funding, but rarely does it make a difference to what works best—regardless of these labels.

Teacher clarity

One of the themes in this book is how important it is for the teacher to communicate the intentions of the lessons and the notions of what success means for these intentions.



KEY	
Standard error	na
Rank	8th
Number of meta-analyses	1
Number of studies	na
Number of effects	na
Number of people (0)	na

Fendick (1990) investigated teacher clarity, which he defined as organization, explanation, examples and guided practice, and assessment of student learning – such that clarity of speech was a prerequisite of teacher clarity. The correlation was 0.35 (d = 0.75) and the effects were larger when students, rather than observers, rated the teachers; for college rather than elementary school teachers; and class size and subject taught made no difference.

Concluding comments

The most critical aspects contributed by the teacher are the quality of the teacher, and the nature of the teacher–student relationships. Medium effects relate to teacher expectations particularly when lower expectations are held for *all* their students, and to teacher professional development effects on achievement. Low effects come from teacher education programs. From the graph of all effects (Appendix A), it appears that few teachers are harmful to students in that they decrease their achievement—although Rubie-Davies (2007) has demonstrated the power of low expectations on systematically decreasing achievement. While the message from this chapter is about the power of teachers, it is teachers *using particular teaching methods*, teachers *with high expectations for all students*, and teachers *who have created positive student-teacher relationships* that are more likely to have the above average effects on student achievement. There appear to be as many teachers who have effects below this d = 0.4 hinge-point as there are above, and every year a student faces a huge gamble as to who is at the front of their class—will it be a teacher who has a major positive influence or a teacher who has a less-than-average although positive influence? It is any teacher who does not achieve an average of d > 0.40 per year that I do not want my children to experience!

We need to talk about quality teachers in terms of what they do and the effects they have on students. Too often our discussion on what constitutes quality in teachers emphasizes the personal and professional attributes. Maybe we should constrain our discussion from talking about qualities of teachers to the quality of *the effects of teachers on learning*—so the discussion about teaching is more critical than the discussion about teachers (see Chapters 8 and 9).

Teachers' initial teacher training programs have little impact on how well those teachers influence the achievement of their students. Maybe subsequent effects wash out this earlier training, limited as it is in effectiveness, although the low quantity and quality of evidence of teacher training should be a major embarrassment for these institutions who constantly ask for more—more years, more resources, more influence. There is little substantive evidence of the effects of initial teacher training—and the little there is would not suggest that here is a place that could make a difference. Teacher education might be more successful if it placed more emphasis on learning and teaching strategies; on developing teachers' conceptions of teaching as an evidence-based profession (learning from errors as much as from successes); creating an appraisal system that involves a high level of trust and dependence on observed or videotaped reflection/evaluation of practice; and providing beginning teachers with a range of different teaching methods to use when current ones do not work. It might be more successful if it re-introduced micro-skills teaching methods that have demonstrably positive effects on new teachers; developed teachers' understanding of different ways to teach surface, deep, and conceptual knowledge; demonstrated how teachers can build positive relationships with *all* students; and showed how evaluation and assessment of students provides powerful feedback to teachers about how well they are teaching, who they have not taught so well, and where they need to re-teach. A major overhaul of teacher education is well overdue (see Darling-Hammond, 2006) and one way forward is to ask each teacher education program to articulate a set of graduating standards, and then evaluate how appropriate these standards are, and evaluate the nature and quality of evidence provided that all students meet these standards. If employers and independent educationalists sit along with the education program academics in making these decisions, there is a higher likelihood that these programs will then change to concentrate on training new teachers to have an effect on students' learning.

It is difficult to find evidence that subject matter knowledge is important. This is a conundrum. It may be that teachers all have an acceptable amount of subject matter knowledge and thus there is little variance to then associate with student outcomes. But teachers often teach in areas in which they have little training in the content, which suggests an interaction between teaching competence and need for high levels of knowledge in the subject. It would seem that those who have high levels of subject matter knowledge are better placed to understand the content and the optimal progressions of surface and deep learning in that content. Also teachers more knowledgeable about the content should be better placed to provide feedback as students struggle, and help move them from their current understanding to deeper and more richly constructed views of the content. It would be expected that students are more likely to become passionate about and enjoy the subject as they master the content; as opposed to those students who learn in a minimax fashion to pass the test, complete the assignment, and move on to whatever is next prescribed for them. But the evidence is lacking for these claims, and we may need to ask: "what is the minimum subject matter knowledge needed to be an accomplished teacher and how can we optimize the teaching strategies of those teachers with greater subject matter knowledge?" It may also be intriguing to investigate *how* teachers with lesser subject matter knowledge have such positive effects on their students.

Teachers walk into classrooms with conceptions of teaching, learning, curricula, assessment, and their students (Brown, 2004). We need to better understand these conceptions, as it seems they are powerful moderators on the success of these teachers. Having low expectations of the students' success is a self-fulfilling prophecy, and it appears that expectations are less mediated by between-student attributes (gender, race, and so on) than by whether they are held (high or low) for all students. How to invoke high expectations seems critical, and this may require more in-school discussion of appropriate benchmarks across grades, and seeing evidence of performance before starting the year (Nuthall, 2005, shows half of all material taught in any class is already known by the students); so much of the early part of the year involves trial and error as teachers find out proficiencies of students—information which could have more readily been garnered by reviewing student records, and having discussion with previous teachers. As I have argued in the New Zealand context from analyzing achievement performance from 100,000 students, the greatest single issue facing the further enhancement of students is the need for teachers to have a common conception of progress. When a student moves from one teacher to another, there is no guarantee that he or she will experience increasingly challenging tasks, have a teacher with similar (hopefully high) expectations of how to progress up the curricula, or work with a teacher who will grow the student from where he or she is, as opposed to where the teacher believes he or she should be at the start of the year.

To have high expectations and to share a common conception of progress requires teachers to be concerned about the nature of their relationships with their students. My colleague Russell Bishop moves around classes asking students "Does your teacher like you?" and so many ethnic minority students (in New Zealand) say no, but the white students say yes! When teachers are shown the results of surveys (including this question), they are often astonished—primarily because they assumed that the relations were positive, looked for cues that all was well, and rarely saw the classroom through the eyes of the students. The powerful effect of Bishop's work is that, after seeing these results, the teachers are quick to change their practices. The power of positive teacher–student relationships is critical for learning to occur. This relationship involves showing students that the teacher cares for their learning as a student, can "see their perspective, communicate it back to them so that they have valuable feedback to self-assess, feel safe, and learn to understand others and the content with the same interest and concern." (Cornelius-White, 2007, p. 123). Then the powers of developing a warmer socio-emotional climate in the classroom and fostering effort and thus engagement for *all* students are invoked. This requires teachers to enter the classroom with certain conceptions about progress, relationships, and students. It requires them to believe that their role is that of a change agent—that all students *can* learn and progress, that achievement for all is changeable and not fixed, and that demonstrating to all students that they care about their learning is both powerful and effective.

The contributions from the curricula

This chapter reviews various curricula and special types of programs. Given the attention to literacy and numeracy, it is not surprising that these dominate the literature as outcomes, but there are also meta-analyses relating to writing, drama/arts, science, values, and integrated curricula programs. The chapter also reviews specific programs such as creativity programs, bilingual programs, career interventions, outdoor programs, moral education programs, perceptual motor programs, tactile stimulation programs, and play. Table 8.1 summarizes the data examined.

Curricula programs: reading

Reading is one of the most contested curricula areas, as so many educationalists have made strong claims as to the best way to teach reading. Whatever the best method, if students do not develop sufficient reading acumen by the middle of elementary school, they are handicapped from learning in other curricula – as it does not take long in schooling to move from learning to read to reading to learn. The recent furore over the release of the National Reading Panel's summary of research (Langenberg, Correro, Ferguson, Kamil, & Shaywitz, 2000) or the Australian Literacy Report (Rowe, 2005) demonstrates the often entrenched positions that various researchers and teachers have to the teaching of reading. It is common to polarize the difference as phonics versus whole language, and the proponents of each are well heard. Even the mere act of defining reading can demonstrate the polarized claims. Anderson *et al.* (1985, p. 7) claimed that "reading is the process of constructing meaning from written texts" whereas Wixson, Peters, Weber, and Roeber (1987) preferred a more whole language definition, claiming that reading involves constructing meaning through the "dynamic interaction" among:

1 existing knowledge;
2 information suggested by the text;
3 the context of the reading situation.

This section summarizes 50 meta-analyses on reading research based on over 2,000 studies and about five million students, with an average effect of 0.51, and demonstrates the importance of gaining a *set of learning strategies* to construct meaning from text. This summary of the meta-analyses shows the importance and value of *actively* teaching the skills and strategies of reading across all years of schooling. There need to be planned, deliberate, explicit, and active programs to teach specific skills. Successful reading requires the development

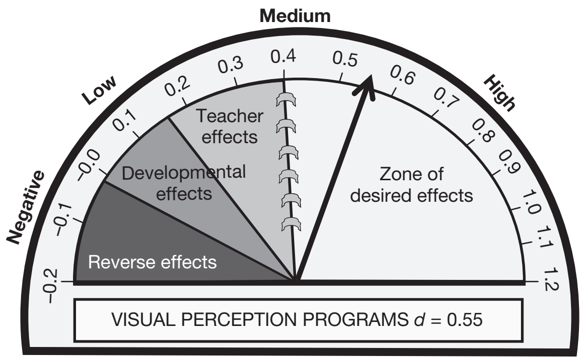
Table 8.1 Summary information from the meta-analyses on the contributions from the curricula

School	*No. metas*	*No. studies*	*No. people*	*No. effects*	*d*	*SE*	*CLE*	*Rank*
Reading								
Visual-perception	6	683	379,400	5035	0.55	0.033	39%	35
Vocabulary programs	7	301	—	800	0.67	0.108	47%	15
Phonics instruction	14	425	12,124	5,968	0.60	0.221	43%	22
Sentence combining	2	35	—	40	0.15	0.087	10%	119
Repeated reading	2	54	—	156	0.67	0.080	47%	16
Comprehension programs	9	415	11,585	2,653	0.58	0.056	41%	28
Whole language	4	64	630	197	0.06	0.056	4%	129
Exposure to reading	6	114	118,593	293	0.36	0.090	25%	76
Second/third chance	2	52	5,685	1,395	0.50	—	35%	47
Writing programs	5	262	31,189	341	0.44	0.042	31%	57
Drama/arts programs	10	715	5,807,883	728	0.35	0.090	25%	77
Mathematics and science								
Mathematics	13	677	8,565	2,370	0.45	0.071	32%	54
Use of calculators	5	222	—	1,083	0.27	0.092	19%	93
Science	13	884	243,505	2,592	0.40	0.018	29%	64
Other curricula programs								
Values/moral education programs	2	84	27,064	97	0.24	—	17%	94
Social skills programs	8	540	7,180	2,278	0.40	0.031	27%	65
Career interventions	3	143	159,243	243	0.38	0.050	27%	69
Integrated curricula programs	2	61	7,894	80	0.39	0.050	28%	67
Perceptual-motor programs	1	180	13,000	637	0.08	0.011	6%	128
Tactile stimulation programs	1	19	505	103	0.58	0.145	41%	27
Play programs	2	70	5,056	70	0.50	—	35%	46
Creativity programs	12	685	23,299	837	0.65	0.097	47%	17
Outdoor/adventure programs	3	187	26,845	429	0.52	0.035	37%	43
Extra-curricular programs	5	102	—	68	0.17	0.072	12%	114
Bilingual programs	7	128	10,183	727	0.37	0.140	26%	73
Total	144	7,102	6,899,428	29,220	0.45	0.071	32%	—

of decoding skills, the development of vocabulary and comprehension, and the learning of specific strategies and processes. It is clear that some programs, particularly those based on skills and strategies, are successful, whereas others without such emphases have very minimal effects. Continuing to develop one's proficiency in reading depends on acquiring these skills as well as learning to derive meaning and often enjoyment from the skills of reading.

Reading: visual perception programs

Visual perception refers to the process of organizing and interpreting letters on a page, and is often considered an important aspect of early reading. Kavale and Forness (2000) found that both auditory and visual perception were important predictors of reading for both average students (d = 0.36) and students with learning or reading disabilities (d = 0.38). There was little difference in accuracy in predicting reading proficiency for many of the auditory perceptual skills (auditory comprehension d = 0.40, memory d = 0.38, blending d = 0.38, discrimination d = 0.37), or visual perceptual skills (memory d = 0.47, closure d = 0.43, discrimination d = 0.39, association d = 0.38, motor integration d = 0.36, spatial



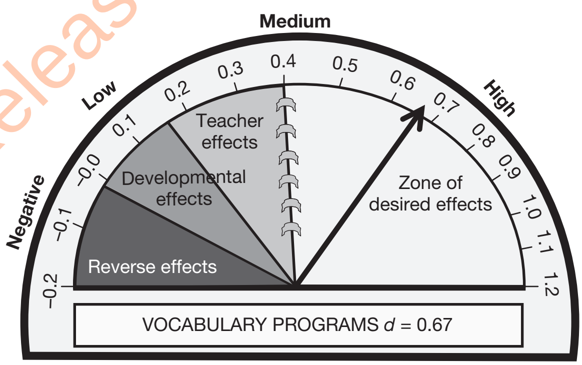
KEY	
Standard error	0.033 (Low)
Rank	35th
Number of meta-analyses	6
Number of studies	683
Number of effects	5,035
Number of people (6)	379,400

relation *d* = 0.33), but it was lower for figure-ground discrimination (*d* = 0.25). Further, the ability to *integrate* perceptual stimuli appears no more associated with reading ability than individual auditory or visual skills. More importantly, the effects of the various auditory and visual perceptual skills were similarly related to word recognition and reading comprehension.

There were variations, however, according to the tests used to detect visual perception (Kavale, 1982a). The widely used Frostig development test of visual perception and accompanying training program were significantly less successful predictors of reading achievement than many other measures of visual–motor ability and visual–spatial relationships (e.g., the Bender and Illinois Psycholinguistic Abilities visual subtests). The conclusion was that the Frostig test or program was not particularly useful for either identifying preparing young students to read or for remediating visual perceptual deficits.

Reading: vocabulary programs

Stahl and Fairbanks (1986) found that vocabulary instruction and knowledge of word meanings generally help growth in reading comprehension. A mean effect size of 0.97 indicated that students who experienced vocabulary instruction had major improvements in reading comprehension of passages containing taught words; there was also an effect size of *d* = 0.30 for global measures of comprehension. The most effective vocabulary teaching methods included providing both definitional and contextual information,



KEY	
Standard error	0.108 (High)
Rank	15th
Number of meta-analyses	7
Number of studies	301
Number of effects	800
Number of people (0)	na

involved students in deeper processing, and gave students more than one or two exposures to the words they were to learn. The mnemonic keyword method also had positive effects on recall of definitions and sentence comprehension (see also Mastropieri & Scruggs, 1989). This method involves students first learning a concrete word than sounds like the target word, and then creating an image linking the target word to its definition. For example, for *angler*, a keyword could be *angel* and the interactive image could be an *angel catching a fish*. Klesius and Searls (1990) found similar high effect sizes for this keyword method, but also reported very quick fading effects, with the highest delayed post-test effect of only d = 0.19. Fukkink and de Glopper (1998) also examined the effects of instruction in deriving word meaning from context and claimed that the derivation of word meaning was indeed amenable to instruction with even relatively short instruction having positive effects.

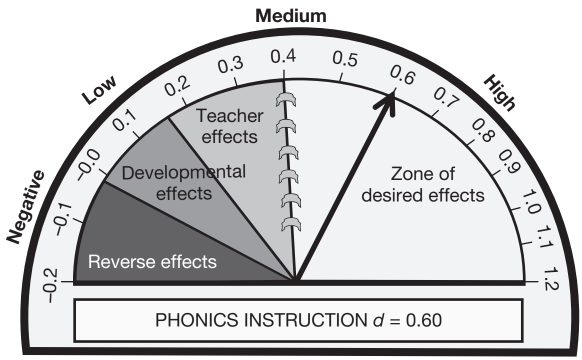
Arnold, Myette, and Casto (1986) found that language intervention programs had immediate and positive gains for intellectually handicapped preschool children across many subject characteristics such as demographic, pretreatment language level, type of handicap, and medical history. Where there was significant neurological impairment, intervention effects were reduced. Nye, Foster, and Seaman (1987) found that language intervention in clinical settings was effective with language-disordered children, with experimental subjects moving from the 50th to the 85th percentile as a result of intervention. Treatment was more beneficial for language-disordered children than for those who were learning or reading disabled. Syntax showed the greatest degree of improvement but there was little effect on pragmatic language functioning. There was a greater degree of language improvement with the modeling approach than other methods (e.g., focused stimulation, comprehension). Kavale (1982b) found that psycholinguistic training programs were more affected by the Peabody Language Development Kit (PLDK), a highly structured sequence of lessons designed to increase general verbal ability, than either the Illinois Test of Psycholinguistic Abilities or other types of training activities (e.g., perceptual motor approaches). The structured and sequential nature of PLDK was considered the key element in the greater effectiveness.

These meta-analyses show that vocabulary programs are beneficial in developing reading skills and comprehension.

Reading: phonics instruction

> Phonics instruction teaches beginning readers the alphabetic code and how to use this knowledge to read words. In systematic phonics programs, a planned set of phonics elements is taught sequentially. The set includes the major correspondences between consonant letters and sounds, short and long vowel letters and sounds, and vowel and consonant digraphs … It also may include blends of letter-sounds that form larger sub-units in words.
>
> (Ehri, Nunes, Stahl, & Willows, 2001, p. 394)

The meta-analysis published by the National Reading Panel (Langenberg *et al.*, 2000) made great play of the power of phonemic awareness in learning to read. They concluded that there are many tasks commonly used to assess and improve phonemic awareness, such as phoneme isolation (what is the first sound in *paste*?); identification (which sound is the same in *bike*, *boy*, *bell*?); categorization (recognizing sounds in sequence: *bus*, *bun, rug*);



KEY	
Standard error	0.221 (High)
Rank	22nd
Number of meta-analyses	14
Number of studies	425
Number of effects	5,968
Number of people (5)	12,124

blending (which word is s/k/u/l?); segmentation (how many phonemes in *ship*?); and deletion (what word remains when s is removed from *smile*?). The panel argued that an essential part in learning to read involves:

> learning the alphabetic systems, that is, letter-sound correspondences and spelling patterns, and learning how to apply this knowledge in their reading. Systematic phonics instruction is a way of teaching reading that stresses the acquisition of letter-sound correspondents and their use to read and spell words (Harris & Hodges, 1995). Phonics instruction is designed for beginners in the elementary grades and for children having difficulty learning to read.
>
> (Langenberg *et al.*, 2000, p. 2–89)

The National Reading Panel found an overall effect size on phonological outcomes of d = 0.86, on reading outcomes of d = 0.53, and on spelling of d = 0.59. Teaching that focused on one or two types of phonemic awareness led to larger effects than teaching many more; teaching to manipulate phonemes using letters led to greater effects than teaching without letters; as did synthetic phonics programs that emphasized teaching students to convert letters into sounds and then blend the sounds to form recognizable words, and then analyze and blend larger subparts of words and phonemes. These phonemic awareness effects were present whether classroom teachers or computer formats were used, were higher for preschool than for higher grade levels (that is, more powerful in learning to read), and were effective when delivered through tutoring, in small groups, or through teaching classes of students.

These National Reading Panel findings were hotly contested, in part because there were so few studies used from the myriad of reading studies that were available. The findings from other meta-analyses on the teaching of reading, however, are not dissimilar in their conclusions from those of the National Reading Panel. For example, Bus and van Ijzendoorn (1999) conducted a meta-analysis of phonological awareness training programs and early reading. They determined that phonological awareness training should be seen as a causal factor in learning to read. The combined effect sizes for phonological awareness and reading were d = 0.73 and d = 0.70 for randomized and matched designs respectively. They noted that the effects for long-term studies were smaller than for short-term studies for both awareness and reading skills. At the same time, the effect of phonemic training was still discernable after, on average, 18.5 months.

Other findings included: training in groups for phonological awareness had more effect than individual training; programs combining phonological and letter training were more effective than phonological training alone; training effects were stronger with post-tests assessing simple decoding skills than with real-word identification tests; and preschoolers seemed to benefit from phonological training more than elementary school children, with effects decreasing as age increases. Stuebing, Barth, Cirino, Francis, and Fletcher (2008) reanalyzed the NRP data and concluded that phonics with additional language and literacy activities were the most effective. The core ingredients were phonics, fluency and comprehension.

Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh and Shanahan, (2001) only considered controlled experiments that included phonics instruction on learning to read. They concluded that:

> [The] benefits of phonemic awareness instruction were replicated multiple times across experiments and thus provided solid support for the claim that PA instruction is more effective than alternative forms of instruction or no instruction in teaching PA and in helping children acquire reading and spelling skills.
>
> (Ehri, *et al.*, 2001, p. 274)

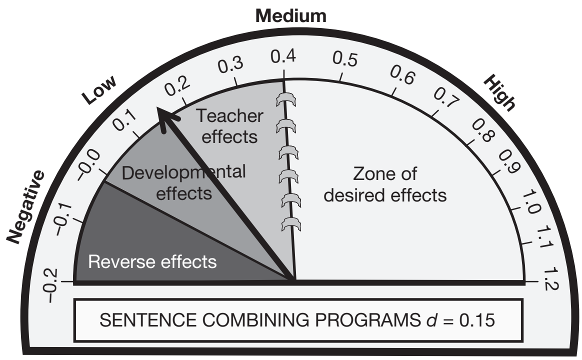
The effects of phonemic awareness were as great with low as with middle and high socioeconomic status students (contrary to claims made by Dressman, 1999). Further, phonemic awareness did increase reading comprehension (d = 0.34). Thomas (2000) used kindergarten students (which probably accounts for his higher overall effect size), and concluded that the most successful phonemic awareness program was word recognition skills, implemented for more than 1.5 hours for more than 8 weeks (d = 1.02).

Direct instruction methods have been most powerful in teaching phonics skills. Swanson (1999) synthesized empirical evidence from research on reading intervention for students with learning disabilities and found that models that used both direct instruction and taught students strategies for recognizing words improved their reading comprehension performance. Swanson and colleagues (Swanson, Trainin, Necoechea, & Hammill, 2003) also found that measures such as rapid naming and letter identification were highly related to reading—especially reading comprehension. The greatest predictors of reading comprehension were real-word reading and spelling ability followed by word attack skills.

Overall, phonics instruction is powerful in the process of learning to read—both for reading skills and for reading comprehension.

Reading: sentence combining programs

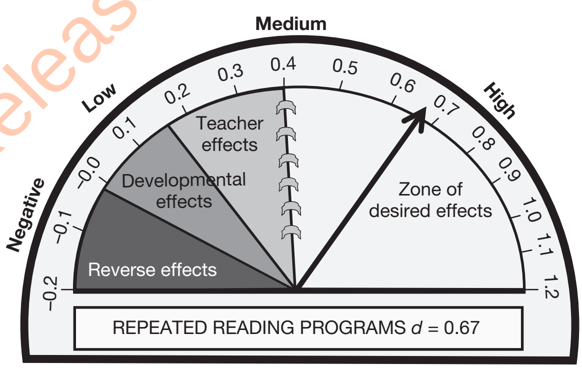
Sentence combining is an instructional strategy that requires students to combine one or more sentences into one compound, complex, or compound-complex sentence (see Fusaro, 1993, p. 228). The effects are small. Neville and Searls (1991) found that sentence-combining as an instructional technique was much more effective at elementary than at high school levels, whereas Fusaro (1993) found that the effects of sentence-combining on reading comprehension were ambiguous across all levels. Overall the various reading meta-analyses, sentence-combining methods do not seem to have high value in the tool kit of reading instruction.



KEY	
Standard error	0.087 (High)
Rank	119th
Number of meta-analyses	2
Number of studies	35
Number of effects	40
Number of people (0)	na

Reading: repeated reading programs

Repeated reading consists of re-reading a short and meaningful passage until a satisfactory level of fluency is reached. In their meta-analysis of repeated reading programs Chard, Vaughn, and Tyler (2002) identified a number of variables that they claimed explained the variation in learning to read. The greatest source of variance was the test format—effects from timed tests were larger than from untimed tests, and they argued that this was because timed tests were more likely to assess a student's capacity to automatically apply word recognition and decoding skills. Such automaticity usually develops naturally between second and third grade, but for learning disabled students it is a separate set of skills that need to be taught. Indeed tasks that require high levels of automaticity, such as rapid-naming tasks, are typically the major discriminating tasks between learning disabled and learning enabled children. Their message is clear—the skills of automaticity in word recognition and decoding (the move from accurate to automatic word reading) need to be specifically assessed and taught, especially to learning disabled students. It is perhaps not surprising that such automaticity, or over learning, is a major feature in many second- and third-chance reading programs (see below). Therrien (2004) found that the effects of repeated reading had marked positive effects on reading comprehension as well as reading fluency—although the effect on near transfer (immediate influence and comprehension) was greater ($d = 0.76$) than on far transfer (ability to fluently read or comprehend new passages), although the latter effect ($d = 0.50$) is still substantial.



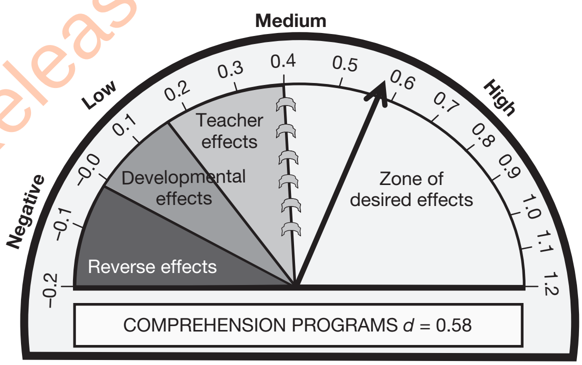
KEY	
Standard error	0.080 (High)
Rank	16th
Number of meta-analyses	2
Number of studies	54
Number of effects	156
Number of people (0)	na

Reading: comprehension programs

Rowe (1985) undertook one of the earliest and largest meta-analyses of reading comprehension research. She found that the effects of these programs on vocabulary (d = 1.77) were greater that on reading comprehension outcomes (d = 0.70), and measures using words as the unit of analysis (d = 1.28) were greater than when whole texts were used (d = 0.82). In general, the effects were higher for more specific and structured outcomes. The effects were similar for poor (d = 0.80) and good readers (d = 0.74). Reading comprehension programs with a dominant focus on processing strategies (e.g., inferential reasoning, rules for summarizing, and chunking texts) produced a higher effect (d = 1.04) than did the text programs (e.g., repetition of concepts, explicitness, d = 0.77), and task programs (d = 0.69).

Sencibaugh (2005) reviewed two major programs: those using visually dependent strategies and those that depended on auditory or language strategies. Visually dependent strategies involved the use of pictures that improved reading comprehension, whereas auditory/language-dependent strategies involved language used in either pre-reading or post-reading activities to assist in comprehension. The former had an average effect of d = 0.94 and the latter d = 1.18, but the key was that these effects accrued only because the teacher had taught these specific strategies to augment reading comprehension. Pflaum, Walberg, Karegianes, and Rasher (1980) examined the viewpoint that different methods for teaching reading cause few differences in achievement. They found that this was largely true except for the superiority of the sound-symbol blending methods (single sounds or letters are taught separately and blended together). They concluded that the support from this form of systematic phonics appeared to be strong: that is, the synthesis of separate sounds associated with letters appears to be superior to many other methods.

Guthrie, McRae, and Klauda (2007) reviewed a specific program to enhance reading comprehension—the concept-oriented reading program. This program is based on the premise that the engaged reader is internally motivated to read, hence the aim is to engage students and attend to motivational as well as reading instruction strategies. The engaged reader is cognitively active in using strategies and seeking to link old to new information; behaviorally active in task participation, effort, and persistence in the face of difficulty; and reading frequently for pleasure and learning. The concept-oriented reading program is a 12-week intervention and each lesson has various segments: oral reading, a mini-lesson on comprehension strategies (inference, asking questions during reading, summarizing, and comprehension monitoring), independent writing and reading, and teacher-guided



KEY	
Standard error	0.056 (Medium)
Rank	28th
Number of meta-analyses	9
Number of studies	415
Number of effects	2,653
Number of people (6)	11,585

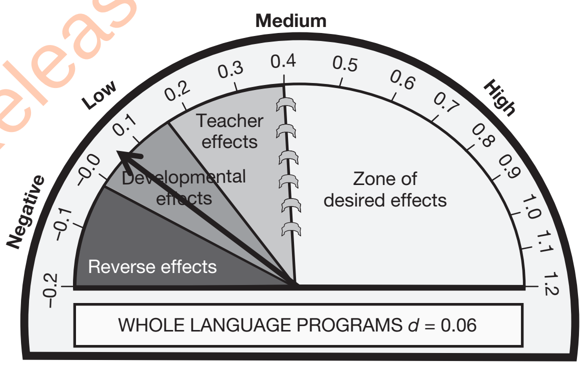
reading in small groups (for modeling, scaffolding, and guided practice). The effects are positive on multiple text comprehension (d = 0.93), fluency (d = 0.73), and story comprehension (d = 0.65), as well as on motivation outcomes (curiosity d = 0.47, willingness to engage in challenge, d = 0.31, task orientation d = 0.28, self-efficacy d = 0.49).

Many have argued that words are learned incidentally during reading, and this is a major premise of those who argue that reading is best facilitated by a high frequency of reading experiences. A meta-analysis of studies on incidental word learning during normal reading showed that students learn only about 15 percent of the unknown words they encounter during normal reading (Swanborn & de Glopper, 2002). A low density of unknown words in a text produces a higher word learning change than a high density of unknown words. Students can learn words incidentally while reading; the effects are not only small, but also there is a confound with reading ability—older and more able students learn more word meanings during reading and thus if a student is a poor reader, it is unlikely that they will improve their learning of words just by being asked to read.

Reading: whole language

The whole language approach to reading instruction is based on the idea that the "acquisition of reading skills depends on the context in which these skills are presented. Individual words are learned more easily and fluently when presented within a particular context. The words gather meaning from other words around them and from the structure of the story" (Gee, 1995, p. 5). Gee found that such whole language approaches in reading instruction had positive influences on reading achievement. He did qualify this finding by noting that studies with larger sample sizes produced smaller effects, and interventions shorter than one year did not provide the depth of instruction to produce measurable outcomes.

At first look there is remarkable divergence in the overall effects from the four meta-analyses on whole language approaches. The average effect from the Gee study has an overall positive effect compared to the average from Jeynes and Littell (2000), which has an overall negative effect. There was much overlap in the articles used in these two meta-analyses and the difference is a function of how the authors classified some key studies, and the coding of what constituted whole language. On the latter, Gee included programs with systematic phonics and word study as whole language programs, and thus had what he considered a more "balanced" program of both sets of skills. For example, the study by Tunmer and Nesdale (1985) is classified as whole language, which is opposite



KEY	
Standard error	0.056 (Medium)
Rank	129th
Number of meta-analyses	4
Number of studies	64
Number of effects	197
Number of people (1)	630

from what Tunmer and Nesdale claimed for their program. Tunmer and Nesdale's three whole language classes, according to Gee, included a "heavy emphasis on the teaching of phonological recoding skills" (p. 421). Trachtenburg and Ferruggia's (1989) study, also classified by Gee as whole language, used various strategies including word lists, letter-sound naming, and decoding techniques. Similarly Gee classified Uhry and Shepherd's (1993) study as whole language, and they used segmentation and spelling instruction, a 10–20 minute phonics lesson, and copying words. If these three studies were reclassified so that they were not included as whole language studies, then the Gee average would shift from $d = +0.65$ to zero—and the average across all whole language meta-analyses to $d = 0.06$ and its rank to 129 out of 138.

Stahl and Miller (1989) also had zero effects ($d = 0.17$ for word recognition and $d = 0.09$ for reading comprehension) from whole language programs. Whole language approaches may be more effective in kindergarten than in first grade, they may produce higher (but still close to zero) effects on measures of word recognition than reading comprehension measures, and they are more effective when used instead of a reading readiness program. They compared the effects to basal readers, and there was a trend towards higher effects for basal reading programs. Stahl, McKenna, and Pagnucco (1994) carried out an update of Stahl and Miller's (1989) meta-analysis on whole language instruction and again reported small effect sizes. They did add that whole language approaches were effective in improving children's attitudes towards reading, and they concluded that there was a slight advantage for traditional approaches on measures of decoding.

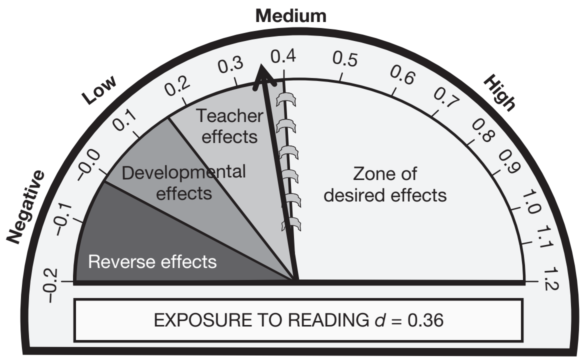
The most recent study found a substantial negative relationship between whole language interventions compared to basal readers and learning to read programs. Jeynes and Littell (2000) investigated the effect of whole language instruction on the literacy of low-socio-economic status students from kindergarten through to grade level 3 and found that low socioeconomic status children receiving basal readers did consistently better than their counterparts receiving whole language instruction.

In summary, whole language programs have negligible effects on learning to read—be it on word recognition or on comprehension. Such methods may be of value to later reading, but certainly not for the processes of learning to read; it appears that strategies of reading need to be deliberately taught, especially to students struggling to read.

Reading: exposure to reading

What effect does exposing young children to reading have? The answer seems to be that it depends on who is doing the reading—the parent to engage in the excitement of reading, the teacher who uses reading aloud as a teaching tool, or a volunteer who seems to have little or any effect. Blok (1999) noted the pervasive push by many that teachers read to their young students almost every day. This typically involves "talking with and to the child" as reading fosters a great deal of interaction between the reader, the child, and the text. The overall effect was $d = 0.63$ on oral language and $d = 0.41$ on reading. The effects were higher with younger students, when the groups were small (as this fostered more interactions). It is not, however, merely exposure to reading but also the teaching of reading that makes the difference. Sustained silent reading, time on task alone, and having parents reading have much lower effects.

Having parents read to their children has positive effects on reading, and in particular on vocabulary acquisition. A meta-analysis on intergenerational transmission of literacy



KEY	
Standard error	0.090 (High)
Rank	76th
Number of meta-analyses	6
Number of studies	114
Number of effects	293
Number of people (3)	118,593

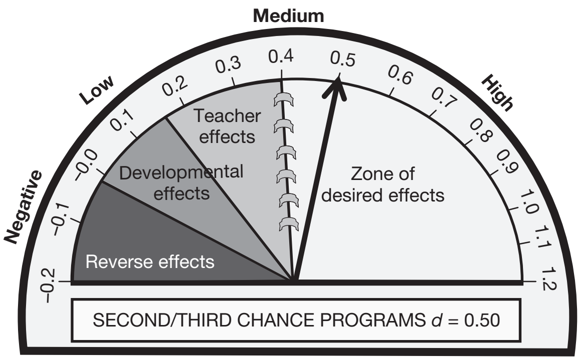
affirmed the positive effect of parent–child interactions in supporting children's literacy orientation (Bus, van Ijzendoorn, & Pellegrini, 1995). Parent–preschooler joint book reading experiences were shown to be related to positive outcomes in language growth (d = 0.67), emergent literacy (d = 0.58) and reading achievement (d = 0.55). This was so across all socioeconomic groups. The effects were not restricted to preschoolers but did diminish as children became more able to read on their own.

Reading to children, however, is not sufficient to lead to competent readers—instruction is also needed. Torgerson, King, and Sowden (2002) investigated the effects of unpaid classroom volunteers to provide extra support to children learning to read. Almost half the studies showed negative effects, and the overall relationship was small indeed. Their conclusion was that the "there is little good evidence that the policy of encouraging volunteers to help teach children to read is effective" (p. 443). Exposure and practice in listening to reading is insufficient. Lewis and Samuels (2003) found that more practice at reading was minimally associated with reading gains (d = 0.10). The effects were slightly larger for grade 1 to 3 students, second language students, learning disabled students, and students reading below grade level: practice helps minimally but is not enough. Similarly, Yoon (2002) found that sustained silent reading had little effect on reading attitude, and the effects drop to zero above grade 3—students who struggle or do not enjoy reading gain little reading instruction when silent reading; it is another opportunity to engage in an activity confirming that reading is not enjoyable.

Reading: second-and third-chance programs

The Reading Recovery program was invented by Dame Marie Clay, who was also a professor at the University of Auckland in New Zealand. Reading Recovery is a second-chance program undertaken over a 12 to 20-week specified period. Children are discontinued from the program when it is agreed that they are ready to return to regular classroom instruction. D'Agostino and Murphy (2004) found that Reading Recovery students outperformed control students especially on scales in the observation schedule (a key part of the program). They concluded that Reading Recovery "was reaching its fundamental goal of increasing the lowest performing first graders' reading and writing skills to levels comparable with their classroom peers" (p. 35), and there was a "lasting effect, at least by the end of second grade, on broad reading skills".

Students at risk for reading failure who complete the Reading Recovery program have



KEY	
Standard error	na
Rank	47th
Number of meta-analyses	2
Number of studies	52
Number of effects	1,395
Number of people (1)	5,685

been found to perform better than those at risk not receiving this intervention (Elbaum, Vaughn, Hughes, & Moody, 2000). Large effect sizes were found for Reading Recovery (d = 0.96), and it was highest when Reading Recovery was a supplement to, not a substitute for, classroom teaching. The effects were high for reading comprehension (d = 0.67), decoding (d = 0.56), and oral reading of words (d = 0.69). Elbaum *et al.* concluded that "well-designed, reliably implemented, one-to-one interventions can make a significant contribution to improved reading outcomes for many students whose poor reading skills place them at risk of academic failure" (p. 617).

Overall comments on reading meta-analyses

There is much support for the five pillars of good reading instruction: phonemic awareness, phonics, fluency, vocabulary, and comprehension—and attending to all is far more critical than whether the program teaches one of the five as opposed to another. The most effective programs for teaching reading are, first, to attend to the visual and auditory perceptual skills. Then a combination of vocabulary, comprehension, and phonics instruction with repeated reading opportunities is the most powerful set of instructional methods. The least effective methods are whole language, sentence combining, and assuming that students will learn vocabulary incidentally when reading. If reading is not successful the first time, then second-chance programs such as Reading Recovery are most effective. Another way of summarizing the typical debate is that a teacher using the whole language method needs to be at least ten times more effective in his or her teaching than a teacher using the phonics methods to attain the same outcomes in developing reading vocabulary, skills, and comprehension. A teacher using a combination of vocabulary, phonics, and comprehension methods will be much more effective than either a phonics or a whole language teacher.

It is noted that most of the research, not surprisingly, concentrates on the early years of reading, and there are no meta-analyses and only limited research evidence about teaching to read beyond the first years. In our study of New Zealand classrooms from grades 3 to 12 (N = 40,000) we found that there was a flattening of reading in the upper years of elementary school, which then accelerated as the students moved through their high school years (Hattie, 2007). More than 80 percent of students in year 5 are at or *above* expectation, but by year 8 close to half are *below* expectation, returning to about 80 percent *above* by year 11 (see Figure 8.10).

Chall (1983, 1996) has argued that reading is not a process that is the same from the beginning

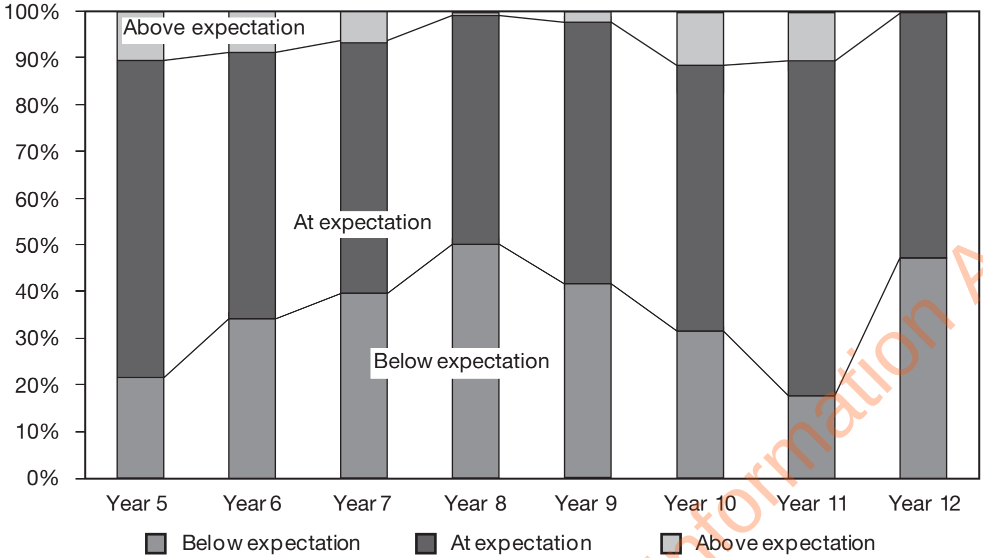
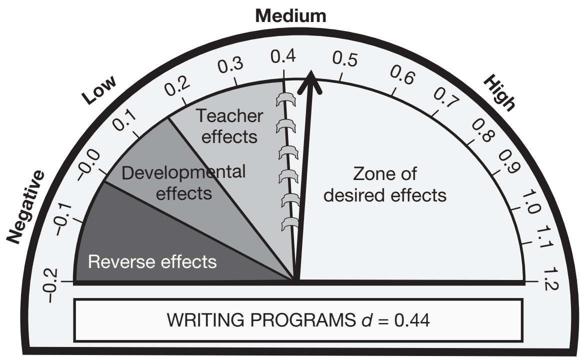


Figure 8.10 The percentage of students performing below, at, and above expectation in each year level

stages through to mature, skilled reading, but one that changes as the reader becomes more able and proficient. We did not find, however, a "4th grade reading slump" as did Chall—there was no slump; just no growth or increase during the upper elementary years. Several potential reasons for this plateau effect were suggested (Hattie, 2007). These reasons include that teachers do not have a common conception of progress in learning to read during these years; most curricula do not attend to reading progressions; and there is so much emphasis placed on early learning to read that we have not built a perceived need to then continue to develop excellent programs to build on this early start. Other factors in the plateau effect could be that an early lack of word meaning would mean readers could fail to capitalize on a sufficient depth and breadth of words to thus sustain growth in reading; a lack of fluency and automaticity (that is, quick and accurate recognition of words and phrases) may hamper growth beyond first learning to read; and that schooling in these upper years has less emphasis on decoding and inference and more on reading of expository tests. Also, previously "unimportant" reading difficulties may appear for the first time in Grade 5 when children encounter informational materials and multiple text types that require more inference, comprehension, vocabulary of less frequent words, connections, and understanding (Snow, Burns, & Griffin, 1998). Finally, we need to learn from what high school teachers do as the flattening turns to an incline when students enter high schools (e.g., they demand that students use their skills in finding information, connections, inference, and understanding—the higher level skills in reading—in the content area literacy and comprehension domains).

Writing programs

Graham and Perin (2007) completed the largest study of writing programs. They recommended that it is powerful to teach strategies for planning, revising, and editing compositions



KEY	
Standard error	0.042 (Medium)
Rank	57th
Number of meta-analyses	5
Number of studies	262
Number of effects	341
Number of people (3)	31,189

(d = 0.82), particularly if the students are struggling writers. Effect sizes for various strategies were: strategies for summarizing reading material (d = 0.82), working together to plan, draft, revise, and edit (d = 0.75), setting clear and specific goals for what students are to accomplish with their writing product (d = 0.70), using word processing (d = 0.55), and teaching students strategies to write increasingly complex sentences (d = 0.50). The results show the power of teaching students the processes and strategies involved in writing, structuring the teaching of writing by having students work together in an organized fashion, and of setting clear and specific goals, especially as to the *purpose* of each piece of writing.

Bangert-Drowns, Hurley, and Wilkinson (2004) also found support for developing writing programs that were more informational, personal, imaginative, or attended to the meta-cognitive reflections of the writing task. Gersten and Baker (2001) found similar effects for strategy teaching with students with learning disabilities. They reported a d = 0.81 effect from expressive writing programs with students involved in collaborative practice with teachers (d = 0.76), with peers (d = 0.70), for teacher modeling of strategy use (d = 0.68), for use of procedural prompts (d = 0.86), and for use of computers (d = 0.64). The emphasis is on explicit teaching of the critical steps of the writing process, the conventions of a writing genre, and guided feedback. They noted that:

> teachers or peers provided frequent feedback to students on the overall quality of writing, missing elements, and strengths. When feedback was combined with instruction on the writing process or text structure, a common vocabulary was created that gave teachers and students a meaningful way to engage in dialogue, which results in improved written products. The prompts helped give teachers or peers concrete suggestions for providing appropriate feedback.
>
> (Gersten & Baker, 2001, p. 266)

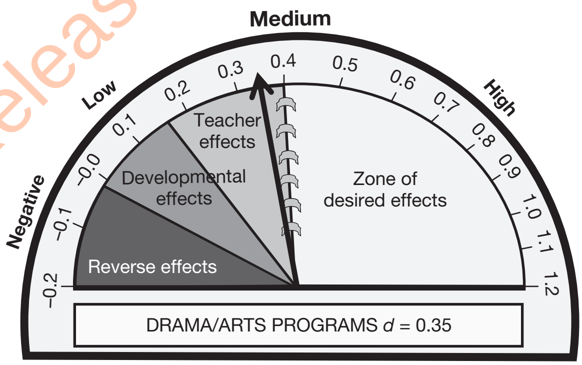
Atkinson (1993) reported an effect size of d = 0.52 from workshop instructional treatments of writing, d = 0.32 from computer support, d = 0.45 from teaching of inquiry skills. The common elements of what was successful in workshops were the use of teams, peer-feedback, and collaborative authorship. The effect from the inquiry skills method was similar to that reported by Hillocks (1984, d = 0.56) and this typically included exploration of and systematic approaches to learning various strategies in writing. Atkinson also argued that these treatments may be the result of the relationship with an "audience" "either because of the presence of a real and immediate audience as in writing workshops, or because of a need to collaborate with others to complete a task" (p. 105). The importance of including the purpose of writing in the lesson is thus emphasized.

Drama/Arts programs

Kardash and Wright (1987) found that creative drama activities have positive effects on children's achievement at elementary grade levels in oral language skills, self-esteem, moral reasoning, role-taking abilities, and drama skills. Conard's (1992) meta-analysis of experimental studies examined the effect of creative drama on the acquisition of cognitive skills and found an effect size of 0.48 for studies in which creative drama was used as an instructional tool. Creative drama tended to be more effective at the preschool and elementary school levels than for older children, and both regular and remedial students appeared to benefit from and enjoy participating in creative drama. Butzlaff (2000) argued that practice in reading music notation makes the reading of linguistic notation an easier task; this is because the skill in listening to music requires a sensitivity to tonal distinctions that can assist in acquiring a sensitivity to phonological distinctions; reading the repetitive and hence predictable lyrics of songs helps train reading skills; and working together in music groups instils a sense of personal responsibility, which in turns leads to heightened academic responsibility and performance. He was more cautious, however, about the effect size between participating in music programs and achievement in reading, claiming that causality could not be determined from his meta-analysis.

Hetland (2000) related the listening to music by college students and improvement in spatial-temporal reasoning ($d = 0.49$), but she was hard-pressed to find any importance of this finding to education, noted it was remarkably variable, and at best was temporary. It is likely that the two skills—listening to music and spatial reasoning—may be related because they depend on some similar underlying skills. Moga, Burger, Hetland, and Winner (2000) conducted three studies on the relation between studying the arts and creative thinking. There was a medium association for figural but zero for verbal/conceptual creativity outcomes.

> we find some transfer when the bridge is narrow: from experience in the arts, which includes the visual arts, to performance on tests requiring drawing. We find no transfer when the bridge is wide: from experience in the arts to performance on tests requiring one to generate ideas, concepts, or words.
>
> (Moga *et al.*, 2000, p. 102)



KEY	
Standard error	0.090 (High)
Rank	77th
Number of meta-analyses	10
Number of studies	715
Number of effects	728
Number of people (4)	5,807,883

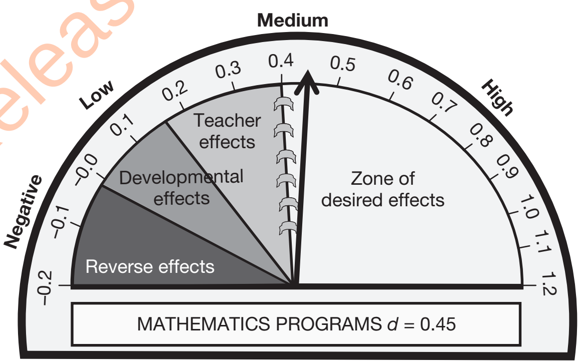
Standley (1996) reviewed 98 studies with 208 effects and found that providing music when students had successfully completed an activity had dramatic effects (d = 2.90) in promoting education and therapy objectives. The problem of this meta-analysis is that many of the more extreme effects were from therapy rather than from education—although the effects on education were still very large. Specifically, using music (mainly as a reward) increased behavior across various ability groups (e.g., physically or medically impaired d = 2.25; emotionally impaired d = 2.38, normal d = 2.99, mentally impaired d = 3.16). The effects on achievement outcomes was still a very large d = 2.18 (N = 24). They concluded that "music is highly effective as a contingency for either increasing desirable behavior or reducing undesirable behavior, with slightly better results in increasing behavior. Music interruption is more effective than music initiative as the procedure for establishing the contingency" (p. 124).

Vaughn (2000) found a medium relation between the voluntary study of music and mathematic achievement, but the effects of training in instrumental or vocal music performance were much lower. Playing music in the background while students are taking mathematics tests has only a small positive effect, perhaps an arousal effect, at best. Winner and Cooper (2000) found a very small relation between studying arts and achievement (d = 0.10); the relation to verbal was higher (d = 0.39) than mathematics (d = 0.20). They were careful not to assume causality, and suggested that studying the arts may lead to greater engagement in schooling, which in turn leads to greater academic achievement.

Mathematics programs

The major interests in the mathematics meta-analyses have related to the use of aids such as calculators, manipulative materials, and graphing aids. There are three major themes in these studies. The effects of many of these innovatives are greatest: with the lower compared to higher ability students; when aids are provided to reduce cognitive load (such as using calculators to reduce the load of calculation in problem solving); and with feedback from teachers to students and students to teachers.

The power of feedback to students learning mathematics was highlighted by Baker, Gersten, and Lee (2002). They found that the highest effects accrued when teachers provided feedback data or recommendations to students (d = 0.71), then for peer-assisted learning (d = 0.62), explicit teacher-led instruction (d = 0.65), direct instruction (d = 0.65), and concrete feedback to parents (d = 0.43). The lowest effects occurred when teachers



KEY	
Standard error	0.071 (Medium)
Rank	54th
Number of meta-analyses	13
Number of studies	677
Number of effects	2,370
Number of people (4)	8,565

emphasized real-world applications of mathematics (*d* = –0.04). As they noted, one consistent finding was that providing teachers and students with specific information on how each student was performing seemed to enhance mathematics achievement consistently.

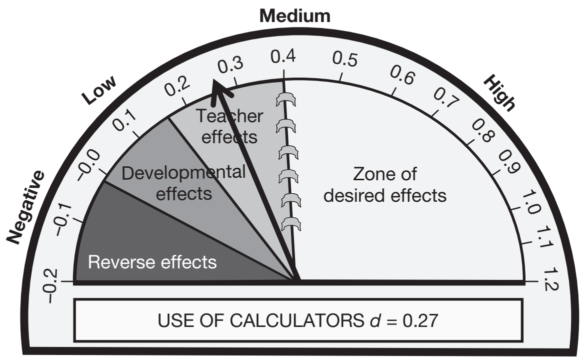
Like most curricula domains, there are many packages or ideas about how a subject should be taught. "Modern" or new mathematics was heralded as a major breakthrough as it involved making mathematics more relevant to real-world problems, and involved a high level of use of manipulative materials. The overall effects (*d* = 0.24) are reasonably similar across all levels of schooling, but lower in kindergarten and post-high school (Athappilly, Smidchens, & Kofel, 1983). Lower ability students gain more (*d* = 0.35) than middle (*d* = 0.25) or high ability students (*d* = 0.21). Effects are higher for teaching concepts (*d* = 0.36) and computation (*d* = 0.31), but not application (*d* = 0.06); and higher in algebra (*d* = 0.43) than in arithmetic (*d* = 0.21) and geometry (*d* = 0.14). Overall, the use of manipulative materials does not detract but does little to support the learning of mathematics (Mitchell, 1987). However, there are more effective methods than manipulables. In a study investigating differing methods for teaching high school algebra (Haas, 2005), the greatest effects were from direct instruction (*d* = 0.55) and problem solving (*d* = 0.52), and the lowest effects were from technology-aided (*d* = 0.07) and communication and study skills methods (*d* = 0.07). There were medium effects from cooperative learning (*d* = 0.34) and manipulative, models, and multiple representations (*d* = 0.38). Haas concluded that the higher effects from direct instruction were because of its focus on desired learning outcomes, decisions about pacing and curriculum emphasis, and the emphasis of seeking enhanced learning for all students.

Similarly powerful effects of feedback and strategy teaching are found in studies of teaching mathematics to lower ability students. Lee (2000) investigated the influences on mathematics competencies for learning disabled and lower achieving students. The programs with greatest effect were strategy-based methods (*d* = 0.85), guided practice (*d* = 0.86), peer tutoring (*d* = 0.76), teacher modeling (*d* = 0.73), using specific forms of feedback (*d* = 0.62), using mastery criteria (*d* = 0.63), sequencing examples (*d* = 0.58), and changing instruction on the basis of feedback (*d* = 0.42). The least effective were using the strategy of working within a peer group (*d* = 0.15), using technology for independent practice (*d* = 0.16), using alternative representation modes (*d* = 0.26), and identifying and teaching relevant preskills (*d* = 0.28). Similarly, Sowell (1989) and Parham (Parham, 1983) found that the use of manipulative materials in mathematics had highest effects on the concrete, rather than the more abstract, instructional components.

Use of calculators

One major form of "manipulable" aids is calculators and this has been subject to much debate. With one exception, the meta-analyses show a low but positive (about *d* = 0.20) effect from the presence of calculators in mathematics. The key findings supporting the use of calculators seem to be: a) when they are used for computation, drill and practice work, and for checking work; (b) when they reduce the cognitive 'load' on students so they can attend to other, more mathematical, concepts; and (c) when used for a pedagogical purpose in which they are to be an important element in the teaching and learning process.

Ellington (2000) found that the effects of calculators were greatest for lower ability students (*d* = 0.30), most variable for average ability students (*d* = 0.20), and negative for



KEY	
Standard error	0.092 (High)
Rank	93rd
Number of meta-analyses	5
Number of studies	22
Number of effects	1,083
Number of people (0)	na

high ability students (d = –0.23). The argument was that calculators can assist in reducing the cognitive load for the lower ability students whereas the higher ability students are less constrained by the additional requirements of knowing the computational aspects when learning mathematics. Further, Ellington found that the effects were much higher when calculators were involved in the teaching process; for example, when used for composition problem solving, the effects were d = 0.72: "When compared with students who did not use calculators, students in treatment groups were able to solve more problems and make better decisions with regard to selecting methods for generating solutions" (Ellington, 2003, p. 169). Ellington (2006) specifically investigated graphing calculators, and the overall effects were quite low, although the effects were larger for conceptual (d = 0.72) compared with procedural (d = 0.52) skills. When students were allowed to use these calculators as part of instruction but tested without them, the effects were negative (d = –0.21). The conclusion was that the calculator is neither a help nor a hindrance to students' overall mathematics achievement, and at minimum their use helps reduce cognitive load and enhance students' attitudes towards the study of mathematics. Smith (1996) also reported a positive effect of calculators on attitude (d = 0.37), but lower effects on computational skills (d = 0.21), concept development (d = 0.19), problem solving (d = 0.15) and graphing skills (d = –0.05). He found greater effects for calculators for high school compared to elementary school students—except for the use of graphing calculators in high schools. Nikolaou (2001) found a higher effect on problem solving skills (d = 0.49, particularly in pre-algebra classes). He found no differences in the effects relating to socioeconomic status, gender, grade level, student ability level, student ethnicity, or student calculator expertise.

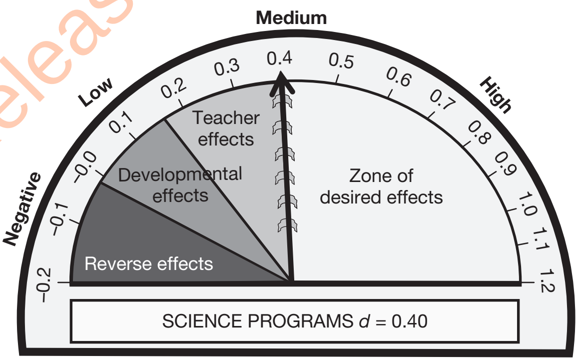
Hembree and Dessart (1986) found that the pedagogical use of calculators improved students' basic skills both in completing exercises and problem solving. Across all grades (and particularly above grade 5, when calculators become more prevalent) and across all ability levels, students using calculators led to greater effects in students' basic skills in operations and particularly in problem solving. The effects on problem solving seem to relate to improved computation and lower cognitive workload demands. They also found that there was a better attitude toward mathematics and an especially higher self-concept in mathematics for those using calculators compared to those not using calculators. Their suggestion was that this enhancement in attitude was probably because the use of calculators helped relieve students' traditional dislike of problems expressed in words (by reducing the cognitive load of having to compute as well as problem solve).

Overall, the presence of feedback, direct instruction, strategy-based methods, high levels of challenge and mastery has much effect on the learning of mathematics. That is, directive teaching makes the difference when teaching mathematics. Using manipulative materials and calculators helps to reduce students' cognitive load and allows them to devote their attention to problem solving

Science programs

Many of the meta-analyses in science investigated competing science curricula. Shymansky (1984) looked at new science programs, most of which were developed in the 1960s and early 1970s. The programs typically emphasized analytic and process skills, integrated laboratory activities as an integral part of the class routine, and higher cognitive skills and appreciation of science. This is in contrast to traditional curricula, which emphasized knowledge of scientific facts, laws, theories, and applications. In general, students on the skills-based programs outperformed students in traditional classes on attitudes, process skills, analytic skills, and achievement (Kyle, 1982). Shymansky, Kyle, and Alport (1983) found positive effects on all outcomes but self-concept. In particular there were higher effects on areas involving higher cognitive skills (critical thinking, problem solving, creativity, logical thinking), and on reading, mathematics, and communication skills. The effects were positive in life sciences, general science, physics, and biology but not in chemistry or earth science. Kyle (1982) also noted that new science curricula in biology produced the most positive scores and also that chemistry and earth science had the least positive effect.

The use of laboratory and more hands-on activities has produced mixed results. Rubin (1996) distinguished between two forms of laboratory experiences. The first form aims to question, explain, and encourage thinking at higher levels, and use a variety of sources to discover answers to questions. The second form uses "the laboratory" to verify what has been previously presented. When these two methods were compared, Rubin found major differences (d = 0.57) between these two uses, in favor of the first use. Kyle (1982) reported that students in science classes with a low rather than high emphasis on laboratory activities had higher outcomes. Rubin partly explained these lower effects by introducing an important moderator—laboratory experiences increased outcomes relating to manipulation skills (d = 1.26) rather than reasoning skills (d = 0.06) or concepts and subject learning (d = 0.33).



KEY	
Standard error	0.018 (Low)
Rank	64th
Number of meta-analyses	13
Number of studies	844
Number of effects	2,592
Number of people (5)	243,505

Many of these newer curricula emphasized strategies and processing and this required teachers to thus use these methods rather than a more didactic form of teaching. Yeany and Padilla (1983) carried out a research synthesis comparing the effectiveness of various procedures for training science teachers to use better teaching strategies. All procedures were found to have a positive effect on the behavior of science teachers, as did all strategy analysis training methods. This study suggests that the more formalized the training becomes, the greater the effect (replicated by Shymansky *et al.*, 1983). Analysis with feedback was the most effective training technique; observing or analyzing models had an intermediate effect; and just studying an analysis system and self-analysis were least effective. The greatest changes were more on conceptual understanding. Effects were greatest on both innovative and neutral tests, and much lower on tests favoring traditional science content (Weinstein, Boulanger, & Walberg, 1982). Bredderman (1983) cautioned, however, that the advantages of these activity-based curricula for elementary school students may be lost when they later enroll in classrooms where more traditional methods prevail.

Wise and Okey (1983) looked at the effects of various science teaching strategies on achievement. Experimental science teaching techniques, on average, resulted in one third of a standard deviation improvement over traditional techniques. Their results suggest that an effective classroom is one in which students are kept aware of instructional objectives and receive feedback on their progress towards these goals. Students also need to have opportunities to physically interact with instructional materials and engage in a range of activities. Verbal interactions focused on a plan, such as the cognitive level of positioning of questions asked during lessons, were effective. Overall, the effective science classroom reflected considerable teacher planning, with students taking some responsibility for task definition.

Schroeder, Scott, Tolson, Huang, and Lee (2007) also investigated the effects of various science teaching strategies on achievement. The highest effects came from enhanced content strategies (e.g., relating topics to previous experience or learning and engaging students' interest; d = 1.48), collaborative learning strategies (d = 0.67), inquiry strategies (d = 0.65), manipulation strategies (d = 0.57), assessment strategies (d = 0.51), and instructional technology strategies (d = 0.48). They concluded that "if students are placed in an environment in which they can actively connect the instruction to their interests and present understandings and have an opportunity to experience collaborative scientific inquiry under the guidance of an effective teacher, achievement will be accelerated" (p. 1452).

There are many successful methods for engendering conceptual change in science. Guzzetti, Snyder, Glass, and Gamas (1993) found that learning charts (d = 0.43), discussion webs (d = 0.51), and augmented activation (d = 0.43) were more effective than activation of prior knowledge (d = 0.10) and question–answer–explanation (d = 0.02) in reducing misconceptions from reading science texts. Texts are the most effective way to eliminate misconceptions, either when text is refutational or when text is used in combination with other strategies that cause cognitive conflict. These refutational texts created a form of cognitive dissonance in students' thinking and thus students could be taught to explain why the misconception was incorrect: "Augmented activation activities facilitated cognitive conflict by directing the reader's attention to contradictory information in the text or by providing illustrative demonstrations that caused incongruity with extant beliefs" (Guzzetti *et al.*, 1993, p. 134). Horak (1985) also found positive effects (d = 0.57) from students reading science texts that helped them to select important aspects of the written material, and from students reading those texts that aided in building internal connections within the textual materials.

Wise (1996) examined a number of teaching strategies, and found the following effects: teacher questioning ($d = 0.58$), focusing strategies ($d = 0.57$), manipulation strategies (work or practice with physical objects, $d = 0.58$), enhanced materials (teacher modification of instructional materials, $d = 0.52$), use of immediate or explanatory feedback ($d = 0.32$), inquiry strategies ($d = 0.28$), enhanced context strategies (e.g., field trips, games, self-paced learning, $d = 0.26$), and instructional media ($d = 0.18$). He concluded that active construction of meaning is most often likely to occur "when science teachers use strategies that require students to be both physically and mentally engaged" (Wise, 1996, p. 338).

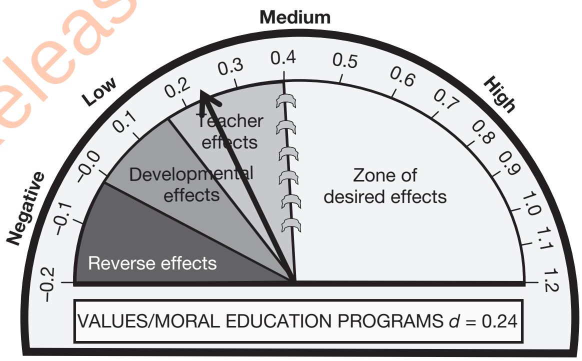
Values and moral education programs

Character education is an umbrella term for many programs: citizenship training, health education, conflict resolution training, life skills, service learning, moral reasoning, moral education, values verification, ethics, and religious education. Berg (2003) investigated 29 values-based character education programs. These programs typically related to character education, citizenship training, life skills, values clarification, moral reasoning, ethics and religious education: "almost anything schools might try to provide outside of academics, especially when the purpose is to help children grow into good people" (Kohn, 1997, p. xx). Most effects related to behavior and attitude ($d = 0.24$) but there were some relating to the effects of these programs on achievement ($d = 0.20$).

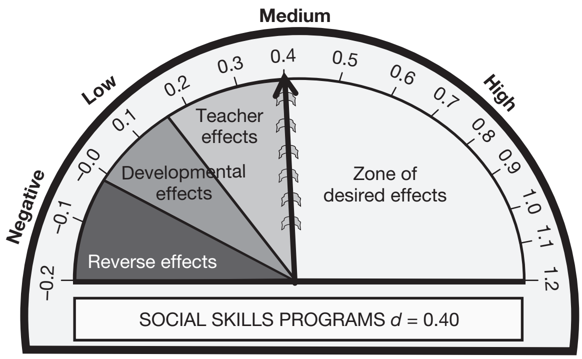
The major outcome from moral education programs is the facilitation of moral judgment, that is, the way in which people define decisions or actions as morally right or wrong (Schlaefli, Rest, & Thoma, 1985), and as this is not strictly achievement as typically defined, these are not included in the tables. The overall effect of 0.28 from the moral education programs that emphasized moral dilemma discussions had slightly higher effects ($d = 0.41$) compared to those based on personality development ($d = 0.36$). The effects were greater for adults ($d = 0.61$) than for college students ($d = 0.28$), senior high school students ($d = 0.23$) and junior high school students ($d = 0.22$).

Social skills programs

Social skills or social competence programs are usually provided for learners whose behavior is either highly internalized or highly externalized (e.g., socially isolated and withdrawn, or exhibitionist). The aim is higher levels of social appropriateness, social problem solving



KEY	
Standard error	na
Rank	94th
Number of meta-analyses	2
Number of studies	84
Number of effects	97
Number of people (1)	27,064



KEY	
Standard error	0.031 (Low)
Rank	65th
Number of meta-analyses	8
Number of studies	540
Number of effects	2,278
Number of people (3)	7,180

skills, self-control, or social perspective training. Over all these meta-analyses involving social skills programs, the effects are stronger on enhancing peer relations (d = 0.80 to d = 0.90) and social outcomes (about d = 0.5 to d = 0.6); lower when the students are initially identified as social problems (d = 0.20); and lowest when academic achievement is the outcome of the social-skill programs (d = 0.10 to d = 0.20). Students with learning disabilities have lower social skills than their non-disabled peers (d = 0.60 to d = 0.70). In all these programs there were mostly short-term gains, indicating a need to provide social skills training on a regular and sustained basis.

Three meta-analyses are more concerned with the effects of social skills training on social outcomes. Beelmann, Pfingsten, and Loesel (1994) found that social competence training was an effective intervention in children's (three to 15 years) social outcomes in the short term (d = 0.61). The effects were greatest on social-cognitive skills (d = 0.77), compared to social interaction skills (d = 0.34), social adjustment (d = 0.18), and self-related cognitions (e.g., self-concept, control beliefs). The greatest effects were for at-risk children and younger children, and larger effect sizes were only found when direct goal criteria such as social-cognitive skills were evaluated. There were few effects on broader constructs such as social adjustment. Furthermore, long-term effects were weak. Social skills programs can make a positive difference to social outcomes, particularly social problem solving programs. Denham and Almeida (1987) were particularly interested in the effects on interpersonal social cognitive problem solving (ICPS) and found similar effects (d = 0.62) (see also Beelmann *et al.*, 1994). An increase in ICPS skills is related to improvement in behavioral adjustment, particularly for elementary-aged children. The more effective programs were behavioral programs, dialogue between teacher and student on social problem solving, and when interventions lasted for 40 lessons or more. Hanson's (1988) review of social skills training literature found that the average participant in a social skills training program was more socially skilful than 74 percent of those who had not been given training (d = 0.65). There were greater effects from measures based on behavioral observation, followed by self-report and role-play, and then teacher ratings.

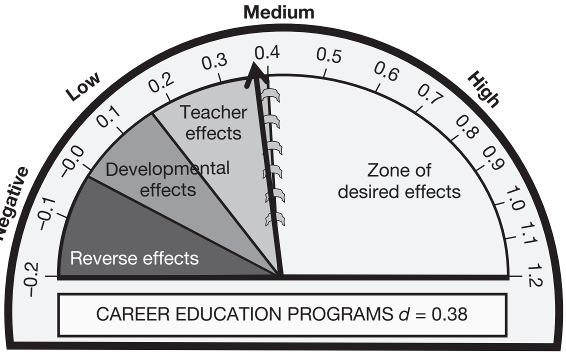
The domain with the highest effects from social skills training related to peer relations among all students (Schneider, 1992, d = 0.98). He found that there was overall short-term moderate effectiveness in social skills training. The more effective programs were the use of coaching and modeling, particularly when focused on individual peer relation issues. They suggested that students receiving social skills training may benefit in reduced social anxiety, increased comfort in social situations, or enhanced motivation as they are made to feel that meaningful improvements in social behaviors are within reach. The effects on academic achievement were very low (d = 0.19).

Two meta-analyses were more concerned with the effects of social training on students with specific issues (emotional or behavioral disorders). Quinn, Kavale, Mathur, Rutherford, and Forness (1999) were particularly concerned with students with emotional or behavioral disorders and not surprisingly found lower overall effects (d = 0.20). This effect was similar when rated by teachers, self, peer, experimenter, or parent; and for pro-social behavior (social relations, behavior, problem solving, competence), problem behaviors (family relations, school social behavior, social communication, and disruptive behavior) and for specific social outcomes (anxiety, adjustment, cooperation, self-concept, and aggression). There were no differences related to duration of the intervention, or whether the program was established or published, or created for the particular group. Forness and Kavale (1996) found similar low effects when social skills programs were implemented with children with learning disabilities and social skill deficits (d = 0.21). Again, there were no differences in length of treatment, whether peer, teacher, or self assessed, and across social outcomes—with one exception: students in social skills programs believed that their social status was enhanced. Forness and Kavale found that the most effective social skills training included a combination of modeling, coaching, and reinforcement programs particularly when the social skills training related directly to the student's social skills deficit—although the persistence of the effects over time was problematic.

The last two meta-analyses were more concerned with the differences in social skills between learning disabled and non-disabled comparison groups. Kavale and Forness (1996) found high degrees of differences in social skills between learning disabled and non-disabled comparison groups. The differences in social skills were quite marked (d = 0.65). Kavale and Forness claimed that students with learning disabilities were generally assessed as having social skills deficits irrespective of who assessed them—teachers, peers, or self (although self-assessments were somewhat harsher). Teachers indicated that they considered students as having "learning difficulties" if they had lower academic competence, particularly if they also had social skill deficits. The dimensions of social skills rated highest by teachers were interaction, adjustment, hyperactivity, and distractibility. The lowest were aggression, conduct disorder, dependency, and personality problems. Peers were more likely to reject, and have limited acceptance of, disabled students, particularly those with lower social competencies. Learning disabled students were less popular, less often selected as friends, and viewed as less cooperative. Swanson and Malone (1992) found that in social situations, disabled students were more likely than non-disabled students to be rejected by peers, less well liked, more likely to be rated as aggressive and immature, perceived as suffering from personality problems, and perceived as having difficulty staying on-task. Children with learning disabilities have an accurate perception of their status within the classroom!

Career education programs

Career education involves activities and experiences designed to increase knowledge of occupations, training paths, job-search skills and decision-making strategies that include the integration of work, family, leisure, and community roles (see www.career-symposium.org/act_Defs.html on 14 April 2005). Career education programs do seem to have positive effects on student outcomes (Baker & Popowicz, 1983). Oliver and Spokane (1988) found

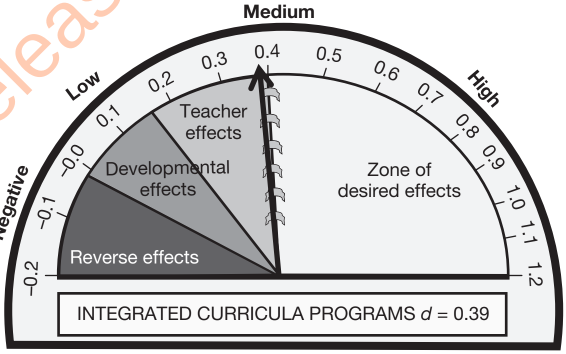


KEY	
Standard error	0.050 (Medium)
Rank	69th
Number of meta-analyses	3
Number of studies	143
Number of effects	243
Number of people (1)	159,243

that career counseling has generally positive effects, with class interventions the most effective but requiring the greatest number of hours. Individual counseling was shown to produce more client gain per hour than other intervention models. Intensity of treatment was the only significant contributor to more positive outcomes. Evans and Burck (1992) found that career education interventions did contribute to academic achievement, but the interventions only improved student academic standards an average of d = 0.16 over alternative or control conditions. Elementary school students of average ability benefited most academically, particularly if: they were randomly assigned to groups; the intervention was coupled with mathematics and language arts subject matter; and the program averaged 151 to 200 hours per school year.

Integrated curricula programs

Hartzler (2000) investigated 30 studies using integrated curricula and found different effects by subject: science (d = 0.61), language arts (d = 0.42), social studies (d = 0.38), and mathematics (d = 0.42). The most important elements in integrated programs were thematic instruction (d = 0.46), and an emphasis on process skills (d = 0.36). Integrated programs were more successful in elementary (d = 0.56) and middle school (d = 0.57) compared to high school (d = 0.27); for lower compared to middle and higher achieving students; for ethnically diverse students; and when more experienced teachers implemented the programs.



KEY	
Standard error	0.050 (Medium)
Rank	67th
Number of meta-analyses	2
Number of studies	61
Number of effects	80
Number of people (1)	7,894

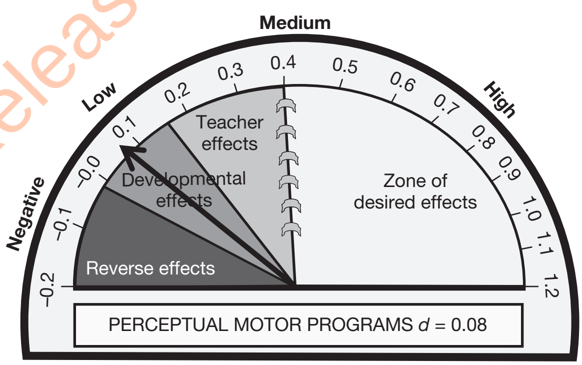
Hurley (2001) investigated integrated mathematic and science programs. The effects were higher on mathematics (d = 0.37) than science (d = 0.27). The conclusion was that integrating mathematics into science might be good for science, but the effects for mathematics were greater when taught in sequence with science, particularly when science was taught prior to mathematics—as the effects were the greatest on the subject taught last (probably because of the greater level of integration from the first to the last taught).

Perceptual motor programs

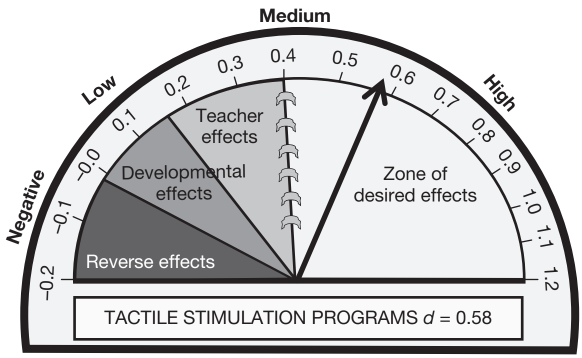
Perceptual motor training is an intervention more often used with learning difficulty students. It was extremely popular in the 1950 to 1970s and is still evident in some schools today. Programs typically include teaching in visual and figure and ground discrimination, visual motor abilities, visual spatial perception, and balance and body awareness. Using 180 studies that examined the effect of perceptual motor training on learning disabled children, Kavale and Mattson (1983) found that overall perceptual motor interventions were not effective in improving academic or cognitive learning. There were no major improvements associated with perceptual/sensory motor outcomes. They did note that the quality of perceptual motor training studies was low and these lower rated studies produced the largest effect sizes. There were relatively higher effects on perceptual sensory motor outcomes (gross motor skills d = 0.21, fine motor d = 0.18, and visual perception d = 0.15) but lower on academic outcomes (reading d = –0.04, mathematics d = 0.10, language d = 0.03, spelling d = 0.02, handwriting d = 0.05). Such programs, therefore, may have value to enhance perceptual motor outcomes but the effects on achievement are close to zero. Indeed, Kavale and Mattson concluded that "a child receiving perceptual motor training is likely to gain little, if anything, or possibly lose status when compared with a child not receiving such intervention" (p. 171).

Tactile stimulation programs

Tactile stimulation is a type of sensory enrichment or stimulation used with infants, often those at risk of developmental delay, to encourage their development. The evidence of the effectiveness of tactile stimulation used with infants and young children as a form of early intervention to stimulate the senses points to its effectiveness. Those receiving some form



KEY	
Standard error	0.011 (Low)
Rank	128th
Number of meta-analyses	1
Number of studies	180
Number of effects	637
Number of people (1)	13,000

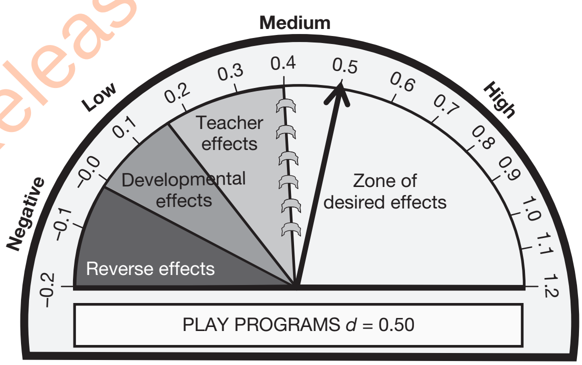


KEY	
Standard error	0.145 (High)
Rank	27th
Number of meta-analyses	1
Number of studies	19
Number of effects	103
Number of people (1)	505

of controlled tactile stimulation performed better on a variety of outcome measures than those not receiving the intervention (Ottenbacher *et al.*, 1987). The effects were greatest on social and personal outcomes (d = 0.61), physiological (d = 0.54), motor/reflex (d = 0.53), cognitive/language (d = 0.36), and lowest on visual/auditory (d = 0.18). Designs associated with weak experimental controls were associated with the largest treatment effects, while designs with more rigorous controls over internal validity produced smaller mean effects.

Play programs

The place of play in enhancing achievement has been long cited and even today it seems it is very powerful. Spies (1987) examined play, problem solving, and creativity in young children and found that there was a small relationship between play and originality for familiar objects, but not for unfamiliar objects, and no effect of play on problem solving. Fisher (1992) in an investigation on the effects of play on development found stronger evidence to suggest play promotes improved performance outcomes both in cognitive-linguistic and affective-social domains. He found somewhat larger effect sizes for ideation fluency (originality or flexibility of association and the kind of divergent thinking characteristic of creative imagination), and for perspective-taking (empathetic role assumption related to greater co-operative behavior, sociability and heightened peer-group popularity). Fisher found some differences in effects between different types of play, with socio-dramatic play having the most striking effect and the smallest effect in imaginative play. Adult-directed



KEY	
Standard error	na
Rank	46th
Number of meta-analyses	2
Number of studies	70
Number of effects	70
Number of people (2)	5,056

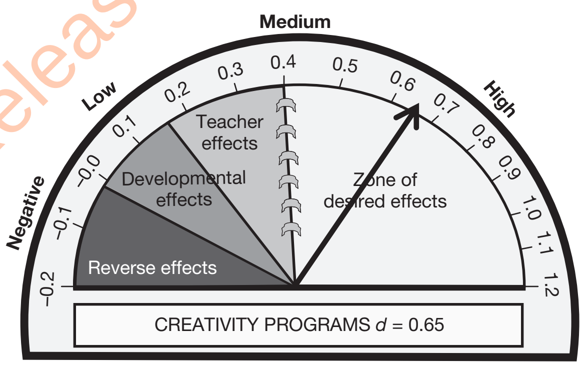
play showed no more gains that for other play conditions. So, for younger children, play makes a difference. The difference is likely to be related to learning about peer relations and learning how to learn from peers, facing and meeting challenges, the consequence of deliberative practice in play, and the satisfaction from deciding or becoming aware of both the learning intentions and success criteria from being involved in play.

Specific curricula programs

Creativity programs

Since the 1950s, a range of techniques and instructional materials has been developed to facilitate creative thinking. Creativity programs are grounded in a common idea that training, practice, and encouragement in using creative thinking skills can improve an individual's ability to use creative thinking techniques such as thinking with fluency, flexibility, and with an element of the unusual in responses to questions or problems (Cohn, 1986; Rose & Lin, 1984). Overall, creativity programs have a large positive effect on outcomes.

Like most other programs, an emphasis on instructional strategies and direct instruction makes a major difference in the effectiveness of creativity programs. Scope (1998), for example, investigated the effects of instructional variables on creativity, and reported that creativity programs that had a high level of structuring (d = 0.80), questioning (d = 0.73), and responding to student questioning (d = 0.70). These effects were constant across all subject areas. Higgins, Hall, Baumfield, and Moseley (2005) undertook one of the more complete reviews of programs to enhance thinking and creative processing. Across all outcomes the effect size was d = 0.74, for cognitive outcomes d = 0.62, for curricula achievement d = 0.62, and for affective outcomes d = 1.44. The greatest effects came from meta-cognitive strategies (d = 0.96), cognitive acceleration (d = 0.61), and instrumental enrichment (d = 0.58). Across curriculum domain, the effects were greatest in mathematics (d = 0.89), science (d = 0.78), then reading (d = 0.48). This team completed an extensive review of various strategies and developed a four-part thinking model (Figure 8.24). Thinking consists of information gathering, building understanding, productive thinking, and strategic and reflective thinking. They argued that the development of strategic and reflective thinking is a major goal of schooling, and the other three are cognitive skills that can develop in unplanned and unreflective ways (Higgins *et al.*, 2005).



KEY	
Standard error	0.097 (High)
Rank	17th
Number of meta-analyses	12
Number of studies	685
Number of effects	837
Number of people (2)	23,299

Strategic and reflective thinking
Engagement with and management of thinking/learning,
supported by value-grounded thinking (including critically reflective thinking)

Information gathering
Experiencing, recognizing and recalling messages & recorded information

Building understanding
Development of meaning
Working with patterns & rules
Concept formation
Organizing ideas

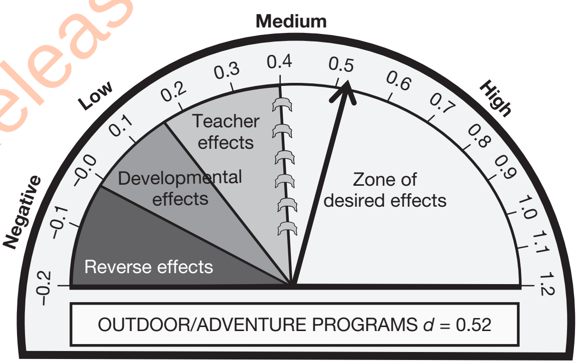
Productive thinking
Reasoning
understanding causal
systematic enquiry
Problem solving
Creative thinking

Figure 8.24 Higgins *et al.* four-part thinking model

Creativity programs that include explicit instruction are among the most successful (Bangert-Drowns & Bankert, 1990). Cohn (1986) demonstrated that the most successful programs were those based on developing thinking strategies; and that it was easier to improve fluency than originality. He suggested that creativity training was enhanced when activities aimed at setting and meeting high expectations are provided. This may, Cohn suggests, indicate that direct training does not affect ability but merely changes our motivation to do well (see also Kardash & Wright, 1987). Rose and Lin (1984) investigated the long-term effects of creativity training programs and also showed that most of these programs improved verbal creativity, particularly the creative problem solving programs. Bertrand (2005) also found higher effects on verbal than figural achievement. Berkowitz (2006) found that various communication strategies enhanced critical thinking outcomes; for example, participation in public speaking courses (d = 0.29), in argumentation-type classes (d = 0.26), various types of competitive forensics methods of creatively working through problems (d = 0.41).

Outdoor education

One of my students completed a meta-analysis of programs that enhanced self-esteem (Clinton, 1987). Programs run by teachers were the least successful and programs that were more cognitively based than emotionally or affective based were more successful. Over all programs, most systematically successful were Outward Bound or Adventure programs.



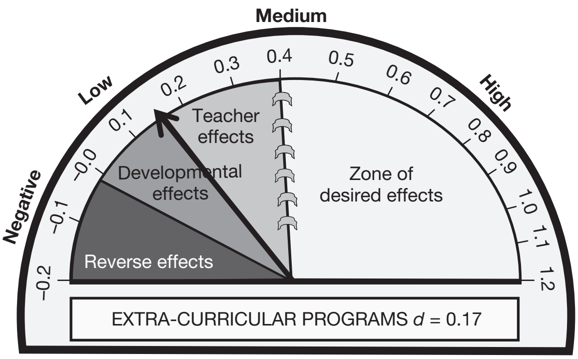
KEY	
Standard error	0.035 (Low)
Rank	43rd
Number of meta-analyses	3
Number of studies	187
Number of effects	429
Number of people (3)	26,845

Hattie, Marsh, Neill, and Richards (1997) reviewed 96 studies and found an average 0.34 increase across outcomes. Perhaps most exciting is that this is one of the few areas in education where the follow-up effects (d = 0.17) were positive and were in addition to the effects at the end of the program (so 0.34 + 0.17 = 0.51). It is rare to find such increasing after-effects from an education intervention, as too many have a diminishing return. Specifically the effects of adventure programs on academic outcomes were d = 0.46, leadership d = 0.38, self-concept d = 0.28, personality d = 0.37, and interpersonal outcomes d = 0.32. There was, however, much variance between programs, with the Australian far exceeding the American programs—which we suggested was because the former were more oriented to "teaching" (e.g., only those with social science degrees could be employed as instructors) whereas the latter were more oriented to the outdoor experience. There are some adventure programs specifically designed to produce gains in achievement domains and as such have an integrated program of teaching, normal schoolwork, and adventure experiences. These experiences help problem solving skills and peer and cooperative learning, and there is an enhanced level of immediate feedback. A major reason for the success is the way activities are structured to emphasise very challenging learning intentions, the success criteria are clear, the peer support optimized, and not only is feedback given throughout the program but it is actively sought by the participants. Many of the coping strategies that students had when they entered the program were found deficient and needed to be replaced with other more cognitive and peer supportive strategies to ensure that the team overcame the many challenges.

Cason and Gillis (1994) found that longer programs were more effective and younger participants gained more from outdoor programs than older participants. The effect on grades was d = 0.61 and on school attendance was d = 0.47, which is above the overall average effect of d = 0.31. Laidlaw (2000) found an effect of d = 0.49 from wilderness and d = 0.39 from school camping programs, but longer programs were more effective. We also found that programs longer than 20 days were much more successful than shorter programs (Hattie, Brown, & Keegan, 2005). Learning about facing challenge, seeking feedback, adapting to peer cooperative learning, and enhanced self-regulation about one's skills and strengths seems to last beyond the experience in the outdoors.

Extra-curricular activities

Students do not learn only via the curricula offered in schools, as many partake in extra-curricular activities. Lewis (2004) found 41 studies that investigated the effects of these activities, and the finding of most direct relevance is the d = 0.47 effect on academic achievement (even though this is one of the few meta-analyses in this book that used a random effects model, so the effect is possibly inflated compared to most of the others in this book). He also reported an effect of d = 0.33 on engagement, d = 0.29 on reducing risk behaviors, and d = 0.23 on identity formation. Similarly, he found an effect from participating in sports of d = 0.10 on achievement, d = 0.16 on engagement, d = –0.16 on reducing risk behaviors, and d = 0.15 on identity formation. Participation in work had a zero (d = –0.01) effect on achievement, d = 0.07 on engagement, d = 0.29 on increasing risk behaviors, and d = 0.35 in identity formation. It seems that if we wish students to enhance achievement then extra-curricular activities relating to academic types of activities is optimal, and sport has least effect on most outcomes; a finding replicated by Lewis (2004). It must be considered that many students participate in sport and work not



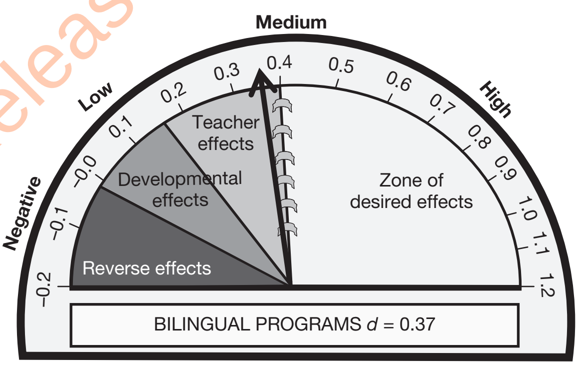
KEY	
Standard error	0.072 (Medium)
Rank	114th
Number of meta-analyses	5
Number of studies	102
Number of effects	68
Number of people (0)	na

expecting any effects on achievement, but because they enjoy it, it engages them, and for many children (like for my boys) keeps them at school—where they gain the dividend of instruction in more academic subjects.

The greatest effects on achievement came from participation in school-based extracurricular activities, then pro-social activities (such as scouting, volunteering, and church activities); participation in the performing arts had the least effect on all outcomes. "The influence of community acts on attendance, interest in school and achievement, and level of investment in activities is just as potent as those of general school activities" (Lewis, 2004, p. 79). Lewis claimed that the effects from work and sport related more to identity formation and peer self-esteem—which are indeed critical attributes of particular importance during adolescence. Lewis concluded that the most effective extra-curricula programs had high levels of organization and structure, were regular, emphasized increasingly complex skill building and goal setting abilities, and involved leadership by one or more competent adults. Such programs provided the development of a sense of belonging, opportunities to develop a social network, provided positive reinforcement and an achievement orientation, allowed participants to have leadership roles, and presented age-appropriate expectations and goals for students.

Bilingual programs

Bilingual education programs are programs where two languages are used as a medium of instruction, in contrast to structured immersion programs where students are instructed



KEY	
Standard error	0.140 (High)
Rank	73rd
Number of meta-analyses	7
Number of studies	128
Number of effects	727
Number of people (3)	10,183

solely in one language. In bilingual education there can be wide variation in the allocation and organization of language use across the timetable and curriculum. There is a high level of variability in these studies, and this reflects the variability in programs (Willig, 1985)—some are remediation programs for immigrants (Oh, 1987), some are programs to teach a second language, and some are related to the preservation of cultural principles (e.g., Māori immersion in Kura Kaupapa schools in New Zealand). The variation in the effect sizes for these programs seems to relate to the quality of teaching competence and the explicit attention to teaching strategies of learning.

Willig (1985) found that participation in bilingual education programs compared to submersion in English showed small to moderate difference favoring bilingual education for tests administered in both English and Spanish. Outcomes were positive for bilingual education for tests of reading, language skills, mathematics, and total achievement administered in English. The results were also in favor of bilingual education when tests were in other languages for reading, language, mathematics, writing, social studies, listening comprehension, and attitudes towards self and school.

A meta-analysis of the Santa Fe Bilingual Education Program results found that the initial impact of the program was greater in the early grades. The bilingual instructional approach had a significant effect on mathematics achievement, but while there were gains in reading, they were small. Overall, the findings support the benefits of bilingual education on student academic performance (Powers & Rossman, 1984). When the language of the residential neighborhood was the same for experimental and comparison groups, effect sizes were positive for bilingual group programs. When the neighborhood language of comparison groups was English and that of experimental groups Spanish there was little difference between groups.

Concluding comments

It is less the content of curricula that is important than the strategies teachers use to implement the curriculum so that students progress upwards through the curricula content. The sharing by teachers of their conceptions about what constitutes progress through the curricula is critical (and this assists in reducing the negative effects of mobility and changing classrooms), as well as ensuring appropriately challenging surface, deep, and conceptual knowledge and understanding. So often changes to curricula are more cosmetic than transformational. Changes are made to the way specific objectives are grouped into higher order concepts, but so often the fundamental objectives do not change, and when teaching methods are cited they usually refer to more passive or to constructivist teaching methods—the very ones that are least successful (no matter how palatable they may seem). Too often there is little attention paid to how to build a common conception of progress across the years studying the curriculum (Hattie, 2006). This makes it harder for teachers, as they then invent their own conceptions of progress, which can be quite different from those of other teachers, even when they are teachers of the same grade within one school. A systematic change to some aspects of the curricula, however, does seem to have a reasonable and substantial effect on student learning. This change typically relates to the inclusion and emphasis on various instructional strategies underlying the curricula, and to the highlighting of learning strategies and skill development in the content area.

Teachers need to help students to develop a series of learning strategies that enables them to construct meaning from text, develop understanding from numbers, and learn principles in science. The teaching of these strategies needs to be planned, deliberate, and explicit, and part of active programs to teach specific skills and deeper understanding. Such strategies can then lead to a student's further engagement in the curricula, lead to the development of problem solving skills, and lead to the enjoyment of some control over one's learning. There are at least two levels of understanding involved: surface knowledge (such as vocabulary programs in reading, phonics instruction), and deep understanding (such as creativity programs). It is necessary to have both levels, and most often there is a simple order in applying them—one needs to *know* something before one can *think about* it. Hence, phonics often precedes comprehension, and placing too much emphasis on the latter before the former is learnt (as is typical of many whole language programs) is not effective. For a student to learn, there must be, at a minimum, time on task, exposure to teaching, collaborative practice between teacher and student, and opportunities to practice. If a student misses the first time, then second and third chance programs need to be available, as they are effective in remediating the deficiencies from the first time around. Innovative techniques that reduce the cognitive load for these lower achieving students are effective (e.g., use of aids such as calculators). For all students, there is a need to identify and then eliminate misconceptions (in reading, mathematics, and science), and this highlights the importance of the teacher looking for the negative—identifying what the child does not know, and determining what instructional strategies the child has or does not have.

The importance of social skills and social competence programs most likely relates to the subsequent enhanced opportunities that accrue from peer co-learning, working together in classes, and minimizing disruption. The highest effects of social skills training related to peer-relations among all students. Similarly, social problem solving skills, self-control, reduction of social anxiety, and social skills in general are important outcomes of schooling. It should not be assumed that all students have these skills or that they could not benefit from systematic social skills interventions, and more research on the progression of learning social skills would be of much benefit to the outcomes of schooling. While most students learn problem solving skills in social and academic contexts, it is clear that they can also be developed in out-of-school activities (e.g., outdoor adventure programs). In such contexts, there is often a high perceived risk, high levels of cooperation needed to survive or perform, and opportunities to develop alternative coping strategies (particularly cognitive rather than emotional strategies). These can then be generalized and used in other contexts. Such programs also demonstrate the power of clear learning intentions, success criteria, and an enhanced frequency and appropriateness of feedback.

The contributions from teaching approaches—part I

To keep the discussion on the various teaching approaches to a reasonable size, the contributions are divided, somewhat arbitrarily, into two chapters. The first chapter looks at goals, success criteria, and fostering student involvement, and the second other teaching approaches such as direct instruction, school-wide programs, using technology, and out-of school learning. This first of these two chapters follows a model of teaching and learning based on Clarke (2001; Clarke, Timperley, & Hattie, 2003), where the learning intentions and success criteria frame the challenge and purpose of the lesson. If such goal-directed lessons are to be successful, they must also use appropriate feedback, take account of students' views of the process of learning, and ensure students are actively involved in monitoring their own learning and developing their own metacognitive skills.

In a portrait of an exemplary school serving students who had been struggling to achieve and not enjoying schooling, Pressley, Gaskins, Solic, and Collins (2006) showed the power of teaching various learning strategies to these students. They claimed that when teachers critically reflected on conceptions of competent thinking and then taught various learning strategies to students, this was more likely to lead to engaging students in acquiring procedural and declarative knowledge and then to the students actually using this knowledge. The exemplary school emphasized the *engagement* of students in the learning process, teachers *articulating strategies of instruction* and paying attention to learning theories, and the school building as an infrastructure to support such instruction. The teachers provided constant scaffolding and modeling, attended to the day-to-day monitoring of students, and *sought feedback about their teaching* while also being concerned with making decisions about *optimal challenging tasks* to assign, and seeking insights from other professionals (e.g., counselors and mentors) about engaging students. There is much more, but the key ingredients of what it means to be strategic in teaching and learning relates to teachers finding ways to engage and motivate students, teach appropriate strategies in the context of various curricula domains, and constantly seeking feedback about how effective their teaching is being with all the students. The portrait by Pressley *et al.* sets the scene for this and the next chapter, which emphasizes the importance of setting challenging tasks, knowing when one (the teacher and the student) is successful in attaining these goals, the power of feedback, and the critical role of teaching appropriate learning strategies.

Table 9.1 Summary information from the meta-analyses on the contributions from teaching approaches

	No. metas	*No. studies*	*No. people*	*No. effects*	*d*	*SE*	*CLE*	*Rank*
Strategies emphasizing learning intentions								
Goals	11	604	41,342	820	0.56	0.057	40%	34
Behavioral organizers/advance organizers	11	577	3,905	1,933	0.41	0.040	29%	61
Concept mapping	6	287	8,471	332	0.57	0.051	40%	33
Learning hierarchies	1	24	—	24	0.19	—	13%	110
Strategies emphasizing success criteria								
Mastery learning	9	377	9,323	296	0.58	0.055	41%	29
Keller's PIS	3	263	—	162	0.53	—	37%	40
Worked examples	1	62	3,324	151	0.57	0.042	40%	30
Strategies emphasizing feedback								
Feedback	23	1,287	67,931	2,050	0.73	0.061	52%	10
Frequency or effects of testing	8	569	135,925	1,749	0.34	0.044	24%	79
Teaching test taking and coaching	10	267	15,772	364	0.22	0.024	16%	103
Providing formative evaluation	2	30	3,835	78	0.90	0.079	64%	3
Questioning	7	211	—	271	0.46	0.068	32%	53
Teacher immediacy	1	16	5,437	16	0.16	—	8%	115
Strategies emphasizing student perspectives in learning								
Time on task	4	100	—	136	0.38	0.101	27%	70
Spaced vs. massed practice	2	63	—	112	0.71	—	—	12
Peer tutoring	14	767	2,676	1,200	0.55	0.103	39%	36
Mentoring	2	74	10,250	74	0.15	0.047	11%	120
Strategies emphasizing student meta-cognitive/self-regulated learning								
Meta-cognitive strategies	2	63	5,028	143	0.69	0.181	49%	13
Study skills	14	668	29,311	2,217	0.59	0.090	41%	25
Self-verbalization/self-questioning	3	113	3,098	1,150	0.64	0.060	45%	18
Student control over learning	2	65	—	38	0.04	0.176	5%	132
Aptitude-treatment interactions	2	61	1,434	340	0.19	0.070	14%	108
Matching style of learning	8	411	29,911	1,218	0.41	0.016	29%	62
Individualized instruction	9	600	9,380	1,146	0.23	0.056	16%	100
Total	155	7,559	386,353	16,020	0.45	0.071	31%	—

Strategies emphasizing learning intentions

This section on learning intentions covers the teaching strategies of:

1 goals;
2 behavioral objectives;
3 organizers and adjunct questions;
4 concept mapping;
5 learning hierarchies.

Learning intentions describe what it is we want students to learn in terms of the skills, knowledge, attitudes, and values within any particular unit or lesson. Learning intentions should be clear, and provide guidance to the teacher about what to teach, help learners be aware of what they should learn from the lesson, and form the basis for assessing what the students have learnt and for assessing what the teachers have taught well to each student. The activities planned for the lesson need to be focused on these intentions and move away from the all-too-often "busy" work that students might enjoy but which has little relationship to the learning intention.

Clarke, Timperley and Hattie (2003) have noted some important points about learning intentions and planning.

- Not all students in the class will be working at the same level, so it is important to adapt the learning intentions to make them appropriate to all students.
- The amount of time allocated should not be the same for all learning intentions, but should vary depending on whether they are developing concepts, skills or knowledge—*concepts or deeper learning* are likely to need more time than, say, the acquisition of *knowledge* or *surface information*.
- Learning intentions and activities can be grouped, because one activity can contribute to more than one learning intention, or one learning intention may need several activities or several exposures to the activities for the students to understand it fully.
- While learning intentions are what we intend students to learn, the students may also learn other things not planned for, and we need to be aware of these unintended consequences.

A more specific type of learning intention is the "mastery goal". Ames (1992) explained that, with a mastery goal, individuals are oriented toward developing new skills, trying to understand their work, improving their level of competence, or achieving a sense of mastery based on self-referenced standards. Elliott and Dweck (1988) further distinguished between mastery and learning goals. They defined learning goals as about more than the mastery of new things, and claimed that students encouraged to use learning goals were less worried about their intellect, remained focused on-task, and maintained their effective problem-solving strategies. Compatible with this goal construct is Brophy's (1983) description of "motivation to learn" whereby individuals focus on mastering and understanding content and demonstrate a willingness to engage in the process of learning.

Another important aspect of learning intentions is knowing *how* they will be implemented. Learning intentions take the form "I intend to reach x" and by articulating *how* they intend to reach "x", teachers and students are expressing an "implementation intention". Gollwitzer and Sheeran (2006) completed a meta-analysis testing the notion that implementation intentions help teachers and students attain goals. "Implementation intentions should enhance people's ability to initiate, maintain, disengage from, and undertake further goal pursuit and thereby increase the likelihood that strong goal intentions are realized successfully" (p. 20). They used 63 studies and the effect size was $d = 0.65$. It is not just the presence of a learning intention and having commitment that helps, but most importantly it is having a sense of "if-then" that helps the implementation of goal intentions. Thus, the art is setting appropriately challenging goals, developing commitment to attaining them, and developing intentions to implement strategies to attain them.

Goals

Locke and Latham (1990) have provided a compelling set of evidence, including many meta-analyses (but few with school achievement as the outcome) that indicate how critical goals are for enhancing performance. They argued that goals serve a variety of functions that are essential in the teaching process: goals regulate action and they explain the nature of the link between the past and the future; and goals assume that human action is directed by conscious goals and intentions, although they do not assume that all human action is under fully conscious control (as we shall see later). A major finding of their book is that achievement is enhanced to the degree that students and teachers set challenging rather than "do your best" goals, relative to the students' present competencies.

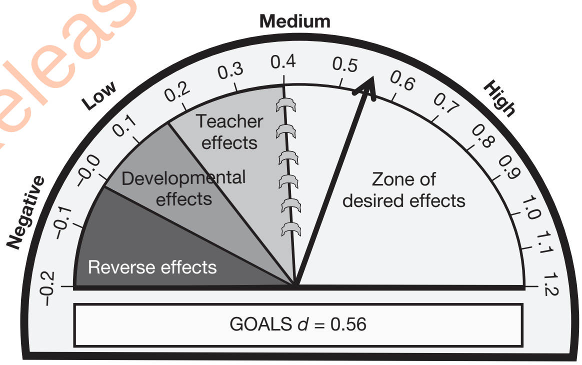
A major reason difficult goals are more effective is that they lead to a clearer notion of success and direct the student's attention to relevant behaviors or outcomes, whereas "doing your best" can fit with a very wide range of goals. It is not the specificity of the goals but the difficulty that is crucial to success. There is a direct linear relationship between the degree of goal difficulty and performance. There are five meta-analyses relative to this contention (Table 9.2) and the overall effect size is a large $d = 0.67$ (these are not all achievement outcomes and so are not included in the Appendices of this book). The performances of the students who have the most challenging goals are over 250 percent higher than the performances of the subjects with the easiest goals (Wood & Locke, 1997).

Also, difficult goals are much better than "do your best" or no assigned goals. Any school with the motto "do your best" should immediately change it to "face your challenges" or "strive to the highest". The following five meta-analyses relate to this contention (Table 9.3). This is because "do your best" goals are easily attained—in one sense, anything you do can be defined as your best. Instead, teachers and learners should be setting challenging goals.

Goals have a self-energizing effect if they are appropriately challenging for the student, as they can motivate students to exert effort in line with the difficulty or demands of the goal. Commitment to the goals helps, but is not necessary for goal attainment—except for special education students, where commitment makes a major difference. Klein, Wesson, Hollenbeck, and Alge (1999) found a high relationship ($d = 0.47$) between goal commitment and subsequent performance, and the effect between commitment and outcome increased as a function of goal difficulty. Donovan and Radosevich (1998) found lower effects of commitment to goals than they expected, but these were still quite high ($d = 0.36$).

Thus, goals inform individuals:

> as to what type or level of performance is to be attained so that they can direct and evaluate their actions and efforts accordingly. Feedback allows them to set reasonable



KEY	
Standard error	0.057 (Medium)
Rank	34th
Number of meta-analyses	11
Number of studies	604
Number of effects	820
Number of people (7)	41,342

Table 9.2 Relation between goal difficulty and performance

Authors	*Year*	*No. studies*	*No. effects*	*d*
Chidester & Grisgby	1984	12	1,770	0.52
Mento, Steel, & Karren	1987	70	7,407	0.55
Tubbs	1986	56	4,732	0.82
Wofford, Goodwin, & Premack	1992	3	207	0.90
Wood, Mento, & Locke	1987	72	7,548	0.58
Total	—	213	21,664	0.67

> goals and to track their performance in relation to their goals so that adjustments in effort, direction, and even strategy can be made as needed.
>
> (Locke & Latham, 1990, p. 23)

The scenario is that effective teachers set appropriately challenging goals and then structure situations so that students can reach these goals. If teachers can encourage students to share commitment to these challenging goals, and if they provide feedback on how to be successful in learning as one is working to achieve the goals, then goals are more likely to be attained.

Because assigned goals provide an individual with normative information on the expected level of performance, such goals have major effects on the development of self-efficacy and confidence, which in turn affects the choice of difficulty of goals. Table 9.4 provides a summary of meta-analyses as to the relationship between higher levels of self-efficacy and goal attainment (average $d = 0.92$).

A basis of many claims about the value of student self-assessment, self-evaluation, self-monitoring, and self-learning is that students have a reasonable understanding of where they are at, where they are going, what it will look like when they get there, and where they will go to next: that is, they have clear goals, learning intentions, and success criteria. Martin (2006) argued that one method to assist students to set task-specific and situation-specific goals was to use the notion of "personal bests". Task-specific goals provide students with clear information about what they are trying to achieve in the immediate future (both in terms of specificity and degree of challenge), and situation-specific goals provide students with the reason they want to achieve a particular outcome (to beat one's previous level of achievement on that goal). He found that setting personal bests had high positive relationships to educational aspirations, enjoyment of school, participation in

Table 9.3 Difficulty compared to "do your best" goals

Authors	*Year*	*No. studies*	*No. students*	*d*
Chidester & Grisgby	1984	17	2400	0.51
Guzzo, Jette, & Katzell	1985	na	na	0.65
Hunter & Schmidt	1983	17	1278	0.80
Mento, Steel, & Karren	1987	49	5844	0.42
Tubbs	1986	48	4960	0.50
Wood, Mento, & Locke	1987	53	6635	0.43
Total	—	184	21117	0.66

Table 9.4 Relation of self-efficacy to goal attainment

Study	*Year*	*No. studies*	*d*
Ajzen & Madden	1986	169	0.57
Ajzen & Madden	1986	90	0.44
Bandura & Cervone	1986	88	0.43
Garland	1985	127	0.39
Hollenbeck & Brief	1987	47	0.49
Locke, Frederick, Lee, & Bobko	1984	181	0.54
Meyer	1988	90	0.69
Meyer & Gellatly	1988	56	0.62
Meyer & Gellatly	1988	60	0.48
Silver & Greenhaiis	1983	56	0.29
Taylor	1984	223	0.20
Weiss & Rakestraw	1988	80	0.60
Wofford, Goodwin, & Premack	1992	6	1.06
Wood & Locke	1987	517	0.32
Total	—	1784	0.46

class, and persistence on the task. The most salient features of the personal bests were the specificity and degree of challenge of the goals, and that the goals were seen to relate to self-improvement. Personal bests combined the best features of mastery and performance goals, as personal bests "primarily reflect a mastery orientation because it is self-referenced and self-improvement based and yet holds a slice of performance orientation because the student competes with his or her own previous performance" (Martin, 2006, p. 816).

Challenging goals are also effective when teaching special education students. Fuchs and Fuchs (1986) reported an effect of $d = 0.63$ for long-term and $d = 0.67$ for short-term goals. More importantly, there was an interaction effect with the outcome measure. For more probe-like outcomes the effect of challenge was largest for short-term goals ($d = 0.85$ compared to $d = 0.41$), whereas the reverse was the case for global outcomes ($d = 0.45$ for short-term and $d = 0.92$ for long-term goals). This indicates a need, therefore, to set appropriately challenging short-term goals for surface learning outcomes and set appropriately challenging long-term goals for deep learning outcomes.

It has been noted that "challenge" is a relative term—relative to a student's current performance and understanding, and to the success criteria deriving from the learning intention. The challenge should not be so difficult that the goal is seen as unattainable, given the student's level of self-efficacy or confidence; rather, teachers and students must be able to see a pathway to attaining the challenging goal—a pathway which can include strategies for understanding the goal or intention, implementation plans to attain it, and, preferably, a commitment to attaining the goal. Burns (2002) was specific: He used meta-analysis to ascertain the optimal ratio of known to unknown tasks for drill tasks (which is but one specific set of tasks that teachers can engage students with). He found that the ratios differed depending on whether the student was in the acquisition or proficiency stage (the former relates to acquiring the knowledge and information, the latter relates to increasing accuracy and fluency). He also acknowledged that there was a maintenance, generalization, or application stage but there were no studies investigating the appropriate ratios at this stage. Drill ratios were more applicable to the acquisition ($d = 1.09$), than to the proficiency ($d = 0.39$) stage; and the optimal rate seems to be to include at least 90 percent known to unknown items in the tasks (d = 1.19) and certainly not less than 50 percent known to unknown (d = 0.49). Gickling (1984) showed that the ratios for learning to read needed to be more like ninety-five percent known to five percent unknown words in a text. It is also important for the teacher to choose the tasks with these ratios, as the effects are much greater than when students choose the ratios. While not explored, there are suggestions that the ratios may need to be higher when deeper learning is desired rather than surface knowledge.

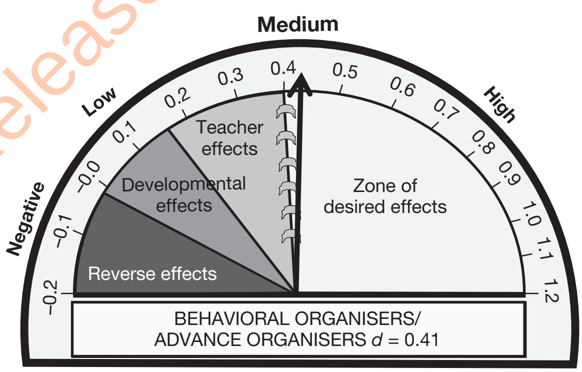
Behavioral objectives and advance organizers

Advance organizers can be:

> broadly defined as bridges from the reader's previous knowledge to whatever is to be learned; they are supposed to be more abstract and inclusive than the more specific material to be learned, and to provide a means for organizing the new material.
>
> (Stone, 1983, p. 194)

They are aimed to bridge and link old with new information, and as they are meant to be presented prior to learning, then advance organizers can assist in helping the learner organize and interpret new upcoming instruction. Similarly, behavioral objectives are statements of what students ought to be able to do as a consequence of instruction (Popham, Eisner, Sullivan, & Tyler, 1969), but they tend to be more often used for surface rather than deeper knowledge. The overall effects show much variance but the effects are highest when the learning intentions of the lessons are articulated, when notions of success included, and when these are shared with the students. When they are primarily for the teacher, usually in lesson plans, or aimed primarily at surface learning and not including any deep learning, then the effects are lower. Kozlow (1978) found that behavioral objectives were more effective when they involved comparisons to some standards of performance rather than being expository in nature.

Luiten, Ames, and Ackerman (1980) found that advance organizers have a small but facilitative effect on both learning and retention, with the effect increasing over time (d = 0.21). Similarly, Stone (1983) found that advance organizers were associated with increased learning and retention of teaching material. Using advance organizers to introduce new material, by providing a bridge from previous knowledge, did facilitate long-term learning,



KEY	
Standard error	0.040 (Low)
Rank	61st
Number of meta-analyses	11
Number of studies	577
Number of effects	1,933
Number of people (2)	3,905

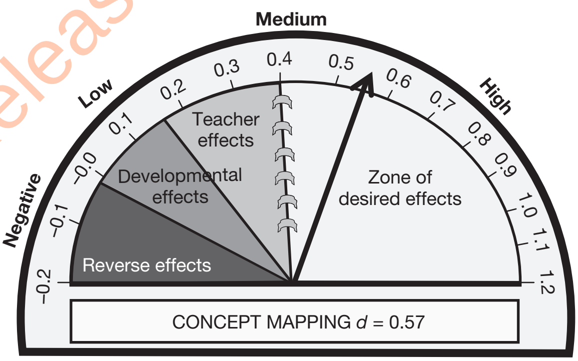
but the effects were lower for written advance organizers compared to non-written ones, and had no effect when used for teaching low-ability or low-knowledge learners. Too often, advance organizers and behavioral objectives tended to be specific, ignore challenge, and have no notions of what would be deemed as success in attaining the objective.

Concept mapping

Concept mapping involves the development of graphical representations of the conceptual structure of the content to be learnt. Thus, it can be considered as a form of learning intention, if for no other reason than it identifies the material to be learnt, oftentimes with indicators of priorities and higher-order concepts. As with behavioral objectives and learning hierarchies, concept mapping derives from Ausubel's (1968) claims that concepts can be organized in hierarchical form in the cognitive structure, and it helps learning if concepts related to what is to be learned can be linked to the concept maps a student already has (see also Novak, 1977). The difference between concept mapping and other organizing methods (e.g., behavioral objectives, learning hierarchies) is that it involves the students in the development of the organizational tool.

The importance of concept mapping relates to its emphasis on summarizing the main ideas in what is to be learnt—although only if the students have some familiarity with the surface knowledge of the (often deeper) concept to be mapped. Concept mapping can assist in synthesizing and identifying the major ideas, themes, and interrelationships—particularly for the learners who do not have these organizing and synthesizing skills. Kim, Vaughn, Wanzek, and Wei (2004) argued that the visual displays of information such as those provided by concept mapping enhance the reading comprehension of students with learning difficulties, possibly by helping these students organize the verbal information and thereby improving their recall.

Moore and Readance (1984) reported greater effects when concept mapping occurred after initial exposure to the material to be mapped (and not before or during this learning; see also Kang, 2002). Nesbit and Adesope (2006) found greater effects when the emphasis was on understanding the central rather than the detailed ideas of the topic being mapped. Nesbit and Adesope also found that there was little difference between concept mapping and asking students to construct an outline of the topic ($d = 0.19$), but the effects were larger for concept mapping when compared to lectures or discussions on the topic ($d = 0.74$). It is the heuristic process of organizing and synthesizing that is the important feature, and



KEY	
Standard error	0.051 (Medium)
Rank	33rd
Number of meta-analyses	6
Number of studies	287
Number of effects	332
Number of people (3)	8,471

concept mapping is but one of many of these methods—but an effective method. It does not seem to matter who does the mapping (student alone, in groups, or teacher, Horton *et al.*, 1993) but the strongest effects are when students provided the terms for the maps, regardless of who then devised the maps. Kim *et al.* (2004), however, found higher effects for teacher- than student-generated maps, whereas Nesbit and Adesope (2006) found higher effects when students were made to construct (d = 0.81), rather than just study, concept maps (d = 0.37).

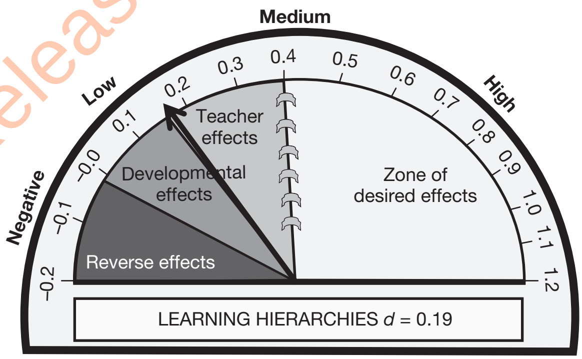
Various authors have found that the effects were highest with those students least likely to know the relationship between lower and higher-order notions; that is, with lower rather than higher ability or highly verbal students (Horton *et al.*, 1993; Nesbit & Adesope, 2006; Vásquez & Caraballo, 1993). As Nesbit and Adesope (2006) concluded, many of these gains may be "due to greater learner engagement occasioned by concept mapping … rather than the properties of the concept map as an information medium" (p. 434), although it is noted that the effects from concept mapping were higher than for studying text passages, lists, and outlines. Thus they argue that it is not just the "summarizing/integrating" nature of concept maps, but also there may be a lower cognitive load "by arranging nodes in two-dimensional space to represent relatedness, consolidating all references to a concept in a single symbol, and explicitly labeling links to identify relationships" (p. 434).

Learning hierarchies

A different form of learning intention is to structure the learning in some form of hierarchy, such that it is more effective to acquire first a series of skills that will support later learning. Horon and Lynn (1980) found that learning hierarchies can facilitate learning (d = 0.19) and shorten learning time to a small extent (d = 0.09). Hierarchical instruction is more effective in promoting learning at the elementary level (d = 0.44) than at the high school level (d = 0.07). The overall effects are very low.

Strategies emphasizing success criteria

The purpose of the success criteria, or "What are we looking for?" is to make students understand what the teacher is using as the criteria for judging their work, and, of course, to ensure that the teacher is clear about the criteria that will determine if the learning intentions have been successfully achieved. Too often students may know the learning

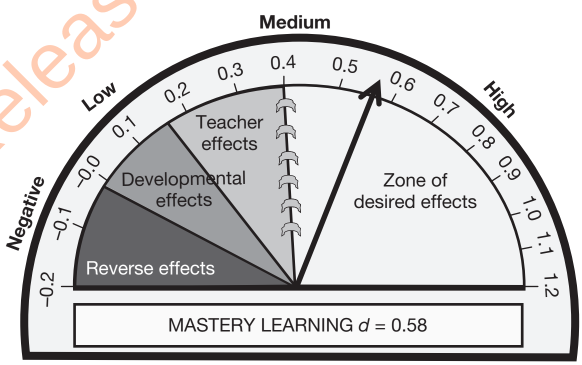


KEY	
Standard error	na
Rank	110th
Number of meta-analyses	1
Number of studies	24
Number of effects	24
Number of people (0)	na

intention, but not how the teacher is going to judge their performance, or when or whether they have been successful. A learning intention of "to learn to use effective adjectives", for instance, does not give the students the marking criteria or how they will be judged. The success criteria, or "How will we know?", need to state as exactly as possible what the students and teacher will want to see. In this case, two alternatives might be: "What you're looking for is that you have used at least five effective adjectives", or "What you're looking for is that you have used an adjective just before a noun on at least four occasions that will help to paint a detailed picture so the reader can understand the feel of the jungle and the light of the jungle". It is important that the success criteria are as clear and specific as possible (at surface or at deep levels, or both) because the teacher (and learner) needs to monitor the students' progress throughout the lesson to make sure they understand the intended meaning. There are three sets of related notions that emphasize success criteria: mastery learning, Keller's personalized system of instruction, and the provision of worked examples.

Mastery learning

The claim underlying mastery learning is that all children can learn when provided with clear explanations of what it means to "master" the material being taught. Other features involved include: appropriate learning conditions in the classroom, such as high levels of cooperation between classmates; high levels of teacher feedback that is both frequent and specific by using diagnostic formative tests; and the regular correction of mistakes students make as they travel along their learning path. Mastery learning requires numerous feedback loops, based on small units of well-defined, appropriately sequenced outcomes. Bloom (1968) defined mastery in terms of behavioral objectives, with class instruction supplemented by feedback or correction mechanisms. Willett, Yamashita, and Anderson (1983, p. 408) added that "tests on unit objectives are followed by supplementary instruction on objectives not attained, and the specific levels of attainment are specified". The important variable in mastery learning is the time required to reach the levels of attainment. The notion is that learning should be held constant and time should be allowed to vary, rather than the opposite, which is the norm in traditional instruction. The teacher determines the pace of the instruction and directs the accompanying feedback and corrective procedures (Guskey & Pigott, 1988). The material is divided into relatively small learning units, each with their own objectives and assessment. Each unit is preceded by brief diagnostic tests,



KEY	
Standard error	0.055 (Medium)
Rank	29th
Number of meta-analyses	9
Number of studies	377
Number of effects	296
Number of people (2)	9,323

which provide information to identify gaps and strengths. No student proceeds to new material until prior or more basic prerequisite material is mastered.

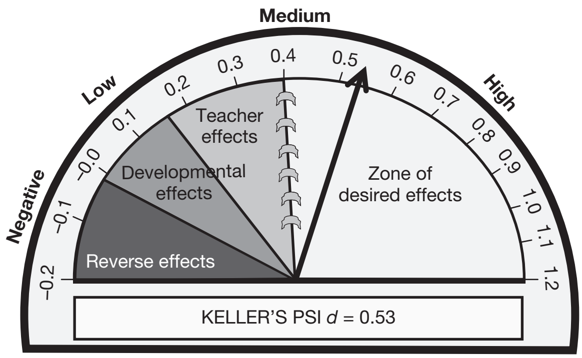
Willett *et al.* (1983) reviewed a dozen different innovations in teaching strategies, and mastery learning had the highest effects. They argued that mastery learning was the most successful innovative system, closely followed my Keller's PSI (see next section). Guskey and Gates (1986) found similar high effects for mastery learning in each of elementary school (d = 0.94), high school (d = 0.72), and college (d = 0.65). In a follow-up study, Guskey and Piggott (1988), using group-based applications of mastery strategies, showed consistently positive effects on both cognitive and affective student learning outcomes. Kulik and Kulik (1986) determined that testing for mastery had positive effects on student achievement both at college and pre-college levels (d = 0.52). The effects of mastery testing were particularly strong on lower ability students (d = 0.96). Mastery testing, they argued, increased the amount of instructional time required by, on average, 25 percent. Their evidence, however, did not support Bloom's prediction that variation in performance will be reduced to near zero with mastery testing procedures.

Kulik, Kulik, and Bangert-Drowns (1990) found mastery learning programs had a positive effect on examination performance of students in colleges, high schools, and the upper grades of elementary schools, raising examination performance by about half a standard deviation, especially for low-aptitude students. Mastery programs had positive effects on student attitudes towards course content and instruction, but increased student time spent on instructional tasks. Self-paced mastery programs often reduced completion rates in college classes.

The only exception to the positive findings on mastery learning programs is the meta-analysis by Slavin (1987), who found no evidence to support the effectiveness of group-based mastery learning on standardized achievement measures. One of the features of Slavin's argument is that studies that do not meet his criteria should be excluded, which leaves only seven articles—a very small representation of a large set of potential studies. His criteria included: students had to have been tested on their mastery at least once every four weeks, only studies where students were taught as a total group were included, studies could not use a feedback-corrective cycle, interventions had to last a minimum of four weeks, and there had to be at least two experimental and two control groups used.

Keller's Personalized System of Instruction

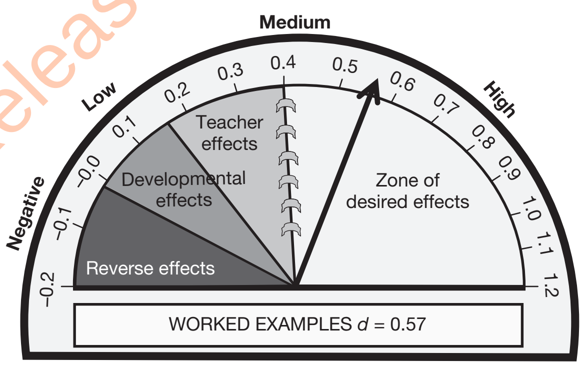
A specific implementation of mastery learning is the Personalized System of Instruction, developed by Keller and Sherman during the 1960s as a form of programmed instruction that employs a highly structured, student-centered approach to course design that emphasizes self-pacing and mastery (Keller, 1968; Keller & Sherman, 1974). The key features include: students proceed through the course at their own pace; students demonstrate mastery of each component of the course before proceeding to the next; teaching materials and other communications between teachers and students are largely text-based; and teachers are involved more in tutorial support and in providing motivation for students to complete the work and attain the goals. The effects are very similar to the other mastery learning programs. The meta-analyses show that students using PSI had higher grades and higher satisfaction rates than students in conventional classes, but that study time was similar in both types of classes (Kulik, Kulik, & Cohen, 1980).



KEY	
Standard error	Na
Rank	40th
Number of meta-analyses	3
Number of studies	263
Number of effects	162
Number of people (0)	na

Worked examples

Another form for demonstrating to students what "success" looks like and thus what the goal could be for their own learning, is by providing them with worked examples (Crissman, 2006). Worked examples typically consist of a problem statement and the appropriate steps to the solution. The defense for providing such worked examples is that they reduce the cognitive load for students such that they concentrate on the processes that lead to the correct answer and not just providing an answer (which may or may not be correct). A typical example of worked examples consists of three parts: an introductory phase (exposure to the example), an acquisition or training phase, and a test phase (assessing the learning). Most studies follow this pattern, although there may be slight deviations, such as the inclusion of a pretest or the introduction of a delayed acquisition or delayed test phase, or both. The studies used for this meta-analysis involved the use of worked examples to alleviate cognitive load in the learner. The overall effect was d = 0.52, and most programs were close to this average: intra-example features (such as multiple examples, story variation, example/problem pairs) had an effect size of d = 0.52; the effect size for conventional worked examples was d = 0.49; integration of sources of information (e.g., diagrams, text) was d = 0.52; fading (omitting some of the steps in the example) was d = 0.60; inclusion of subgoals was d = 0.52; and self-explanations of the steps as they used the worked example was d = 0.57. All these various types of instruction using worked examples generally help to reduce cognitive load.



KEY	
Standard error	0.042 (Medium)
Rank	30th
Number of meta-analyses	1
Number of studies	62
Number of effects	151
Number of people (1)	3,324

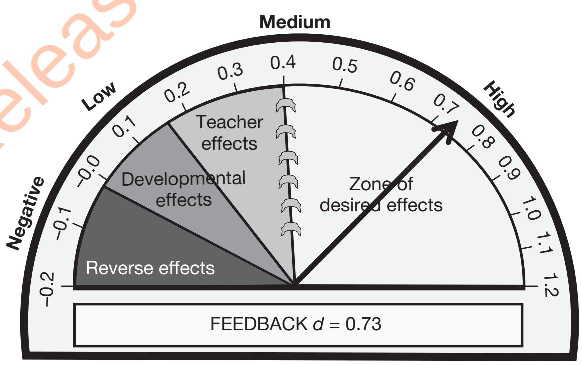
There do seem to be worthwhile effects from providing worked examples to students, but it is more difficult to find evidence of the effects from providing worked examples to teachers (often called exemplars). Peddie, Hattie and Vaughan (1999) completed an exhaustive search of evidence for research on the effects of exemplars and could find much rhetoric and many claims about their importance. When 50-plus organizations that had developed exemplars were asked to send their research, all sent boxes of exemplars, but none were able to send evidence of their effects.

Implementations that emphasize feedback

This section outlines the meanings of feedback, the effects of different types of feedback, feedback via frequent testing, teaching test-taking skills, providing formative evaluation to teachers, questioning to provide teachers and students with feedback, and the immediacy of feedback.

Feedback

When I completed the first synthesis of 134 meta-analyses of all possible influences on achievement (Hattie, 1992) it soon became clear that feedback was among the most powerful influences on achievement. Most programs and methods that worked best were based on heavy dollops of feedback. When I was presenting these early results in Hong Kong, a questioner asked what was meant by feedback, and I have struggled to understand the concept of feedback ever since. I have spent many hours in classrooms (noting its absence, despite the claims of the best of teachers that they are constantly engaged in providing feedback), worked with students to increase self-helping (with little success), and have tried different methods of providing feedback. The mistake I was making was seeing feedback as something *teachers provided to students*—they typically did not, although they made claims that they did it all the time, and most of the feedback they did provide was social and behavioral. It was only when I discovered that feedback was most powerful when it is from the *student to the teacher* that I started to understand it better. When teachers seek, or at least are open to, feedback from students as to what students know, what they understand, where they make errors, when they have misconceptions, when they are not engaged—then teaching and learning can be synchronized and powerful. Feedback to teachers helps make learning visible.



KEY	
Standard error	0.061 (Medium)
Rank	10th
Number of meta-analyses	23
Number of studies	1,287
Number of effects	2,050
Number of people (10)	67,931

Recently a colleague and I published a paper devoted to the power of feedback, which provides a deeper explanation than can be presented in this book (Hattie & Timperley, 2007). But, in summary, feedback is information provided by an agent (e.g., teacher, peer, book, parent, or one's own experience) about aspects of one's performance or understanding. For example, a teacher or parent can provide corrective information, a peer can provide an alternative strategy, a book can provide information to clarify ideas, a parent can provide encouragement, and a learner can look up the answer to evaluate the correctness of a response. *Feedback is a "consequence" of performance*.

To assist in understanding the purpose, effects, and types of feedback, it is useful to consider a continuum of instruction and feedback. At one end of the continuum is a clear distinction between providing instruction and providing feedback. However, when feedback is combined with a correctional review, feedback and instruction become intertwined until "the process itself takes on the forms of new instruction, rather than informing the student solely about correctness" (Kulhavy, 1977, p. 212). To take on this instructional purpose, feedback needs to provide information specifically relating to the task or process of learning that fills a gap between what is understood and what is aimed to be understood (Sadler, 1989), and it can do this in a number of different ways. For example, this may be through affective processes, such as increased effort, motivation, or engagement. Alternatively, the gap may be reduced through a number of different cognitive processes, including helping students to come to a different viewpoint, confirming to the student that they are correct or incorrect, indicating that more information is available or needed, pointing to directions that the student could pursue, and indicating alternative strategies to understand particular information. Winne and Butler (1994) provided an excellent summary in their claim that "feedback is information with which a learner can confirm, add to, overwrite, tune, or restructure information in memory, whether that information is domain knowledge, meta-cognitive knowledge, beliefs about self and tasks, or cognitive tactics and strategies" (p. 5740).

The effect sizes reported in the feedback meta-analyses show considerable variability, which indicates that some types of feedback are more powerful than others. The most effective forms of feedback provide cues or reinforcement to the learner, are in the form of video, audio or computer-assisted instruction feedback, or relate feedback to learning goals. It is also worth noting that the key is feedback that is received and acted upon by students—many teachers claim they provide ample amounts of feedback but the issue is whether students receive and interpret the information in the feedback. At best, each student receives moments of feedback in a single day (Nuthall, 2005; Sirotnik, 1983). Carless (2006) asked students and teachers whether teachers provided detailed feedback that helped students improve their next assignments. About 70 percent of the teachers claimed they provided such detailed feedback often or always, but only 45 percent of students agreed with their teachers' claims. Further, Nuthall (2005) found that most feedback that students obtained in any day in classrooms was from other students, and most of this feedback was incorrect.

Programmed instruction, praise, punishment, and extrinsic rewards were the least effective forms of feedback for enhancing achievement. Indeed, it is doubtful whether rewards should be thought of as feedback at all. Deci, Koestner, and Ryan (1999) have described tangible rewards (stickers, awards, and so on) as contingencies to activities rather than feedback because they contain so little task information. In their meta-analysis of the effects of feedback on motivation, these authors found a negative correlation between extrinsic rewards and task performance (*d* = –0.34). Tangible rewards significantly undermined intrinsic motivation, particularly for interesting tasks (*d* = –0.68) compared to uninteresting tasks (*d* = 0.18). In addition, when the feedback was administered in a controlling manner (e.g., saying that the student performed as they "should" have performed), the effects were even worse (*d* = –0.78). Thus, Deci *et al.* concluded that extrinsic rewards are typically negative because they "undermine people's taking responsibility for motivating or regulating themselves" (Deci *et al.*, 1999, p. 659). Rather, extrinsic rewards are a controlling strategy that often leads to greater surveillance, evaluation, and competition, all of which have been found to undermine enhanced engagement and regulation (Deci & Ryan, 1985).

Providing feedback is not about giving rewards, but rather providing information about the task. Cameron and Pierce (1994) asked about the causal effects of extrinsic rewards and reinforcement on intrinsic motivation (hence this meta-analysis is not included in the Appendices because achievement is not the outcome). The results show that rewards did not significantly affect intrinsic motivation: the effects of rewards were *d* = –0.06 for free time on task, *d* = 0.21 for attitude, *d* = 0.08 for performance during free-time period, and *d* = 0.05 for willingness to volunteer. When intrinsic motivation was measured by attitude toward a task, rewarded subjects reported higher intrinsic motivation than non-rewarded subjects. Verbal rewards appeared to produce a positive effect and tangible rewards suggested a negative effect. Those rewarded with verbal praise or positive feedback showed greater intrinsic motivation and spent more time on a task once the reward was withdrawn than non-rewarded subjects. It is critical, however, to note how small these effects are and thus to conclude that rewards and praise are or are not critical seems moot.

The most systematic study addressing the effects of various types of feedback was published by Kluger and DeNisi (1996). Their meta-analysis included studies of feedback interventions that were not confounded with other manipulations, included at least a control group, measured performance, and included at least ten participants. Although many of their studies were not classroom or achievement based, their messages are of much interest. From the 131 studies, they estimated 470 effect sizes, based on 12,652 participants, and the average effect size was *d* = 0.38, and 32 percent of the effects were negative. Specifically, feedback is more effective when it provides information on correct rather than incorrect responses and when it builds on changes from previous trails. The impact of feedback was also influenced by the difficulty of goals and tasks. There is highest impact when goals are specific and challenging but when task complexity is low. Giving praise for completing a task appears to be ineffective, which is hardly surprising because it contains such little learning-related information. Feedback is more effective when there are perceived low rather than high levels of threat to self-esteem, presumably because low threat conditions allow attention to be paid to the feedback.

Figure 9.9 presents a framework in which feedback can be considered. The claim is made that the main purpose of feedback is to reduce discrepancies between current understandings and performance and a learning intention or goal. The strategies that students and teachers use to reduce this discrepancy depend partly on the level at which the feedback operates. These levels include the level of task performance, the level of process of understanding how to do a task, the regulatory or meta-cognitive process level, and the self or person (unrelated to the specifics of the task). Feedback has differing effects across these levels.

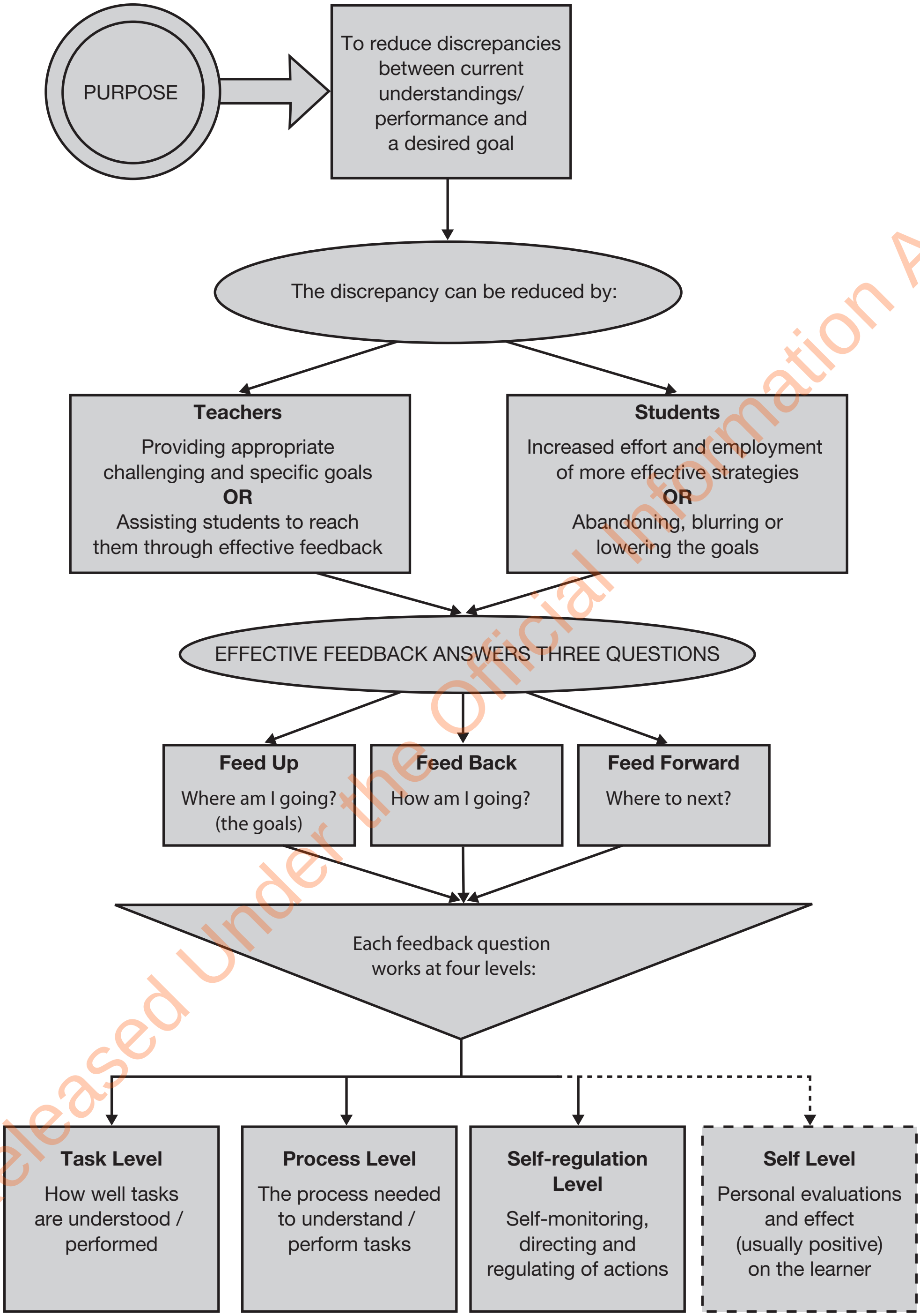


Figure 9.9 A model of feedback

The major feedback questions are "Where am I going?" (learning intentions/goals/success criteria), "How am I going?" (self-assessment and self-evaluation), and "Where to next?" (progression, new goals). An ideal learning environment or experience is when both teachers and students seek answers to each of these questions. These three questions do not work in isolation at each of the four levels, but typically work together. Feedback relating to "How am I going?" has the power to lead to doing further tasks or "Where to next?" and "Where am I going?". As Sadler (1989) has convincingly argued, it is closing the gap between where the student is and where they are aiming to be that leads to the power of feedback.

So far so good, but the difficulty arises from the way in which feedback works at the four levels noted above. First, feedback can be about the task or product, such as the work is correct or incorrect. This level of feedback may include directions to acquire more, different, or correct information, such as "You need to include more about the Treaty of Versailles". Second, feedback can be aimed at the process used to create the product or complete the task. This kind of feedback is more directly aimed at the processing of information, or learning processes required for understanding or completing the task. For example, a teacher or peer may say to a learner, "You need to edit this piece of writing by attending to the descriptors you have used, so the reader is able to understand the nuances of your meaning", or "This page may make more sense if you use the comprehension strategies we talked about earlier". Third, feedback to the student can be focused at the self-regulation level, including greater skill in self-evaluation, or confidence to engage further on the task. For example, "You already know the key features of the opening of an argument. Check to see whether you have incorporated them in your first paragraph." Such feedback can have major influences on self-efficacy, self-regulatory proficiencies, and self-beliefs about the student as a learner, such that the student is encouraged or informed how to better and more effortlessly continue on the task. Fourth, feedback can be personal in the sense that it is directed to the "self" which, it will be argued below, is too often unrelated to performance on the task. Examples of such feedback include, "You are a great student", "Well done!".

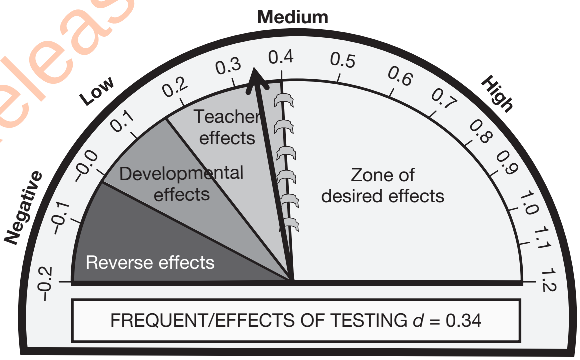
The art is to provide the right form of feedback at, or just above, the level where the student is working—with one exception. Feedback at the self or personal level (usually praise) is rarely effective. Praise is rarely directed at addressing the three feedback questions and so is ineffective in enhancing learning. When feedback draws attention to the self, students try to avoid the risks involved in tackling a challenging assignment, they minimize effort, and they have a high fear of failure (Black & Wiliam, 1998) in order to minimize the risk to the self. Thus, ideally, teaching and learning move from the task to the processes and understandings necessary to learn the task, and then to continuing beyond it to more challenging tasks and goals. This process results in higher confidence and greater investment of effort. This flow typically occurs as the student gains greater fluency and mastery.

We need to be somewhat cautious, however. Feedback is not "the answer" to effective teaching and learning; rather it is but one powerful answer. With inefficient learners or learners at the acquisition (not proficiency) phase, it is better for a teacher to provide elaborations through instruction than to provide feedback on poorly understood concepts. If feedback is directed at the right level it can assist students to comprehend, engage, or develop effective strategies to process the information intended to the learnt. To be effective, feedback needs to be clear, purposeful, meaningful and compatible with students' prior knowledge, and to provide logical connections. It also needs to prompt active information processing on the part of the learner, have low task complexity, relate to specific and clear goals, and provide little threat to the person at the self level. The major discriminator is whether feedback is clearly directed to the various levels of task, processes, or regulation, and not directed to the level of "self". These conditions highlight the importance of classroom climates that foster peer and self-assessment, and allow for learning from mistakes. We need classes that develop the courage to err.

Thus, when feedback is combined with effective instruction in classrooms, it can be very powerful in enhancing learning. As Kluger and DeNisi (1996) noted, a feedback intervention provided for a familiar task that contains cues that support learning, attracts attention to feedback-standard discrepancies at the task level, and is void of cues that direct attention to the self, is likely to yield impressive gains in students' performance. It is important to note, however, that under particular circumstances, instruction is more effective than feedback. Feedback can only build on something; it is of little use when there is no initial learning or surface information. In summary, feedback is what happens second, is one of the most powerful influences on learning, occurs too rarely, and needs to be more fully researched by qualitatively and quantitatively investigating how feedback works in the classroom and learning process.

Frequent testing/Effects of testing

Another form of feedback is repeated testing, but this is only effective if there is feedback from the tests to teachers such that they modify their instruction to attend to the strengths and gaps in student performance. Although performance is increased with more frequent testing, the amount of improvement in achievement diminishes as the number of tests increase (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991). Students taking at least one test during a 15-week term scored about half a standard deviation higher in criterion examinations than students taking no tests. When two groups answered identical test items, superior performance was obtained from students who answered the questions on a large number of short tests rather than on a small number of long tests. The caution is that it may not be the frequency of test taking but that frequent test taking made the learning intentions and success criteria more specific and transparent. Clariana and Koul (2006) found that multiple-try feedback was less effective for surface outcomes (d = –0.22) but more effective for higher-order outcomes (d = 0.10). "Multiple try



KEY	
Standard error	0.044 (Medium)
Rank	79th
Number of meta-analyses	8
Number of studies	569
Number of effects	1,749
Number of people (2)	135,925

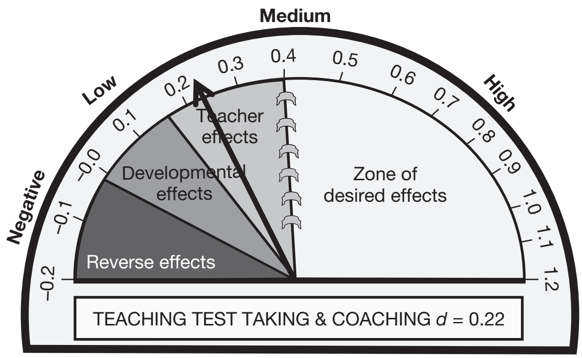
feedback on error requires the learner to think more about the lesson question, unless the learner just guesses randomly due to frustration or impatience" (p. 261). Similarly, Kim (2005) found that performance assessment was more effective the longer the period it had been implemented—as then students and teachers become more adept at completing this form of assessment.

The effect is not merely from testing and testing, it is from learning from testing. Gocmen (2003), for example, found an effect size of d = 0.41 from frequent testing, but this was higher when the testing was accompanied by feedback (d = 0.62) compared to no feedback (d = 0.30). Lee (2006) investigated the effects of statewide high-stakes testing and test-driven accountability policies on reading and mathematics achievement in the United States (since 1990). He found a d = 0.36 effect (d = 0.29 for reading and d = 0.38 for mathematics), but the effects only occurred in elementary (d = 0.44) and middle schools (d = 0.35) and not in high schools (d = 0.03). States with the strongest accountability programs made greater gains over the years than those with weaker accountability measures, but Lee noted that these gains mapped to similar trajectories from the years before these accountability policies were brought into law! He concluded that "to argue that states adopting strong accountability policies significantly improved student achievement is not convincing until substantial improvements in schooling conditions and practices occur" (p. 26).

Many states in the United States have high-stakes testing and there is also much testing embedded in the No Child Left Behind imperatives. There have been arguments that such frequent testing is akin to a coaching effect, whereas others consider that any gains are because of narrowing the curriculum, teaching to the test, and because too many students are excluded who may not perform so well. Amrein and Berliner (2002) raised much debate with their analysis of the performance of 18 states with high-stakes testing systems and found little effect of these systems on student achievement. This conclusion was contested (e.g., Braun, 2004; Raymond & Hanushek, 2003; Rosenshine, 2003). Lee (2006) used meta-analysis to compare different state policies on the National Assessment of Educational Progress examination. He found six studies favored high-stakes testing states, five were mixed, and one favored low-stakes testing states. The effects were extremely varied (d = –0.67 to d = 1.24), although it made no difference as to the focus of the accountability—that is, whether the focus is a combination of schools and students d = 0.38, for schools alone d = 0.39, or for students alone d = 0.31. The effects on mathematics (d = 0.38) are slightly higher than on reading (d = 0.29), and higher for elementary (d = 0.44) and middle schools (d = 0.35) than for high schools (d = 0.03).

Teaching test taking and coaching

The term "coaching" is used to refer to a wide range of test preparation activities carried out in order to improve test scores. Typically, coaching is instruction given or practice undertaken in preparation for taking a test (Cole, 1982). DerSimonian and Laird (1983) evaluated the effect of coaching on Scholastic Aptitude test scores and found that while the results did support the positive effect of coaching on SAT scores, the size of the coaching effect from the matched or randomized studies appeared too small to be practically important. Uncontrolled studies showed more variation in the effects attributed to coaching than matched or randomized studies and higher levels overall.



KEY	
Standard error	0.024 (Low)
Rank	103rd
Number of meta-analyses	10
Number of studies	267
Number of effects	364
Number of people (1)	15,772

Bangert-Drowns, Kulik, and Kulik, (1983) found the effects of coaching raised achievement test scores by d = 0.25. The level of intervention influenced effect sizes, with effect sizes smaller for short test-taking sessions, larger for more extensive programs, and greatest in single length programs designed to influence broader cognitive skills. An examination of 14 studies on the effectiveness of coaching for aptitude tests (Kulik, Bangert-Drowns, & Kulik, 1984) found that coaching raised scores on SAT as well as intelligence and other aptitude tests. SAT scores were raised d = 0.15 standard deviations with scores for aptitude and intelligence tests raised d = 0.43 standard deviation. The length of the training program also seems important. Samson (1985) reported that programs continuing for five weeks or more produced greater effects than those of a shorter duration. Samson also noted that the effects were higher with students in upper grades rather than in lower grade levels, and for students from lower socioeconomic backgrounds.

Hausknecht, Halpert, Di Paolo, and Gerrard, 2007 found an overall effect of d = 0.22 when test were re-administered, but much less for a third administration of the test. More specifically they found that the magnitude of practice was positively related to the amount of student contact time with coaching (d = 0.26), was greater for identical test (d = 0.46) than for alternate forms (d = 0.24), was similar for tests of analytical (d = 0.32) and quantitative measures (d = 0.30), and, most importantly, the effects were much greater (d = 0.70) when there was some form of test coaching than when there was no such coaching (d = 0.24).

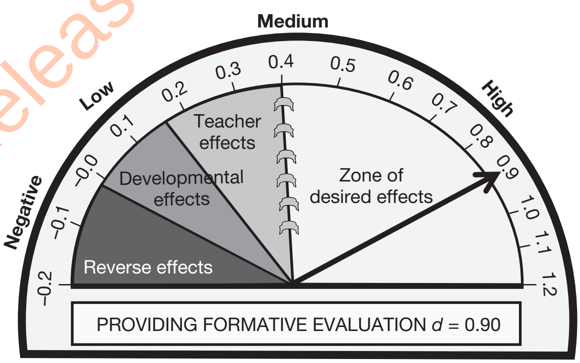
Coaching students for SAT tests has moderate effects on SAT performance, although the effects were greater on SAT mathematics than on verbal tests (Becker, 1990). Becker argued that the considerable variability in results of the examination of studies on coaching was because not all coaching is effective. Studies in which the coaching intervention included practice and instruction on answering particular items showed significant advantages over practice in taking complete examinations or instructions in general test-taking skills. The effects of coaching are greater when pre-tests are given in conjunction with the coaching program (Witt, 1993), and when the items in the test follow a format that is more complex and is not usually used (Powers, 1993).

Another form of coaching is to become familiar with the examination process and examiner, particularly in one-to-one testing situations. In these situations, reducing anxiety about the testing context can make a difference. Fuchs and Fuchs (1985) found that examiner familiarity raised test performance by d = 0.35 standard deviations. Differential performance favoring the familiar examiner condition was stronger when students were of low socioeconomic status, when students were tested on comparatively difficult tests, and when the examiner had been known to students for a longer duration. A further meta-analysis of the effects of examiner familiarity on student test performance (Fuchs & Fuchs, 1986) supported their 1985 findings. This meta-analysis also showed that students taking examinations scored higher when tested by familiar rather than unfamiliar examiners. The duration of the activity inducing familiarity had a strong positive influence on effect size. Again, low socioeconomic status students performed much better with a familiar examiner, while high socioeconomic status students performed similarly across examiner conditions.

Providing formative evaluation of programs

A major argument throughout this book is the power of feedback to teachers on what is happening in their classroom so that they can ascertain "How am I going?" in achieving the learning intentions they have set for their students, such that they can then decide "Where to next?" for the students. Formative evaluation provides one such form of feedback. Fuchs and Fuchs (1986) examined the effects of systematic formative evaluation by the teachers and found that this technique increased achievement for students with a mild learning disability (d = 0.70). The formative evaluations were effective across student age, treatment duration, frequency of measurement, and special needs status. When teachers were required to use data and evidence based models, effect sizes were higher than when data were evaluated by teacher judgment. In addition, when the data was graphed, effect sizes were higher than when data were simply recorded.

It is this feedback to teachers that assists in explaining why most of the more powerful effects are higher than what has been termed the "typical teacher effects" of d = 0.25 to d = 0.40. It is the attention to the purposes of innovations, the willingness to seek negative evidence (i.e., seeking evidence on where students are not doing well) to improve the teaching innovation, the keenness to see the effects on all students, and the openness to new experiences that make the difference. Interventions are not "change for change's sake" as not all interventions are successful. The major message is for teachers to pay attention to the formative effects of their teaching, as it is these attributes of seeking formative evaluation of the effects (intended and unintended) of their programs that makes for excellence in teaching.



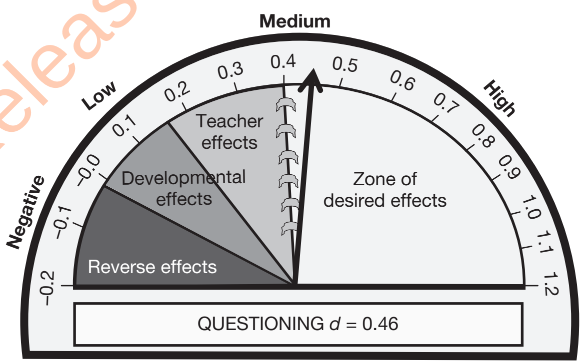
KEY	
Standard error	0.079 (Medium)
Rank	3rd
Number of meta-analyses	2
Number of studies	30
Number of effects	78
Number of people (1)	3,835

Questioning

Feedback can also come via teachers asking questions of their students, although it is an adage that teachers already know the answer to most of the questions they ask. The use of questions, especially higher-order questions, is often promulgated as a worthwhile teaching strategy: "Questioning opens up possibilities of meaning" (Gadamer, 1993, p. 375); "Questioning is a powerful strategy for building comprehension" (Mantione & Smead, 2003, p. 55); "Good questions lead to improved comprehension, learning, and memory of the materials among school children as well" (Craig *et al.*, 2006, p. 567). The study of the frequency, classification, and training of teacher questioning behaviors is based on the notion that skilled questioning by teachers can guide students to thoughtful and reflective answers and so facilitate higher levels of academic achievement (Samson, Strykowski, Weinstein, & Walberg, 1987).

So much of classroom time is spent with teachers questioning the students. Cotton (1989), for example, reviewed the evidence and found questioning was the second most dominant teaching method (after teacher talk), with teachers spending between 35–50 percent of teaching time posing questioning (e.g., Long & Sato, 1983; van Lier, 1998)—that is about 100 questions per hour (Mohr, 1998)—and the responses from the teacher to the students' answers to these questions was some form of judgment or correction, primarily reinforcing in nature, affirming, restating, and consolidating student responses. Brualdi (1998) claimed that teachers asked 300 to 400 questions per day, and the majority of these were low-level cognitive questions—60 percent recall facts and 20 percent are procedural in nature (Wilen, 1991) These are not open, inquiry questions, as students understand that the teacher already knows the answer (they are "display" questions; 82 percent are of this nature: Cotton, 1989). The reason for so much questioning relates to the conceptions of teaching and learning held by many teachers—that is, their role is to impart knowledge and information about a subject, and student learning is the acquisition of this information through processes of repetition, memorization, and recall: hence the need for much questioning to check that they have recalled this information.

The overall effects of questioning vary, and the major moderator is the type of question asked—surface questions can enhance surface knowing and higher-order questions can enhance deeper understanding. Samson, Strykowski, Weinstein, and Walberg (1987) used 14 studies to contrast the effects of predominantly higher cognitive questions and predominantly factual questions. Higher cognitive questioning strategies were found to have a small positive effect on learning measures. Factual pre-questions can facilitate learning



KEY	
Standard error	0.068 (Medium)
Rank	53rd
Number of meta-analyses	7
Number of studies	211
Number of effects	271
Number of people (0)	na

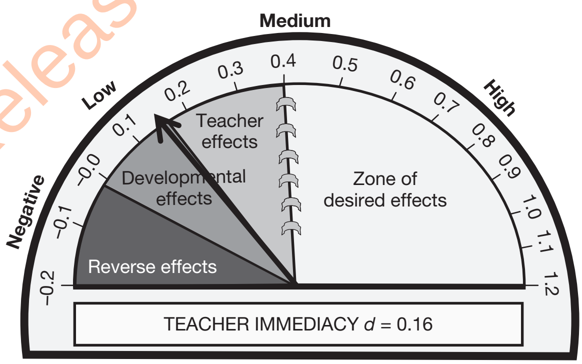
provided they are directly related to the texts or materials to be learnt (and have a negative effect when the questions asked are unrelated to the text material to be learnt, Hamaker, 1986). Higher-order questions are more effective on both direct and unrelated materials—"these results indicate that higher-order questions may have a somewhat broader general facilitative effect than factual adjunct questions" (Hamaker, 1986, p. 237).

Training in questioning matters. Gliessman, Pugh, Dowden, and Hutchins (1988) found that the questioning skills examined in the studies were very open to change through training. The general effect of training, academic level of trainees within training method, consistency of trainee certification level and pupils taught in practice, as well as consistency across practice and criterion teaching settings were all variables that had significant effects in the acquisition of questioning skills. Redfield and Rousseau (1981) also found that gains in achievement may be expected when teachers are trained in questioning skills. They found that lower level questions are more effective when aiming at surface level information, and a mixture of lower and higher level questions are more effective when aiming at deeper information and understanding. Studies designed to provide monitoring of program implementation show positive effects of 0.66 while those without monitoring showed negative effects (–0.10). Such attention by teachers to monitoring their own actions is powerful (and also reported in Gliessman *et al.*, 1988).

Perhaps of more importance than teacher questioning is analyzing the questions that students ask. As the work of my colleagues and I on the Socratic questioning in the Paideia project has demonstrated, structuring class sessions to entice, teach, and listen to students questioning of students is powerful (Hattie, *et al.*, 1998; Roberts & Billings, 1999).

Teacher immediacy

The immediacy and closeness of responses to the students shows them that teachers are listening and responding. "The applications of immediacy to educational settings introduced the idea that a teacher, through the use of certain cues, could reduce the perceived distance between instructor and learners and thereby influence certain classroom outcomes, especially student learning" (Allen, Witt, & Wheeless, 2006, p. 22). This immediacy is perceived by students as an acknowledgement of their engagement; it reduces the perceived distance between instructor and learners, is seen as rewarding to the student, and increases their level of enthusiasm or commitment to the learning task (Christophel & Gorham, 1995). The effects of teacher immediacy were much stronger on affective learning such



KEY	
Standard error	0.042 (Medium)
Rank	115th
Number of meta-analyses	1
Number of studies	16
Number of effects	16
Number of people (1)	5,437

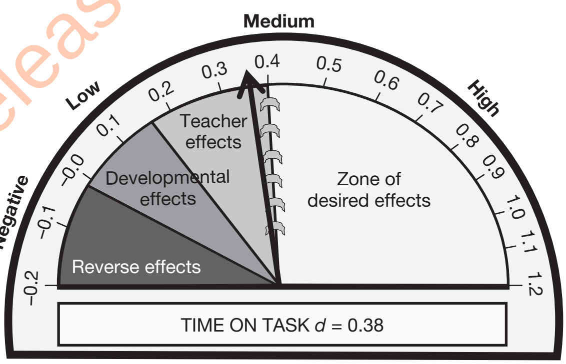
as attitudes to the teacher, course or engaging in the learning experience (d = 1.15) than on achievement (d = 0.16). From these results, and the correlation between affective and achievement learning, Allen *et al.* (2006) concluded that "teacher immediacy behaviors predict or cause a level of affective learning. In turn, the level of affective learning predicts or causes the level of cognitive thinking. … (the) teacher creates a motivational affective outcome that subsequently contributes to the generation of a cognitive outcome" (p. 26). They suggested that the teacher's immediacy also provided a source of feedback by the teacher about their interest, caring, and involvement in the student's learning.

Implementations that emphasize student perspectives in learning

The next set of topics relates to seeing learning from the student's perspective. Time on task, self-questioning, self-verbalization, peer tutoring, concept mapping, and the aptitude-treatment interaction.

Time on task

The typical claim is that practice makes perfect. I decided this was the case when I decided to play golf most mornings for a year. While my score dropped dramatically, there came a time when I realized that practice was not enough. Either professional coaching or a change to some physical predispositions would be needed. Further, we certainly do not want more time on task if the learning is not positive—it is like asking an unhealthy obese person to just eat more! Time on learning can involve: longer school days, longer school years, procedural time, time off-task, on-task time, and so on. There are various claims about how much actual time is spent in "engaged" learning time; Berliner (1984), for example, claims that about 40 percent of class time is spent on engaged time—and less of this engaged time is spent on productive time (which is that time that individual students find productive in their learning). So what happens in classes? Yair (2000) put wristwatches on 865 students (from 33 schools) that were programmed to emit signals (beeps) eight times a day for a week. When beeped, the students were asked to record what activity they were engaged in, and their thoughts and mood (which led to 28,193 daily experiences). The students were engaged with their lessons about half the total class time: engaged time was similar for boys and girls, but decreased over school grade. It was higher in mathematics than in English and social sciences, and was lowest when teachers were lecturing



KEY	
Standard error	0.101 (High)
Rank	70th
Number of meta-analyses	4
Number of studies	100
Number of effects	136
Number of people (0)	na

or when students were asked to watch television, and highest when students were working in groups or laboratories. The more students felt "challenged, and the greater the academic demand on students—the more the students are engaged with instruction—the less prone they are to external preoccupations" (Yair, 2000, p. 256).

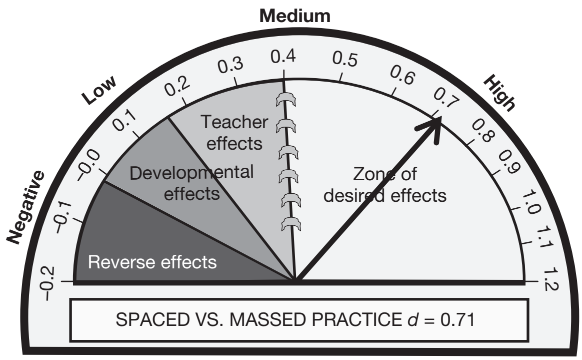
So at best half of student time in class involves engagement in the class activity—perhaps not surprising given so much time is spent listening (or pretending to listen) to teachers talking! Many have thus argued that making the available school time more productive should be the key to enhancing learning—and not merely extending the school day or year (Karweit, 1984; 1985): "Increasing allocated time, without increasing productive time, is unlikely to improve educational performance" (Walberg, Niemiec, & Frederick, 1994, pp. 98–99).

Fredrick (1980) explored the relationship between "engaged" instructional time and instructional outcome from 35 studies, and reported an effect size of $d = 0.34$. Lewis and Samuels (2003) found that more practice at reading was positively associated with reading ability, but the effect was only $d = 0.10$. The effects were slightly larger for grade 1–3 students, second language students, learning disabled students, and students reading below grade level: practice helps but it is not enough.

More important is that practice needs to be deliberate; particularly when first learning new material. Van Gog, Ericsson, Rikers, and Paas (2005) argued that it was not the amount of experience or practice in a domain that is relevant, but rather the amount of deliberate effort to improve performance. Deliberate practice refers to the relevant practice activities aimed to improve performance; it needs to be at "an appropriate, challenging level of difficulty, and enable successive refinement by allowing for repetition, giving room to make and correct errors, and providing informative feedback to the learner" (p. 75). Van Gog *et al.* further noted that such practice requires students to stretch themselves to higher levels of performance, and requires much concentration and effort over extended periods, usually of fixed times over many days. Feltz and Landers (1983) examined the effects of mental practice on motor-skill learning and performance and concluded that mental practice effects are found in both the initial and later stages of learning. Large effect sizes for cognitive tasks were more often achieved in a relatively short practice session and with only a few trials compared to motor and strength tasks.

Spaced and massed practice

It is the frequency of different opportunities rather than merely spending "more" time on task that makes the difference to learning. So teachers need to consider increasing the rate of correct academic responses to deliberative practice opportunities until minimal levels of mastery (defined by success criteria) are met (Walker, Greenwood, Hart, & Carta, 1994). This finding helps us to understand a common denominator to many of the effective practices in this book, such as direct instruction, peer-tutoring, mastery learning, and feedback. It is not over learning for the sake of it. Deliberative practice increases opportunities to not only enhance mastery but also fluency (the core of precision teaching). This is not "drill and practice", which so often can be: dull and repetitive; involve minimal feedback; not extend or provide multiple different experiences; not provide sufficient contextual variability to facilitate transfer of learning; and not be embedded in the context of the deeper and conceptual understandings that are part of the more total learning experience, and which so often aims at the surface knowledge. Deliberative practice can involve



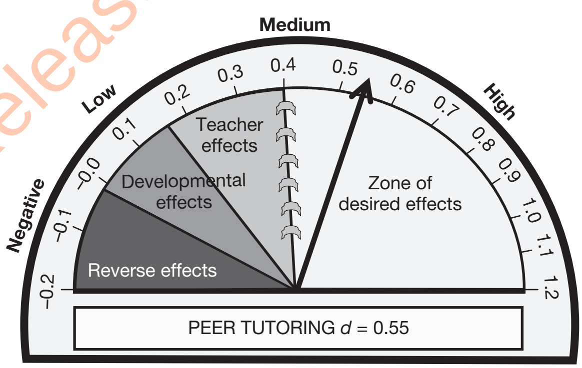
KEY	
Standard error	na
Rank	12th
Number of meta-analyses	2
Number of studies	63
Number of effects	112
Number of people (0)	na

specific skills and complex performances, and the attainment of success criteria can be motivating and certainly lead to longer retention of sometimes over-learned surface and deep knowing (Péladeau, Forget, & Gagné, 2003).

Nuthall (2005) claimed that students often needed three to four exposures to the learning—usually over several days—before there was a reasonable probability they would learn. This is consistent with the power of spaced rather than massed practice. Donovan and Radosevich (1998) concluded that students in spaced practice conditions performed higher than those in massed practice conditions ($d = 0.46$). Both acquisition ($d = 0.45$) and retention ($d = 0.51$) were enhanced by spaced rather than massed practice. The effectiveness of length of spacing was related to the complexity and challenge of the tasks—stronger effects were found for simple tasks with relatively brief rest periods, and longer rest periods were needed for more complex tasks (at least 24 hours or more).

Peer tutoring

The overall effects of the use of peers as co-teachers (of themselves and of others) in classes is, overall, quite powerful. If the aim is to teach students self-regulation and control over their own learning then they must move from being students to being teachers of themselves. One way to achieve this aim is to use peer tutoring—which too many consider a tool for older students to teach struggling younger children. While it is used for this purpose, the major influence is that it is an excellent method to teach students to become their own teachers. Reviews of tutoring literature have shown that peer tutoring has



KEY	
Standard error	0.103 (High)
Rank	36th
Number of meta-analyses	14
Number of studies	767
Number of effects	1,200
Number of people (3)	2,676

many academic and social benefits for both those tutoring *and* those being tutored (Cook, Scruggs, Mastropieri, & Casto, 1985). The overall effects from most of the meta-analyses on this topic are typically above the d = 0.40 average.

Hartley's (1977) meta-analysis of the effects on mathematics achievement of different instructional modes found that peer tutoring was the most effective of the various conditions she compared (d = 0.60). Peer tutoring was most effective when used as a supplement to, rather than a substitute for, the teacher roles. Cross-age tutors (d = 0.79) were more effective than same-age peers (d = 0.52) and adult tutors (d = 0.54). She also found a commonly reported conclusion: the effects on the tutors (d = 0.58) were not that different from the effects on those being tutored (d = 0.63) (see also Cook *et al.*, 1985, where supplemental was d = 0.96 and substitution was d = 0.63).

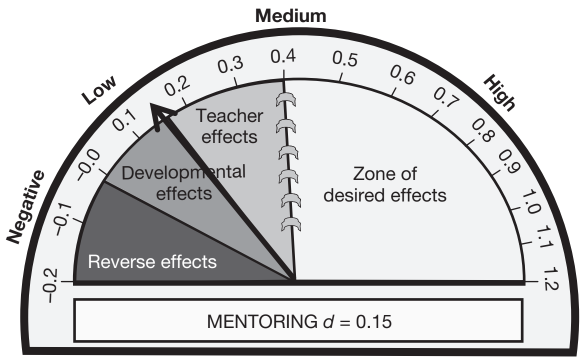
Peer tutoring has often been used with students with disabilities. Elbaum, Vaughn, Hughes, and Moody (2000) found that the magnitude of peer-tutoring effects did not differ according to whether disabled or non-disabled students acted as tutors or were doing the teaching. Cook, Scruggs, Mastropieri, and Casto (1985) reviewed studies where students with special needs were used as tutors of other students with special needs and found that those being tutored (d = 0.53) gained as much as those undertaking the tutoring (d = 0.58). Mathes and Fuchs (1991) found that peer tutoring was more effective than the instruction these students typically experienced. Kunsch, Jitendra, and Sood (2007) reported that these peer-mediated interventions were higher with disabled students in general (d = 0.56) than when they were in special classes (d = 0.32). Phillips (1983) found tutor methods were most effective with students in the acquisition rather than the proficiency phase of learning and when there were clear criterion measures (success criteria) used as targets.

Rohrbeck, Ginsberg-Block, Fantuzzo, and Miller (2003) found that peer interventions that were more student controlled (when peers are involved in setting goals, monitoring performance, evaluating performance, and selecting rewards), the effects were greater than when these were primarily controlled by teachers. When students were self-managers of their learning or the learning of others (in the peer-tutoring situation), then this autonomy led to greater achievement effects.

Thus, when students become teachers of others, they learn as much as those they are teaching. When they have some control or autonomy over this teaching, the effects are higher. It is likely that these effects are more critical when new surface level information is being taught, although it is likely that the tutors may need to understand the material at a deeper level to be effective teachers. This conjecture is not well explored in this literature and could well be subjected to further research. How often do we hear from teachers that "we learnt more when we were asked to teach it" but then see this maxim ignored as teachers enter classrooms and see students as recipients rather than producers of teaching and learning?

Mentoring

Mentoring is a form of peer tutoring, although it is normally involves older persons (often adults) providing academic or social assistance, or both, to younger people—but it also occurs throughout adult work situations to facilitate career development. Such mentoring assumes that supportive relationships with older people are important for personal, emotional, cognitive, and psychological growth. Mentoring usually involves little,



KEY	
Standard error	0.047 (Medium)
Rank	120th
Number of meta-analyses	2
Number of studies	74
Number of effects	74
Number of people (1)	10,250

if any, teaching and is more an "apprentice" model based on social and role model experiences. Mentoring had a close to zero effect on performance outcomes (d = 0.08), although there were higher effects on attitudes (satisfaction d = 0.6, school attitudes d = 0.19), and on motivation and involvement (d = 0.11) (Eby, Allen, Evans, Ng, & DuBois, 2008). That is, there is more change on attitudes than achievements, probably because "attitudes are more amenable to change than are outcomes that are more contextually-dependent" (p. 16). It was the case that effects were higher for academic mentoring than for youth (at risk, family-related mentoring) and workplace mentoring.

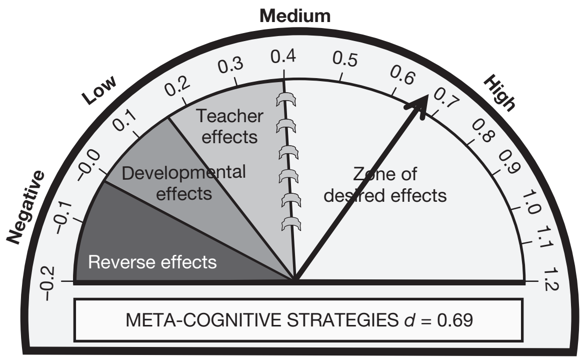
DuBois, Holloway, Valentine, and Cooper (2002) investigated many outcomes from mentoring. Across their 575 effect sizes, the average was d = 0.18 on achievement, and these low effects occurred when the program was one-on-one or in groups; the effects were lower in schools than in workplaces and higher for trained compared with non-trained mentors, but there was no relation with the frequency of contact nor the length of relationship between mentors and youth. The effects were similarly low for emotional or psychological outcomes (d = 0.20), problem and high risk behaviors (d = 0.19), social competence (d = 0.16), and career and employment outcomes (d = 0.19).

Implementations using student meta-cognitive and self-regulation learning

Meta-cognition relates to thinking about thinking. This section outlines a series of programs based on teaching various meta-cognitive strategies, including study skills, self-verbalization, self-questioning, aptitude-treatment interactions, matching learning styles, and individualized instruction.

Meta-cognitive strategies

Newell (1990) noted that there are two layers of problem solving: applying a strategy to the problem, and selecting and monitoring that strategy. Such "thinking about thinking" involved in this second layer of problem-solving has recently been referred to by the term "meta-cognition"; this refers to higher-order thinking which involves active control over the cognitive processes engaged in learning. Meta-cognitive activities can include planning how to approach a given learning task, evaluating progress, and monitoring comprehension. A synthesis of effective meta-cognitive training programs (Chiu, 1998),



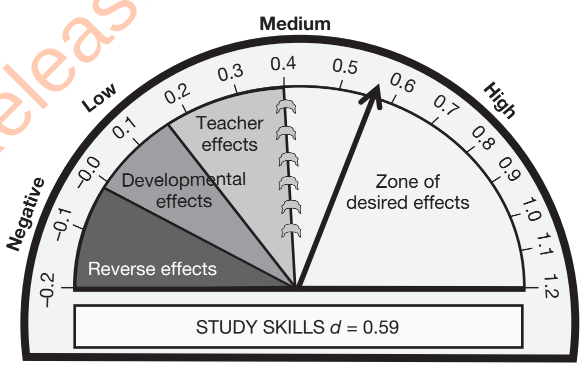
KEY	
Standard error	0.18 (High)
Rank	13th
Number of meta-analyses	2
Number of studies	63
Number of effects	143
Number of people (2)	5,028

found that such training is more effectively implemented using small-group instruction, with students in higher grades, with remedial students, and in less intensive programs. Haller, Child, and Walberg (1988) assessed the effects of meta-cognitive instruction on reading comprehension, and reported an effect size of d = 0.71 (see also Chiu, 1998). The most effective meta-cognitive strategies were awareness of textual inconsistency and the use of self-questioning. The more varied the instructional strategies throughout a lesson, the more students were influenced.

Study skills

Study skills interventions are programs that work on improving student learning using interventions outside what the teacher or teachers involved would normally undertake in the course of teaching. Interventions can be classified as *cognitive*, *meta-cognitive*, and *affective*. Cognitive interventions focus on the development of task-related skills, such as note taking and summarizing. Meta-cognitive interventions work on self-management learning skills such as planning; monitoring; and where, when, and how to use tactics and strategies. Affective interventions focus on non-cognitive features of learning such as motivation and self-concept (Hattie, Biggs, & Purdie, 1996). The argument in this section is that courses in study skills *alone* can have an effect on the surface level information, but it is necessary to combine the study skills *with the content* to have an effect on the deeper levels of understanding.

Lavery (2008) found a d = 0.46 effect on achievement from meta-cognitive study skills



KEY	
Standard error	0.090 (High)
Rank	25th
Number of meta-analyses	14
Number of studies	668
Number of effects	2,217
Number of people (8)	29,311

interventions. She found the highest effects from strategies that aimed at the "forethought" phase of learning; such as goal-setting and planning, self-instruction, and self-evaluation (Table 9.5). This strategy is "a major part of the forethought phase of this model (which occurs before the learner engages in the task) and has previously been shown to be a crucial aspect of interventions" (Greiner and Karoly, 1976, p. 497). Self-instruction occurs during the performance phase of the model and is an invaluable tool for guiding the learner through the focusing of attention and use of appropriate strategies. Self-evaluation concludes the cyclical model by allowing the learner to self-reflect on performance in

Table 9.5 Various meta-cognitive strategies and the effect sizes (Lavery, 2008)

Strategy	*Definition*	*Description*	*No. effects*	*ES*	*se*
Organizing and transforming	Overt or covert rearrangement of instructional materials to improve learning	Making an outline before writing a paper	89	0.85	0.04
Self-consequences	Student arrangement or imagination of rewards or punishment for success or failure	Putting off pleasurable events until work is completed	75	0.70	0.05
Self-instruction	Self-verbalizing the steps to complete a given task	Verbalizing steps in solving a mathematics problem	124	0.62	0.03
Self-evaluation	Setting standards and using them for self-judgment	Checking work before handing in to teacher	156	0.62	0.03
Help-seeking	Efforts to seek help from either a peer, teacher, or other adult	Using a study partner	62	0.60	0.05
Keeping records	Recording of information related to study tasks	Taking class notes	46	0.59	0.06
Rehearsing and memorizing	Memorization of material by overt or covert strategies	Writing a mathematics formula down until it is remembered	99	0.57	0.04
Goal-setting/ planning	Setting of educational goals or planning subgoals and planning for sequencing, timing, and completing activities related to those goals	Making lists to accomplish during studying	130	0.49	0.03
Reviewing records	Efforts to reread notes, tests, or textbooks to prepare for class or further testing	Reviewing class textbook before going to lecture	131	0.49	0.03
Self-monitoring	Observing and tracking one's own performance and outcomes, often recording them	Keeping records of study output	154	0.45	0.02
Task strategies	Analyzing tasks and identifying specific, advantageous methods for learning	Creating mnemonics to remember facts	154	0.45	0.03
Imagery	Creating or recalling vivid mental images to assist learning	Imagining the consequences of failing to study	6	0.44	0.09
Time management	Estimating and budgeting use of time	Scheduling daily studying and homework time	8	0.44	0.08
Environmental restructuring	Efforts to select or arrange the physical setting to make learning easier	Studying in a secluded place	4	0.22	0.09

relation to the previously set goals. While self-monitoring is very effective, it was not as high as that of self-evaluation, suggesting that self-monitoring in itself (such as ticking off completed tasks) can be much improved if taken a step further, where the learner actually evaluates what they have monitored.

The highest ranked strategy, that of organizing and transforming, has also been found to be a valuable component of many interventions (Hattie *et al.*, 1996). It is likely that the types of strategies included in this category (such as summarizing and paraphrasing) promote a more *active* approach to learning tasks. While several strategies such as record keeping, imagery, time management, and restructuring the learning environment were ranked lowest, it is likely that this is because they are more passive and involve non-active involvement with the content.

With regard to tertiary students, a closer examination of the effect sizes for these students shows that the smaller effects (and in one case a negative effect) generally came from the studies of shorter duration (i.e., those of a few days). Considering that the students in the tertiary studies were often identified as having difficulties with studying or were considered to be "at risk" by their institution, it seems that longer interventions may be required with these students. It is also likely that, as has been previously suggested, study habits are somewhat more "ingrained" with older students, thus making them more resistant to change (Hattie *et al.*, 1996). This was also indicated by one of the studies included in the meta-analysis, that of Nist and Simpson (1989), whereby achievement scores suffered an initial decrease after the implementation of the intervention, suggesting that a longer time frame is necessary, at least with tertiary-age students. There needs to be some un-learning of prior study skills before new learning can occur.

For students struggling to begin to understand, for lower achieving students, and for those wanting higher achievement, then teaching study skills can have advantages. Shrager and Mayer (1989), for example, claimed that note taking may facilitate better test performance for less skilled learners, but not for highly skilled learners. Mastropieri and Scruggs (1989) found the highest effect sizes of all for training special needs students with mnemonic methods of studying (see also Crismore, 1985; Kobayashi, 2005; Rolheiser-Bennett, 1986; Runyan, 1987)—although the effects of study skills programs for those struggling at the college level is quite low (Burley, 1994; Kulik, Kulik, & Shwalb, 1983). The mnemonic keyword strategies involve relating unfamiliar verbal stimuli into acoustically similar representations that become the keywords for remembering (e.g., Roy G. Biv for the colors of the rainbow). They did note that to maximize the chances of this knowledge being transferred and sustaining the learning, it was most effective when students were first able to *read* the text and determine what was important to remember, determine the optimal mnemonic strategy, correctly recall and implement the appropriate steps of strategy adaptation, and self-test, monitor, and correctly apply the learned information in the appropriate situation.

Kobayashi (2005) found that note taking effects were higher when students were given instructor's notes to work from ($d = 0.82$), as these provided exemplars for their own note taking and a rubric to work from when learning from the notes. The effects were higher when notes were provided ($d = 0.41$, compared to not provided ($d = 0.19$), and it was the reviewing of the notes ($d = 0.45$) that was more effective than the taking of the notes. He found no moderation effect relating to the length of the review, the presentation length that led to the taking of notes, or the format of the presentation (video, audio, or live).

Hattie, Biggs, and Purdie (1996) divided study skills programs into those aiming for near- and far-transfer in terms of degree of transfer between training task and outcome measure, and whether they were more out of, or in-context of the discipline, They found greater effects of study skills programs on the lower order thinking tasks (e.g., memory, d = 1.09), than on reproductive performance in general (d = 0.69), and lower (but still high) on transformational performance (d = 0.53). As noted above, programs involving direct teaching of mostly mnemonic devices are highly effective with most students, and also conventional study skills training is effective for near transfer on low-cognitive-level tasks. Programs that were provided outside of the context of the subject matter (the more general study skills programs) were only effective when surface knowledge was the outcome, whereas programs run in-context (associated highly with the subject matter to be learnt) were most effective at surface and deeper knowing and understanding. We concluded that "the best results came when strategy training was used meta-cognitively, with appropriate motivational and contextual support" (Hattie *et al.*, 1996, p. 129) and questioned whether "learning-to-learn" programs that are not embedded in the context of the subject to be learnt are of much value. Three recommendations from the meta-analysis are that training should be (1) in context, (2) use tasks within the same domain as the target content, and (3) promote a high degree of learner activity and meta-cognitive awareness. "Strategy training should be seen as a balanced system in which the individual's abilities, insights, and sense of responsibility are brought into use, so that the strategies that are appropriate to the task at hand can be used" (Hattie *et al.*, 1996, p. 131). The student needs to know various strategies that are appropriate to the task at hand: the how, when, where, and why of their use. Strategy training needs to be embedded in the teaching context itself.

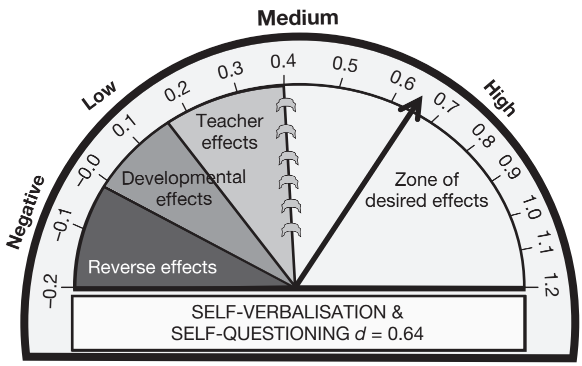
Study skills can also assist students to gain confidence that they are "learners" of the subject. Robbins, Lauver, Le, Davis, Langley, and Carlstrom (2004) found that the best study skills predictors of grade point average (GPA) were academic self-efficacy (d = 0.38), and that this confidence was as influential as high school GPA (d = 0.41), achievement motivation (d = 0.26), social involvement (d = 0.12), and academic goals (d = 0.16). Similarly, Ley and Young (2001) found self-efficacy to be among the best predictors of GPA (d = 0.50) and achievement motivation (d = 0.30), and that it had an incremental contribution over and above socioeconomic status, academic achievement, and high school GPA in predicting college outcomes. They argued that there were four principles to embed study regulation support in instruction:

1 guide learners to prepare and structure an effective learning environment;
2 organize instruction and activities to facilitate cognitive and meta-cognitive processes;
3 use instructional goals and feedback to present student monitoring opportunities;
4 provide learners with continuous evaluation information and occasions to self-evaluate.

These four principles can guide embedding study skills support in a wide variety of instructional media and contexts.

Self-verbalization and self-questioning

Self-questioning is one form of self-regulation, and given the comments in the previous section, are probably of more use to those in the early to intermediate phase of skill acquisition and for those of lower to middle ability (cf., de Bruin, Rikers, & Schmidt, 2007).



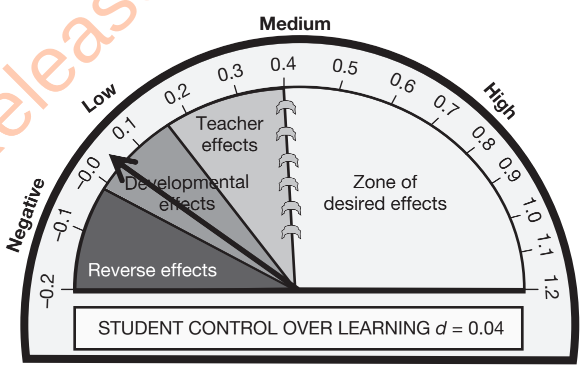
KEY	
Standard error	0.060 (Medium)
Rank	18th
Number of meta-analyses	3
Number of studies	113
Number of effects	1,150
Number of people (2)	3,098

Duzinski (1987) reviewed many procedures that taught a learning strategy or cognitive mediation strategy to students. Self-verbalization was among the most effective of the strategies, and it worked better for task oriented skills (e.g., writing or mathematics). In Huang's (1991) study of student self-questioning, the effects were higher with lower ability students. Similarly, Rock (1985) found that self-instructional training was effective for many students in special education programs.

Huang also noted that the use of self-questioning provided assistance in searching for the information needed, and thus increased student understanding of the messages of the material to be learned. Higher ability students were probably using a variety of self-regulation strategies already and self-questioning may not be as effective for them. The effects were higher for pre-lesson questioning (d = 0.94) and post-lesson questioning (d = 0.86), compared to questions interspersed during the lesson (d = 0.52); when the questionings were delayed (d = 0.72) compared to immediate (d = 0.54); and where there was teacher modeling (d = 0.69) compared to none (d = 0.47).

Student control over learning

The effect of student choice and control over learning is somewhat higher on motivation outcomes (d = 0.30) than on subsequent student learning (d = 0.04; Niemiec, Sikorski, & Walberg, 1996; Patall, Cooper, & Robinson, 2008). Indeed the more instructionally irrelevant choices had higher outcomes (e.g., color of pen to use, what music to listen to when



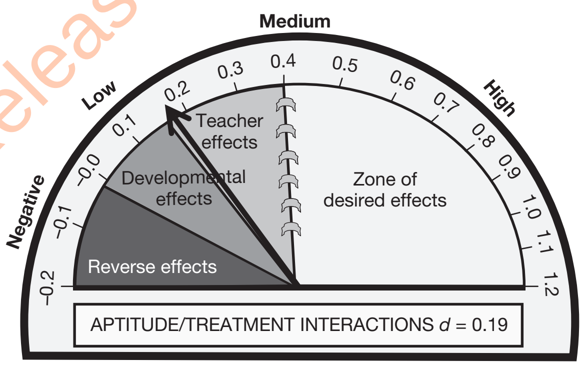
KEY	
Standard error	0.176 (High)
Rank	132nd
Number of meta-analyses	2
Number of studies	65
Number of effects	38
Number of people (0)	na

learning). Such irrelevant choices are less effortful and do not have major consequences on the learning, and too many choices may be overwhelming.

Aptitude-treatment interactions

There are many claims that instruction must be altered for different types of students. This very rich source of literature has commonly been identified by the term "aptitude-treatment interactions." There has been a long search for these aptitude-treatment interactions, and many researchers lost must interest after Cronbach and Snow (1977) produced a magnum opus on the subject. While they were optimistic that such interactions were critical and could be found, they still concluded that "well-substantiated findings regarding ATI [aptitude-treatment interactions] are scarce" (p. 6), and Glass (1970) claimed he did not "know of another statement that has been confirmed so many times by so many people" (p. 210). Since that time the search has continued, and many new aptitude-treatment interactions have emerged under headings such as learning styles (see next section), or differential treatments. All are premised on the search for instruction to accommodate individual differences.

There are few meta-analyses that provide evidence about aptitude-treatment interactions in general, possibly because most meta-analyses have been concerned with main effects. It is rare for meta-analyses to include information about interactions. Many include moderators (e.g., sex, age) but few include mediators, which are at the core of aptitude-treatment interactions (Cronbach & Snow, 1977). Whitener (1989) used the standardized interaction terms from 11 studies to find a weighted average regression coefficient—which is the best measure of the presence of an aptitude-treatment interaction. The average slope difference was about $d = 0.11$, and from her various careful analyses, she found support for the claim that students who have higher prior achievement benefit more than students with lower prior achievement from an increase in instructional support. That is, "higher achieving subjects capitalize on higher support, increasing the difference in performance between high and low achievers" (p. 78). It is important to appreciate that this effect of $d = 0.11$ is the effect after the main effects for prior achievement and treatment have been removed from the variance in learning—and this is worth considering (and as it is an aptitude-treatment interaction effect, it cannot to be compared to the other effects throughout this book). Pintrich, Cross, Kozma, and McKeachie (1986) claimed that aptitude-treatment interaction studies cannot be used with any confidence to construct general principles of



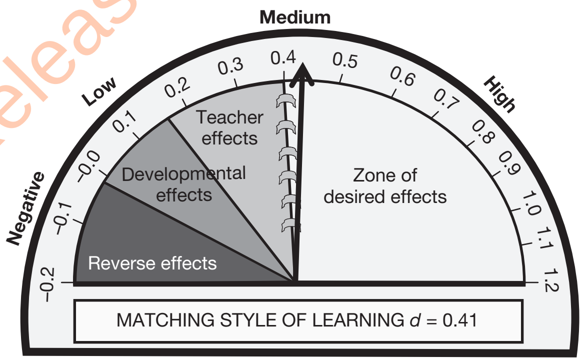
KEY	
Standard error	0.070 (Medium)
Rank	108th
Number of meta-analyses	2
Number of studies	61
Number of effects	340
Number of people (1)	1,434

instructional design, thus echoing Cronbach and Snow's (1977) earlier conclusion (based on a very comprehensive review of all possible research at that time) that "no Aptitude x Treatment interactions are so well confirmed that they can be used directly as guides to instruction" (p. 492).

Matching style of learning

Learning styles are one specific type of aptitude-treatment interaction and presume that different students have differing preferences for particular ways of learning. Often the claim is that when teaching is aligned with the preferred or dominant learning style then achievement is enhanced. For example, Dunn and colleagues (Dunn, Griggs, Olson, Beasley, & Gorman, 1995) claimed that students with strong learning styles, such as auditory, visual, tactile, or kinesthetic styles, showed greater academic gains as a result of congruent instructional interventions than those students who had mixed preferences or moderate preferences. Their model has five dimensions: biological (preference for warm vs. cool temperatures when learning), emotional (persistence vs. needing breaks when learning), sociological (working in groups or alone), physiological (intake while learning, mobility needs) and psychological (global versus analytic processing style differences). The claim is that teaching is more effective when these learning preferences are taken into account—although others have claimed the opposite: that we should be teaching students the learning styles they do not have (Apter, 2001).

It is hard to discern the meaning of some of these meta-analyses. One conclusion, given the average effect size of $d = 0.41$, is that learning style is somewhat important. But when we delve deeper, the model includes a mixture of attributes, especially the confusion of learning styles with learning strategies. Further, many of the meta-analyses correlate the learning style scores with achievement and thus are neither aptitude-treatment interactions nor learning style interventions. Many studies say no more than what students learn is correlated with achievement. Kavale and Forness (1987), for example, were interested in students with learning difficulties and found little support for the claim that there were higher outcomes when teaching students based on some supposed strength in auditory ($d = 0.18$), visual ($d = 0.09$), or kinesthetic $d = 0.18$) preference. Indeed they commented that "the groups seemingly differentiated on the basis of modality preferences actually revealed considerable overlap and it was doubtful whether any of the presumed preferences could really be deemed preferences" and "little (or no) gain in achievement was



KEY	
Standard error	0.016 (Low)
Rank	62nd
Number of meta-analyses	8
Number of studies	411
Number of effects	1,218
Number of people (6)	29,911

found when instructional methods were matched to preferred learning modality" (p. 237). Iliff (1994) found that no one style predicted achievement outcomes better than any other: d = 0.28 for diverger, d = 0.29 for assimilator, d = 0.28 for converger, and d = 0.29 for accommodator. He concluded that "since this study found the LSI [learning styles inventory] not to be a predictor of learner outcome and career fields of study, researchers will be advised to stop trying to fit square pegs into round holes" (p. 76).

Two meta-analyses seem so different from the others, and include so many errors that they should be excluded. Dunn, Griggs, Olson, Beasley, and Gorman's (1995) meta-analysis was mainly based on doctoral dissertations, many supervised by the authors, with mostly attitudinal outcomes, and many were based on adult samples. There are some unusual aspects in this meta-analysis. Some of the effects are large; Rowan (1988), for example, assigned teachers to in-service courses based on matched and mismatched learning style and preferences for time of day for instruction. The effect size reported is d = 22.29! This translates into a correlation between learning styles and achievement of d = 0.996—which is beyond the imaginable. The next largest correlation was d = 0.887 from Lashell (1986). She assigned 48 students to a control and 42 to a treatment group. Students' reading styles were evaluated and educational strategies recommended for each student (e.g., preferences were related to phonics-linguistics, whole-word, individualized, or language experience). Using a measure of reading as the outcome, Lashell used a regression analysis including grade, treatment or control group, gender, pre-reading score, teacher's years of education, and others. The Multiple R = 0.887 and Dunn *et al.* mistakenly used this R as the effect size—the pre-reading beta-weight, not surprisingly, is the largest predictor, and the treatment over control effect is relatively very small.

In many of the other studies in this meta-analysis there were similar problems; and some of the sample sizes were tiny. Zippert (1985) assigned nine adults to courses to match their (unspecified) learning styles and eight to a control course—both taught by the same instructor; the effect size was d = 2.5. Hutto (1982) asked four teachers to teach three classes where they were asked to match instruction to the students' learning preference and three where they were not so matched. Although a number of statistical tests were provided, only one was chosen to be interpreted—in third grade, the matched group exceeded the control group (and this is reported in the meta-analysis). Ingham (1989) gave 314 employees (route sales representatives, mechanics, and management) two lessons—one an auditory strategy with visuals, and one a tactual/kinesthetic strategy with visuals. When matched for preferences, there were differences in their attitudes towards the company training programs.

Overall in the Dunn *et al.* meta-analysis, the correlations were r = 0.26 for emotional, r = 0.23 for sociological, r = 0.24 for environmental, and r = 0.46 for physiological and outcomes. Given the studies in this latter group, it seems that matching learning to the students' preferred time of day for learning, intake preferences (food, snacking), mobile versus passive environments, and auditory preferences—but it is just not believable that the correlations of these effects exceed, in most cases, r = 0.60. For the same reasons, the meta-analysis by Sullivan (1993) should be disregarded. A student of Dunn, she synthesized 42 studies, but nearly all were the same as in the Dunn *et al.*, paper and included the same analysis flaws. Kavale, Hirshoren, and Forness (1998) also reviewed the Dunn *et al.* meta-analysis and concluded that the "weak rationale, curious procedures, significant omissions, and circumscribed interpretation should all serve as cautions" and that the study has "all the hallmarks of a desperate attempt to rescue a failed model of learning style" (p. 79).

It is difficult to contemplate that some of these single influences (such as whether you prefer to snack, or to sit up straight) explain more of the variance of achievement that so many of the other influences in this book. Mangino (2004), for example, noted that students enrolled in remedial courses had the highest achievement correlations with kinesthetic learning (doing, touching, interaction, $r = 0.64$), need for consistency in learning strategies and not learning in several ways ($r = 0.44$), a strong preference for intake (eating and drinking while learning, $r = 0.41$), and having an authority figure present when learning ($r = 0.34$). Higher achieving students had preferences for learning in several ways ($r = 0.31$), an authority-figure present ($r = 0.28$), the need for structure ($r = 0.38$), no sound ($r = 0.40$), a formal design (a preference to learn sitting up straight; back at a 90 degree angle, $r = 0.47$), and tended to be more motivated ($r = 0.25$). The message is that learners need teachers (authority figures), low cognitive load if in remedial classes, and multiple means of learning if in typical classes. The claims about need for snacking and sitting up straight defy my powers to make sense of them.

An alternative explanation is that when students enjoy learning then achievement is higher. The conditions under which they most enjoy learning are thus correlated, but it is the enjoyment of learning rather than the conditions that are critical. This would explain the correlations between various environmental influences and achievement. Lovelace (2005), for example, included a potpourri of studies relating achievement to modifying classroom environment, structured compared to unstructured situations, working alone or in pairs, effects of time of day of instruction, individual compared to other teaching methods. She argued that achievement is enhanced particularly when there is matching of preferences for mobility, light, auditory, tactual, or intake compared to matching on sound, temperature, design, or kinesthetic.

Slemmer (2002) was particularly interested in how technology-enhanced learning environments accommodate the learning styles of students. While she found small effects relating learning styles to outcomes, the highest effect was when the same treatment was provided for all students and not varying the instruction depending on learning preferences. Tamir (1985) related three cognitive preferences and learning and reported an effect size of $d = -0.28$ with recall (acceptance of information without consideration of implementations, applications, or limitations), $d = 0.32$ with principles (acceptance of information because it exemplifies or illuminates a fundamental principal, concept, or relation), $d = 0.24$ with critical questioning of information regarding its completeness, generalizability, or limitations, and $d = -0.06$ with application and emphasis on the usefulness and applicability of information in a general, social, or scientific context. Lower achievers prefer recall, whereas higher achievement is related to a preference for principles, critical questioning and application.

It is hard not to be skeptical about these learning preference claims. Holt, Denny, Capps, and de Vore (2005) asked whether teachers are able to perceive their students' learning preferences more accurately than random guessing. They found that the percentage correctly assessed was 30 percent whereas by chance the estimate was 25 percent—not a great show of confidence in teachers' ability to ascertain preferences. Coffield, Ecclestone, Moseley, and Hall (2004) completed an extensive analysis of various learning style models. There were few studies that met their minimum acceptability criteria, and they provided many criticisms of the field such as: too much overstatement; poor items and assessments; low validity and negligible impact on practice; and much of the advocacy in this is aimed at commercial ends. Learning strategies, yes; enjoying learning, yes; learning styles, no.

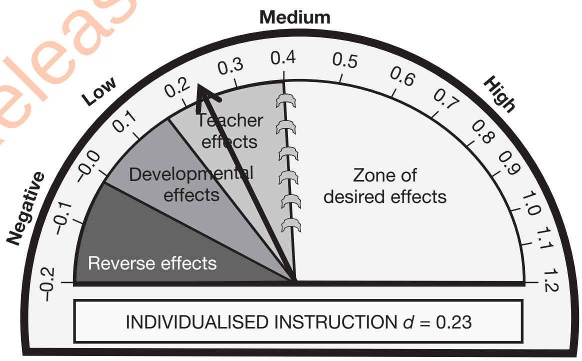
Individual instruction

Individualized instruction is based on the idea that each student has unique interests and past learning experiences, hence an individualized instructional program for each student allows for flexibility in teaching methods and motivational strategies to consider these individual differences. The evidence supporting individualized instruction, however, is not so supportive. Students are typically taught in classes of 20 or more; thus one of the major skills of teachers is to manage such classes, optimize peer co-teaching (even though this is not so common), and capitalize on the similarities and differences among the students.

Hartley's (1977) meta-analysis of the effects on mathematics achievement of different instructional modes found that individualized learning and programmed instruction were only slightly better than regular classroom instruction. In contrast, peer tutoring and computer-assisted instruction were more effective (d = 0.60) in increasing achievement. Similarly, Bangert, Kulik, and Kulik (1983) found that use of an individualized teaching system had only a small effect on student achievement in high school courses. There was limited contribution to student self-esteem, critical thinking ability, or attitude towards the subject matter taught when taught through individualized programs.

Waxman, Wang, Anderson, and Walberg (1985a, 1985b) claimed higher effects, but noted the importance of not just teaching the students by means of many individualized programs, but the importance of adapting instruction to the needs of students; ensuring these needs are based on the assessed capabilities of each student; using materials and procedures that allow students to make progress at their own pace; having periodic evaluations used to inform students about mastery; including aspects of self-responsibility for evaluating mastery; having student choice in educational goals; and aiming to have students assist each other in pursuing individual goals. There is no reason, however, why these attributes could not also occur in small or even larger groups.

Individualized instruction has been researched often in mathematics and science programs. Horak (1981) examined the effects of individualized instruction on mathematics achievement at elementary and high school level and found no significant difference to larger groupings. Similarly, Atash and Dawson (1986) examined the effects of the Intermediate Science Curriculum Study (ISCS), a semi-programmed, individualized course, and found that students on this program barely outperformed students taking a traditional junior high science curriculum (d = 0.09). Aiello and Wolfle's (1980) meta-analysis of individualized instruction in science in high school through college found individualized instruction to be similarly barely more effective than the traditional lecture approach (d = 0.08).



KEY	
Standard error	0.056 (Medium)
Rank	100th
Number of meta-analyses	9
Number of studies	600
Number of effects	1,146
Number of people (2)	9,380

Concluding comments

The argument defended in this chapter is that successful learning is a function of the worthwhileness and clarity of the learning intentions, the specifications, and the success criteria; the power of using multiple and appropriate teaching strategies with a particular emphasis on the presence of feedback focused at the right level of instruction (acquisition or proficiency); seeing learning and teaching from the students' perceptive; and placing reliance on teaching study skills and strategies of learning. Emphasizing learning styles, coaching for tests, mentoring, and individualized instruction are noted for their lack of impact.

The emphasis should be on what students can do, and then on students knowing what they are aiming to do, having multiple strategies for learning to do, and knowing when they have done it. It is teachers having teaching strategies aimed at enhancing the learning that was identified as the outcomes for the lesson, and who provide appropriate feedback to reduce the gap between where the student is and where they need to be. Both student and teacher need to set challenging goals, as this then sets the bar for the standards to be completed (at least, aiming for the h-point of 0.40 or higher effects), and to reach that bar challenging learning intentions, clear success criteria, and feedback will be needed. Setting challenging goals is a powerful part in the overall equation of what makes the difference in learning. Setting learning intentions invokes a "discrepancy-creative process", such that there is often a gap between present performance and where you wish to be (and which involves both teachers and students knowing where they are, where they are going, how they are going, what they need to do next, and how they can reduce this gap). Latham and Locke (2006), however, noted various pitfalls in goal setting, which highlight many of the factors of value noted in this chapter. When students *lack* the knowledge and skills to attain a goal, giving them a challenging goal sometimes leads to poorer performance than telling them to do their best. Goals may have an adverse effect on risk taking, if failure to attain a specific challenging goal is punished. Failures and false starts often are precursors to success. "Positive self-talk regarding an error ('I have made an error, great. I have learned something.') helps to keep our attention on the task rather than on ourselves ('How can I be so stupid?')" (p. 335).

The major messages in this chapter are the importance of learning intentions, success criteria, a classroom environment that not only tolerates but welcomes errors, attention to the challenge of the task, the presence of feedback to reduce the gaps, and a sense of satisfaction and further engagement and perseverance to succeed in the tasks of learning. This outline of successful teaching and learning is for all students—as another of my heroes, Sir Edmund Hillary, claimed with reference to himself, he was a man of modest abilities, and he combined these with a good deal of determination, and rather liked to succeed.

The contributions from teaching approaches—part II

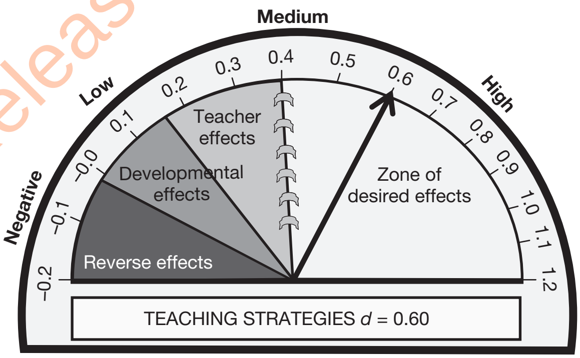
This chapter investigates a range of teaching strategies, school-wide programs, implementations using technologies, and out-of-school learning. As noted in the previous chapter, there are the same common themes in what makes some of these successful—pre-planning, deliberate attention to learning intentions and success criteria, and a constant effort to ensure teachers are seeking feedback on how successfully they are teaching their students.

Implementations that emphasize teaching strategies

There are many teaching strategies. This section highlights some of the better known, beginning with studies that specifically aim to provide teachers with different teaching strategies or increase their repertoire of different strategies. Then there are discussions of reciprocal teaching, direct instruction, adjunct aids, inductive teaching, inquiry based teaching, problem solving teaching, and cooperative versus competitive versus individualistic teaching.

Teaching strategies

The teaching of strategies covers a wide ambit of methods and has among the higher effect sizes, although most of these meta-analyses relate to special education or students with learning difficulties. As an example of the multiplicity of methods, Swanson and Hoskyn (1998) included instructional components such as: explanation, elaboration, and plans to direct task performance; modeling from teachers including verbal modeling, questioning, and demonstration; reminders to use certain strategies or procedures; step-by-step



KEY	
Standard error	0.058 (Medium)
Rank	23rd
Number of meta-analyses	14
Number of studies	5,667
Number of effects	13,572
Number of people (7)	1,491,369

Table 10.1 Summary information from the meta-analyses on the contributions from teaching approaches

Strategies	*No. metas*	*No. studies*	*No. people*	*No. effects*	*d*	*SE*	*CLE*	*Rank*
Implementations emphasizing teaching strategies								
Teaching strategies	14	5,667	1,491,369	13,572	0.60	0.058	42%	23
Reciprocal teaching	2	38	677	53	0.74	—	52%	9
Direct Instruction	4	304	42,618	597	0.59	0.096	41%	26
Adjunct aids	4	73	9,409	258	0.37	0.043	26%	72
Inductive teaching	2	97	3,595	103	0.33	0.035	23%	83
Inquiry-based teaching	4	205	7,437	420	0.31	0.092	22%	86
Problem-solving teaching	6	221	15,235	719	0.61	0.076	43%	20
Problem-based learning	8	285	38,090	546	0.15	0.085	11%	118
Cooperative learning	10	306	24,025	829	0.41	0.060	29%	63
Cooperative vs. competitive learning	7	1,024	17,000	933	0.54	0.112	39%	37
Cooperative vs. individualistic learning	4	774	—	284	0.59	0.088	42%	24
Competitive vs. individualistic learning	4	831	—	203	0.24	0.232	17%	97
Implementations that emphasize school-wide teaching strategies								
Comprehensive teaching reforms	3	282	41,929,152	1,818	0.22	—	15%	105
Comprehensive interventions for learning disabled students	3	343	56,638	2,654	0.77	0.030	54%	7
Special college programs	2	108	—	108	0.24	0.040	17%	96
Co-teaching/team teaching	2	136	1,617	47	0.19	0.057	13%	111
Implementations using technologies								
Computer-assisted instruction	81	4,875	3,990,028	8,886	0.37	0.059	27%	71
Web-based learning	3	45	22,554	136	0.18	0.124	12%	112
Interactive video methods	6	441	4,800	3,930	0.52	0.076	36%	44
Visual/audio-visual methods	6	359	2,760	231	0.22	0.070	16%	104
Simulations	9	361	6,416	482	0.33	0.092	23%	82
Programmed instruction	7	464	—	362	0.24	0.089	17%	95
Implementations using out of school learning								
Distance education	13	839	4,024,638	1,643	0.09	0.050	6%	126
Home-school programs	1	14	—	14	0.16	—	11%	117
Homework	5	161	105,282	295	0.29	0.027	21%	88
Total	210	17,253	51,742,366	39,123	0.37	0.077	26%	—
Total for all from teaching	365	25,860	52,128,719	55,143	0.42	0.071	30%	—

prompts or multi-process instructions; dialogue between teacher and student; questions from teachers; and provision by the teacher of necessary assistance only. Their meta-analyses only included experimental intervention research on students with learning disabilities. They found higher effect sizes for models of instruction that included direct and strategy instruction. The most successful were sequencing, drill repetition, and strategy cues, and these were particularly high in reading comprehension ($d = 0.82$), vocabulary ($d = 0.79$), and creativity ($d = 0.84$).

Seidel and Shavelson (2007) completed a meta-analysis based on various teaching strategies and included a high proportion of European research literature. They noted that most of the current syntheses of teaching research were framed by a product-process model of learning. These models refers to the various teaching and school processes that interact with student characteristics such as their prior knowledge, and context variables such as home and parents. Together, these processes interact to lead to the products (achievement outcomes). Over the earlier decades, however, the emphasis has been more on holistic patterns, analyzing teaching patterns or regimes instead of single teaching acts. This has drawn more attention to specific processes, usually within different curricula and knowledge domains, and lead to an increase in more sophisticated multi-level analyses of larger data sets (although it is my impression that the literature is more dominated by qualitative studies, often using very few students and one or two teachers. The need for syntheses (akin to meta-analyses) of these qualitative studies is much needed). So, Seidel and Shavelson used a more cognitive processing and learning components model to aggregate their results.

They located 112 studies and used a model developed by Bolhuis (2003) to present the various attributes of teaching (Table 10.2). Their results are appreciably lower than those of most other meta-analyses on these topics (such as the others presented in this book), which they explain by noting differences in the studies included (e.g., using European studies, which are rarely included in meta-analyses due to translation costs, and using only studies with controls for student prerequisites) and the method of categorizing by these attributes based on this new model of teaching.

The most critical dimension was domain-specific processing, which refers to "learning activities that are necessary and most adaptive for knowledge building in a domain" (Seidel & Shavelson, 2007, pp. 460–461). Seidel and Shavelson concluded that such domain-specific activities "consistently represented the most important influence of teaching on student

Table 10.2 Effect sizes for various teaching strategies (from Seidel & Shavelson, 2007)

		All outcomes		*Learning processes*		*Motivational affective*		*Cognitive*	
	Studies	*No.*	*d*	*No.*	*d*	*No.*	*d*	*No.*	*d*
Time for learning	34	178	0.08	8	0.29	13	0.24	157	0.06
Organization for learning	17	121	0.02	9	0.02	26	0.12	86	0.00
Social context	20	113	0.08	6	–0.06	35	0.02	72	0.10
Goal setting and orientation	33	133	0.06	38	0.18	19	0.14	98	0.04
Execution of learning activities									
Social/direct experiences	33	202	0.02	21	0.22	24	0.26	157	0.00
Basic processing	29	213	0.04	21	0.10	41	0.16	151	0.02
Domain-specific processing	18	112	0.43	19	0.32	15	0.42	78	0.45
Evaluation of learning	10	87	0.02	—	—	15	0.00	72	0.04
Regulation/monitoring	32	171	0.03	17	0.10	40	0.16	114	0.02

learning and stood out from other components" (2007, p. 483)—regardless of domain (reading, mathematics, science), stage of schooling, or type of learning outcome. This is consistent with the findings of my colleagues and I on the implementation of study skills—surface level study strategies can be learnt across domains, but with deeper strategies the best results are obtained when the strategies are taught directly within the domain (Hattie, Biggs, & Purdie, 1996; see also Baenninger & Newcombe, 1989).

Marzano (1998) started with the 134 studies from my 1987 synthesis of meta-analyses and added more articles to include 4,000 effect sizes of various instructional teaching methods. The overall effect was $d = 0.65$, and this was typical across his four major outcomes: knowledge ($d = 0.60$), cognitive systems ($d = 0.75$), meta-cognitive systems ($d = 0.55$), and self-system ($d = 0.74$). When the instructional technique was designed for the student, the effect was higher ($d = 0.73$) than when the technique was designed for the teacher ($d = 0.61$).

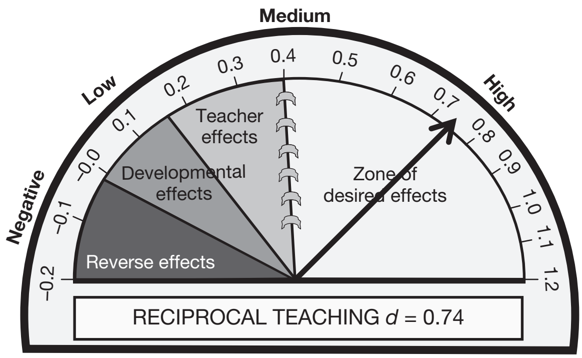
Marzano (1998) concluded that "the effective teacher is one who has clear instructional goals. These goals are communicated both to students and to parents. Ideally, the instructional goals address elements of the knowledge domains as well as the cognitive, meta-cognitive and self-system" (p. 135) and it is most important for the teacher to understand the interrelationships among the various domains.

Reciprocal teaching

Reciprocal teaching was devised as an instructional process to teach students cognitive strategies that might lead to improved learning outcomes (initially in reading

Table 10.3 Effect sizes for various teaching strategies from Marzano (1998)

	No. of studies	*d*	*se*
Storage and retrieval processes			
Cues	7	1.13	0.43
Questions	45	0.93	0.14
Direct scheme activation	83	0.75	0.08
Information processing functions			
Matching	51	1.32	0.18
Idea representation	708	0.69	0.03
Information generalization	237	0.11	0.01
Information specification	242	0.38	0.02
Idea representation			
Advanced organizers	358	0.48	0.03
Note taking	36	0.99	0.17
Manipulative	236	0.89	0.06
Knowledge utilization			
Problem solving	343	0.54	0.03
Experimental inquiry	6	1.14	0.47
Meta-cognitive systems			
Goal specification	53	0.97	0.13
Process specification and monitoring	15	0.30	0.08
Dispositional monitoring	15	0.30	0.08
Self systems			
Self attributes	15	0.74	0.19
Efficacy	10	0.80	0.20



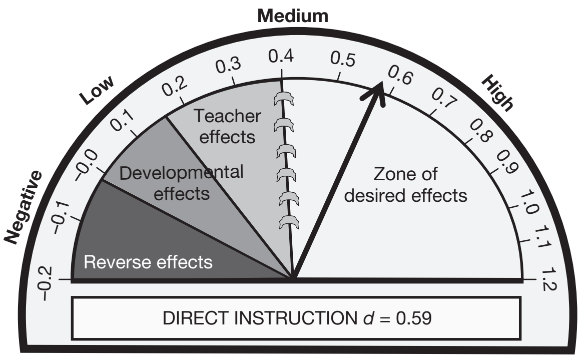
KEY	
Standard error	na
Rank	9th
Number of meta-analyses	2
Number of studies	38
Number of effects	53
Number of people (1)	677

comprehension). The emphasis is on teachers enabling their students to learn and use cognitive strategies such as summarizing, questioning, clarifying, and predicting, and these are "supported through dialogue between teacher and students as they attempt to gain meaning from text" (Rosenshine & Meister, 1994, p. 479). Each student takes a turn at being the "teacher", and often the teacher and students take turns leading a dialogue concerning sections of a text. Students check their own understanding of the material they have encountered by generating questions and summarizing. Expert scaffolding is essential for cognitive development as students move from spectator to performer after repeated modeling by adults. The aim, therefore, is to help students actively bring meaning to the written word, and assist them to learn to monitor their own learning and thinking.

The effect size from both meta-analyses is a very high $d = 0.74$, and both studies found that this high effect was evident regardless of who delivered the intervention, with classroom teachers being able to implement reciprocal teaching with the same level of effect as produced by study authors. Rosenshine and Meister (1994) reported no differences in results by grade level, number of sessions, size of instructional group, number of cognitive strategies taught, or whether the investigator or the teacher did the training. The effects were greater when the comprehension assessments was experimenter-developed ($d = 0.88$) than when using standardized tests ($d = 0.32$), although both short answer tests and tests asking students to summarize passages gave similar results. The effects were highest when there was explicit teaching of cognitive strategies before beginning reciprocal teaching dialogue, showing the importance of modeling and practice as well as giving instruction in the use of the strategies close to the time students used them. The explicit teaching of cognitive strategies and deliberative practice with content when using these strategies makes a major difference.

Direct Instruction

Every year I present lectures to teacher education students and find that they are already indoctrinated with the mantra "constructivism good, direct instruction bad". When I show them the results of these meta-analyses, they are stunned, and they often become angry at having been given an agreed set of truths and commandments against direct instruction. Too often, what the critics mean by direct instruction is didactic teacher-led talking from the front; this should *not* be confused with the very successful "Direct



KEY	
Standard error	0.096 (High)
Rank	26th
Number of meta-analyses	4
Number of studies	304
Number of effects	597
Number of people (1)	42,618

Instruction" method as first outlined by Adams and Engelmann (1996). Direct Instruction has a bad name for the wrong reasons, especially when it is confused with didactic teaching, as the underlying principles of Direct Instruction place it among the most successful outcomes.

Direct Instruction involves seven major steps:

1 Before the lesson is prepared, the teacher should have a clear idea of what the *learning intentions* are. What, specifically, should the student be able to do, understand, care about as a result of the teaching?
2 The teacher needs to know what *success criteria* of performance are to be expected and when and what students will be held accountable for from the lesson/activity. The students need to be informed about the standards of performance.
3 There is a need to *build commitment and engagement* in the learning task. In the terminology of Direct Instruction, this is sometimes called a "hook" to grab the student's attention. The aim is to put students into a receptive frame of mind; to focus student attention on the lesson; to share the learning intentions.
4 There are guides to *how the teacher should present the lesson*—including notions such as input, modeling, and checking for understanding. Input refers to providing information needed for students to gain the knowledge or skill through lecture, film, tape, video, pictures, and so on. Modeling is where the teacher shows students examples of what is expected as an end product of their work. The critical aspects are explained through labeling, categorizing, and comparing to exemplars of what is desired. Checking for understanding involves monitoring whether students have "got it" before proceeding. It is essential that students practice *doing it right,* so the teacher must know that students understand before they start to practice. If there is any doubt that the class has not understood, the concept or skill should be re-taught before practice begins.
5 There is the notion of *guided practice*. This involves an opportunity for each student to demonstrate his or her grasp of new learning by working through an activity or exercise under the teacher's direct supervision. The teacher moves around the room to determine the level of mastery and to provide feedback and individual remediation as needed.
6 There is the *closure* part of the lesson. Closure involves those actions or statements by a teacher that are designed to bring a lesson presentation to an appropriate

conclusion: the part wherein students are helped to bring things together in their own minds, to make sense out of what has just been taught. "Any questions? No. OK, let's move on" is not closure. Closure is used to cue students to the fact that they have arrived at an important point in the lesson or the end of a lesson, to help organize student learning, to help form a coherent picture, to consolidate, eliminate confusion and frustration, and so on, and to reinforce the major points to be learned. Thus closure involves reviewing and clarifying the key points of a lesson, tying them together into a coherent whole, and ensuring they will be applied by the student by ensuring they have become part of the student's conceptual network.

7 There is *independent practice*. Once students have mastered the content or skill, it is time to provide for reinforcement practice. It is provided on a repeating schedule so that the learning is not forgotten. It may be homework or group or individual work in class. It is important to note that this practice can provide for decontextualization: enough different contexts so that the skill or concept may be applied to any relevant situation and not only the context in which it was originally learned. For example, if the lesson is about inference from reading a passage about dinosaurs, the practice should be about inference from reading about another topic such as whales. The advocates of Direct Instruction argue that the failure to do this seventh step is responsible for most student failure to be able to apply something learned.

In a nutshell: The teacher decides the learning intentions and success criteria, makes them transparent to the students, demonstrates them by modeling, evaluates if they understand what they have been told by checking for understanding, and re-telling them what they have told by tying it all together with closure (see Cooper, 2006). Carnine (2000, p. 12) summarized the Follow Through findings this way:

> In only one approach, the Direct Instruction (DI) model, were participating students near or at national norms in math and language and close to national norms in reading. Students in … the other Follow Through 8 approaches—discovery learning, language experience, developmentally appropriate practices, and open education—often performed worse than the control group. This poor performance came in spite of tens of thousands of additional dollars provided for each classroom each year.
>
> (Carnine, 2000, p. 12)

Adams and Englemann (1996) made a useful connection between direct instruction and acceleration, as the principal objective of direct instruction is to provide instruction to accelerate the performance of the students; that is, teach more in less clock time, aim at teaching generalizations beyond rote learning, sequence learning and constantly monitor the performance of students as they move to achieve their challenging goals.

One of the common criticisms is that Direct Instruction works with very low-level or specific skills, and with lower ability and the youngest students. These are the not the findings from the meta-analyses. The effects of Direct Instruction are similar for regular (d = 0.99), and special education and lower ability students (d = 0.86), higher for reading

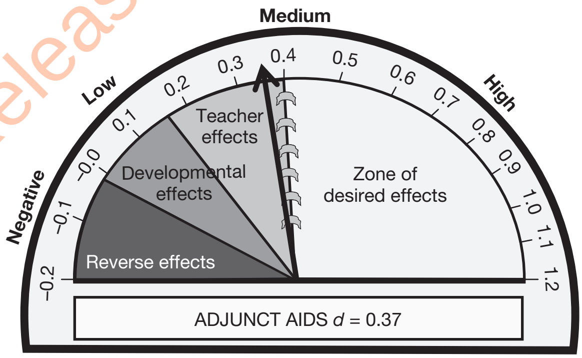
(d = 0.89) than mathematics (d = 0.50), similar for the more low-level word-attack (d = 0.64) and also for high-level comprehension (d = 0.54), and similar for elementary and high school students (Adams & Engelmann, 1996). Similarly, a 1997 integrative analysis of intervention programs for special education students found direct instruction to be the only one of seven interventions showing strong evidence of effectiveness (Forness, Kavale, Blum, & Lloyd, 1997). To demonstrate that the effects from direct instruction are not specifically teacher effects, Fischer and Tarver (Fischer & Tarver, 1997) delivered mathematics lessons via videodisc; the effects were close to d = 1.00.

The messages of these meta-analyses on Direct Instruction underline the power of stating the learning intentions and success criteria, and then engaging students in moving towards these. The teacher needs to invite the students to learn, provide much deliberative practice and modeling, and provide appropriate feedback and multiple opportunities to learn. Students need opportunities for independent practice, and then there need to be opportunities to learn the skill or knowledge implicit in the learning intention in contexts other than those directly taught.

Adjunct aids

It seems that it is not so much the presence of adjunct aids that enhances achievement, but how and where they are used in the texts, and the level of sophistication of the student when using adjunct aids. Hoeffler and Leutner (2007) found that animations were superior to static pictures (d = 0.46) but it made a difference whether the animation was for decorative purposes (d = 0.29) or for representational purposes (d = 0.89)—that is the notion should be central to the concept being learnt. There were no differences related to the level of realism, although animations acted as significant cues to the students about what was needed to be learnt. Levie and Lentz (1982) compared outcomes from students reading texts with and without illustrations and concluded that:

> when the test of learning is something other than a test of only illustrated text information or only non-illustrated text information, the addition of pictures should not be expected to hinder learning; nor should pictures always be expected to facilitate leaning. Even so, learning is better with pictures in most cases.
>
> (Levie & Lentz, 1982, p. 206)



KEY	
Standard error	0.043 (Medium)
Rank	72th
Number of meta-analyses	4
Number of studies	73
Number of effects	258
Number of people (2)	9,409

The more interesting question is how illustrations facilitate learning.

Although not above the h-point of $d = 0.40$, it does seem that adjunct aids can assist learning when they function to attract and direct attention, and highlight main ideas and comprehension, and when the text assists readers to see details in the pictures.

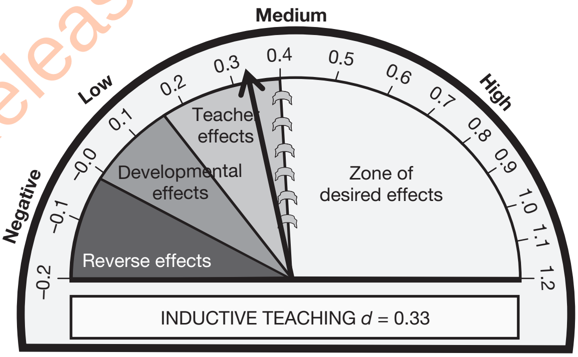
Inductive teaching

Induction is usually described as moving from the specific to the general, while deduction begins with the general and ends with the specific. Lott's (1983) meta-analysis included a comparison of inductive versus deductive teaching approaches in science education. He argued that inductive teaching occurs when educational experiences (such as examples or observations) are provided to students prior to formalizing generalizations; whereas when generalizations are formulated prior to any illustrative examples they are characterized as deductive. As can be seen from the overall effect, it makes no difference which order is used, and this was across many outcomes such as knowledge, application, process, transfer, comprehension, and problem solving.

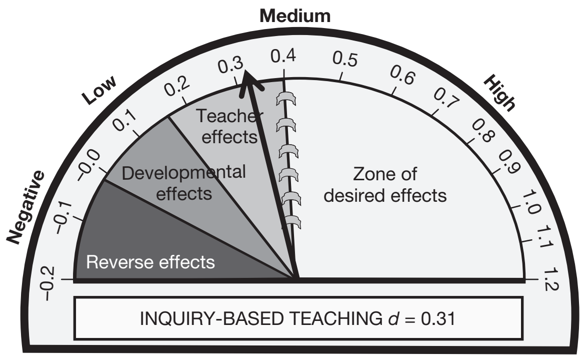
Klauer and Phye (2008) were more interested in inductive reasoning across all subject areas. Their meta-analysis was related to programs that aimed to teach detecting generalizations, rules or regularities. They developed a series of non-verbal training materials and then analyzed 74 studies that used these methods. The overall effect ($d = 0.59$) is quite high, showing the positive effects of teaching these skills, and supporting the claim that teaching of "making comparisons and contrasts" can be enhanced when taught across context, but they noted that there comes a point after students have acquired inductive reasoning when there needs to be greater knowledge and understanding to more fully capitalize on these methods.

Inquiry-based teaching

Inquiry-based teaching is the art of developing challenging situations in which students are asked to observe and question phenomena; pose explanations of what they observe; devise and conduct experiments in which data are collected to support or contradict their theories; analyze data; draw conclusions from experimental data; design and build models; or any combination of these. Such learning situations are meant to be open-ended in that they do not aim to achieve a single "right" answer for a particular question being



KEY	
Standard error	0.035 (Low)
Rank	83rd
Number of meta-analyses	2
Number of studies	97
Number of effects	103
Number of people (1)	3,595



KEY	
Standard error	0.092 (High)
Rank	86th
Number of meta-analyses	4
Number of studies	205
Number of effects	420
Number of people (1)	7,437

addressed, but rather involve students more in the process of observing, posing questions, engaging in experimentation or exploration, and learning to analyze and reason.

Inquiry methods have often been studied in the context of science education. Bredderman (1983), for example, reported a $d = 0.35$ average effect size when teaching science using inquiry/activity based methods. These activities included direct experience, experimentation, and observation as the major sources of information; although he reported large variations across classrooms. The effect on science process ($d = 0.52$) was much greater than the effect on science content ($d = 0.16$). Bredderman (1985) examined the effects of laboratory programs on learning for elementary school students. These programs differed from the traditional science programs in that they did not use textbooks and focused on use of laboratory activities. Bredderman commented that these programs resulted in improved student performance in a number of curricular areas. In addition the use of inquiry programs increased the amount of student laboratory activity and decreased teacher-led discussion in classrooms.

Shymansky, Hedges, and Woodworth (1990) also reported greater effects of inquiry teaching on process ($d = 0.40$) than on content ($d = 0.26$)—and the effects were higher in biology ($d = 0.30$) and physics ($d = 0.27$) compared to chemistry ($d = 0.10$). Effects were greatest at elementary level and decreased as students progressed through their school years. Where science teachers received in-service training in inquiry methods, students significantly outperformed students in traditional programs. Smith (1996) found larger effects from inquiry methods in critical thinking skills ($d = 1.02$) than in achievement ($d = 0.40$), and less in laboratory skills ($d = 0.24$) and process skills ($d = 0.18$). Sweitzer and Anderson (1983) were more interested in effects of inquiry teaching on science teacher education knowledge and practices. They found that a wide variety of teacher education programs, both preservice and in-service, across a range of settings (university and school settings) resulted in changes in teachers' knowledge, classroom behaviors, and attitudes. Again, the effects were twice as large on processes as on content.

Bangert-Drowns and Bankert (1990) found that inquiry-based instruction can foster critical thinking. Two factors were found to be related to critical thinking effect size: cultural factors and teachers. It appeared that some cultural factors may account for the fact that the four largest effect sizes came from studies with atypical populations where students' thinking may not previously have been valued. It would seem that inquiry-based instruction might have powerful effects where students have the cognitive capacity to think critically but have not previously been encouraged to think in this way. Overall, inquiry-based instruction was shown to produce transferable critical thinking skills as well as significant domain benefits, improved achievement, and improved attitude towards the subject.

Problem-solving teaching

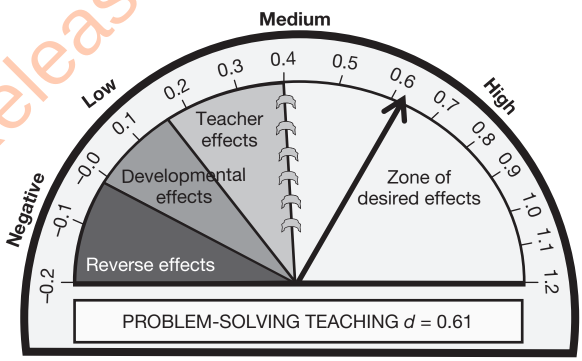
Problem solving involves the act of defining or determining the cause of the problem; identifying, prioritizing and selecting alternatives for a solution; or using multiple perspectives to uncover the issues related to a particular problem, designing an intervention plan, and then evaluating the outcome. Mellinger (1991) examined studies on the development of cognitive flexibility in problem solving. The outcome measures used in all the studies were the verbal and figural flexibility scales of the Torrance tests of Creative Thinking. Overall the effects were high—and the influence on verbal flexibility (d = 0.81) was much larger than for figural flexibility (d = 0.40). Hembree (1992) also found significant direct links between problem solving and various measures of basic performance, in particular skills in basic mathematics. A format consisting of full problem statements supported by diagrams, figures, or sketches directly related to better performance. The teacher characteristic with the most positive effect on students' performance was specialist training in heuristic methods (d = 0.71). These methods include, for example, Pólya's (1945) four phases of: (1) understand the problem, (2) obtain a plan of the solution, (3) carry out the plan, and (4) examine the solution obtained.

Marcucci's (1980) meta-analysis of research on methods of teaching mathematical problem solving also supported the power of teaching the heuristic method of problem solving. Curbelo (1984) found similar effects of problem solving in mathematics, but these effects were twice as high as they were in science. Problem solving methods can also have a positive influence on interpersonal outcomes. Almeida and Denham (1984) reported positive effects of interpersonal cognitive problem solving skills on behavioral adjustment and social behaviors (see also Denham & Almeida, 1987).

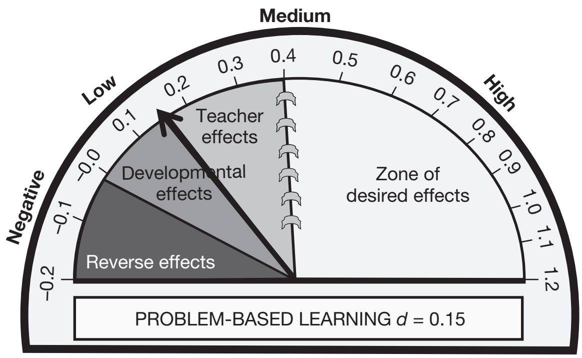
Problem-based learning

Gijbels (2005) outlined six core characteristics of problem-based learning:

1 Learning is student-centered.
2 Learning occurs in small groups.



KEY	
Standard error	0.076 (Medium)
Rank	20th
Number of meta-analyses	6
Number of studies	221
Number of effects	719
Number of people (3)	15,235



KEY	
Standard error	0.085 (High)
Rank	118th
Number of meta-analyses	8
Number of studies	285
Number of effects	546
Number of people (4)	38,090

3 A tutor is present as facilitator or guide.
4 Authentic problems are presented at the beginning of the learning sequence.
5 The problems encountered are used as tools to achieve the required knowledge and the problem solving skills necessary to eventually solve the problem.
6 New information is acquired through self-directed learning.

As will be seen, this is a topic where it is important to separate the effects on surface and deep knowledge and understanding. For surface knowledge, problem-based learning can have limited and even negative effects, whereas for deeper learning, when students already have the surface level knowledge, problem-based learning can have positive effects. This should not be surprising, as problem-based learning places more emphasis on meaning and understanding than on reproduction, acquisition, or surface level knowledge.

Vernon and Blake (1993), for example, found that the more traditional instructional methods were more effective in raising achievement than problem-based learning (d= –0.18)—the outcomes in these studies were predominantly basic science factual knowledge. Dochy, Segers, Van den Bossche, and Gijbels (2003) found an overall negative effect for problem-based learning compared to a conventional learning environment on knowledge (d = –0.78) but noted that problem-based learning had a positive effect on skills (d = 0.66). It was the case that students taught using problem-based learning had less knowledge but had better recall of the knowledge they had. This is probably because in problem-based learning, knowledge is more often elaborated and, consequentially, the students had a better recall of their knowledge. Similarly, Gijbels, Dochy, Van den Bossche, and Segers (2005) found zero effects from problem-based learning on the learning of concepts (d = –0.04), but positive effects on application (d = 0.40), and principles (d = 0.75). They concluded that "PBL had the most positive effects when the focal constructs being assessed were at the level of understanding the principles that link concepts, the second level of the knowledge structure" (Gijbels *et al.*, 2005, p. 45) It is the application and principles underlying the knowledge, rather than the concepts or knowledge, that are most influenced by problem-based learning. The application of knowledge, not development of knowledge, is the heart of the success of problem-based learning. Smith (2003) also found that effects from problem-based learning were higher in self-directed learning (d = 0.54) and attitude toward learning (d = 0.52), compared to those for problem solving (d = 0.30). Newman (2004) found negative effects for problem-based learning on the "accumulation of facts"—which appeared to be the major outcome from most studies used for this teaching method.

Cooperative, competitive, individualistic and heterogeneous class environments

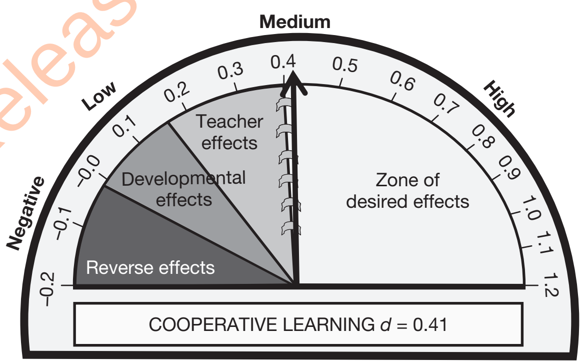
There are four groups of meta-analyses that involve cooperative learning:

1 those that compare cooperative learning versus heterogeneous classes (d = 0.41);
2 those that compare cooperative versus individualistic learning (d = 0.59);
3 those that compare cooperative versus competitive learning (d = 0.54);
4 those that compare competitive versus individualistic learning (d = 0.24).

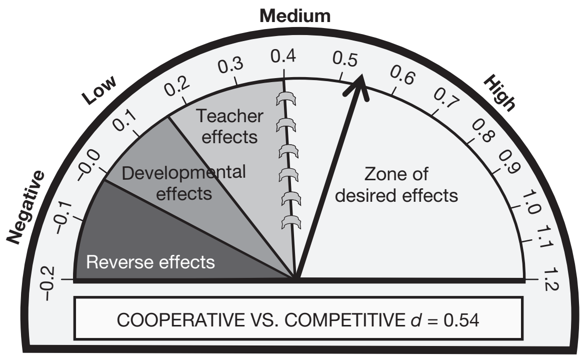
Both cooperative and competitive learning are more effective than individualistic methods—pointing again to the power of peers in the learning equation.

There seems a universal agreement that cooperative learning is effective, especially when contrasted with competitive and individualistic learning. One of the features I particularly like about the New Zealand education system is that on the international comparisons, New Zealand comes out top on cooperativeness in schools, and also is top in competitiveness. This notion that both could be beneficial seems too often forgotten, as most of the research contrasts one with the other. Further, cooperative learning has a prime effect on enhancing interest and problem solving provided it is set up with high levels of peer involvement. Of course, not all students succeed or even prefer cooperative learning situations, although what is important is less whether some students may enjoy these situations but whether these situations produce greater outcomes, deeper comprehension, and understanding.

All of the many meta-analyses by the Johnsons and their colleagues show high effect sizes, whereas the others hover around the small to medium effects. Johnson, Maruyama, Johnson, Nelson, and Skon (1981) claimed that cooperation was superior to competition in promoting achievement across all subject areas (language arts, reading, mathematics, science, social studies, psychology, and physical education), for all age groups (although it seems that the results are stronger for elementary and high school students than for college students), and for tasks involving concept attainment, verbal problem solving, categorizing, spatial problem solving, retention and memory, motor performance, and guessing-judging-predicting. Further, cooperation with intergroup competition is superior to interpersonal



KEY	
Standard error	0.060 (Medium)
Rank	63rd
Number of meta-analyses	10
Number of studies	306
Number of effects	829
Number of people (5)	24,025

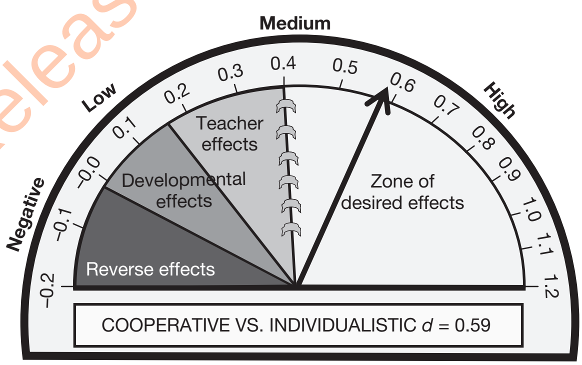


KEY	
Standard error	0.112 (High)
Rank	37th
Number of meta-analyses	7
Number of studies	1,024
Number of effects	933
Number of people (1)	17,000

competition and individualistic efforts, and particularly effective in studies using tangible rewards and maximizing tasks.

Johnson and Johnson (1987) argued also that cooperation was most effective among adults as it promoted achievement, positive interpersonal relationships, social support, and self-esteem. The effects were similar across decades, and there were no differences for individual or group rewards, laboratory or field settings, studies lasting one hour or several months, or different types of tasks, and this was independent of the quality of the study. Qin (1992; Qin, Johnson, & Johnson, 1995) found that students who engaged in cooperative learning were more successful in four types of problem solving—linguistic, non-linguistic, well-defined problem, and ill-defined problem—than those in competitive learning (d = 0.55). Johnson, Johnson, and Maruyama (1983) found that cooperative experiences promoted more positive relationships among individuals from different ethnic backgrounds, and between handicapped and non-handicapped individuals.

It seems that surface and deeper learning is affected by cooperative or competitive learning. Howard (1996) claimed that scripting, defined as formal directions to implement a cooperative learning session, is effective particularly when new material is organized and elaborated on (deep versus surface processing). Cooperative learning is more effective in reading (Hall, 1988, d = 0.44) than in mathematics (d = 0.01), and Johnson *et al.* (1981) found that for rote decoding and correcting tasks, cooperation does not seem to be superior. Moreover the effects increase with age: Hall (1988) reported that the effects increased as students moved through elementary (d = 0.28), junior high (d = 0.33), and



KEY	
Standard error	0.088 (High)
Rank	24th
Number of meta-analyses	4
Number of studies	774
Number of effects	284
Number of people (0)	na

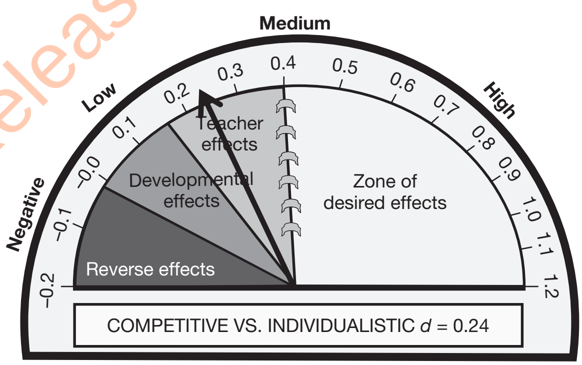
high school (d = 0.43). Stevens and Slavin (1991) found high effects when there was individual accountability and group rewards.

Roseth, Fang, Johnson, and Johnson (2006) investigated the effects of cooperative learning on middle school students. They found more support for cooperative than competitive conditions (d = 0.46), cooperative than individualistic (d = 0.55), and competitive versus individualist (d = 0.20). Similarly, the effects were greatest for cooperative over competitive over individualistic for interpersonal attraction. They concluded that under cooperative conditions, interpersonal relations have the strongest influence on achievement, and this clearly points to the value of friendship in the achievement equation. As they concluded, "if you want to increase student academic achievement, give each student a friend" (p. 7). Friendship in schools is not only powerful for the student's sense of well-being but it also facilitates a student's sense of school belonging, provides a sense of worth, and is an important source of positive feelings toward school (Hamm & Fairclough, 2007)—although for too many adolescents friendships can have the opposite effect if they convey the message that "learning is not cool".

Peer learning can be powerful—whether cooperatively or competitively. As Nuthall (2007) has shown, most feedback that students receive is from other students (although most of it is incorrect), and the peer tutoring literature has reinforced the power of peers as teachers and facilitators. When there is some structure to this peer learning (as in most instances of cooperative and competitive learning) then the power of peers can be unleashed. Students are more able to collectively make and learn from errors, and their conversations can assist in having the goals, learning intentions and success criteria from a lesson spelt out for all.

Competitive learning

A competitive situation is one where the students compete to reach a goal—although this competition can be with other students or when students aim to compete with their own previous performance. Competitiveness can be towards "beating" a standard—either a personal best standard, or a standard of the curriculum (competing to reach a goal). In contrast, in an individualistic situation, the outcome for others is ignored as irrelevant to the attainment of personal outcomes (Johnson *et al.*, 1983). As noted above, cooperative learning leads to higher effects than competitive learning, and both are superior to individualistic learning.



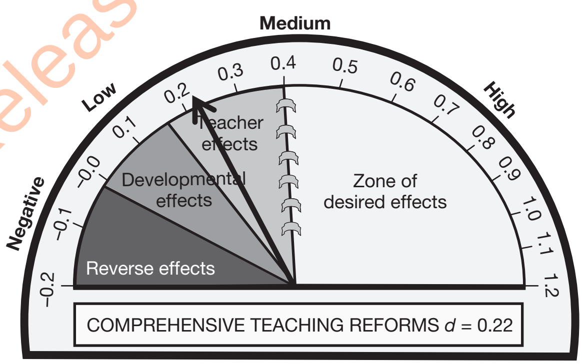
KEY	
Standard error	0.232 (High)
Rank	96th
Number of meta-analyses	4
Number of studies	831
Number of effects	203
Number of people (0)	na

Implementations that emphasize school-wide teaching reform

In one of the more ambitious meta-analyses, Borman, Hewes, Overman, and Brown (2003) reviewed the achievement effects of comprehensive school reform programs. They noted that many comprehensive programs were being "scaled up" at an unprecedented rate, and that these programs were serving millions of students and being implemented in many school districts. Such comprehensive reform appeals to many superintendents and school officials as a systematic answer to the issue of improving teaching. My own experience of these forced reforms to many schools came from being required to evaluate a program that was being forcibly introduced into 91 schools in a North Carolina school district. To me the new method seemed doomed to failure as I never underestimate teachers' skill in continuing to do what they consider works for them and resisting that with which they do not wish to engage. However, resources were poured in, training days scheduled, and there was a major push to make every school a school that used the Paideia method (Roberts, 1998; Roberts & Billings, 1999) The surprise to me was how successful the method was—even teachers whom I knew were "below average" improved, and there was the desired increase in state achievement scores. But when the Superintendent left the district, back the schools went to their previous methods.

The most critical effect was on my own teaching; if this method was so good, why not try it myself? Paideia involves three methods. The first is didactic teaching, so I taught my three-hour class on Messick's (1990) concept of validity, was able to elicit some excellent answers to my questions, and left the class with a sense of confidence that my teaching was at a high level. The second method is the "Paideia seminar", which involves getting the students to ask questions of each other and engage in a dialogue about what they do and do not understand (I as the teacher must not be involved in the questions and answers, but instead my purpose is to facilitate these interactions *between* the students). The quality of the questions and the assertiveness of some answers scared me, as they clearly did not understand what I had so beautifully taught. I realized I had built the skill of asking questions about what I had just said and looking for the students (there are always some) who were keen to retell the story and to nod at the right times (to ensure I continued); they all knew the game we played. Of course, learning occurs when the students learn, not when the teacher has satisfactorily taught. (The third method is coached products.)

Borman *et al.* (2003) noted that effect sizes from studies undertaken by the developers



COMPREHENSIVE TEACHING REFORMS $d = 0.22$

KEY	
Standard error	na
Rank	105th
Number of meta-analyses	3
Number of studies	282
Number of effects	1,818
Number of people (2)	41,929,152

of the programs were systematically higher, there were no differences in effects relating to socioeconomic resources, very little difference by subject, and the effects became most apparent after the fifth year of implementation. They considered the programs with the strongest systematic evidence of effectiveness to be Direct Instruction (*d* = 0.21), Comer's School Development program (*d* = 0.18), and Success for All (*d* = 0.18). Other programs (with more than ten effects) are listed in Table 10.4.

Borman *et al.* (2003) noted that about half of these programs were still evaluated only by their developers, they could be cost-effective (especially for poorer schools) as the costs for developing the program was already invested, but there were still highly variable outcomes. The key components of these programs were the presence of ongoing professional development, measureable goals and benchmarks for student learning, a faculty vote to increase the likelihood of the model's acceptance and buy-in, the use of specific and innovative curricular materials, and instructional practices designed to improve teaching and student learning.

A common aim for introducing these comprehensive reforms is to reduce the achievement gap. Borman and D'Agostino (1996) provided evidence on the effectiveness of "Title I" programs—which are programs funded to assist local boards to improve the achievement of children from low-income families in the United States. They reported an overall increasing achievement for students who participated in Title I programs (*d* = 0.12), and more so in mathematics than reading. Programs aimed at early remediation were more effective than programs aimed at later years, and negative effects were more pronounced over the summer vacation than for students not in Title I programs. The subsequent annual gains for these students during the regular school year alone "may not sustain their relatively large fall/spring achievement improvements" (p. 323). These low effects certainly provide little confidence that these programs *alone* will reduce the achievement gap between

Table 10.4 Summary of effects from comprehensive teaching reforms (Borman *et al.*, 2003)

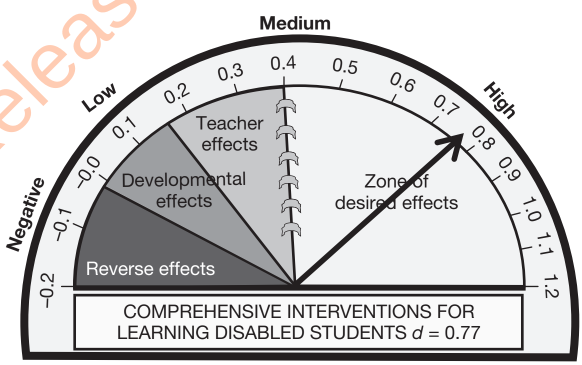
Program	*No. studies*	*No. effects*	*d*	*SE*	*Age*	*Focus*
Roots and Wings	6	14	0.38	0.04	K–6	students
High Schools That Work	45	64	0.30	0.01	9–12	curriculum
Microsociety	3	32	0.29	0.03	K–8	students
Modern Red Schoolhouse	6	23	0.26	0.03	K–12	curriculum
Onward to Excellence II	4	13	0.25	0.03	K–12	curriculum
American's Choice	2	27	0.22	0.02	K–12	standards
The Learning Network	3	38	0.22	0.02	K–8	teaching
Direct Instruction	49	182	0.21	0.02	K–8	students
Expeditionary Learning Outward Bound Students	6	40	0.19	0.03	K–12	
Success For All	42	173	0.18	0.01	K–8	students
School Development Program	10	25	0.15	0.03	K–12	community
Centre for Effective Schools	1	26	0.13	0.01	K–12	students
Accelerated Schools	6	50	0.09	0.02	K–8	students
Edison	5	209	0.06	0.01	K–12	school
Co-nect	5	42	0.04	0.02	K–12	curriculum
Community Learning Centers	5	17	0.03	0.03	K–8	curriculum
Core Knowledge	6	58	0.03	0.02	K–8	curriculum
High/Scope	4	23	–0.02	0.04	K–3	curriculum

at-risk students and their more advantaged peers. But solace should be found in the final comments: "without the program, children served over the last 30 years would have fallen farther behind academically" (p. 324).

Comprehension interventions for learning disabled students

It would be possible to have a whole book on the effects of the various interventions for students with learning difficulties, and indeed Swanson, Hoskyn, and Lee (1999) have provided such a book. They summarized the research based on group and single-subject designs. For the group design studies, they located 180 studies with a mean effect size of $d = 0.56$. The more successful interventions included meta-cognitive ($d = 0.98$), attribution ($d = 0.79$), and programs in word recognition ($d = 0.71$), reading comprehension ($d = 0.82$), spelling ($d = 0.54$), memory/recall ($d = 0.81$), mathematics ($d = 0.58$), writing ($d = 0.84$), vocabulary ($d = 0.79$), attitude/self-concept ($d = 0.68$), general reading ($d = 0.60$), phonics ($d = 0.70$), creativity ($d = 0.84$), social skills ($d = 0.46$), and language ($d = 0.54$). For the 85 single-subject designs (a rare meta-analysis of these types of studies), the effects were high ($d = 0.90$), with high effects in most areas. Swanson *et al.* concluded from their extensive comparative analyses that a combined direct instruction and strategy instruction model was an "effective procedure for remediating learning disabilities" (Swanson *et al.*, 1999, p. 218). These two approaches are somewhat independent, hence the importance of using both to maximize the effect on achievement. The important instructional components included "attention to sequencing, drill-repetition-practice, segmenting information into parts or units for later synthesis, controlling task difficulty through prompts and cues, making use of technology, systematically modeling problem solving steps, and making use of small interactive groups" (p. 218). They also noted the much higher effects from the "bottom-up" approach to teaching reading that emphasizes accurate word recognition, decoding, and letter awareness, compared to the "top down" approach where reading is viewed as dependent on the reader's cognitive and language abilities (including familiarity with the topic of discourse). More importantly, the direct instruction and strategy training models were superior to both the bottom up and top down models.

A major review of instructional methods to enhance various learning strategies among learning disabled students was also published by Swanson (2000). He found that teaching the 20-plus identified strategies by themselves ($d = 0.72$) or by direct instruction without an emphasis on strategies ($d = 0.72$) was very effective, but even more so when strategy

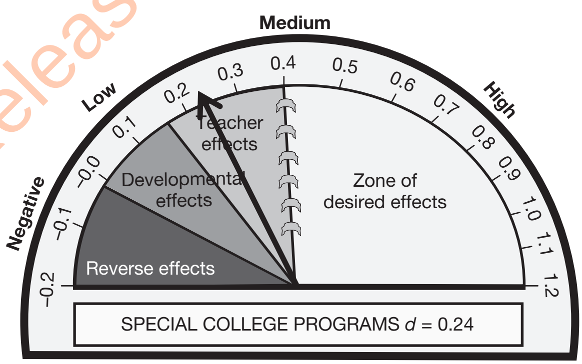


KEY	
Standard error	0.058 (Medium)
Rank	7th
Number of meta-analyses	3
Number of studies	343
Number of effects	2,654
Number of people (2)	5,664

training was combined with methods of direct instruction (d = 0.84). The strategies with the greatest impact on the achievement outcomes included controlling for difficulty or processing demands of the tasks (scaffolding), directed response and questioning (Socratic teaching, directing students to ask questions), sequencing (breaking down the task, step-by-step prompts), drill-repetition-practice-review, segmentation, and strategy cueing. These effects were stronger in reading (d = 0.82) than in mathematics (d = 0.58). Swanson (2001) investigated programs to enhance higher-order processing for adolescents with learning disabilities. Programs that included extended deliberative practice yielded larger outcomes, with the strongest instructional components relating to extended practice. The highest effects were in areas of meta-cognition (e.g., planning, self-questioning, interviews of strategy behaviors) and understanding text (e.g., inferential comprehension, thematic understanding, content knowledge). The hardest area to change was related to learned attributions (e.g., self-efficacy and effort). Similar high gains were shown by O'Neal (1985) using cerebral palsy students.

Forness and Kavale (1993) completed a meta-analysis of studies on strategy training addressing memory and learning deficits in learning disabled students. They found that strategy training, especially verbal elaboration, mediation, imagery, and verbal rehearsal, were beneficial for children with mild intellectual disabilities. All children benefited from strategy training; both those with and those without intellectual disabilities. Xin and Jitendra (1999) in their examination of the effects of instruction in solving mathematical word problems for students with learning problems found that strategy training (d = 0.77) was effective in facilitating the acquisition of problem solving skills. The results of this study also supported the use of direct instruction, cognitive strategies, and goal-directed strategies to promote student learning. Word-problem solving instruction seemed to have a positive effect on skills maintenance and generalization.

Even when meta-analyses were completed with students across all ranges of ability, the effects were still high for the lower ability students. Fan (1993) investigated the effects of strategy training for all abilities of student, specifically in reading. The effects were greater in high school (d = 0.85) and college (d = 0.62) than in elementary school (d = 0.55), and with lower (d = 0.89) and middle ability (d = 0.71) compared to higher ability students (d = 0.28). Reciprocal teaching (d = 0.82) and direct instruction (d = 0.55) were among the higher effects, and the effects of these programs were evident across curricula domains. The conclusion was that "in order to facilitate reading across the curriculum, meta-cognitive strategies should be an integral part of the reading curriculum … [and]



KEY	
Standard error	0.040 (Low)
Rank	96th
Number of meta-analyses	2
Number of studies	108
Number of effects	108
Number of people (0)	na

reading teachers and subject teachers should also work together to design a meta-cognitive reading program which will foster reading and learning (Fan, 1993, pp. 117–118).

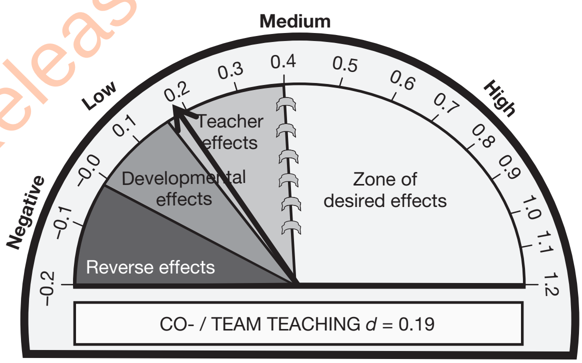
Special college programs

There have been many remediation programs for college students. Kulik, Kulik, and Shwalb (1983) claimed that special college programs for high-risk students led to them staying in college longer (62 percent versus 52 percent for control students, although, as noted by the authors, this is a very small effect). The more successful programs related to academic skills (d = 0.28), guidance sessions (d = 0.41) but the effects of remedial programs have been limited to zero effects (d = 0.05). The effects were stronger in new programs and weaker in institutionalized programs, and thus colleges seem more proficient at setting up programs for high-risk students than they are at keeping these programs going.

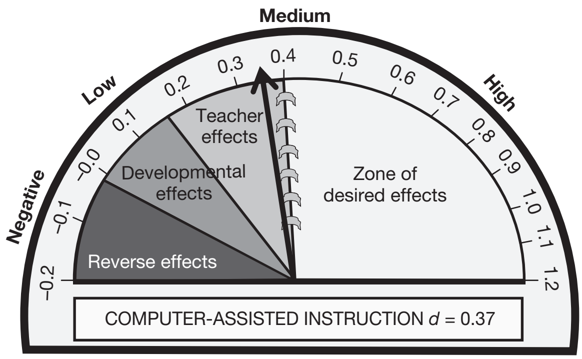
Co-teaching/Team teaching

Co-teaching involves two teachers working together in a single physical space to deliver instruction, and there are many variants: one teaching, one assisting; station teaching; parallel teaching; alternate teaching; team teaching. The typical claims in favor of team teaching include that it takes into account the strength of both teachers, it spurs creativity as teachers are forced to plan together and can spark off each other, and it allows for more individual attention to students (Armstrong, 1977). However, there is a dearth of literature on the effects of team teaching, which probably reflects its absence in our schools.

Murawski and Swanson (2001) investigated co-teaching with regular and special education teachers of mainstreamed students. They only found six articles, but all reported effects close to the average of d = 0.31. Willett, Yamashita, and Anderson (1983) included team teaching in their meta-analysis of effects in science, but did not find much support (d = 0.06). We concur with Armstrong's (1977) conclusion that "one is struck by the very basic nature of the questions for which research has failed … to supply at least tentative answers. Team teaching, it is evident, represents one of those educational practices that have not been subjected to truly intensive and systematic investigation … At this juncture, little in the research literature provides solace either for team teaching's critics or its most ardent supporters" (p. 83).



KEY	
Standard error	0.057 (Medium)
Rank	111th
Number of meta-analyses	2
Number of studies	136
Number of effects	47
Number of people (1)	1,617



KEY	
Standard error	0.059 (Medium)
Rank	71st
Number of meta-analyses	81
Number of studies	4,875
Number of effects	8,886
Number of people (18)	3,990,028

Implementations using technologies

Computer-assisted instruction

As indicated by the number of studies and meta-analyses, computers are among the hottest topics for research—and the term "computer" now covers a multitude of meanings and implementations from mainframes, desktops, and hand-held devices to the internet. Some of the major uses involve tutoring, managing, simulation, enrichment, programming, and problem solving (Kulik, 1994). Across the 76 meta-analyses on computer-assisted instruction, there were 4,498 studies, 8,096 effects, and about 4 million students—but in this area, more than most, there is much overlap of articles (and hence students) across the meta-analyses. The average effect size across all studies is $d = 0.37$ ($se = 0.02$) and the Common Language Effect (CLE) average is 25 percent; that is, 25 times out of a hundred when computer-aided instruction is used, it will make a positive difference. As can be seen in Figure 10.18, there is a reasonable degree of variability across these meta-analyses.

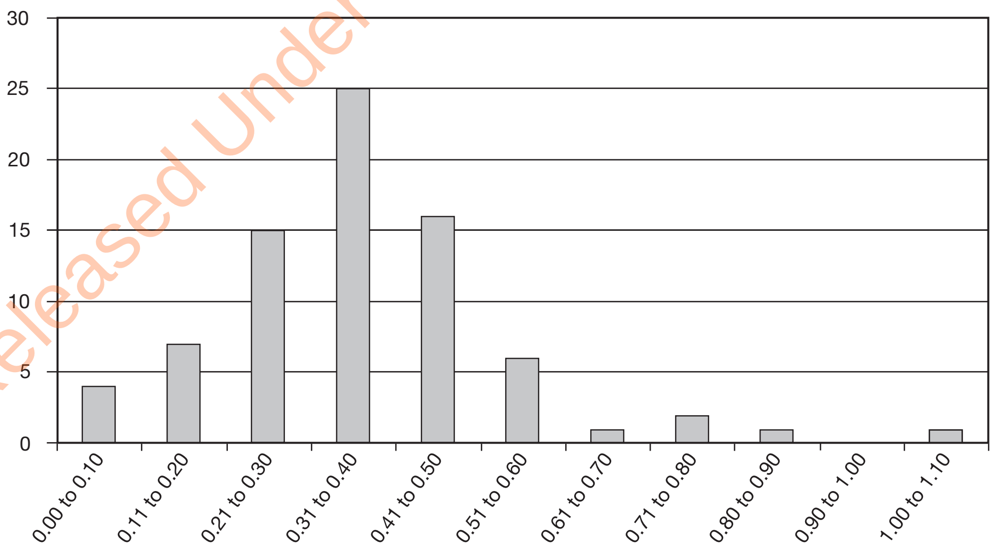


Figure 10.18 The number of computer-based meta-analyses and their overall effect size

There is no correlation of the effect sizes with the year of study, which counters the typical claim that the effect from computers is increasing with the sophistication of the technology (Figure 10.19, $r = 0.05$).

Across the various meta-analyses there were no differences across grades (Table 10.5), or ability levels of the students. There are some differences across subjects but not in any meaningful manner, and there are no differences relating to the duration of the computer intervention. The use of computers can assist in engagement and positive attitudes to learning and school.

The myriad different potential uses of computers have led many to wax lyrical about their future. Some claim that computer-aided instruction will revolutionize how we teach and learn, and some say that computers have come and just sit there mostly unused (Cuban, 2001). My own view is that, like many structural innovations in education, computers can increase the probability of learning, but there is no necessary relation between having computers, using computers, and learning outcomes.

There is no question, however, that the range of uses of computers in classes is wide, although the majority of studies are about teachers using computers in instruction and there are fewer studies about students using them in learning. That is, often the studies compare teaching in classes with and without computers (of some variant) rather than comparing students learning in different ways when using computers. Most of the effects range between $d = 0.20$ and $d = 0.60$; there are some common themes, and these have been used to organize this section.

An analysis of the meta-analyses of computers in schools indicates that computers are used effectively (a) when there is a diversity of teaching strategies; (b) when there is a pre-training in the use of computers as a teaching and learning tool; (c) when there are multiple opportunities for learning (e.g., deliberative practice, increasing time on task); (d) when the student, not teacher, is in "control" of learning; (e) when peer learning is optimized; and (f) when feedback is optimized. This list should be no surprise given the rest of the claims in this book, as they also emphasize the "visible teaching—visible learning" messages.

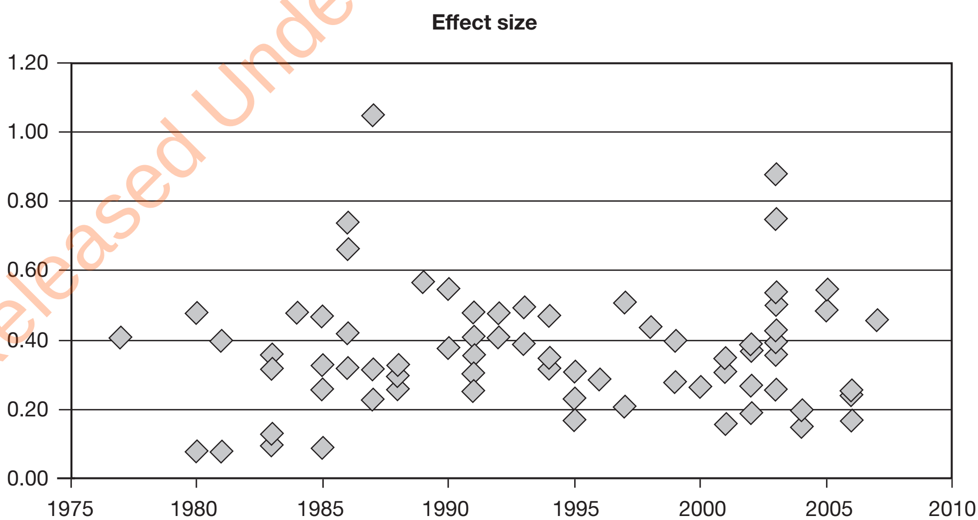


Figure 10.19 Relation between effect sizes for computer-based instruction and year of publication

Table 10.5 Summary of effects from computer-based instruction

Grade	*No. meta-analyses*	*No. effects*	*d*
Kindergarten	5	128	0.46
Elementary	25	2710	0.42
Junior high	26	592	0.33
Senior high	9	342	0.46
Post-secondary	12	745	0.38
Gender	*No. meta-analyses*	*No. effects*	*d*
Males	7	139	0.33
Females	7	121	0.25
Ability Level	*No. meta-analyses*	*No. effects*	*d*
Low	12	818	0.35
Average	11	258	0.38
High	10	223	0.33
Subject	*No. meta-analyses*	*No. effects*	*d*
Vocabulary	2	33	0.48
Language arts	3	36	0.38
Reading	8	200	0.35
Comprehension	2	46	0.35
Spelling	2	24	0.73
Writing	4	74	0.35
Math	11	1250	0.21
Science	5	52	0.32
Problem solving	4	68	0.57
Duration	*No. meta-analyses*	*No. effects*	*d*
< 4 weeks	12	315	0.45
4–8 weeks	12	715	0.41
9–12 weeks	13	588	0.39
13–26 weeks	11	620	0.35
> 26 weeks	4	487	0.36
Attitudes	*No. meta-analyses*	*No. effects*	*d*
… towards computers	4	55	0.18
… towards learning/subject	11	391	0.28

The use of computers is more effective when there is a diversity of teaching strategies

An advantage of the computer is that the method of teaching is most likely to be different from that experienced when the teacher instructs the students—at minimum, students get to experience two different teaching strategies and are offered "deliberative practice" in learning knowledge and concepts. Over the many meta-analyses, there was an advantage for computer work to be a supplement (d = 0.45, N = 162) rather than a substitute or replacement for teacher instruction (d = 0.30, N = 100;

Table 10.6). There are no differences, however, as to whether it is the same (d = 0.36, N = 522) or a different teacher (d = 0.41, N = 344) teaching the students across the two treatments (computer and traditional; Table 10.7).

The use of computers is more effective when there is teacher pre-training in the use of computers as a teaching and learning tool

One of the fascinating findings is that teachers are frequent users of computers—but more for their personal and administrative use; they find it more difficult to see how computers can be related to their particular conceptions of teaching (Cuban, 2001). When many of today's teachers were students in schools, computers were not as common, and many were then taught in teachers' colleges by lecturers who were even more distanced from the use of computers in their teaching and learning. For too many teachers, teaching using computer resources is not part of their "grammar of schooling". Abrami *et al.* (2006) noted that many teachers "are still on the threshold of understanding how to design courses to maximize the potentials of technology" (p. 32). Hence, there needs to be some pre-training in the use of computers as a teaching and learning tool for that use to be effective.

Jones (1991) looked at pre-training variables of the effectiveness of teachers using computers. Across all reports he found a d = 0.31 effect, and more than ten hours of pre-training resulting in the greatest effects (d = 0.53). More importantly, he claimed that

Table 10.6 Summary of effects from computers as substitute and as supplement to the teacher

		Substitute		*Supplement*	
Author	*Year*	*No. effects*	*d*	*No. effects*	*d*
Bayraktar	2000	27	0.18	81	0.29
Cohen & Dacanay	1992	28	0.36	9	0.56
Hsu	2003	9	0.35	22	0.44
Kuchler	1998	17	0.28	42	0.51
Lee	2004	na	0.29	na	0.41
Yaakub & Finch	2001	19	0.32	8	0.49

Table 10.7 Summary of effects from using computers with the same or a different teacher

		Same		*Different*	
Author	*Year*	*No. effects*	*d*	*No. effects*	*d*
Gordon	1991	43	0.22	79	0.32
Kulik and Kulik	1986b	68	0.23	31	0.32
Kulik, Kulik & Bangert-Drowns	1985	7	0.44	21	0.48
Liao	2005	20	0.59	17	0.71
Kuchler	1998	13	0.62	48	0.40
Fletcher-Flynn & Gravatt	1995	33	0.23	36	0.30
Banger-Drowns	1993	8	0.16	7	0.28
Bayraktar	2000	33	0.22	37	0.21
Cohen & Dacanay	1994	28	0.35	8	0.60
Chen	1994	269	0.58	60	0.51

"less than 10 hours of training is not only unproductive, but it is counterproductive. Those teachers who received such short-term training seem to have classes that achieve substantially less than average computer-using classes, whereas teachers receiving more than 10 hours of training achieve up to 72 percent additional gain beyond the average computer using class". It is noted, however, that this time is better concentrated in a few weeks or less, as there was a decrease in the effect sizes if the course was spread out too long (< 4 weeks d = 0.67; 4 to 8 weeks d = 0.52; 8 to 14 weeks d = 0.57; > 14 weeks d = 0.32). Similarly, Ryan (1991) reported effects of d = 0.53 from more than ten hours of training, but only d = 0.19 from five to ten hours, and d = 0.14 from less than five hours of training (see also Lou, Abrami, & d'Apollonia, 2001).

The use of computers is more effective when there are multiple opportunities for learning (e.g., deliberative practice, increasing time on task)

There are many ways whereby the use of computers can assist with multiple learning opportunities. Table 10.8 summarizes some of the major uses, and these range from high effects when using computers in tutorial mode to low effects when using computers for problem solving and simulations.

Tutorials involve structured learning experiences and these have the greatest effect compared to other computer-administered methods. It does seem that many computer packages may be of better instructional quality compared to many teachers' instructional methods and this, as Fletcher-Flynn and Gravatt (1995) claimed, was because of the attention given in these computer packages to making them versatile enough to be used effectively over a range of subjects and educational settings.

Of particular interest is the effects of drill and practice—and despite the moans by many adults, students need much drill and practice. However, it does not need to be dull and boring, but can be, and indeed should be, engaging and informative. Drill is a euphemism for practice: repeated learning of the material under it is mastered—this is the key ingredient in mastery learning, many of the more effective methods outlined in this book, and of deliberative practice. It does not have to be deadly, and a key skill for many teachers is to make deliberative practice engaging and worthwhile. Luik (2007) classified 145 attributes of drills using computers into six categories: motivating the learner, learner control, presentation of information, characteristics of questions, characteristics of replying, and feedback. The key attributes that led to the highest effects included learner control, not losing sight of the learning goal, and the immediate announcement of correctness or otherwise of the answer to the drill.

Many computer games are basically invested with high levels of drill and practice and

Table 10.8 Summary of major uses of computers in classrooms

Method	*No. metas*	*No. effect sizes*	*d*
Tutorials	8	78	0.71
Programming	2	43	0.50
Word processing	2	47	0.42
Drill & practice	9	506	0.34
Simulations	5	94	0.34
Problem solving	7	197	0.26

many students can be thrilled and motivated to engage in these often repetitive tasks to attain higher levels of skill and thus make more progress through the game. Computer games include much engaging drill and practice with increasing levels of challenge that usually is mastered by over learning or undertaking high degrees of drill and practice. So often, the evidence has shown positive effects from using computers to engage in deliberative practice, particularly for those students struggling to first learn a concept. Meta-analyses have also frequently demonstrated that drill and practice routines via computer are more effective than traditional teaching (Burns & Bozeman, 1981). Perhaps teachers should pause and wonder why their traditional teaching is less effective than many computer drill and practice programs.

The use of computers is more effective when the student, not the teacher, is in "control" of learning

One of the key findings from reading the many meta-analyses on computer-aided instruction was that when the student is in "control" over his or her learning (pacing, time allocations for mastery, sequencing and pacing of instructional materials, choice of practice items, reviewing) then the effects were greater than when the teacher was in "control" over these dimensions of learning (Niemiec, Sikorski, & Walberg, 1996). Abrami *et al.* (2006) concluded that it is more important for the student than the teacher to be regulating the technology. Similarly the effects are higher when the learner rather than the system had control. When the software was mostly learner- (d = 0.41) rather than system-controlled (d = –0.02), the effects were positive provided students were learning in groups (Lou, Abrami, & d'Apolloni, 2001). Cohen and Dacanay (1994) reported an effect of d = 0.49 when the package was paced by the student and d = 0.34 when paced by the instructor; and d = 0.60 when the student was in control and d = 0.20 when the student was not in control over pacing.

A good example of the student being in control of his or her learning relates to the use of word processors. When using these packages, students tend to write much more than when asked to write on paper, and the quality of writing is enhanced, especially for the weaker writers (Bangert-Drowns, 1993). This "more" is not more of low quality, as quality of writing and length was highly positively related. Students are more likely to make revisions, write more, and make fewer errors (Goldberg, Russell, & Cook, 2003; Schramm, 1991). Torgerson and Elbourne (2002) completed a meta-analysis of studies conducted between 1992 and 2002 on computers and student writing, and found that, on average, students who used computers when learning to write were not only more engaged and motivated in their writing but produced work that was of greater length and higher quality than students learning to write on paper (d = 0.40).

The use of computers is more effective when peer learning is optimized

Using computers in pairs is much more effective than when computers are used alone or in larger groups. Peers can be involved in problem solving, suggesting and trying new strategies, and working through possible next steps. As is noted in the sections on group learning above (cooperation or competition), students can learn most effectively when working together, as it exposes them to multiple perspectives, revision on their thinking, varied explanations for resolving dilemmas, more sources of feedback and correction of errors, and alternative ways to construct knowing. When the group gets too large, there can be reduced opportunity for individual students to explore their beliefs and hypotheses about what is to be learnt, leading to lower levels of learning and (re-)building constructs of knowing. There can be less opportunity to try out ideas and explore alternatives, and in larger groups there can be dominant and more submissive members, which detracts from effective learning in such groups.

Lou, Abrami, and d'Apollonia (2001) reported higher effects for pairs than individuals or more than two in a group. Liao (2007) also found greater effects for small groups (d = 0.96) than individuals (d = 0.56) or larger groups (d = 0.39). Gordon (1991) found effects were larger for learning in pairs (d = 0.54) compared to alone (d = 0.25); and Kuchler (1998) reported d = 0.69 for pairs and d = 0.29 for individuals. Lou, Abrami, and d'Apollonia (2001) reported that students learning in pairs had a higher frequency of positive peer interactions (d = 0.33), higher frequency of using appropriate learning or task strategies (d = 0.50), persevered more on tasks (d = 0.48), and more students succeeded (d = 0.28) than those learning individually when using computers. Students learning individually requested more help from the teacher (d = 0.67) and accomplished tasks faster than those working in groups (d = 0.16). There were, however, no differences between learning alone or in groups in attitudes towards computers, or attitudes to learning. The effects of small group learning were significantly enhanced when students had group work experience or instruction, and when specific cooperative learning strategies were employed. From 198 effects from 71 studies, Lou (2004) found that students learning with computers in small groups attempted a greater amount of tasks (d = 0.15), used more learning strategies (d = 0.36), and had a more positive attitude toward small group learning d = 0.54), but there was little difference in attitude towards instruction (d = 0.07) and they needed more task completion time in groups than when alone (d = –0.21). These results show that when learning using computers, it is important to emphasize discussion and for each student to work with a peer to articulate, explain, and understand a variety of possible hypotheses and solutions.

Such findings led Lou, Abrami, and d'Apollonia (2001) to recommend the following:

- When having students learn with tutorial or practice programs on tasks that are mostly system-controlled and close-ended, it is more effective cognitively and affectively to have students learn in pairs than individually.
- When having students learn with exploratory programs such as simulations and hypermedia resources for discovery learning or with general purpose tools (e.g., Word) for writing, it is important to emphasize discussions and have opportunities for each member to use learning strategies and to articulate, explain, and understand a variety of possible hypotheses and solutions.
- When students work with computers in small groups, it is important to provide them with specific cooperative learning structures and to encourage them to work together and to use appropriate and varied learning strategies.
- Students should be trained to develop group work experience.
- When forming groups it is advantageous to have heterogeneous groups (d = 1.15) rather than homogenous groups (d = 0.51)—but both types of groups are more effective than working alone.

The use of computers is more effective when feedback is optimized

A further advantage of computers is that they respond to the student despite who they are—male or female, black or white, slow or fast. Teachers claim expertise in their flexibility in anticipating students' reactions and deciding when and to whom to provide feedback, but given the low levels of feedback in most classrooms it is clear that this flexibility means many students miss out. Computer feedback is potentially less threatening to students and can occur in a more programmed manner (Blok, Oostdam, Otter, & Overmaat, 2002).

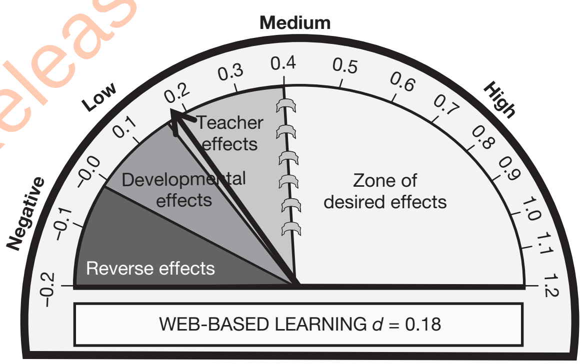
As noted above, there are many types of feedback, and feedback is optimized when there are appropriate challenging tasks. Timmerman and Kruepke (2006) found that explanations (d = 0.66) and remediation (d = 0.73) are much more effective than just providing the correct answer (d = –0.11, see also Cohen & Dacanay, 1994). Lou, Abrami, and d'Apolloni (2001) found that effects were more positive when tasks were challenging (d = 0.13), than when moderately challenging (d = –0.34) or not challenging (d = –0.57). There is no point asking students to engage in computer-assisted instruction activities unless there is some challenge.

The meta-analysis by Gillingham and Guthrie (1987) provided the highest average of all computer-assisted instruction studies, but it was based on only 13 studies. They established three critical principles included: the teacher needs to use computer-assisted instruction to manage the attention and motivation of the learner, the teacher needs to use computer-assisted instruction to present new subject matter content and learning strategies to the learner, and the teacher needs to use computer-assisted instruction to guide the practice and active involvement of learners.

Mukawa (2006) completed a meta-analysis evaluating Chickering and Ehrmann's (1996) seven principles of good practice for online learning. Their effects were very much lower than those found by Gillingham and Guthrie (1987), but the messages were similar. They found that the highest effects related to computer-assisted instruction encouraging greater student–faculty contact (d = 0.14), cooperation among students (d = 0.10), active learning (d = 0.10), respecting different ways of learning (d = 0.09), and emphasizing time on task (d = 0.07).

Web-based learning

The use of the world wide web is a fairly recent phenomenon in our classrooms. Over the past decade, the web has become a more important part of the lives of many students,



KEY	
Standard error	0.124 (High)
Rank	112th
Number of meta-analyses	3
Number of studies	45
Number of effects	136
Number of people (2)	22,554

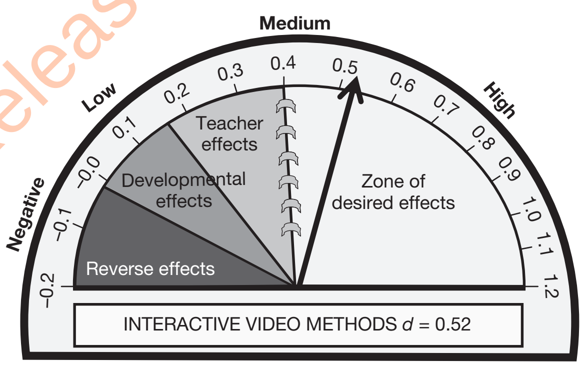
but many teachers are not as familiar with some parts of this world as their students are. Students can live in a world of their making and control, and knowledge is but a click away. The older notion of teaching students how to look up encyclopedias, reference books, and over learn details seems far less relevant than teaching them how to conduct Boolean searches, evaluate the credibility of knowledge, and synthesize the plethora of information now available to them.

Olson and Wisher (2002) noted that some have argued that the use of the web often ignores the fundamentals of instructional design—such as interaction and timely feedback. The average effect was small (d = 0.24) but the variability was huge across the 15 studies. They noted that these effects are, in general, much lower than effects from other computer-based interventions. They cautioned that the field is new, and that the average effect may become more stable when many more studies are completed. They noted that many of the early adopters were faculty from a diversity of fields not necessarily trained in instructional design. The hope is that "the potential of web-based instruction will increase as pedagogical practices improve, advances in standards for structure learning content programs, and improvements in bandwidth are made" (p. 13).

Interactive video methods

Interactive video, a combination of computer-assisted instruction and video technology, is used as an instructional media for teaching and training (Herschbach, 1984). A study by McNeil and Nelson (1990) found that effect sizes from studies on interactive video were not homogeneous, indicating that cognitive achievement from interactive video instruction is influenced by a wide range of variables such as the nature of instructional content, environmental factors, instructional methods and the learning materials. Program-controlled interactive video appears to be more effective than learner-controlled. McNeil and Nelson also noted that differences in program effectiveness favoring group instruction were possibly explained by factors such as decisions made by the teacher relative to the amount of practice, the extent and kind of feedback, and the nature of remediation procedures. Blanchard, Stock, and Marshall (1999) used meta-analysis over ten implementations of a multimedia curriculum based on video games. They found a very low overall effect, both in mathematics (d = 0.13) and language arts (d = 0.18), in high (d = 0.23) and low (d = 0.16) quality implementations of the multimedia method.

Baker and Dwyer (2000) explored the instructional effects of visualization compared to



KEY	
Standard error	0.076 (Medium)
Rank	44th
Number of meta-analyses	6
Number of studies	441
Number of effects	3,930
Number of people (1)	4,800

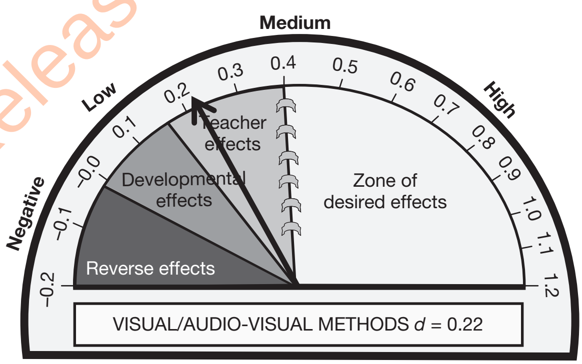
no visualization in interactive video (d = 0.71), and argued that the visual presentations can convey the essence of the message to be learned (see also Fletcher, 1989). Clark and Angert (1980) carried out a meta-analytic study on pictorial effectiveness, which focused on the use of static iconic visuals in instructional materials. Four major variables were investigated: illustrations, pacing, grade level, and achievement; and five physical attributes of illustrations: production, shading, context, embellishment, and chroma. Illustrated materials were more effective than verbal descriptions (particularly with high school students); and color illustrations were more effective than black and white.

Mayer (1989) was more concerned with searching for principles of multimedia design that enhanced science outcomes. When multimedia messages were designed in ways that overload visual or verbal working memory then the influences were markedly reduced and it was much more important for the teacher (or text) to help students connect verbal explanations to visual ones. It was more effective for students to receive both visual and verbal materials, as "when only verbal material is presented, the learner may construct an impoverished visual mental model that is insufficient to integrate with the verbal mental model." Having both allows more appropriate visual and verbal models to be built and retained.

Hypermedia incorporates two fundamental concepts: multiple representations of information and interactivities between users and this information. Typically this involves multimedia and computer-assisted instruction. Liao's examination of hypermedia encompasses interactive multimedia, multimedia computer simulations, and interactive videodiscs. Liao (1998) looked at the effects of hypermedia versus traditional instruction on students' achievement and found that there were positive effects for hypermedia over traditional instruction. The effects were greater when regular class teachers rather than specialist teachers were used, in elementary school compared to high school, and when used to supplement rather than substitute regular instruction. Liao noted that hypermedia may be more effective when used as a supplement to traditional learning.

Audio/Visual methods

Visual-based instruction involves the use of a wide range of visual media such as television, film, video, and slides. Willet, Yamashita, and Anderson (1983) found very small effects from these methods: television d = 0.05, film d = –0.07, slides d = –0.47, and tapes d = –0.27. Blanchard, Stock, and Marshall (1999) found similar low effects (d = 0.15) from their multimedia applications. Further, providing audio-tapes of lessons had a small overall effect on



KEY	
Standard error	0.070 (Medium)
Rank	104th
Number of meta-analyses	6
Number of studies	359
Number of effects	231
Number of people (1)	2,760

student achievement in college courses and no major effect on student course evaluations or on course completions (Kulik, Kulik, & Cohen (1980). Shwalb, Shwalb, and Azuma's (1986) study was completed in Japan; they found a lower effect from providing audio-tapes, and this method had the lowest effects of all methods they compared.

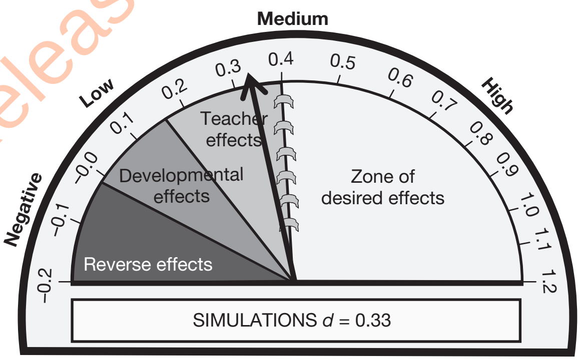
Simulations

Simulations and games typically involve the use of a model or game (such as role playing, decision making) with an aim to engage students in learning (although some games are not engaging or fun). Szczurek (1982) defined simulation as:

> an instructional method based on a simplified model or representation of a physical or social reality in which students compete for certain outcomes according to an established set of rules or constraints. The competition can be (1) among themselves as individuals or as groups, or (2) against some specified standard working as individuals or cooperating as a group.
>
> (Szczurek, 1982, p. 27)

Many simulations are not competitive but do aim to mimic real-world problems.

VanSickle (1986) found small effects (*d* = 0.12) for recall of knowledge of facts, concepts, and generalizations, and *d* = 0.18 for retention over time. He concluded that these findings show that simulating and gaming has a small positive effect over alternative instructional techniques, although somewhat larger when compared with lectures only (*d* = 0.32). Dekkers and Donatti (1981) found slightly higher effects for achievement (*d* = 0.33) and similar effects for retention (*d* = 0.15), but much higher attitude effects (*d* = 0.64). McKenna (1991) found a similar effect (*d* = 0.38) and also reported that there were no differences over age groups, but simulations were more effective with lower than higher ability students. Lee (1990), however, found simulation and gaming had higher effect sizes in achievement when used with students in higher grade levels. McKenna found, as did Dekkers and Donatti, that shorter (up to one-week) interventions were more effective than longer interactions. Remmer and Jernsted (1982) examined the effectiveness of simulation games in high school and college level instruction. The effects on achievement were small, leading them to conclude that the use of simulation games on achievement and retention was not more effective than conventional instruction. Armstrong (1991) found an overall



KEY	
Standard error	0.092 (High)
Rank	82nd
Number of meta-analyses	9
Number of studies	361
Number of effects	482
Number of people (0)	na

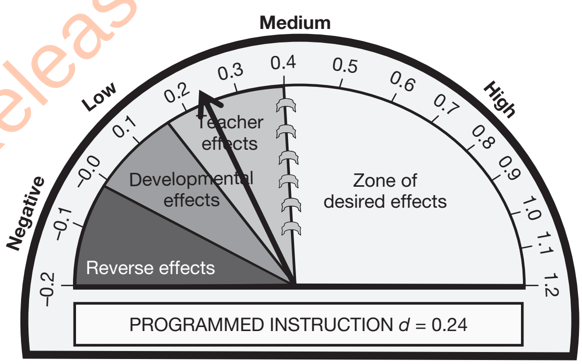
effect (d = 0.29) between computer-based simulations and traditional instruction, and the effects were similar for low-level thinking, high-level thinking, and retention outcomes.

LeJeune (2002) used interactive videodisc-based simulations and computer-simulated experiments in science. These are computer programs that model real world phenomena or duplicate traditional laboratory activities. He divided achievement outcomes into surface (d = 0.34) and deeper outcomes (d = 0.38), and found no effects on attitudes (d = –0.03), or on retention at least two weeks later (d = 0.19). The effects in colleges (d = 0.49) were much greater than in K–12 (d = 0.14). The surface outcomes were greater when taught to confirm what had been taught (d = 0.44) compared to allowing the students to explore during their learning (d = 0.27), but there were no differences when the outcomes were deeper thinking (d = 0.35 versus d = 0.41). His conclusion was that these simulations improved low-level achievement such as the ability to learn scientific facts, comprehend scientific processes, and apply that knowledge to everyday phenomena; and to deeper outcomes such as problem solving ability and other high-level thinking skills.

Programmed instruction

Programmed instruction is a teaching method of presenting new subject matter to students in graded sequence of controlled steps. A book version, for example, presents a problem or issue, then, depending on the student's answer to a question about the material, the student chooses from optional answers which refers them to particular pages of the book to find out why they were correct or incorrect—and then proceed to the next part of the problem or issue. In many ways, programmed instruction was the precursor to many computer-controlled branching and pacing programs. When comparisons are made between many methods, programmed instruction often comes near the bottom. Hartley's (1977) meta-analysis of the effects on mathematics achievement of different instructional modes found that tutoring was the most effective, then computer-assisted instruction, and both were much higher than individual learning packets and programmed instruction. Similarly, Aiello and Wolfle (1980) found programmed instruction the least effective compared to computer-assisted instruction, Keller's personalized system of instruction, audio-tutorials, and finally programmed instruction. Willett, Yamashita and Anderson (Willett *et al.*, 1983) looked at various instructional systems in science education—again, programmed instruction was among the lowest effects.

Kulik, Schwalb, and Kulik (1993) found very low effects from programmed instruction,



KEY	
Standard error	0.089 (High)
Rank	95th
Number of meta-analyses	7
Number of studies	464
Number of effects	362
Number of people (0)	na

especially in mathematics and science. Kulik, Cohen, and Ebeling (1980) found similar small effects with students in higher education, and also noted that there was no support for students enjoying this method of instruction. Boden, Archwamety, and McFarland (2000) found a higher effect of d = 0.40, which they attributed to using only older students who were more self-regulating of their learning.

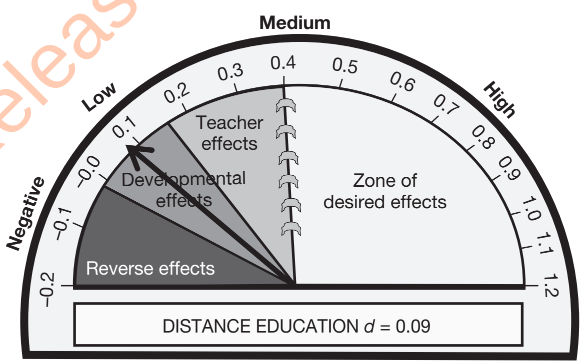
Implementations using out-of-school learning

Three programs are reviewed that involve some aspect of out-of-school learning: distance education, home-school programs, and homework.

Distance education

My first decade as an academic was in a university that specialized in distance learning. It was a great experience in learning to be very well prepared with all courses (as they had to be printed and sent many months before the classes started), with supervising students writing theses (then all was via written letters, and being forced to write a letter helped most students work out what their problem was—and thus supervision was so much easier, as most of the time the student wants the supervisor to listen and work out their problem for them; it also revealed if they could "write" or not). The meta-analyses discussed here show there are no differences in outcomes according to whether a student is a distance student or not—and certainly the message is not that "distance education does not work". The medium is not the message. This is also the case with the newer technologies, which have increased the accessibility of educational opportunities for learners through distance learning. Integral to distance education are instructional features that include a range of media types, such as televised instruction and video conferencing (Allen, Bourhis, Burrell, & Mabry, 2002; Machtmes & Asher, 2000). A meta-analysis by Machtmes and Asher (2000) of the effectiveness of telecourses in distance education found no difference between a traditional classroom with no studio equipment and a distance course with studio equipment.

Cavanaugh's (2001) meta-analysis included only web-delivered K-12 distance programs and she concluded that such programs had a similar effect to traditional face-to-face classroom programs (d = 0.15). There were no moderation effects relating to academic content, grade level, type of school, frequency of the distance learning experience, pacing of instruction, timing of instruction, instructor preparation and experience in distance



KEY	
Standard error	0.050 (Medium)
Rank	126th
Number of meta-analyses	13
Number of studies	839
Number of effects	1,643
Number of people (7)	4,024,638

education, or the setting of the students. The conclusion was that students can experience similar levels of academic success when they learn using telecommunications and when they learn in classroom settings.

A comparison of student satisfaction with distance education and traditional classrooms in higher education found a slight student *preference* for a live course setting and little difference in *satisfaction* levels (Allen *et al.*, 2002). There is also no difference in levels of satisfaction with distance education methods that include interactive links and those that do not. There is some support for videotaped instruction as a preferred option of instruction over written.

Bernard *et al.* (2004) argued that there were two distinctively different patterns of distance education: synchronous distance education derived from earlier applications of closed circuit television, and that which occurs when two or more classrooms in different locations are joined in real time and run, synchronously, usually from the originating site. We evaluated one of these programs for the North Carolina School of Mathematics and Science (Hattie, *et al.*, 1998). They had linked various schools through closed circuit to the school where the top teachers in the state taught courses in science. The net effect was that once the technology issues had been solved and paid for, the difference was attributable to the quality of the teaching.

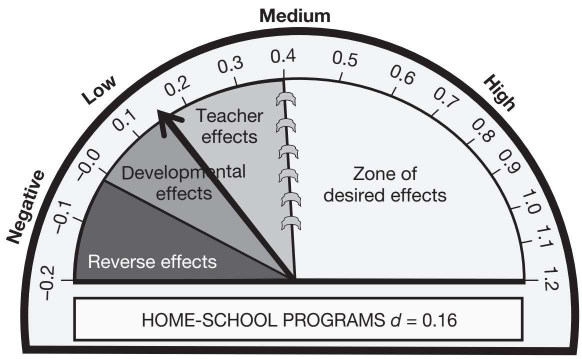
Various forms of synchronous distance education include audio and video interactive teleconferencing, and this has become the fastest growing form of distance education in American universities (Mottet, 1998; Ostendorf, 1997). This is contrasted with asynchronous distance education, a derivative of correspondence education, where students work independently and their work is supported with an instructor or tutor. Typically there is some delay (post office, email) between completing the work and any feedback. Bernard *et al.* found zero effects for both synchronous ($d = -0.10$) and asynchronous ($d = 0.05$) on achievement, and negative to zero effects on attitude ($d = -0.19, -0.00$), and retention ($d = 0.00, -0.09$). Lou, Bernard, and Abrami (2006) specifically looked at synchronous ($d = -0.02$) and asynchronous ($d = 0.06$) and concluded that the medium of instruction does not matter; it is how it is used to support instruction and facilitate learning that affects outcomes.

> When media are used to deliver the same instruction simultaneously by the same instructor and with the same course activities and materials, there is little reason to expect undergraduate students to learn differently in the remote sites than at the host site. … [there is no] difference between the live classroom and the remote site.
>
> (Lou *et al.*, 2006, p. 162)

Zhao, Lei, Yan, Lai, and Tan (2005) argued that the reason they found a major difference between pre- and post-1998 was because of the facility now in many technologies to include interactions between the student and the teacher, and between students. "Whether and how much students interact with peers and instructors seems to be a differentiating quality of distance programs" (p. 1861).

Home-school programs

Penuel *et al.* (2002) were interested in using technology to develop home–school connections in student learning. In particular, they looked at the use of laptops, programs



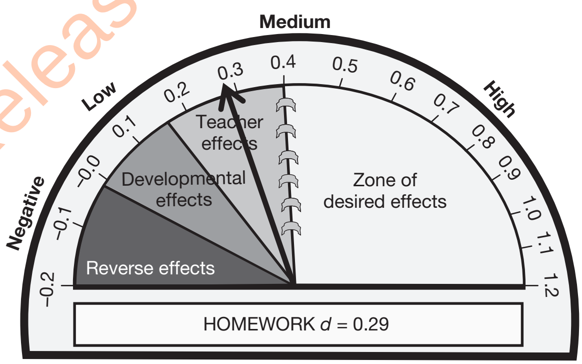
KEY	
Standard error	na
Rank	116th
Number of meta-analyses	1
Number of studies	14
Number of effects	14
Number of people (0)	na

using discrete educational software for use at home and at school, and desktop programs. The effects of these programs on reading were small (*d* = 0.10), slightly higher for mathematics (*d* = 0.18). and highest for writing (*d* = 0.34); there was not a lot of evidence showing enhanced home–school communication or increased parental involvement that affected students' learning.

Homework

Homework involves "tasks assigned to students by school teachers that are meant to be carried out during non-school hours" (Cooper, 1989, p. 7). It is a hotly contested area, and my experience is that many parents judge the effectiveness of schools by the presence or amount of homework—although they expect to not be involved in this learning other than by providing a quiet and secluded space, as they believe that these are the right conditions for deep and meaningful learning. The overall effects are positive, but there are some important moderators.

Cooper (1989) has written many studies and conducted a series of meta-analyses on homework. He argued that the effects of homework are twice as large for high as for junior high, and twice as large again for junior high as for elementary students. The smallest effects were in mathematics, whereas the effects in science and social studies were the largest, with English in the middle. The positive effects of homework were negatively related to the duration of the homework treatment (see also Trautwein, Köller, Schmitz, & Baumert, 2002). Shorter is better, but, for elementary students, Cooper, Lindsay, Nye,



KEY	
Standard error	0.027 (Low)
Rank	88th
Number of meta-analyses	5
Number of studies	161
Number of effects	295
Number of people (4)	105,282

and Greathouse (1998) estimated a correlation of near zero ($d = -0.04$) between time spent on homework and achievement. Student attitude to homework was not related to completion or grade, and nor did parent facilitation relate to student attitude to homework: "Parent support for autonomous student behavior showed a positive relationship to achievement, whereas direct instructional involvement showed a negative relationship" (Cooper, Jackson, Nye, and Lindsay, 2001, p. 197). My reading of Cooper's results suggests that more task-oriented homework had higher effects than did deep learning and problem solving homework. It is likely that this interaction is because of the importance of the teaching cycle to ensure appropriate learning, feedback, and monitoring (especially for deeper learning), whereas rehearsal of basic skills (surface knowledge) can be undertaken with minimal teacher supervision.

The nature of the homework also makes a difference. The effects were highest in mathematics, and lowest in science and social studies. The effects were higher when the material was not complex or if it was novel. Homework involving higher level conceptual thinking, and project based was the least effective. Trautwein, Köller, Schmitz, and Baumert (2002) aimed to identify the key components of homework that made the difference, with a particular emphasis on untangling the interactions between homework and student characteristics. They found that a lot of homework and a lack of monitoring seem to indicate an ineffective teaching method. They warned against homework that undermined a student's motivation and that led to the student internalizing incorrect routines, and they favored short, frequent homework that was closely monitored by the teachers. It would probably be more effective to construct these opportunities under the gaze of a teacher, in the school. Teaching does matter when it comes to students' learning. The manner in which parents become involved may or may not make a difference.

The effects are greater for higher than for lower ability students and for older rather than younger students. For too many students, homework reinforces that they cannot learn by themselves, and that they cannot do the schoolwork. For these students, homework can undermine motivation, internalize incorrect routines and strategies, and reinforce less effective study habits, especially for elementary students. The novelist Richard Russo summed up the views of many students:

> She tried shit like doing her homework for a while, but it was counterproductive since she always did it wrong. Doing homework wrong, to her, was worse than not doing it at all, because doing it required time and effort and yielded the same results as not doing it, which required neither. Besides, our teachers had it all figured out in advance, she said, like who was going to get good grades and who'd flunk.
>
> (Russo, 2007, p. 157)

There are marked differences in effect sizes between elementary ($d = 0.15$) and high school students ($d = 0.64$), which probably reflects the more advanced skills of studying involved in high school. It is important to note, however, that prescribing homework does not help students develop time management skills—there is no evidence this occurs. High school teachers are more likely to assign homework related to learning subject matter, and the effects are highest, whatever the subject, when homework involves rote learning, practice, or rehearsal of the subject matter. Perhaps one set of reasons why the effects of homework are lower in elementary levels is that younger children are less able than older children to ignore irrelevant information or stimulation in their environment, have less effective study habits, and receive little support (from teachers or parents) (Muhlenbruck, Cooper, Nye, & Lindsay, 1999).

Concluding comments

There are many teaching strategies that have an important effect on student learning. Such teaching strategies include explanation, elaboration, plans to direct task performance, sequencing, drill repetition, providing strategy cues, domain-specific processing, and clear instructional goals. These can be achieved using methods such as reciprocal teaching, direct instruction, and problem solving methods. As noted above, effective teaching occurs when the teacher decides the learning intentions and success criteria, makes them transparent to the students, demonstrates them by modeling, evaluates if they understand what they have been told by checking for understanding, and re-telling them what they have told by tying it all together with closure. These effective teaching strategies involve much cooperative pre-planning and discussion between teachers, optimizing peer learning, and require explicit learning intentions and success criteria.

Peers play a powerful role, as is demonstrated in the strategies involving reciprocal teaching, learning in pairs on computers, and both cooperative and competitive learning (as opposed to individualistic learning). Many of the strategies also help reduce cognitive load and this allows students to focus on the critical aspects of learning, which is particularly useful when they are given multiple opportunities for deliberative practice.

The use of resources, such as adjunct aids and computers, can add value to learning. They add a diversity of teaching strategies, provide alternative opportunities to practice and learn, and increase the nature and amount of feedback to the learner and teachers. They do, however, require learning how to optimize their uses.

It is also clear that, yet again, it is the differences in the teachers that make the difference in student learning. Homework in which there is no active involvement by the teacher does not contribute to student learning, and likewise the use, or not, of technologies (such as distance learning) does not show major effects on learning if there is no teacher involvement. Related to these teacher influences are the lower effects of many of the interventions when they are part of comprehensive teaching reforms. Many of these reforms are "top down" innovations, which can mean teachers do not evaluate whether the reforms are working for them or not. Commitment to the teaching strategy, and re-learning how to use many of these methods (through professional development, see Chapter 7) seems important.

Chapter 11

Bringing it all together

> Where is the wisdom we have lost in knowledge?
> Where is the knowledge we have lost in information?
>
> (Eliot, 1934)

Any book synthesizing meta-analyses is fundamentally a literature review, and thus it builds on the scholarship and research of those who have come before. A major purpose of this book is to generate a model of successful teaching and learning based on the many thousands of studies in 800 and more meta-analyses. The aim is not to merely average the studies and present screeds of data. This is not uncommon; so often meta-analyses have been criticized as mere number crunching exercises, and a book based on more than 800 meta-analyses could certainly have been just that. That was not my intent. Instead, I aimed to build a model based on the theme of "visible teaching, visible learning" that not only synthesized existing literature but also permitted a new perspective on that literature.

What seems needed is not another recipe for success, another quest for certainty, another unmasking of truth—if for no other reason that these are aplenty and no one should be asked to listen to yet another. A recipe would lead to little change, and there would little interest developing policy to build on another recipe. Certainly it could be claimed that more than 800 meta-analyses based on many millions of students is the epitome of "evidence based" decision making. But the current obsession with evidence-based too often ignores the lens that researchers use to make decisions about what to include (as evidence), what to exclude, and how they marshal the evidence to tell their story. It is the *story* that is meant to be the compelling contribution—it is my lens on this evidence.

Michael Scriven claimed that one of the more difficult tasks in research is providing explanation rather than determining causality. Often I may have slipped and made or inferred causality—and in some cases reasonably so. Certainly, the fundamental word in meta-analysis, *effect size*, implies causation (What is the *effect* of *a* on *b*?) and this claim is often not defensible. The claims in this book are more oriented to developing an explanation—a plausible set of claims based on evidence. It is more an abductive than an inductive or deductive exercise (Haig, 2005)—the explanation or story offers a plausible theory, a set of inferences to the best explanation in light of my experience of reviewing and interpreting the many studies, and it is hoped the story is bold enough to be potentially disprovable. My task is to present a series of claims that have high explanatory value, with many (refutable) conjectures.

In the present case, the story is about the visibility of teaching and learning; it is the power of passionate, accomplished teachers who focus on students' cognitive engagement with the content of what it is they are teaching. It is about teachers who focus their skills in developing a way of thinking, reasoning, and emphasizing problem solving and strategies in their teaching about the content they wish students to learn. It is about teachers enabling students to do more than what teachers do unto them; it is the focus on imparting new knowledge and understanding and then considering and monitoring how students gain fluency and appreciation in this new knowledge and build conceptions of this knowing and understanding. It is how teachers and students strategize, think about, play with, and build conceptions about worthwhile knowledge and understanding. Monitoring, assessing, and evaluating the progress in this task is what then leads to the power of feedback—which comes second in the learning equation. Feedback to students involves providing information and understanding about the tasks that make the difference in light of what the *student* already understands, misunderstands, and constructs. Feedback from students to teachers involves information and understanding about the tasks that make the difference in light of what the *teacher* already understands, misunderstands, and constructs about the learning of his or her students. It matters when teachers see learning through the lens of the student grappling to construct beliefs and knowledge about whatever is the goal of the lesson. This is never linear, not always easy, requires learning and over learning, needs dollops of feedback, involves much deliberative practice, leads to lots of errors and mis-directions, requires both accommodating and assimilating prior knowledge and conceptions, and demands a sense of excitement and mission to know, understand, and make a difference.

The conclusions are recast here as six signposts towards excellence in education:

1 Teachers are among the most powerful influences in learning.
2 Teachers need to be directive, influential, caring, and actively engaged in the passion of teaching and learning.
3 Teachers need to be aware of what each and every student is thinking and knowing, to construct meaning and meaningful experiences in light of this knowledge, and have proficient knowledge and understanding of their content to provide meaningful and appropriate feedback such that each student moves progressively through the curriculum levels.

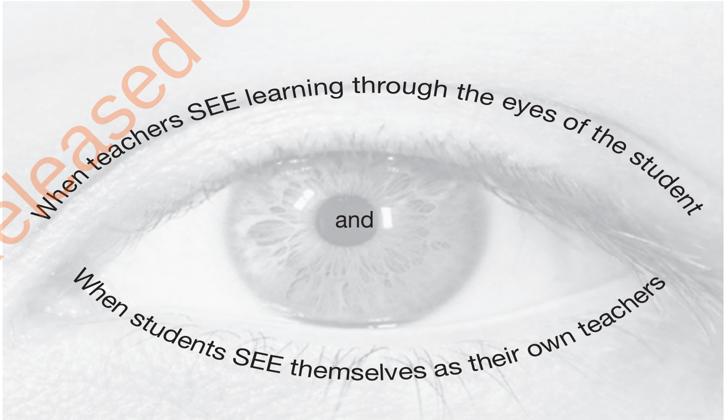


Figure 11.1 A model of Visible teaching – Visible learning

4. Teachers need to *know the learning intentions* and success criteria of their lessons, know *how well they are attaining* these criteria for all students, and know *where to go next* in light of the gap between students' current knowledge and understanding and the success criteria of: "Where are you going?", "How are you going?", and "Where to next?".
5. Teachers need to move from the single idea to multiple ideas, and to relate and then extend these ideas such that learners construct and reconstruct knowledge and ideas. It is not the knowledge or ideas, but the learner's construction of this knowledge and these ideas that is critical.
6. School leaders and teachers need to create school, staffroom, and classroom environments where error is welcomed as a learning opportunity, where discarding incorrect knowledge and understandings is welcomed, and where participants can feel safe to learn, re-learn, and explore knowledge and understanding.

In these six signposts, the word "teachers" is deliberate, as a major theme is when teachers meet to discuss, evaluate, and plan their teaching in light of the feedback evidence about the success or otherwise of their teaching strategies and conceptions about progress and appropriate challenge. This is not critical reflection, but *critical reflection in light of evidence* about their teaching.

Note what is *not* said. There are no claims about additional structural resources, although to achieve the above it helps not to have the hindrance of a lack of resources. There is nothing about class size, about which particular students are present in the school or class, or about which subject is being taught—effective teaching can occur similarly for all students, all ethnicities, and all subjects. There is nothing about between-school differences, which are not a major effect in developed countries. There is little about working conditions of teachers or students—although their effects, though small, are positive, and positive means we should not make these working conditions worse.

Sure, it helps to have students who are committed learners, who are quiet and receptive, who have high levels of self-regulation, and who have financially gifted parents. Such desires are often the basis for claims about school choice. The usual argument is that if only parents had the power (e.g., vouchers) to choose the best schools, then the quality of education would be driven up. Such choice claims imply that lower performing schools would close or change, and that parents who do not make the choice to send their children away from the neighborhood school do not "want" to. New Zealand experienced a voucher-type system for more than a decade, and the disparity between the top and bottom schools increased dramatically. Parents moved their children from the schools in lower socioeconomic areas to those in higher socioeconomic areas; there was "white flight" to the higher socioeconomic areas that left increasingly concentrated ethnic minorities in lower socioeconomic schools. The reasons were not that they were moving to schools where student outcomes were higher (such information was not available in New Zealand) but because they were "fleeing from schools with high proportions of minorities" (Fiske & Ladd, 2000, p. 201). Certainly, children from the more advantaged families were the major beneficiaries of the voucher system (and loudest advocates). With few exceptions, we have to teach *all* in front of us.

Will evidence make a difference?

The theme throughout this book is that the beliefs and conceptions held by teachers need to be questioned—not because they are wrong (or right) but because the essence of good teaching is that teachers' expectations and conceptions must be subjected to debate, refutation, and investigation. Only then can there be major improvements in student achievement. We need to ask about the conceptions of teaching that have led to teachers making decisions about:

- what is best to teach next, without attending closely to what these students already know;
- what materials to choose, with no regard to any evidence (other than prior use) that these are the optimal materials (and so often these materials are made by the cottage industry in teachers' homes);
- how to keep students engaged and busy, but not ensuring that they actually learn;
- what activities provoke the most interest, instead of asking what leads to students putting in effort (it is the effort, not the interest level, of the activity that is important);
- how to maximize the challenge of the learning goals and create structures for students to learn via the challenge, rather than structuring the material so that it is easy to learn.

We can set benchmarks of what progress looks like (preferably $d = 0.40$ for *every* student, at least $d = 0.30$, and certainly not less than $d = 0.20$) per implementation or year. We can agree to learning intentions and success criteria, and we can set the goalpost of accomplished teachers at the level of those who systematically make these differences to students: that is, those who engage them, turn them on to the subject, who inspire them, and who communicate a passion for learning. We also need to recognize that sometimes learning is dull and repetitive, but turning students on to this part of learning requires the same passions. As I learn to make bread, or coach cricket, there are many tasks I have to repeat seemingly endlessly to over learn some skills to thus allow cognitive resources to be freed for other tasks—especially anticipation and a sense of understanding about the bread or state of the cricket game. My cricket coaching requires monitoring process and not just performance—my aim is to be a coach, not a score keeper.

Teachers and principals need to collect the effect sizes within their schools and then ask "What is working best?", "Why is it working best?", and "Who is it not working for?" (e.g., see Petty, 2006; Schagen & Elliot, 2004). This will create a discussion among teachers about teaching. This would require a caring, supportive staffroom, a tolerance of errors, and for learning from other teachers, a peer culture among teachers of engagement, trust, shared passion, and so on. It is the same attributes that work for student learning that also work for teachers' learning. Bryk and Schneider (2002) found that higher levels of trust were reported in schools that eventually could be categorized as academically improving than in those in the non-improving group ($d = 0.61$ for increases in reading and $d = 0.64$ in mathematics). Their message was that trust does not directly affect student learning, but it fosters a set of organizational conditions. Trust reduces the sense of vulnerability that teachers experience as they take on new and uncertain tasks associated with reform; it facilitates teachers' efforts to innovate in their classroom in order to develop more effective instruction, facilitates public problem solving within a school, and creates a moral resource that leads to commitments and greater effort to implement successful innovations (Bryk & Schneider, 2002, p. 117). Trust also maximizes the occurrence of error and thus allows feedback to be powerful in use and effectiveness. To engender reform that will make the difference requires incentives primarily in terms of teachers learning about their teaching, about what is working and for whom, and from sharing *evidence* of the effectiveness of their methods. The current penchant for "reflective teaching" too often ignores that such reflection needs to be based on evidence and not on post-hoc justification. We can go further, as my colleagues and I are doing in a trial of our work, which involves providing a computerized system for teachers to set targets for their students based on the students' prior progress, then creating a dialogue among principal and teachers about the desirability of these targets, and then closely monitoring the success of achieving the targets (Hattie, *et al.*, 2007). Hence the theme of visible teaching and visible learning.

The personal nature of learning

Olson (2003) states it simply—it is students themselves, in the end, not teachers, who decide what students will learn. Thus we must attend to what students are thinking, what their goals are, and why they would want to engage in learning what is offered in schools. Learning is very personal to the teacher *and* to each student. While we assemble students in groups (classes, and within-class groups), the meaning of the implications of education is personal for each of us. This does not mean we need to attend to individualized instruction but that we need to be aware of the progression of knowledge and understanding for each student—and how they learn by themselves, learn with others, and learn with adults, along with an awareness of what they bring from their home and their culture. There are at least three worlds in the classroom (Nuthall, 2005): the public world, which includes teacher-led discussion and work tasks; the private-social word of informal peer interactions, whispers, and note-passing; and the private-individual world of self-talk and thinking. Each world has its own characteristic patterns of behavior, interaction structures, customs, rules, roles, expectations, and discourse.

Nuthall (2005) spent many years putting microphones on every student in the class and monitoring and evaluating their dialogue. This is a robust method of understanding teaching and learning through the eyes of the students—even observations were not sufficient, argued Nuthall, as up to 40 percent of what occurred among students was missed by the observation recordings and observers. No wonder that critical reflection by teachers is barely adequate. His major conclusion related to "how little teachers knew about what was going on in their classrooms" (p. 902). It is, therefore, no surprise that "Teachers often feel that learning outcomes are unpredictable, mysterious, and uncontrollable" (Kennedy, 1999, p. 528). Nuthall found that students lived in a personal and social world of their own in the classroom, they already knew at least 40 percent of what the teachers intended them to learn, a third of what each student learned was not learned by any other student in the class, students learned how and when the teacher would notice them and how to give the appearance of active involvement, and a quarter of the specific concepts and principles that students learned were critically dependent on private peer talk or on self-designed activities or use of resources (Nuthall, 2005). The world of learning and classrooms from the student's personal viewpoint is so often unknown to the teacher—hence reinforcing the major claim in this book about how teachers need to spend more time and energy understanding learning through the eyes of students.

Nuthall found that teachers, rather than seeing learning through the eyes of students, knew their teaching was going well from signs that their students were actively engaged with learning activities. "They monitor the look in their students' eyes, their enthusiasm, their puzzlement, and the questions they ask. In most teachers' minds, the criteria for successful learning are the same as the criteria for successful classroom management" (Nuthall, 2005, p. 916). The focus of teachers' thinking when they were planning and carrying out their role in the classroom was keeping students busily engaged in activities that produced some tangible product. Further, although the learning activity was supposed to produce learning, neither the teachers nor the students talked about learning. Instead, teachers talked about resources, about how long an activity should take, and what would happen if it was not finished on time.

> The teacher is largely cut off from information about what individual students are learning. Teachers are forced to rely on secondary indicators such as the visible signs that students are motivated and interested. They are sustained, however, by the commonly held belief that if students are engaged most of the time in appropriate activities, some kind of learning will be taking place … Teachers depend on the responses of a small number of key students as indicators and remain ignorant of what most of the class knows and understands.
>
> (Nuthall, 2005, pp. 919–920)

Students' on-task talk was about the same things. When students were asked what they were thinking, "their most common response was that they were thinking about how to get finished quickly or how to the answer with the least possible effort" (Nuthall, 2005, p. 918).

Nuthall (2007) found that the experiences from the less able and more able students were similar. Less able students appeared to learn from their experiences in exactly the same way as the more able students. For both groups of students, a significant proportion of their learning experiences was either self-selected or self-generated, even in traditional classrooms. Those students, regardless of prior ability, who used the classroom and its activities to further their own interests and purposes learned more than those who dutifully did what they were told but did not want or know how to create their own opportunities. It takes "three or four experiences involving interaction with relevant information for a new knowledge construct to be created in working memory and then transferred to long-term memory" (Nuthall, 2000, p. 93). This is not simple repetitions but opportunities to come at the material to be learned in different ways. Students need much deliberative practice distributed over the learning time. Such distributed, rather than spaced, teaching has been noted in Chapter 9, and well studied in psychology. Cepeda, Pashler, Vul, Wixted, and Rohrer (2006) completed a meta-analysis of the effects of distributed practice and concluded that "Distributing practice across different days (instead of grouping learning episodes within a single day) greatly improves the amount of material retained for sizeable periods of time; the literature clearly suggests that distributing practice in this way is likely to markedly improve students' retention of course material" (p. 371). Students who, for reasons of cultural and ethnic differences, may have difficulty participating in a learning activity, not only fail to acquire the knowledge they need to understand and acquire further knowledge; they "learn" that their ability to acquire knowledge is inferior. Such deficit thinking can be reinforced by teachers sharing the same beliefs (Bishop, 2003).

Nuthall argued that teachers should focus on direct observation of the realities of student experience and the processes that students experience in developing knowledge and skill. This involves developing a precise, accurate, and replicable account of both the subjective and objective realities of student experience. This is personalized teaching and personalized learning by the teacher, as only this kind of understanding maximizes the personal learning by the student.

The empirical quest for explanations

The aim in this book has been to provide an explanatory story about active and passionate teachers as contrasted with facilitative and inquiry methods. Teachers who are passionate about making a difference are more likely to make a difference. Consider a contrast between the teacher as an "activator" and the teacher as a "facilitator". In the activist mode, teachers are key agents in all the interventions on the left of Table 11.1, and more facilitative in the interventions on the right hand side. The contrast in effects is marked—from an average of $d = 0.60$ to $d = 0.17$.

These results show that active and guided instruction is much more effective than unguided, facilitative instruction. Kirschner, Sweller, and Clark (2006) provided an extensive review on why providing only minimal guidance during instruction does not work. They contrasted guided models, such as direct instruction, with minimally guided methods such as discovery learning, problem-based learning, inquiry learning, experiential learning, and constructivist learning. These latter methods, they argued, are based on two main assumptions. First, they challenge students to solve "authentic" problems on the assumption that learners construct their own solutions, and second, knowledge is best acquired through experience based on the procedures of the discipline (e.g., developing processes for understanding mathematics rather than learning the skills of mathematics). They noted that each new set of advocates for these approaches seem either unaware of or uninterested in previous evidence that unguided approaches have not been validated. No matter if students preferred less guided methods, they learned less from them (Clark, 1989). Students profit from the facility, active use, and flexibility of various learning strategies (Samuelstuen & Bråten, 2007), and the use of various strategies is a major attribute of expertise in many domains (Lundeberg, 1987; Pressley & Afflerbach, 1995). Constructivism is a form of knowing and not a form of teaching, and it is important not to confuse constructing conceptual knowledge with the current fad of constructivism (Bereiter, 2002; Small, 2003). Constructing conceptual knowledge involves considering learning from the learner's viewpoint; starting from the premise that all learners are active, appreciating that what they learn is socially constructed, and understanding that learners need to create or recreate knowledge of themselves (Phillips, 1995). If this is the

Table 11.1 Effect sizes for teacher as activator and teacher as facilitator

Teacher as activator	*d*	*Teacher as facilitator*	*d*
Reciprocal teaching	0.74	Simulations and gaming	0.32
Feedback	0.72	Inquiry-based teaching	0.31
Teaching students self-verbalization	0.67	Smaller class sizes	0.21
Meta-cognition strategies	0.67	Individualized instruction	0.20
Direct Instruction	0.59	Problem-based learning	0.15
Mastery learning	0.57	Different teaching for boys and girls	0.12
Goals – challenging	0.56	Web-based learning	0.09
Frequent/effects of testing	0.46	Whole language – reading	0.06
Behavioral organizers	0.41	Inductive teaching	0.06
Average activator	0.60	Average facilitator	0.17

meaning of constructivism from a learner perspective, then the more direct and active methods of teaching appear to be optimal for achieving this type of learning. The only way constructive thinking applies to teaching is to the teachers themselves, as they "construct" conceptions, beliefs, and models about how they teach and how students learn. The methods that work best, as identified from the synthesis of meta-analyses, lead to a very active, direct involvement, and high sense of agency, in the learning and teaching process. Such teaching leads to higher levels of learning, autonomy, and self-regulation on behalf of the learner (whether student or teacher).

Another contrast is between active and quality teaching strategies on the one hand, working conditions on the other; and the averages are $d = 0.68$ compared to $d = 0.08$ (Table 11.2). Educational *structures* and *working conditions* have mainly indirect or probabilistic effects on student learning (Barr & Dreeben, 1983). That is, the effects of these structures (e.g., tracking, class size, school mix, finances) are mediated by an array of instructional and peer processes. The presence or otherwise of these kinds of structures can change the *probability* that these processes occur (which then influences student learning). So, for example, reducing class size does not *directly* influence student learning. Rather, reducing class size merely increases the *probability* that the environment can be structured to capitalize on various teaching and peer influences (such as changing self-efficacy, enhancing academic reputations, and altering expectancies for success). Reducing class size rarely has a direct effect on outcomes. I noted in Chapter 6 the many instances when changing these class structures led to no change in the manner in which teachers configured interactions, no change in the nature of the curricula and instructional strategies used by teachers, and no change in the interactions among students (Hattie, 2007). Hence, the claim is that the school and class compositional effects, at best, change probabilities that successful learning conditions can be constructed. Any inspection of the policies of state or federal government, however, would show that there are few policies that directly affect teaching. Most policies are about structural issues such as resources, smaller class sizes, choice (or whom you want to send your children to school with), curriculum, and tests and high stakes assessment. It is rare to find a policy that relates to teaching.

Teaching and learning strategies

The messages in this book relate to the six signposts noted above rather than to endorsing particular methods. It may be very possible to use these signposts and other messages about

Table 11.2 Effect sizes from teaching or working conditions

Teaching	*d*	*Working Conditions*	*d*
Quality of teaching	0.77	Within-class grouping	0.28
Reciprocal teaching	0.74	Adding more finances	0.23
Teacher-student relationships	0.72	Reducing class size	0.21
Providing feedback	0.72	Ability grouping	0.11
Teaching student self-verbalization	0.67	Multi-grade/age classes	0.04
Meta-cognition strategies	0.67	Open vs. traditional classes	0.01
Direct Instruction	0.59	Summer vacation classes	–0.09
Mastery learning	0.57	Retention	–0.16
Average	0.68		0.08

what makes the best difference to teaching and learning to improve many of the methods that may not, on average, be above the $d = 0.40$ hinge-point. For example, team teaching has an overall very low effect ($d = 0.19$), but if team teaching is undertaken with more attention to the feedback from students to the teachers, from each teacher to the other(s), and using appropriately challenging goals and so on, then the effects may be much greater. It is less the "methods" per se, than the principles of effective teaching and learning that matter. Fullan, Hill, and Crévola (2006) have warned against what they term the "prescription trap". Such prescription prescribes "specificity to instruction with the promise of and in some cases the evidence of, increased student performance" (Fullan *et al.*, 2006, p. 9). They claim that prescriptions, like Direct Instruction, more often work in schools where teachers are poorly prepared, where there is a long history of failure, and where there is chaos and disorder. But the method is difficult to maintain, particularly as the students do not become independent learners when they are confronted with new tasks. This is not my reading of this literature, but the point made by Fullan *et al.* about "prescriptions" of a particular teaching package is well worth heeding. It is not a particular method, nor a particular script, that makes the difference; it is attending to personalizing the learning, getting greater precision about how students are progressing in this learning, and ensuring professional learning of the teachers about how and when to provide different or more effective strategies for teaching and learning.

These principles should not be confused with transmission teaching, or what Ben-Ari and Eliassy (2003) called the traditional frontal instructional strategy. This transmission strategy involves primarily teacher directed instruction of tasks to all the class, suggesting uniform ways of performing them. The level of instruction is adjusted to meet the needs of middle to high achieving students, and the pacing of instruction based on feedback from lower achieving students. "As a result, the entire student body suffers, so that fast-paced achievers are not sufficiently stimulated, whereas low achievers may feel frustrated; decreased motivation and off-task behaviors are likely to follow" (Ben-Ari & Eliassy, 2003, p. 145). This then leads to teachers conceiving their role to finding more engaging rather than more challenging tasks, more frontal talking, and asking questions they already know the answers to, lower self-regulation by students, and students learning that progress depends on the teacher-directed methods and tasks.

Instead, active teaching involves more backward design. Rather than starting from the textbooks, favored lesson, and time honored activities, start backwards—from the desired results (success criteria related to learning intentions) (van Gog, Ericsson, Rikers, & Paas, 2005; Wiggins & McTighe, 2005). The aim is to help students to develop explicit cognitive schemas to thence self-regulate and teach themselves the knowledge and understanding, to realize why they need to invest deliberative practice, and then for teachers to evaluate the success of their chosen textbooks, favored lessons, methods, and activities to achieve these goals. The aim is to get students to learn the skills of teaching themselves—to self-regulate their learning.

Learning strategies clearly make a difference. Learning strategies enable progress through the three "worlds" of surface, deep, and constructed knowing and understanding. Such strategies assist in reducing cognitive load (e.g., over learning of surface information to assist in developing learning strategies and developing heuristics, Shah & Oppenheimer, 2008) and can assist in deliberative practice, which depends on and can lead to expectations of "can do", a thriving on challenge, deliberative practice, and an appreciation of feedback. For such deliberative practice to be effective there need to be various pre-conditions, of which the most important is that the practice must be embedded into a higher-order set of learnings—practice by itself without relating to more challenging goals is dull, repetitive, and counter to engaging students in learning. Other pre-conditions could include being aware of the learning intentions, goals, advance organizers, showing worked examples, and pre-practice briefs and orientation. Associated conditions can include the effectiveness of deliberative practice (including feedback), alternative learning strategies, and peer tutoring and assistance (see Cannon-Bowers, Rhodenizer, Salas, & Bowers, 1998).

A recent major review by Bransford, Brown, and Cocking (Bransford, Brown, & Cocking, 2000) of how people learn identified three major principles, which are consistent with the findings in these meta-analyses. The first was that students come into classes with preconceptions about how the world works, and teachers need to engage with this initial understanding otherwise the students may fail to grasp the new concepts and information. Second, for teachers to develop student competence, their students must have a deep foundation of factual knowledge, understand the ideas in the context of a conceptual framework, and organize knowledge in ways that facilitate retrieval and application. Third, a meta-cognitive approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them. The key questions are: "Where are we going?", "How are we going?", and "Where to next?".

There is also much consistency with the principles for "how children learn" outlined by Vosniadou (2001): learning requires the active involvement of the learner; learning is primarily a social activity; new knowledge is constructed on the basis of what is already understood and believed; we learn by employing effective and flexible strategies that help us to understand, reason, memorize, and solve problems; learners must know how to plan and monitor their learning, how to set their own learning goals, and how to correct errors; sometimes prior knowledge can stand in the way of learning something new, and students must learn how to solve internal inconsistencies and restructure existing conceptions when necessary; and learning takes considerable time and periods of practice to start building expertise in that area.

This means that teachers need to be "adaptive learning experts" (Bransford *et al.*, 2000; Hatano & Inagaki, 1986), who not only use many of the effective strategies outlined in these chapters but also have high levels of flexibility that allow them to innovate when routines are not enough. They can ascertain when students are not learning, know where to go next, can adapt resources and strategies to assist students meet worthwhile learning intentions, and can recreate or alter the classroom climate to attain these learning goals. "Adaptive experts also know how to continuously expand their expertise, restructuring their knowledge and competencies to meet new challenges" (Darling-Hammond, 2006, p. 11). They have the empathy required "to express concern and take the perspective of a student and it involves cognitive and affective domains of empathy" (Tettegah & Anderson, 2007, p. 50). This involves hearing "the intent and emotions behind what another says and reflecting them back by paraphrasing" (Woolfolk Hoy, 1998, p. 466). Further, teachers need to pay special attention to the way children define, describe, and interpret phenomena and problem-solving situations and begin to understand these experience from the unique perspectives of students (Gage & Berliner, 1998).

The presence of challenging learning intentions has multiple consequences. Students can be induced to invest greater effort, and invest more of their total capacity than under low demand conditions. Such intellectual engagement involves a desire to engage and understand the world, have an interest in a wide variety of things, and not be put off by complex and challenging problems (Goff & Ackerman, 1992). The rate of learning is a direct function of goal difficulty, as is the level of persistence over time to attain difficult goals. It certainly assists if the students are also committed to the goals (and of course they need to know them before committing to them), and doing "one for the Gipper" or "do your best" may help in a few situations but is rarely enough to sustain interest in learning.

Challenging goals increase the effectiveness and need for feedback. If the goal is easy, then feedback is not necessary, but if difficult, there is a greater need for feedback. As Locke and Latham wrote:

> Feedback tells people what is; goals tell them what is desirable. Feedback involves information; goals involve evaluation. Goals inform individuals as to what type or level of performance is to be attained so that they can direct and evaluate their actions and efforts accordingly. Feedback allows them to set reasonable goals and to track their performance in relating to their goals, so that adjustments in effort, direction, and even strategy can be made as needed. Goals and feedback can be considered a paradigm case of the joint effect of motivation and cognition controlling action.
>
> (Locke & Latham, 1990, p. 197)

Classroom contexts are diverse

None of the above should imply that classroom cultures are not critical. Throughout the chapters of this book, the importance of relationships, trust, caring, and safety have been emphasized, as has the importance of teachers choosing worthwhile and appropriately challenging tasks. This highlights the classroom climate and the ethics of making decisions about what is appropriately worthwhile. Evidence does not provide us with rules for action but only with hypotheses for intelligent problem solving, and for making inquiries about our ends of education (Dewey, 1938). Key questions that need to be explored include "What works best?", "Compared to what alternatives?", "When?", "For whom?", and "To what ends?". By itself, "What works?" can be barren (Glass, 1987). It is hoped that the messages in this book highlight the enormous power of the teacher, the amazing power of some of the methods they use, the critical nature of teachers' proficiencies in decision making and making judgments, the vital need to develop a caring relationship with and among students, and the constant need to ask what the desirable outcomes of any "teaching" are—all of which point to the moral dimensions of teaching.

Any recommendations about "what works best" invoke claims about cultural matters that influence and drive classroom interaction and discourse patterns. Consider, for example, the place of "talk" in classrooms. In Alexander's (2003) study of classrooms in many countries, he found that teachers in France, Russia, Britain, and America articulated and enacted three versions of values:

- Individualism (a view that knowledge and expression is personal and unique).
- Community (a view that learning and doing is collaborative in a climate of sharing and caring).
- Collectivism (learning together rather than in small groups, with common ideals and knowledge).

New Zealand classrooms, it would appear, align with Alexander's data on British and American classrooms where one-to-one monitoring, with private and often whispered exchanges, are prominent; in his terms, these classrooms share individualistic and community values. In British classrooms "mistakes" were "embarrassing" and teachers strove to minimize public "mistakes" to avoid the child "losing face". The emphasis tended to be on needing to express "correct" answers and on teacher approval. In contrast, in Russian classrooms problems and "mistakes" were in the public domain to be engaged with alongside "correct" or preferred responses. Collective and public discourse engagement dominated. Where Russian teachers highlighted their role in creating and sustaining dialogue and conversation, British and American teachers aimed to run their classrooms such that conversations were "shared" and seen as "democratic", where there were many teacher-managed sequences of "unchained two-part exchanges", where voices were allowed to be heard rather than creating a strategic expansion of meaning-making. Video studies from the PISA mathematics comparisons across seven countries showed much consistency in lessons, whereby students were asked to solve problems, usually alone or in whole-class groups (rarely in small peer groups), an extensive use of textbooks or work sheets, and teachers talking eight times more than students (Hiebert *et al.*, 2003).

My colleague, Alison Jones, remarked how fascinating it was that I could understand classrooms to the second decimal point. Her comment was a sobering reminder of the importance of the cultural context of the classroom, and what the students and teachers bring to the class from cultural and sociological perspectives. Reducing classrooms to an index number (effect size) could be considered akin to reducing society to unemployment indices, intelligence quotients, or currency rates. This debate about "index numbers" was plentiful in the 1950s and it is well worth remembering the cautions about their use (Guilford, 1954). The variability around the typical value of the effect size can be as informative (as the homework example showed), the unexplained variance is worth knowing as it limits the importance of the wanted variance (and thus highlights the importance of quality measures and research designs), the reference point is critical (as in the argument that the h-point of $d = 0.40$ is a more critical reference point than the usual $d = 0.00$), and the interactions with other variables can dramatically alter the conclusions (as in the learning styles example). Most important to any discussion on indices are "rival plausible hypotheses." The "story" told in this book about visible teaching and visible learning is one set of plausible hypotheses to fit a model to these data and the data to the model—there are certainly many more. Alternative plausible hypotheses are welcomed.

The concept of levels of understanding

As noted at the outset of this book, the focus has been on achievement—but there are many other worthwhile outcomes of schooling. It was surprising to find that, while achievement can be construed across a number of content areas, there was a struggle to find differential effects within the many meta-analyses related to subject. The subject chauvinism of so many high schools may be justified on the basis of the nature of the achievement desired, but good teaching and the most powerful influences on student outcomes seem to be similar across domains. Somewhat surprisingly there was no preponderance of evidence supporting the importance of subject or pedagogical content knowledge. The latter includes not only the content matter (the production view so often studied), and the pedagogical content knowledge (knowing how to teach), but also the teacher knowing when a learner does not comprehend, make mistakes, and so on (see Deng, 2007 for a most worthwhile debate on these issues). One type of content knowledge rarely explored may be more critical—teachers' conception of progress in the subject, knowledge of when to intervene, knowledge of learning theory, and openness to the experience of alternative ways to teach the content. These may be well worth deeper investigation.

In Chapter 3, it was proposed that achievement can be discussed at three levels: surface, deep, and conceptual or constructed understandings. There are also other critical achievement outcomes such as fluency, retention, application, endurance, and problem solving strategies. As well, there are various types of "thinking" and understanding that are critical to developing conceptual understanding: information gathering, building understanding, productive thinking, reflective thinking, strategic management of thinking, and evaluating thinking (Moseley *et al.*, 2004). The model used throughout this book was based on Biggs and Collis's SOLO (Biggs & Collis, 1982) model, and akin to the claims by Bereiter (2002) who used Popper's distinction between three worlds— the physical, the subjective, and the world of ideas. Thus there are multiple meanings of achievement, such as surface, deep, and construction of knowing. It is the case that most tests used in the studies in these meta-analyses are particularly effective at measuring surface features, somewhat effective at measuring deep learning, but rarely effective at measuring the construct representations that students build from their classroom experiences. Knowing is an activity, not a thing, in this third sense, and it is reciprocally constructed in the individual-environment-teacher interaction and not easily objectively defined by a one-off test (Barab & Roth, 2006). Many researchers are aiming to gain a better sense of how measurement would work at this Third World, and this is exciting (Gierl, Zheng, & Cui, 2008; Luecht, 2006; Luecht, Gierl, Tan, & Huff, 2006; Mislevy, 2007). A limitation of many of the results in this book is that they are more related to the surface and deep knowing and less to conceptual understanding.

The zero and hinge point

Even if the story developed to explain the findings is not convincing, the use of the "h-point" (d = 0.40) to demarcate the expected value of any innovations in schools is critical. Rather than using the zero point, which is hardly worthwhile, the standards for minimal success in schools should be more like d = 0.40. Any innovation, any teaching program, and all teachers should be aiming to demonstrate that the effects on student achievement should exceed d = 0.40. This h-point is not only attainable by many innovations but is the average, not the maximum, effect. Many students experience gains of d = 0.40, primarily because of excellent teaching; why cannot all?!

So often progress is cast in terms of activities and events and not in terms of increasingly more challenging demands from the underlying concepts in the curricula. Too often, progress is defined in terms of test scores, rather than in terms of proficiencies and competencies of what these test scores supposedly measure. So often in schools, students' achievement is compared to their achievement last year (or before a treatment) with the usual claims that "It worked", "I was happy with it", "I have passed on all the students to the next teacher who has never criticized my teaching of these students", "Yes, some students are not so able but that is more a function of what they brought to the class and not a consequence of my teaching". It turns out that these claims are among the weakest of all.

A fascinating question to ask teachers is: "What percentage of the students in your class go backwards in one year with you?". The concept of going backwards does not just mean those who genuinely fall behind compared with where they started (and they do exist), but also those who do not make the appropriately expected yearly gain for that year, and those who start falling behind or going backwards, compared to what they could achieve, because their teachers have low expectations. In our experience in a large city in the United States, we found 80 percent of students went backwards in some schools—in mathematics in grade 9, where they first encountered algebra, the students struggled to the point that they become disengaged from mathematics, developed beliefs about their lowered performance in mathematics, and often dropped out of mathematics (Hattie, *et al.* 2007). For many, this question of "going backwards" is rarely considered, and this reduces the chance of teachers looking for these students, and thus being in front of rather than behind the problems these students then encounter.

I would go further and claim those students who do not achieve at least a 0.40 improvement in a year are going backwards—they are with respect to those students who do exceed this average. The current standard, however, is more referenced to the zero point, and this is probably why it is difficult to find a below average teacher; why every teacher is considered effective; and why all can find evidence that they have "added value" (i.e., $> d = 0.0$). In addition, too often the claim is that the quality of teachers has little if any variance—one of the greatest myths of teaching is that all teachers are equal. There is an appreciable amount of variability in the effectiveness of teachers (this is demonstrated by, for example, there being so little between-school variance). We may indeed proclaim that all teachers are performing well; but not all students would agree.

If the criterion of success is achieving effect sizes greater than 0 then nearly all teachers could be considered effective. But this is a false comparison and assumes that any achievement is better than none! Students are more discriminating about teachers and, as noted in Chapter 7, Irving (2004) demonstrated that they are often accurate in their discrimination. Perhaps it is no wonder there is an increasing set of problems relating to student engagement. As Steinberg, Brown, and Dornbusch (1997) claimed, so many students "are physically present but psychologically absent" (p. 67). They also cited that about 40 percent of students are "going through the motions" and say they neither try hard nor pay attention. So many cut class and are truant, so many admit to cheating to get through, so many lose interest because they cannot keep up, and so many are bored by the lack of appropriate challenge. So many do not learn that ability is not enough, and that effort is critical. About half who drop out of school claim that classes were not interesting or inviting, and two-thirds claim that not one teacher was interested in their success in learning at school (Bridgeland, DiIulio, & Morison, 2006) All is not rosy with teachers, teaching, and schooling.

It is sobering to realize that we have a teaching cohort that is average, at best, in the eyes of most students. It is sobering to realize that each child will meet only a few teachers who they will consider to have a lasting and positive effect on them. It is sobering to realize that these teachers will be remembered not because they taught social studies or mathematics but because they cared about teaching the students their passion for their subject, gave students confidence in themselves as learners and as people, treated the student as a person, and instilled a love of learning of their subject(s).

But—teachers claim they are doing the best job they can. Principals attend to implementing the best programs they can. Systems aim to devise policies with the greatest effects they can. A major theme in this book is that these intentions—to introduce the best we know—often fall short because the decisions are inappropriately compared, they are inadequately evaluated relative to alternatives, they tend to be related to structural and working conditions and not to teaching strategies and conceptions, and they are evaluated using models that seek success (anything greater than 0 is too often considered successful) and ignore failures. To readdress this problem, a more effective barometer model of relative success has been suggested, such that educators can use this barometer to more effectively ask whether their influences of choice are successful.

What is special about "innovations"?

The typical teacher's effects are about $d = 0.15$ to $d = 0.35$. It is when there is an *intervention* or *innovation* that the effects can increase markedly beyond this. This does not mean that change for the sake of change is needed, as the question is "What are the attributes of innovations that lead to above average effects?". Innovation does not occur merely because it is something new or different. Innovation occurs when a teacher makes a deliberate action to introduce a different (not necessarily new) method of teaching, curriculum, or strategy that is different from what he or she is currently using. The aim is to encourage teachers to construe their teaching in terms of a series of related experimental designs, as then the benefits of the increased attention to outcomes can be accrued. Many of the innovations that appear near the top of the barometer of influence could be conceived as clinical treatments—for example, direct instruction, reciprocal teaching, reading recovery. It is fascinating to compare a meta-analysis of 150 articles concerning the critical change agents in therapy (Holly, 2002). The critical change agents (in order) are knowledge and skills; a plan of action; strategies to overcome setbacks; a high sense of confidence; monitoring progress; a commitment to achieve; social and environment support; and, finally, freedom, control, or choice.

There are various stages to innovation such as initiation, implementation, and evaluation—and most often the "innovation" changes during the implementation. The most critical attribute, however, is that when undertaking an innovation there is a heightened attention to its effects, to feedback to the teacher about the effects of the innovation, and to a focus on the learning intentions and success criteria from any innovation. Innovations carry the risk of failure; innovations help us free ourselves from the structured life and schemes that are created around us. It is this searching for that which is not working, and those students for whom you are not being successful; it is the heightened sense of seeking feedback, the increased attention to the principles of evaluation (discerning that of merit and worth), and the focus on how to seek the evidence of disconfirmation of the teaching so as to improve it that are important. In the search for how science progresses, Karl Popper (1963) claimed that a key was the search for disconfirmation (as so often we see evidence of our success everywhere). When teachers seek evidence that their teaching may *not* have been successful, then the desirable lens of success is in place. The teaching may not be successful for all students, for all parts of the learning intentions, towards all aspects of the success criteria; and even our goals, level of challenge, and processes of both effortful and conduct engagement may need to be constantly questioned.

Why can't they change?

"They" are teachers, policy makers, teacher educators, and oftentimes parents. I started this book by noting that there are many hundreds of solutions as to how to make learning as effective as possible. Teachers are willing to change, although they are probably sick of change. Most changes they experience are to structural and working conditions. But what if the changes were to their own conceptions of teaching and learning in the directions suggested in the book? This requires an openness to the idea, and a willingness to be wrong. That is, a willingness to seek a better alternative to what the teacher is currently doing by evaluating the effects of the change on student learning. Adopting any innovation means discontinuing the use of familiar practice.

The key issue is less how to change, but why we do not. In a fascinating study, Shermer (1997) researched why we tend (often passionately) to believe in ideas even when they do not work. He attributed this to an over reliance on anecdotes, dressing up one's beliefs in the trappings of science or pedagogical language and jargon, making bold claims, relying on one's past experiences rather than others' experiences, claiming that one's own experience is sufficient evidence, and circular reasoning (I am doing it so it must be ok). He also cited various psychological processes that lead to our accepting what we have done as the "best": the need for certainty, control, and simplicity; the seeking of examples to confirm our current methods; the lack of seeking evidence to demonstrate what is *not* working; the attributions of cause to the student when he or she is not learning but to the teacher when the student is learning; and a build up of an immunity to new or different ideas or ways of doing things (and some of these new ideas are indeed wacky). New and revolutionary ideas in teaching will tend to be "resisted rather than welcomed with open arms, because every successful teacher has a vested intellectual, social, and even financial interest in maintaining the status quo. If every revolutionary new idea were welcomed with open arms, utter chaos would be the result" (Cohen, 1985, p. 35). We have an uphill task.

In an analysis of teachers' accounts of classroom experience, Little (2007) noted that teaching was carried out largely out of sight and hearing of other teachers, and thus there was a tendency to rely on narrative accounts to construct a shared understanding. So often teachers depended on "war stories", personal experiences, and a reliance on their own experience to justify their personal preferences. If this swapping of war stories is the closest teachers come to professional conversations, the picture is bleak for the messages in this book about teachers needing to share evidence about their teaching with their colleagues. Little proceeds to show how these conversations could be more productive. The key is to develop teachers' accounts of classroom experience (and I would add "outcomes for the student and for the teachers") as a "useful resource in making sense of more aggregate patterns of student behavior and achievement, [as] … they constitute a resource for learning and instructional decision making anchored in the particularities of classes and curricula" (Little, 2007, p. 237). By questioning one another, eliciting replays and rehearsals, using evidence in these narratives, and offering and revising interpretations and explanations, teachers can build "general principles of practice anchored both in the conceptual frames they had acquired and in the particularities of their experience" (p. 231). But it takes instructional leadership and the creation of a safe and trusting environment to engage in such criticism, a commitment to share evidence about the effects of teaching, and an openness to new experiences. The message about "what works best" for students also applies to "what works best" for teachers.

The theme throughout the findings is that the lens the teacher uses is critical to success, and it needs to be subject to close scrutiny, considered from an "others" viewpoint, and checked for evidence as to whether all students are learning desirable curricular outcomes at a sufficient rate. If the teacher's lens can be changed to seeing learning through the eyes of students, this would be an excellent beginning. This involves teachers seeking countering evidence as to the effectiveness of their teaching, looking for errors in their thinking and knowledge, seeing how students build on prior knowledge and conceptions of learning, asking whether there is sufficient challenge and engagement in the learning, and understanding the strategies students are using when learning and confronting difficulties.

Another reason for the lack of change is the over reliance on teacher judgments rather than evidence. There has been a long history in many areas of placing more reliance on "professional judgments" than on evidence. This debate has percolated in the literature since Meehl's (1954) book *Clinical versus statistical prediction*, in which he found that in all but one of 20 studies, statistical methods were more accurate than or equally as accurate as the clinical methods. Clinical prediction refers to any judgment using informal or intuitive processes to make decisions. Aegisdottir *et al.* (2006) used 173 effect sizes from 69 studies published over the past 56 years, and concluded that there was a somewhat greater accuracy for statistical rather than clinical judgment methods. Similarly, Martin, Quinn, Ruger, and Kim (2004) found that statistical models could predict the outcomes of United States Supreme Court decisions more effectively than a set of independent predictions by 83 legal experts. The most fascinating aspect of this domain of research, which has been replicated many times, is that these findings have had little influence on clinical practice. Practitioners often lack familiarity with evaluation and statistical methods, are often incredulous about the evidence, more highly value interpersonal cues, believe that statistical methods dehumanize, believe that there is more individual variation than group consensus, and are subject to confirmatory biases such that they recall instances in which their predictions were correct but fail to recall those instances in which independent evidence was more accurate.

A further reason is that the contingencies in schools do not attend to student outcomes as much as the working and structural conditions of teaching and learning. Hanushek (1997) has argued that little rides on success or failure, and teachers measure success more in terms of satisfaction they receive from doing a "good job", and the potential approval or disapproval of parents and principals. There are few direct incentives related to student performance and so often, claimed Hanushek, teachers are "simply reacting to the incentive structure that does not emphasize student performance" (p. 305).

Many years ago, Alessi (1988) reviewed more than 5,000 children referred to school psychologists because they were failing at school. Not one located the problem as due to a poor instructional program, poor school practices, a poor teacher, or something to do with school. The problems were claimed, by the teachers, to be related to the home and located within the student. As Engelmann (1991) claimed "An arrogant system would conclude that all the problems were caused by defects in the children, none caused by defects in the system" (p. 298). Instead, Engelmann challenged teachers and schools to ask:

- Precisely where have you seen this practice installed so that it produces effective results?
- Precisely where have you trained teachers so they can uniformly perform within the guidelines of this new system?
- Where is the data that show you have achieved performance that is superior to that achieved by successful programs (not simply the administration's last unsuccessful attempt)?
- Where are your endorsements from historically successful teachers (those whose students outperform demographic predictions)?

The depressing news is that "the closer an innovation gets to the core of schooling, the less likely it is that it will influence teaching and learning on a large scale" (Elmore, 1996, p. 4) and reciprocally those further away from teaching and learning are more likely to become national policies. The problem is not general resistance or failure of schools to change, claimed Elmore, as schools are constantly changing. He located the resistance, as do I, with the conceptions of teaching and learning shared by teachers. "Just leave me alone to teach my way" is the common mantra. We see the increasing numbers of disengaged students as the problems of students or their families, or of society, not of teachers or schools. It is nigh on impossible to legislate changes to conceptions of teaching and learning—and this is where professional development becomes critical. So often the policy changes have little or no effect. The effect of a storm on the ocean is that the "surface is agitated and turbulent, while the ocean floor is calm and serene (if a bit murky). Policy churns dramatically, creating the appearance of major changes … while deep below the surface, life goes on largely uninterrupted" (Cuban, 1984, p. 234).

A major area in educational research should be why we continue to believe many claims about "what works best" when there is no evidence for these claims (Yates, 2008). The most obvious is class size, as most seem to believe that reducing class size has a major influence on student outcomes. It does not, but listeners to recitations of the evidence so often suspend belief in such claims, and argue from the probabilistic claim—surely reduced class size would lead to many desirable benefits (more feedback, more individualization, better listening to students). Such probability may indeed be the case, but the fascinating question is why the benefits do not accrue when we reduce class sizes (Hattie, 2006). There are so many instances of teachers and parents believing claims when there is an enormous amount of contrary evidence.

If teachers have barely changed teaching methods over the past 200 years, if the predominant mode of classroom "action" is questioning, recall, and the acquisition of large chunks of surface knowledge, where engagement and busyness are sought, then recommendations about the nature of teaching outlined in this book to change this transmission model are unlikely to make a dent. It is so much easier to discuss and seek funds for working conditions—reduced class size, salary, buildings, lengthening school periods or days—or at appeasements to parents (computers, school choice, charter schools, more examinations). We have in education a long history of innovation but it rarely touches but a chosen few. The likelihood of the claims in this book having a major effect will depend more on whether schools can turn, as did much of medicine, to evidence-based claims. The request is for teachers and schools to enhance learning by at least $d = 0.30$ more than last year, and preferably more than $d = 0.40$ before any intervention is considered worthy of retaining or implementing. Putting this challenge squarely on the table of schools and government departments is the most likely mechanism for change.

The nature of evidence

"Evidence" is not neutral. Biesta (2007), for example, has criticized the evidence-based approach such as used in this book on a variety of grounds. First, she claimed that what counts as "effective" crucially depends on judgments about what is educationally desirable. Agreed, but achievement is among what is crucially desirable. Agreed also, there are other critical outcomes such as affective outcomes, persistence and engagement, physical outcomes, and social normative behaviors and skills.

Second, evidence-based methods appear to offer a *neutral* framework that can be applied across areas (such as education, or medicine) and central to the method is the idea of effective intervention. Education, however, is never neutral, and its fundamental purpose is intervention or behavior change. This is what makes teaching a moral profession, with such fundamental issues as: "Why teach this rather than that?", "How does one teach in defensible and ethical ways?". Snook (2003) has argued that teaching involves close personal relationships: between teachers and students, between one student and another, and between one teacher and another. Teaching involves a mission to change people in certain ways. This teaching occurs in schools in which there are hierarchies of control and rules to be obeyed. The "power" in these interactions and contests is very real. Hence, claimed Snook, teaching involves ethics in its aims, its methods and its relationships. He argued that the role of the teacher involved a respect for autonomy, and a respect for reason. He cautioned that "when we hear too much of the technicist teacher, the competent teacher, the skilled teacher, we should remind ourselves that education is essentially a moral enterprise and in that enterprise the ethical teacher has a central role to play" (p. 8).

It is the case that in this book only meta-analyses have been given the privilege of being considered. A review of non-meta-analytic studies could lead to a richer and more nuanced statement of the evidence. I leave this to others to review in this manner, although I have tried to incorporate aspects of these other views in my own summaries of each area. The emerging methodology of qualitative synthesis promises to add a richness to our literature (Au, 2007; Thorne, Jensen, Kearney, Noblit, & Sandelowski, 2004).

The costs as well as the benefits of innovations

It needs to be noted that evidence based on effect sizes alone could lead to poor decisions. For any set of choices, there are costs as well as benefits. The financial costs of the various interventions may need to be taken into account when making decisions about what works best. It may be that we can use some of the cheaper interventions if their effects are positive, and this may be preferable to using some of the more expensive interventions. The problem is that there are many kinds of costs in education: cost-minimization, where the intervention that is least costly is preferred; cost-benefit, where there is a trade-off of the costs and the benefits (in terms of effect size, ease of implementation, consistency with prior teacher practice, alignment with aims of the program); there is also average versus incremental cost-effectiveness, whereby the averages in this book can be considered relative to the average $d = 0.40$, or the incremental or marginal cost-effectiveness ratio, which is the cost of switching from what you are doing now to another treatment. Perhaps more critically, there are also the costs associated with lost opportunities for students to learn or engage in educational activities that truly make a difference—and which many of their fellow students are benefiting from! There are the "suffering costs" of being exposed to interventions with least effectiveness—no matter that the teacher has used the intervention before, how much the teacher enjoys it, or finds evidence to support it from anecdotal and rose-tinted perspectives (e.g., looking for the positives). As Hanushek (2005) and others have demonstrated repeatedly, we spend millions, if not trillions, of dollars investing in innovations, changes, and policies in education without a lot of evidence that this investment is making a difference to student outcomes. They may make a major difference to teachers' and students' working conditions, but not to the achievement outcomes.

The education dollar in the United States has risen a steady 3.5 percent annually over the past 100 years, and the majority (60 percent) is spent on instruction. Odden (2007) argued that increasing the portion spent on instruction will be unlikely to have an effect on student learning, Instead, the schools that doubled performance followed a set of similar strategies such as setting high goals (e.g., 90–95 percent of students to proficiency), analyzed student data to become deeply knowledgeable about the status of student performance in the schools, made use of formative assessments, collectively reviewed evidence on good instruction, used time more productively, and were led by leaders providing instructional leadership.

The cost-benefits of innovations are certainly relatively unexplored. At best, production functions have been used to estimate the relationships between the costs of varying school inputs and the educational outcomes (usually attempting to control for various background features). Such models rarely include the influence of nonpurchased and nonmonetary inputs, (such as peer effects, Hanushek, 1998; Subotnik & Walberg, 2006). In one of the more interesting models, Walberg (1980) proposed using the Cobb-Douglas (1928) production function as it includes many valuable properties. The marginal products of capital and labor are both positive, which means that adding more teaching leads to greater gains (to a point). There are, however, diminishing marginal returns, such that doubling learning time does not mean doubling learning outcomes, or adding more influences and methods may lead to fewer outcomes. Adding more into the teaching situation may not necessarily be as powerful in return as choosing the optimal smaller set of what leads more directly to learning outcomes. This model also highlights the importance of interaction effects or, more importantly, ensuring that the right combination of interventions exists in the right proportions to ensure an interaction effect.

It is unlikely that many of the effects reported in this book are additive—simply coupling together some of the effects does not mean that we can merely "add" the effects together and then expect these changes. There may be some cases where there could be additive effects (e.g., home plus school effects), and there were additive effects from the Adventure programs, but as was noted, this was unusual.

Comparisons of costs can also be most informative. For example, reducing class sizes from 30 to 15 produces an effect size between $d = 0.10$ to $d = 0.20$. Buckingham (2003) estimated that the effects of reducing the overall average ratio of New Zealand elementary and high school students by one student (to 18.4 and 14.5, respectively) was around NZ$113 million per year (it was acknowledged that this ratio is not the same as reducing class size). This cost only provides for one less student per class on average, it would be an ongoing commitment, and is not a one-off investment as it would account only for extra staffing costs. Other additional costs include building more and smaller classrooms, providing additional classroom resources and ongoing professional development, and finding the extra qualified teachers (see also Greenwald, Hedges, & Laine, 1996). Brewer, Krop, Gill, and Reichardt (1999) estimated the costs of reducing class sizes to 18 students in grades 1 to 3 in the United States would require hiring an additional 100,000 teachers at a cost of $US5–6 billion per year, and an additional 55 percent more classrooms. To reduce again from 18 to 15 students would cost a further $US5–6 billion per year. They estimate that this investment could, instead, be used to raise teachers' salaries by $20,000 per year (see also Blatchford, Goldstein, Martin, & Browne, 2002). The right question is to ask "What is the best use of this resource?" or "What could be accomplished if this amount is spent on other innovations with higher effects on student outcomes?".

In a study comparing the relative magnitude of achievement effects resulting from the introduction of textbooks, establishment of radio instruction, and lowering of mean class size, Jamison (1982; see also Heyneman, Jamison, & Montenegro, 1983) estimated that to obtain the achievement benefit gained from increasing the availability of textbooks at a constant increment of cost, schools must lower average class size from 40 to 10 students per teacher. Fuller concluded "in most situations, lowering class size with the intent of raising achievement is not an efficient strategy" (1987, p. 276). Similarly, Levin (1988) compared the cost-effectiveness of four reforms for raising student achievement at the elementary level in reading and mathematics: a longer school day, computer-assisted instruction, cross-age tutoring, and reduced class size. Cross-age tutoring was the most cost-effective. The longer school day and reducing class size by five students showed the smallest returns. Computer-assisted instruction was associated with gains in the middle of the range of results.

The aim of these analyses is not to suggest that the costs of improvement are cheap. As Pressley *et al.* (2006, also see Chapter 7) have noted, the costs of implementing the reforms that seem to have most power in influencing student learning are expensive. These costs are mostly in effort costs of the teachers and school leaders, and in the effort costs of the students. So often these are assumed to be free, or taken from the social and home life of teachers. Changing teachers' conceptions is not easy or cheap. Rogers (1962), for example, proposed an "S-shaped curve of learning" to explain such changes to teachers and teaching. His diffusion model of innovation suggests that initially only a few teachers (typically those open to change, more educated, who have a greater store of knowledge, are self confident, and are not so concerned with the norms of others) begin trying an innovation. Then when there is sufficient critical mix, many more begin to innovate, but it is hard to get acceptance from the final 20 percent plus. Teachers will not just move from not doing a new behavior to doing it; they go through decision phases. Rogers (2003) called these phases: awareness, knowledge, persuasion, decision, implementation, and confirmation. The boundaries between these are not precise, and not all occur, but his argument is that adoption is a process, not a discrete event. There are many ways to make teachers aware of new ideas, but to close the deal and to accelerate the process of innovation adoption there is often a need for interpersonal outreach. The social networks are powerful but often these are the biggest barrier to innovation. Rogers' claims echo the comments in Chapter 1 about Cuban and Tyack's (1995) study of teaching over the past 200 years: 85 percent are resistant to change what they claim works for them; ten percent are willing to change to be more efficient, and five percent are willing to try new innovations. Hence the moves to use accountability, government pressure, compulsion, and the stick rarely change the conceptions or lens of teachers. The costs to make the implementations recommended in this book are among the more expensive, but the claim is that they are the right ones on which to spend our resources.

Implications for policy

In many classrooms and schools, there is evidence of low effect sizes, reliance on poor methods and strategies, a dependence on "war stories" and anecdotes, and an agreement to tolerate different and sometimes poor teaching. We beseech these teachers to be evidence-based but so many government agencies and departments, teacher educators, and others are not evidence-based, and seem reluctant to accept evidence if it is contrary to current policies. There is a preference instead to make changes to structural and working conditions. The clients of schools include government ministers and parents (voters), and it is common to find parents who want schooling for their children better than they experienced. There is a preference for the teaching method that fits the latest ideology, and rarely are these methods assessed by evidence. As the evidence in this book shows, we can do damage in schools—and by this I do not just mean those teachers that have 0 or negative gains over the year: I mean those teachers and schools who do not aim and achieve the h-point (+d = 0.40) effects that so many of our children *do* receive. The others are condemned to mediocrity and lesser opportunities. These high effects can be obtained—they *are* obtained by many teachers in our schools. This is no dream; it is a reality for many students. But for just as many students, the reality is the ordinary—the devil in this story is not the negative, criminal, and incompetent teacher, but the average, let's get through the curricula, behave, be busy, we are "all friends in here" teacher who has no idea of the damage he or she is doing.

Perhaps the most famous example of policy makers not using or being convinced by evidence was Project Follow Through, which started in the late 1960s. It was conducted over 10 years, involved over 72,000 students, and had more than 22 sponsors who worked in more than 180 sites to find the most effective education innovations to break the cycle of poverty through enhancing student learning. The innovations included Direct Instruction, whole language, open education, and developmentally appropriate practices (see Carnine, 2000; House, Glass, McLean, & Walker, 1978 for a history). The students in these programs were compared to control students (Stebbins, 1976; Stebbins, St. Pierre, Proper, Anderson, & Cerva, 1977). All but one program had close to zero effects (some had negative effects). Only Direct Instruction had positive effects on basic skills, on deeper comprehension measures, on social measures, and on affective measures. Meyer (1984) followed these students through to the end of their schooling, and those in the Direct Instruction compared to peers not in this program were twice as likely to graduate from high school, had higher scores on reading (d = 0.43) and mathematics (d = 0.28)—significant long-term differences in the Direct Instruction program effects. The outcome of this study, however, was not to support more implementation of Direct Instruction but to spend more resources on the methods that did not work but were preferred by educators. As Carnine (2000) commented, the romantic view of students discovering learning was more powerful than a method invented by a teacher that actually made a difference; a method that required an attention to detail, to deliberately changing behavior, and to teaching specific skills. The rejection of Direct Instruction in favor of Rousseaian inspired methods "is a classic case of an immature profession, one that lacks a solid scientific base and has less respect for evidence than for opinion and ideology" (p. 12).

Consider the following quotation:

> It is hard to conceive of a less scientific enterprise among human endeavors. Virtually anything that could be thought up for treatment was tried out at one time or another, and, once tried, lasted decades or even centuries before being given up. It was, in retrospect, the most frivolous and irresponsible kind of human experimentation, based on nothing but trial and error, and usually resulting in precisely that sequence.
>
> (Thomas 1979, p. 159)

Thomas was referring to the study of medicine and noted how evidence-based medicine was the mechanism for driving out dogma, as dogma does not destroy itself. The evidence-based revolution came through repugnance and pressure from groups that were adversely affected by the poor quality of service in the medical profession. Maybe legal cases about equity in outcomes across various ethnic groups, poor service by teachers, clinical trials of new educational treatments, and a set of international standards and expectations for outcomes from schooling may be the catalyst for change and improvement in education.

More of the same is certainly not the answer. The key question is whether teaching can shift from an immature to a mature profession, from opinions to evidence, from subjective judgments and personal contact to critique of judgments.

Can all this be done?

Two studies make the case that the claims in this book can be attained. First, a recent set of studies provided a portrait of schools that produced high achievement even though they had previously failed. Pressley, Mohan, Raphael, and Fingeret (2007) used grounded theory to build a picture based on interviews, analyses of test scores, and an in-depth study of the school. They concluded

> effective elementary teachers, especially those effective in promoting reading and writing, tend to do the following: They devote much of their class time to academic activity, engaging most students consistently in activities that require them to think as they read, write, and discuss. Effective teachers do explicit teaching (and reteaching as needed) of skills, and this teaching included modeling and explaining skills, followed by guided student practice. That is, effective teachers show a strong balancing of skills instruction and holistic reading and writing activities. Teacher scaffolding and reteaching are salient, accounting for a large proportion of such teachers' effort. Effective teachers connect content learning (i.e., social studies, science, math) to reading and writing instruction. Effective teachers have high expectations and increase the academic demands on their students (i.e., consistently encouraging students to attempt slightly more advanced books and write slightly longer and more complex stories). From the first day of school, effective teachers communicate high expectations for students to self-regulate and take charge of their behavior and academic engagement.
> (Pressley, Mohan, Raphael, & Fingeret, 2007, p. 222)

Second, I was involved in an in-depth investigation of the classrooms of a large cohort of teachers who had passed or not passed National Board Certification (see Chapter 7). Our interest was to evaluate the differences between experienced experts and experienced non-experts. We visited many teachers' classrooms to observe and to collect many artifacts, transcripts of lessons, interviews, questionnaires, and student work (Smith, Baker, Hattie, & Bond, 2008). We choose two groups: half the teachers had passed (just above the cut-score) the rigorous assessment to become National Board Certified teachers and the others had applied but not passed (just below the cut-score; see NBPTS, 2003; http://www.nbpts.org/about/index.cfm). Each set of evidence was independently coded across 13 dimensions identified from a literature review of experienced experts and experienced non-experts. There were marked differences between the two groups, and a stepwise discriminant function analysis indicated that three of the dimensions (challenge, deep representation, and monitoring and feedback) were sufficient to distinguish between the two groups (Figure 11.2).

We coded all student work along the SOLO scale: 74 percent of student work samples in the classes of certified teachers were judged to reflect a level of deeper understanding and 26 percent reflected a more surface understanding. This compares with 29 percent of the work samples of non-certified teachers so classified as deep and 71 percent as surface. The effects of expertise are greatest on deep understanding (Figure 11.3).

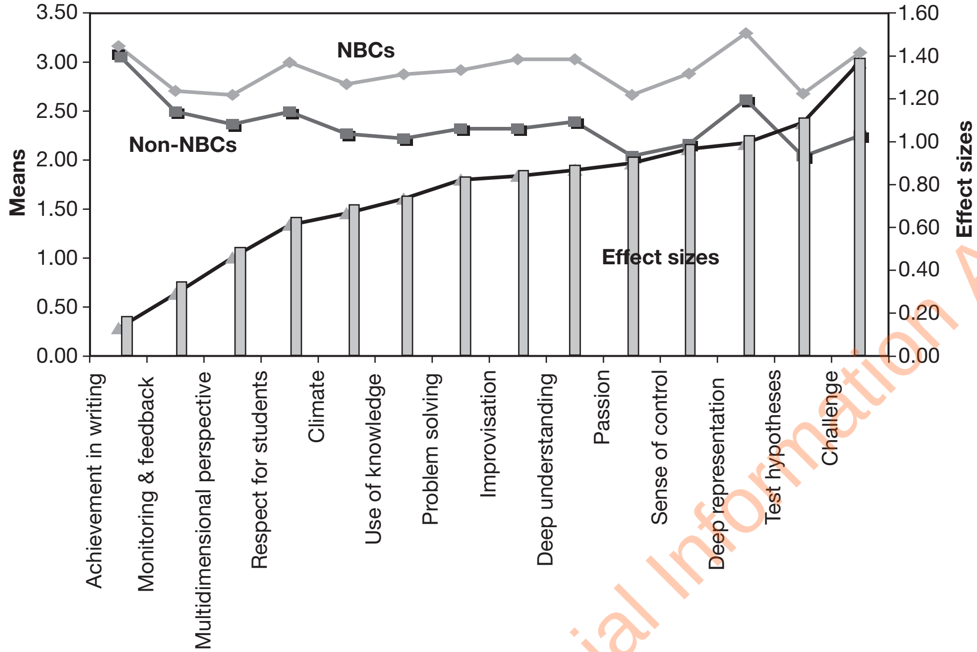


Figure 11.2 The means for the National Board certified teachers (NBCTs) and non-National Board certified teachers (non-NBCTs), and the effect size of the difference between these two groups

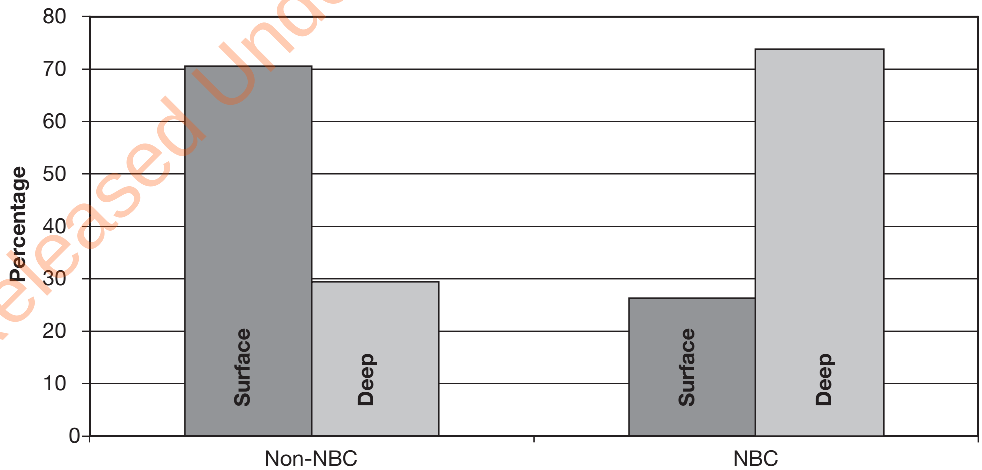


Figure 11.3 Percentage of student work from NBCTs and non-NBCTs classified as surface or deep learning

The conclusion seems clear: experienced experts possess pedagogical content knowledge that is more flexibly and innovatively employed in instruction; they are more able to improvise and to alter instruction in response to contextual features of the classroom situation; they understand at a deeper level the reasons for individual student success and failure on any given academic task; their understanding of students is such that they are more able to provide developmentally appropriate learning tasks that engage, challenge, and even intrigue students, without boring or overwhelming them; they are more able to anticipate and plan for difficulties students are likely to encounter with new concepts; they can more easily improvise when things do not run smoothly; they are more able to generate accurate hypotheses about the causes of student success and failure; and they bring a distinct passion to their work.

Over the years, working with the National Board teachers, as a teacher educator, as a parent, and as a student, I have seen teachers who are stunning, who live the principles outlined in this book, and demonstrably make a difference. They play the game according to the principles outlined here. They question themselves, they worry about which students are not making appropriate progress, they seek evidence of successes and gaps, and they seek help when they need it in their teaching. The future is one of hope as many of these teachers exist in our schools. They are often head-down in the school, not always picked by parents as the better teachers, but the students know and welcome being in their classes. The message in this book is one of hope for an excellent future for teachers and teaching, and based on not just my explanation for 146,000+ effect sizes but on the comfort that there are already many excellent teachers in our profession.

I leave the last words to my friend and colleague Paul Brock:

> Therefore, not just as a professional educator, but as a Dad, I want all future teachers of my Sophie and Millie to abide by three fundamental principles that I believe should underpin teaching and learning in every public school.
>
> First, to nurture and challenge my daughters' intellectual and imaginative capacities way out to horizons unsullied by self-fulfilling minimalist expectations. Don't patronize them with lowest-common-denominator blancmange masquerading as knowledge and learning; nor crush their love for learning through boring pedagogy. Don't bludgeon them with mindless 'busy work' and limit the exploration of the world of evolving knowledge merely to the tyranny of repetitively churned-out recycled worksheets. Ensure that there is legitimate progression of learning from one day, week, month, term and year to the next.
>
> Second, to care for Sophie and Millie with humanity and sensitivity, as developing human beings worthy of being taught with genuine respect, enlightened discipline and imaginative flair.
>
> And third, please strive to maximize their potential for later schooling, post-school education, training and employment and for the quality of life itself so that they can contribute to and enjoy the fruits of living within an Australian society that is fair, just, tolerant, honorable, knowledgeable, prosperous and happy.
>
> When all is said and done, surely this is what every parent and every student should be able to expect of school education: not only as delivered within every public school in NSW, but within every school not only in Australia but throughout the entire world.
>
> (Brock, P., 2004, pp. 250–251)

Document

Appendix A

The meta-analyses by topic

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
Student		*Prior achievement*								
1	Student	Boulanger	1981	34	—	62	1.09	0.039	77%	Ability related to science learning
2	Student	Hattie & Hansford	1983	72	—	503	1.19	—	84%	Intelligence and achievement
3	Student	Samson, Graue, Weinstein, & Walberg	1984	35	—	209	0.31	—	22%	Academic and occupational performance
4	Student	Kavale & Nye	1985	1077	—	268	0.68	—	48%	Ability component in predicting special ed students
5	Student	Cohen	1984	108	—	108	0.37	0.015	26%	College grades and adult achievement
6	Student	McLinden	1988c	47	2,220	47	0.61	—	43%	Blind vs. sighted on spatial tasks
7	Student	Bretz	1989	39	26,816	39	0.39	—	28%	College to adult success
8	Student	Schuler, Funke, & Baron-Boldt	1990	63	29,422	63	1.02	—	72%	High school grades to university grades
9	Student	Lapadat	1991	33	825	275	0.52	0.060	37%	Language ability of special ed students on achievement
10	Student	Rush	1992	100	236,772	404	0.48	—	34%	Differences in at-risk students
11	Student	Piburn	1993	44	—	186	0.80	—	57%	Prior ability on science achievement
12	Student	La Paro & Pianta	2000	70	7,243	63	1.02	0.370	72%	Preschool to first years of schooling
13	Student	Ernst	2001	23	1,733	32	0.41	—	29%	Early cognition and school achievement
14	Student	Kuncel, Hezlett & Ones	2001	1753	82,659	6589	0.52	0.005	37%	High school grades to university grades
15	Student	Murphy & Alexander	2006	20	—	50	0.80	—	57%	Knowledge, beliefs and interests on conceptual change
16	Student	Trapmann, Hell, Weigand, & Schuler	2007	83	—	83	0.90	—	64%	High school grades to university grades
17	Student	Duncan *et al.*	2007	6	—	228	0.35	—	24%	Preschool to first years of schooling
Piagetian programs										
18	Student	Jordan & Brownlee	1981	51	6,000	65	1.28	—	91%	Piagetian tasks and reading and math
Self-reported grades										
19	Student	Mabe & West	1982	35	13,565	35	0.93	—	65%	Self-evaluation of achievement
20	Student	Falchikov & Boud	1989	57	5,332	96	0.47	—	33%	Self-assessment in college
21	Student	Ross	1998	11	—	60	1.63	—	115%	Self-assessment in second language

Appendix A continues

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
22	Student	Falchikov & Goldfinch	2000	48	4,271	56	1.91	—	135%	Self-assessment in college
23	Student	Kuncel, Crede, & Thomas	2005	29	56,265	29	3.10	0.026	219%	Self-assessment of college GPA
24	Student	Kuncel, Crede, & Thomas	2005	29	—	29	0.60	0.034	42%	Differences between self and recorded grades
Creativity										
25	Student	Kim	2005	21	45,880	447	0.35	—	25%	Relationship between creativity and achievement
Attitudes and dispositions										
Personality										
26	Student	Hattie & Hansford	1983	115	—	1197	0.07	0.007	5%	Personality on achievement
27	Student	O'Connor & Paunonen	2007	23	—	108	0.10	—	7%	Big five and achievement
28	Student	Boyd	2007	50	—	130	0.06	—	4%	Extraversion on achievement
29	Student	Lyubomirsky, King, & Diener	2005	46	—	46	0.54	—	38%	Happiness on achievement
Self-concept										
30	Student	Hansford & Hattie	1982	128	202,823	1136	0.41	—	29%	Self-concept
31	Student	Muller, Gullung, & Bocci	1988	38		838	0.36	—	25%	Self-concept
32	Student	Holden, Moncher, Schinke, & Barker	1990	25	—	26	0.37	—	26%	Self-efficacy
33	Student	Multon, Brown, & Lent	1991	36	4,998	38	0.76	—	54%	Self-efficacy
34	Student	Wickline	2003	41	48,038	41	0.35	—	24%	Self-concept
35	Student	Valentine, DuBois, & Cooper	2004	56	50,000	34	0.32	0.010	23%	Self-concept
Motivation										
36	Student	Uguroglu & Walberg	1979	40	36,946	232	0.34	0.070	24%	Motivation
37	Student	Findley & Cooper	1983	98	15,285	275	0.36	0.039	25%	Internal locus of control
38	Student	Whitley & Frieze	1985	25	—	25	0.56	—	40%	Success vs. failure attributions
39	Student	Ross	1988	65	—	65	0.73	0.093	52%	Controlling one's study
40	Student	Schiefee, Krapp, & Schreyer	1993	21	—	121	0.65	0.02	46%	Interest and achievement
41	Student	Kalechstein & Nowicki	1997	78	58,142	261	0.23	0.010	16%	Internal locus of control
Concentration/persistence/engagement										
42	Student	Feltz & Landers	1983	60	1,766	146	0.48	—	34%	Mental practice on motor skill learning
43	Student	Datta & Narayanan	1989	23	—	45	0.61	—	43%	Concentration on achievement
44	Student	Kumar	1991	16	4,518	102	1.09	0.035	77%	Engagement in science
45	Student	Cooper & Dorr	1995	19	6,684	26	0.21	0.030	15%	Race on need for achievement
46	Student	Mikolashek	2004	28	—	268	0.03	—	2%	Resilience for at risk students

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
Reducing anxiety										
47	Student	Hembree	1988	46	28,276	176	0.22	—	16%	Reduced test anxiety
48	Student	Seipp	1991	26	36,626	156	0.43	—	30%	Reduction of anxiety on achievement
49	Student	Bourhis & Allen	1992	23	—	728	0.37	—	26%	Lack of communication apprehension
50	Student	Ma	1999	26	18,279	37	0.56	—	40%	Reducing anxiety towards math and achievement
Attitude to mathematics/science										
51	Student	Willson	1983	43	638,333	280	0.32	—	23%	Attitudes to science
52	Student	Bradford	1990	102	—	241	0.29	—	20%	Attitude to mathematics
53	Student	Ma & Kishor	1997	143	94,661	143	0.47	—	33%	Attitude to mathematics
Physical influences										
Pre-term birth weight										
54	Student	Bhutta, Cleves, Casey, Cradock, & Anand	2002	15	3,276	15	0.73	—	52%	Full vs. pre-term birth weight
55	Student	Corbett & Drewett	2004	31	1,213	121	0.34	—	24%	Thriving and failure to thrive in infancy
Illness										
56	Student	Sharpe & Rossiter	2002	7	—	7	0.20	—	14%	Chronic illness (lack of) on achievement
57	Student	Schatz	2003	6	—	6	0.25	—	18%	Non vs. sickle cell disease on achievement
Diet										
58	Student	Kavale & Forness	1983	23	—	125	0.12	0.037	8%	Reduction of artificial food colors
Exercise/relaxation										
59	Student	Moon, Render, & Pendley	1985	20	—	36	0.16	0.088	11%	Relaxation and achievement
60	Student	Etnier, Salazar, Landers, Petruzzelo, Han, & Nowell	1997	134	—	1260	0.25	0.019	18%	Physical fitness and exercise
61	Student	Sibley & Etnier	2002	36	—	104	0.36	—	25%	Physical activity on achievement
62	Student	Etnier, Nowell, Landers, & Sibley	2006	37	1,306	571	0.34	0.013	24%	Aerobic fitness and cognitive performance
Drugs										
63	Student	Ottenbacher & Cooper	1983	61	1,972	61	0.47	0.038	33%	Stimulant medication on achievement
64	Student	Kavale	1982	135	5,300	984	0.58	0.019	41%	Stimulant drug treatment for hyperactivity
65	Student	Thurber & Walker	1983	20	1,219	20	0.23	0.038	16%	Stimulant medication on achievement
66	Student	Kavale & Nye	1984	70	—	401	0.30	0.038	21%	Drug treatment
67	Student	Crenshaw	1997	36	1,030	36	0.29	0.042	21%	Drugs treatment (ADHD) on cognitive outcomes

Appendix A continues

Appendix A continued

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
68	Student	DuPaul & Ekert	1997	63	637	63	0.31	0.038	22%	School based interventions on ADHD
69	Student	Purdie, Hattie & Carroll	2002	74	2,188	266	0.28	0.038	20%	Drugs treatment (ADHD) on cognitive outcomes
70	Student	Snead	2005	8	815	8	0.20	—	14%	Beh intervention, medication on achievement
Gender – achievement (Male – Female)										
71	Student	Hattie & Hansford	1980	72	—	503	–0.02	—	–1%	Gender and achievement
72	Student	Hyde	1981	16	65,193	16	0.43	—	30%	Gender and cognitive achievement
73	Student	Hyde	1981	27	68,899	27	–0.24	—	–17%	Reading and gender
74	Student	Kahl, Fleming & Malone	1982	169	—	31	0.12	—	8%	Pre-college science and achievement
75	Student	Steinkamp & Maehr	1983	83	—	107	0.19	—	13%	Gender differences in science
76	Student	Freeman	1984	35	—	35	0.09	0.050	6%	Gender differences in mathematics
77	Student	Meehan	1984	53	—	160	0.14	—	10%	Formal operations and gender
78	Student	Johnson, E	1984	9	—	9	0.45	—	32%	Gender in problem solving
79	Student	Linn & Peterson	1985	172	—	263	0.40	—	28%	Spatial achievement and gender
80	Student	Becker & Chang	1986	42	—	42	0.16	—	11%	Science and gender
81	Student	Tohidi, Steinkamp & Maehr	1986	70	—	70	0.32	—	23%	Cognitive functioning and gender
82	Student	Born, Bleichrodt & Van der Flier	1987	17	—	772	0.08	—	6%	Gender in intelligence
83	Student	Hyde & Linn	1988	165	1,418,899	165	–0.11	—	–8%	Gender differences on verbal achievement
84	Student	Friedman	1989	98	227,879	98	0.02	0.016	1%	Math and gender
85	Student	Hines	1989	30	—	260	0.01	—	1%	Math and gender
86	Student	Becker	1989	29	17,603	67	0.16	0.020	11%	Gender differences in science
87	Student	Stumpf & Klieme	1989	18	171,824	18	0.48	—	34%	Spatial achievement and gender
88	Student	Hyde, Fennema & Lamon	1990	100	3,217,489	259	0.20	—	14%	Gender and cognitive achievement
89	Student	Cohn	1991	65	9,000	113	–0.61	—	–43%	Gender on ego enhancement
90	Student	Frost, Hyde & Fennema	1994	100	—	254	0.15	—	11%	Math and gender
91	Student	DeBaz	1994	67	7,026	9	0.26	—	18%	Gender and achievement
92	Student	Schram	1996	13	4,134	18	–0.08	—	–6%	Applied statistics and gender
93	Student	Yang	1997	25	—	25	–0.34	0.054	–24%	Math and gender
94	Student	Lietz	2006	139	—	139	–0.19	—	–13%	Reading and gender
Gender – Attitudes										
95	Student	Cooper, Burger & Good	1980	10	219	10	–0.10	—	–7%	Control beliefs and gender
96	Student	Haladyna & Shaughnessy	1982	49	—	17	0.36	—	25%	Science and gender
97	Student	Hyde, Fenemma, Ryan, Frost & Hopp	1990	70	63,229	126	0.15	—	11%	Math and gender

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
98	Student	DeBaz	1994	67	89,740	25	0.30	0.027	21%	Science and gender
99	Student	Weinburgh	1995	18	6,753	18	0.20	—	14%	Science and gender
100	Student	Whitley	1997	82	40,491	104	0.23	—	16%	Computers and gender
101	Student	Etsey & Snetzler	1998	96	30,490	304	–0.01	—	–1%	Math and gender
Gender – Leadership										
102	Student	Wood	1987	52	3,099	19	0.38	—	27%	Group performance and gender
103	Student	Wood	1987	52	3,099	45	0.39	—	28%	Group performance and gender
104	Student	Eagly & Johnson	1990	370	32,560	370	–0.11	—	–8%	Leadership and gender
105	Student	Pantili, Williams & Fortune	1991	10	—	47	0.18	—	13%	Assessment centers and gender
106	Student	Eagly, Karau & Johnson	1992	50	8,375	125	–0.01	—	–1%	Principal leadership and gender
Gender – Motor outcomes										
107	Student	Eaton & Enns	1986	90	8,636	127	0.49	0.040	35%	Motor activity and gender
108	Student	Thomas & French	1985	64	100,195	445	0.62	—	44%	Motor activity and gender
Gender – Behavior outcomes										
109	Student	Gaub & Carlson	1997	18	—	17	0.13	—	9%	ADHD and gender
110	Student	Hall	1980	42	—	75	–0.32	—	–23%	Emotional cues and gender
111	Student	Lytton & Romney	1991	172	—	717	–0.02	—	–1%	Socialization and gender
Ethnicity										
112	Student	Allen, Bradford, Grimes, Cooper, & Howard	1999	9	2661	9	0.32	0.003	23%	Positive view of own ethnicity
Pre-school interventions										
Early intervention										
113	Student	Exceptional Child Center	1983	156	—	1436	0.43	0.023	30%	Handicapped and disadvantaged students
114	Student	Harrell	1983	71	—	449	0.42	—	30%	Head start programs
115	Student	Collins	1984	67	—	271	0.27	—	19%	Head start programs
116	Student	Horn & Packard	1985	58	59,998	138	0.90	—	64%	Early prediction of learning problems
117	Student	Casto & White	1985	126	—	663	0.43	0.040	30%	At risk children
118	Student	Ottenbacher & Petersen	1985	38	1,544	118	0.97	0.083	69%	Early intervention for disabled students
119	Student	White & Casto	1985	326	—	2266	0.52	—	37%	Handicapped – long term
120	Student	White & Casto	1985	162	—	1665	0.44	0.026	31%	Handicapped and disadvantaged
121	Student	McKey, Condelli, Ganson, Barrett, McConkey, & Plantz	1985	72	—	17	0.31	—	22%	Head start programs

Appendix A continues

Appendix A continued

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
122	Student	Casto & Mastropieri	1986	74	—	215	0.68	0.050	48%	Handicapped
123	Student	Murphy	1991	150	—	104	0.46	—	33%	Sesame Street
124	Student	Innocenti & White	1993	155	—	797	0.60	—	42%	Early intervention
125	Student	Kim, Innocenti, & Kim	1996	80	—	659	0.25	0.024	18%	Early intervention
126	Student	Mentore	1999	77	16,888	319	0.48	0.040	34%	Early interventions
127	Student	Crosby	2004	44	2,267	196	0.14	—	10%	Early intervention with disabled or delayed children
128	Student	Bakermans-Kranenburg, van Ijzendoorn, & Bradley	2005	48	7,350	56	0.20	—	14%	Early intervention in the home
Pre school programs										
129	Student	Snyder & Sheehan	1983	8	—	182	0.48	—	34%	Preschool programs
130	Student	Goldring & Presbrey	1986	11	1,267	11	0.25	—	18%	Preschool programs
131	Student	Applegate	1986	13	—	114	0.42	0.094	30%	Day care
132	Student	Lewis & Vosburgh	1988	65	3,194	444	0.43		31%	Kindergarten based
133	Student	Nelson	1994	21	—	135	0.42	0.037	30%	Parent ed programs
134	Student	Fusaro	1997	23	—	23	1.43	—	101%	Full vs. half day kindergarten
135	Student	Gilliam & Zigler	2000	13	—	22	0.17	—	12%	Preschool across 13 states
136	Student	Violato & Russell	2000	101	32,271	101	0.14	—	10%	Day vs. home care
137	Student	Jones	2002	22	—	22	0.56	—	40%	All day kindergarten
138	Student	Nelson, Westhues, & Macleod	2003	34	—	721	0.53	—	37%	Preschool prevention programs
139	Student	Timmerman	2006	47	7,800	47	0.10	—	7%	Family vs. day care
Home		*Socioeconomic status*								
140	Home	White	1982	101	—	620	0.66	—	47%	Socioeconomic status and achievement
141	Home	Fleming & Malone	1983	273	—	21	0.50	—	35%	Student characteristics and science achievement
142	Home	DeBaz	1994	67	47,001	9	0.50	—	35%	Availability of resources in the home
143	Home	Sirin	2005	58	129,914	307	0.61	0.016	43%	Relation between SES and achievement
Welfare policies										
144	Home	Gennetian, Duncan, Knox, Clark-Kauffman, & London	2004	8	—	8	–0.12	0.030	–8%	Families receiving welfare on school achievement
Family structure										
145	Home	Falbo & Polit	1986	115	—	115	0.17	0.023	12%	Only vs. non-only children
146	Home	Salzman	1987	137	9,955,118	273	0.26	—	18%	Father present vs. father absent

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
147	Home	Amato & Keith	1991	39	—	39	0.16	—	11%	Both parents vs. divorced families
148	Home	Wierzbicki	1993	66	—	31	0.13	0.041	9%	Adoptee vs. nonadoptive achievement
149	Home	Kunz	1995	65	—	65	0.30	—	21%	Both parents vs. divorced families
150	Home	Amato & Gilbreth	1999	63	14,471	52	0.12	—	9%	Resident vs. non resident fathers
151	Home	Amato	2001	67	—	177	0.29	—	21%	Resident vs. non resident fathers
152	Home	Reifman, Villa, Amans, Rethinam, & Telesca	2001	35	—	7	0.16	—	11%	Children of intact vs. divorced parents
153	Home	Pong, Dronkers, Hampden-Thompsom	2003	22	—	22	0.13	—	9%	Single vs. two-parent family on math and science
154	Home	vanIjzendoorn, Juffer, Poelhuis	2005	55	—	52	0.19	—	13%	Nonadopted vs. adopted children
155	Home	Goldberg, Prause, Lucas-Thompson, & Himsel	2008	68	178,323	770	0.06	—	5%	Maternal employment on achievement
156	Home	Jeynes	2007	61	—	78	0.22	—	16%	Intact vs. parental re-marriage on achievement
Home environment										
157	Home	Iverson & Walberg	1982	18	5,831	92	0.80	—	56%	Home environment and school learning
158	Home	Gottfried	1984	17	—	17	0.34	—	24%	Home environment and early achievement
Television										
159	Home	Williams, Haertel, Haertel, & Walberg	1982	23	—	227	–0.12	—	–8%	Leisure time television
160	Home	Neuman	1986	8	—	8	–0.15	—	–11%	TV on reading
161	Home	Razel	2001	6	1,022,000	305	–0.26	—	–18%	TV on achievement
Parental involvement										
162	Home	Graue, Weinstein, & Walberg	1983	29	—	29	0.75	0.178	53%	Effects of home instruction
163	Home	Casto & Lewis	1984	76	—	754	0.41	—	29%	Parent involvement in infant and preschool programs
164	Home	Crimm	1992	57	—	57	0.39	—	28%	Parent involvement and achievement
165	Home	White, Taylor, & Moss	1992	205	—	205	0.13	—	9%	Moderate to extensive parent involvement
166	Home	Rosenzweig	2000	34	—	474	0.31	—	22%	Parent involvement and achievement
167	Home	Fan & Chen	2001	92	—	92	0.52	—	37%	Parent involvement and achievement
168	Home	Comfort	2004	94	—	43	0.56	—	40%	Parent training on cognitive/language
169	Home	Jeynes	2005	41	20,000	41	0.74	—	52%	Parental involvement in urban areas – primary
170	Home	Senechal	2006	14	—	14	0.68	—	48%	Family involvement in reading
171	Home	Earhart, Ramirez, Carlson, & Beretvas	2006	22	—	22	0.70	—	49%	Parent involvement and achievement
172	Home	Jeynes	2007	52	300,000	52	0.38	—	27%	Parental involvement in urban areas – high

Appendix A continues

Appendix A continued

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
Home visiting										
173	Home	Black	1996	11	—	11	0.39	—	28%	Home visiting of learning disabled
174	Home	Sweet & Applebaum	2004	60	—	41	0.18	—	13%	Home visiting
School		*School effects*								
175	School	Scheerens & Bosker	1997	168	—	168	0.48	0.019	34%	School effects
Finances										
176	School	Childs & Shakeshaft	1986	45	2,205,319	417	0.00	—	0%	Educational expenditure
177	School	Murdock	1987	46	71,698	46	0.06	—	4%	Financial aid on persistence at college
178	School	Hedges, Laine, & Greenwald	1994	38	—	38	0.70	—	49%	Effect of $500 per student on achievement
179	School	Greenwald, Hedges, & Laine	1996	60	—	180	0.14	—	10%	Effect of $500 per student on achievement
Types of schools										
Charter schools										
180	School	Miron & Nelson	2001	18	—	18	0.20	—	14%	Charter schools
Religious Schools										
181	School	Jeynes	2002	15	54,060	15	0.25	—	18%	Religious vs. public schooling on achievement
182	School	Jeynes	2004	56	—	56	0.20	—	14%	Religious commitment on achievement
Summer school										
183	School	Cooper, Charlton, Valentine, Muhlenbruck, & Borman	2000	41	26,500	385	0.28	—	20%	Remedial summer programs
184	School	Cooper, Charlton, Valentine, Muhlenbruck, & Borman	2000	7	2,200	60	0.23	—	16%	Acceleration summer programs
185	School	Kim	2002	57	—	155	0.17	—	12%	Academic summer programs
Desegregation										
186	School	Krol	1980	71	—	71	0.16	0.049	11%	Desegregated vs. segregated classes in US
187	School	McEvoy	1982	29	—	29	0.20	—	14%	Desegregated vs. segregated classes in US
188	School	Miller & Carlson	1982	19	—	34	0.19	0.028	14%	Desegregated vs. segregated classes in US
189	School	Walberg	1982	19	—	19	0.88	—	62%	Desegregated vs. segregated classes in US
190	School	Armor	1983	19	—	51	0.05	—	4%	Desegregated vs. segregated classes in US
191	School	Bryant	1983	31	—	31	0.45	0.122	32%	Desegregated vs. segregated classes in US
192	School	Crain & Mahard	1983	93	—	323	0.08	0.013	6%	Desegregated vs. segregated classes in US

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
193	School	Wortman	1983	31	—	98	0.45	0.089	32%	Desegregated vs. segregated classes in US
194	School	Stephan	1983	19	—	63	0.15	—	11%	Desegregated vs. segregated classes in US
195	School	Goldring & Addi	1989	4	6,731	4	0.15	—	11%	Desegregated vs. segregated classes in Israel
College halls of residence										
196	School	Blimling	1999	10	11,581	23	0.05	—	3%	College halls of residence
School compositional effects										
School size										
197	School	Stekelenburg	1991	21	—	120	0.43	—	30%	High school size on achievement
Summer vacation										
198	School	Cooper, Nye, Charlton, Lindsay, & Greathouse	1996	39	—	62	–0.09	—	–6%	Summer vacation on achievement
Mobility										
199	School	Jones	1989	93	51,057	141	–0.50	—	–35%	Mobility and achievement
200	School	Mehana	1997	26	2,889	45	–0.24	0.005	–17%	Mobility and achievement
201	School	Diaz	1992	62	131,689	354	–0.28	—	–20%	Moving from community college to 4-yr institutions
Out of school experiences										
202	School	Lauer, Akiba, Wilkerson, Apthorp, Snow, & Martin-Glenn	2006	30	15,277	24	0.10	—	7%	After school programs on reading and math
203	School	Lauer, Akiba, Wilkerson, Apthorp, Snow, & Martin-Glenn	2006	22	15,277	26	0.07	—	5%	Summer school programs on reading and math
Principals/school leaders										
204	School	Neuman, Edwards, & Raju	1989	126	—	238	0.159	0.034	2%	Organizational development interventions
205	School	Pantili, Williams, & Fortune	1991	32	10,773	32	0.41	—	29%	Assessment ratings of principals and job performance
206	School	Gasper	1992	22	—	25	0.81	—	57%	Transformational leadership
207	School	Bosker & Witziers	1995	21	—	65	0.04	—	3%	Principals on student achievement
208	School	Brown	2001	38	—	339	0.57	0.028	40%	Leadership on student achievement
209	School	Wiseman	2002	59	16,326	59	–0.26	—	–18%	Instructional management on achievement
210	School	Witziers, Bosker, & Kruger	2003	61	—	377	0.02	—	1%	Principals on student achievement
211	School	Waters, Marzano, & McNulty	2003	70	1,100,000	70	0.25	—	18%	Principals on student achievement
212	School	Waters & Marzano	2006	27	—	27	0.49	—	35%	District superintendents on achievement

Appendix A continues

Appendix A continued

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
213	School	Chin	2007	21	6,558	11	1.12	—	79%	Transformational leadership
214	School	Robinson, Lloyd, & Rowe	2008	14	—	14	0.39	—	28%	Principals on student achievement
Classroom compositional effects										
Class size										
215	School	Glass & Smith	1979	77	520,899	725	0.09	—	6%	Class size
216	School	McGiverin *et al.*	1999	10	—	24	0.34	—	24%	Class size
217	School	Goldstein, Yang, Omar, & Thompson	2000	9	29,440	36	0.20	—	14%	Class size
Open vs. traditional										
218	School	Peterson	1980	45	—	45	0.12	—	8%	Traditional vs. open classrooms
219	School	Madamba	1980	72	—	72	–0.03	—	–2%	Traditional vs. open classrooms on reading
220	School	Hetzel, Rasher, Butcher, & Walberg	1980	45	—	45	–0.13	—	–9%	Traditional vs. open classrooms
221	School	Giaconia & Hedges	1982	153	—	171	0.06	0.032	4%	Traditional vs. open classrooms
Ability grouping										
222	School	Kulik	1981	41	—	41	0.13		9%	Ability grouping on high school students
223	School	Kulik & Kulik	1982	52	—	51	0.10	0.045	7%	Ability grouping on high school students
224	School	Kulik & Kulik	1984	23	—	23	0.19	—	13%	Ability grouping in elementary grades
225	School	Bangert-Drowns, Kulik & Kulik	1985	85	—	85	0.15	—	11%	Inter-class ability grouping
226	School	Noland & Taylor	1986	50	—	720	–0.08	—	–6%	Ability grouping
227	School	Slavin	1987	14	—	17	0.00	—	0%	Ability grouping in elementary grades
228	School	Henderson	1989	6	—	6	0.23	—	16%	Ability grouping in elementary grades
229	School	Slavin	1990	29	—	29	–0.02	—	–1%	Ability grouping on high school students
230	School	Gutierrez & Slavin	1992	14	—	14	0.34	—	24%	Nongraded elementary schools
231	School	Kulik & Kulik	1992	56	—	51	0.03	—	2%	Ability grouping
232	School	Kim	1996	96	—	96	0.17	—	12%	Nongraded schools in Kentucky
233	School	Mosteller, Light, & Sachs	1996	10	—	10	0.00	—	0%	Ability grouping
234	School	Lou, Abrami, Spence, Poulsen, Chambers, & d'Apollonia	1996	12	—	12	0.12	—	8%	Ability grouping
235	School	Neber, Finsterwald & Urban	2001	12	—	214	0.33	—	23%	Homogeneous vs. heterogeneous on gifted
Multigrade/Age classes										
236	School	Veenman	1995	11	—	11	–0.03	—	–2%	Multiage classes
237	School	Veenman	1996	56	—	34	–0.01	—	–1%	Multigrade classes

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
238	School	Kim	1996	27	—	27	0.17	—	12%	Nongraded vs. multigrade/multiage classes
Within class grouping										
239	School	Kulik	1985	78	—	78	0.15	—	11%	Inter-class ability grouping
240	School	Lou, Abrami, Spence, Poulsen, Chambers, & d'Apollonia	1996	51	16,073	103	0.17	—	12%	Within-class grouping
Small group learning										
241	School	Springer, Stanne & Donovan	1997	39	3,472	116	0.46	—	33%	Working in small groups in college
242	School	Springer, Stanne & Donovan	1999	39	—	39	0.51	—	36%	Working in small groups in science
Mainstreaming										
243	School	Carlberg & Kavale	1980	50	27,000	50	0.12	0.092	8%	Regular vs. special class placement
244	School	Baker	1994	13	2,532	129	0.08	—	6%	Regular vs. special class placement
245	School	Dixon & Marsh	1997	70	—	70	0.65	—	46%	Regular vs. special class placement
246	School	Baker, Wang, & Walberg	1994	6	—	6	0.20	—	14%	Regular vs. special class placement
247	School	Wang & Baker	1986	11	—	115	0.33	—	23%	Regular vs. special class placement
Retention										
248	School	Holmes	1983	7	—	527	–0.42	—	–30%	Retained vs. non-retained
249	School	Holmes & Matthews	1984	44	11,132	575	–0.37	—	–26%	Retention on all students on elementary students
250	School	Holmes	1986	17	—	217	–0.06	—	–4%	Retained vs. non-retained
251	School	Holmes	1989	63	—	861	–0.15	—	–11%	Retention on all students
252	School	Yoshida	1989	34	—	242	–0.38	—	–27%	Retention on elementary students
253	School	Draney & Wilson	1992	22	—	78	0.66	—	47%	Retained vs. non retained within same year
254	School	Jimerson	2001	20	2,806	175	–0.39	—	–28%	Retained vs. non-retained
School curricula for gifted students										
Ability grouping for gifted students										
255	School	Barget-Drowns, Kulik & Kulik	1985	25	—	25	0.25	—	18%	Classroom organization on gifted
256	School	Goldring	1986	23	—	146	0.35	0.059	25%	Ability grouping for gifted
257	School	Rogers	1991	13	—	13	0.43	—	30%	Grouping on gifted
258	School	Vaughn, Feldhusen, & Asher	1991	8	—	8	0.47	0.070	33%	Pull out programs for gifted
259	School	Kulik & Kulik	1992	56	—	10	0.02	—	1%	Classroom organization on gifted
Acceleration										
260	School	Kulik & Kulik	1984	26	—	13	0.88	0.183	62%	On achievement outcomes on gifted

Appendix A continues

Appendix A continued

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
261	School	Kulik	2004	11	4,340	11	0.87	—	62%	Acceleration with same age controls on gifted
Enrichment										
262	School	Wallace	1989	138	22,908	136	0.57	0.010	40%	Enrichment programs with gifted
263	School	Romney & Samuels	2001	40	13,428	47	0.35	0.025	24%	Feuerstein's instrumental enrichment with gifted
264	School	Shiell	2002	36	—	360	0.26	—	18%	Feuerstein's instrumental enrichment with gifted
Classroom influences										
Classroom management										
265	School	Marzano	2003	100	—	5	0.52	—	37%	Classroom management on achievement
Classroom cohesion										
266	School	Haertel, Walberg & Haertel	1980	12	17,805	403	0.17	0.016	12%	Classroom climate
267	School	Evans & Dion	1991	27	—	372	0.92	—	65%	Group cohesion
268	School	Mullen & Copper	1994	49	8,702	66	0.51	—	36%	Group cohesion
Classroom behavioral										
269	School	Bender & Smith	1990	25	—	124	1.101	0.13	78%	Classroom behavior of disabled and learning disabilities
270	School	DuPaul & Eckert	1997	63	—	637	0.58	0.450	41%	School programs for ADHD
271	School	Frazier, Youngstron, Glutting, & Watkins	2007	72	—	181	0.71	—	50%	Programs for ADHD
Decreasing disruptive behavior										
272	School	Skiba & Casey	1985	41	883	26	0.93	—	66%	Classroom disruptive behavior
273	School	Stage & Quiroz	1997	99	5,057	289	0.78	0.034	55%	Decreasing disruptive behavior
274	School	Reid, Gonzalez, Nordness, Trout, & Epstein	2004	25	2,486	101	–0.69	0.040	–49%	Emotional/behavioral disturbance
Peer influences										
275	School	Ide, Parkerson, Haertel, & Walberg	1980	12	—	122	0.53	—	37%	Peer influences on achievement
Teacher		*Teacher effects*								
276	Teacher	Nye, Konstantopoulos, & Hedges	2004	18	—	18	0.32	0.020	23%	Overall teacher effects
Teacher training										
277	Teacher	Wu, Becker & Kennedy	2002	24	—	192	0.08	0.044	6%	Certified vs. alternative certified teachers
278	Teacher	Wu, Becker & Kennedy	2002	24	—	76	0.14	—	10%	Trad vs. emergency licensed teachers

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
279	Teacher	Sparks	2004	5	—	18	0.12	—	8%	Trad vs. emergency or probationary training
Micro teaching										
280	Teacher	Butcher	1981	47	—	47	0.55	—	39%	Teacher training on teacher skills
281	Teacher	Yeany & Padilla	1986	183	—	183	1.18	—	83%	Teacher training on teacher skills in science
282	Teacher	Bennett	1987	112	—	126	1.10	—	78%	Teacher training on teacher skills
283	Teacher	Metcalf	1995	60	—	83	0.70	—	49%	Lab experiences in teacher education on teacher skills
Teacher subject matter knowledge										
284	Teacher	Druva & Anderson	1983	65	—	360	0.06	—	4%	Teacher background in science
285	Teacher	Ahn & Choi	2004	27	—	64	0.12	0.016	8%	Teacher knowledge in mathematics
Quality of teaching										
286	Teacher	Cohen	1980	22	—	22	0.33	—	23%	Feedback from student ratings
287	Teacher	Cohen	1981	19	—	19	0.68	—	48%	Student rating of teacher
288	Teacher	Cohen	1981	41	—	68	0.48	—	34%	Student rating of teacher
289	Teacher	Abrami, Leventhal, & Perry	1982	12	—	12	0.29	—	20%	Expressiveness of teacher
290	Teacher	Cohen	1986	47	—	74	0.44	0.060	31%	Student rating of teacher
Teacher-student relationships										
291	Teacher	Cornelius-White	2007	229	355,325	1450	0.72	0.01	51%	Teacher-student relations on achievement
Professional development										
292	Teacher	Joslin	1980	137	47,000	902	0.81	—	57%	In-service teacher education
293	Teacher	Harrison	1980	47	—	47	0.80	—	56%	Staff development
294	Teacher	Wade	1985	91	—	715	0.37	—	26%	In-service teacher education on achievement
295	Teacher	Tinoca	2004	35	—	37	0.45	0.007	32%	PD in science
296	Teacher	Timperley, Wilson, Barrar, & Fung	2007	227	—	183	0.66	0.060	47%	PD on student outcomes
Expectations										
297	Teacher	Rosenthal & Rubin	1978	345	—	345	0.70	0.200	49%	Teacher expectations
298	Teacher	Smith	1980	46	—	149	0.82	—	58%	Teacher expectations
299	Teacher	Dusek & Joseph	1983	102	—	102	0.39	—	28%	Teacher expectations
300	Teacher	Raudenbush	1984	18	—	33	0.08	0.044	6%	Teacher expectations
301	Teacher	Harris & Rosenthal	1985	53	—	53	0.41	—	29%	Teacher expectations

Appendix A continues

No.	*Domain*	*Author*	*Year*	*No. studies*	*Total no.*	*No. effects*	*Mean*	*se*	*CLE*	*Variable*
302	Teacher	Ritts, Patterson, & Tubbs	1992	12	—	12	0.36	—	25%	Expectations of physical attractiveness and achievement
303	Teacher	Jackson, Hunter & Hodge	1995	59	—	51	0.47	0.042	33%	Physical attractiveness on achievement
304	Teacher	Tenebaum & Ruck	2007	39	—	39	0.23	0.040	16%	Teacher expectations
Not labeling students										
305	Teacher	Fuchs, Fuchs, Mathes, Lipsey, & Roberts	2002	79	—	79	0.61	—	43%	Low achieving non-disabled students vs. learning disabled in reading
Teacher clarity										
306	Teacher	Fendick	1990	na	—	na	0.75	—	53%	Teacher clarity on outcomes
Curricula		**Reading, writing, and the arts**								
		Visual-perception programs								
307	Curricula	Kavale	1980	31	4,400	101	0.70	0.102	49%	Auditory-visual integration
308	Curricula	Kavale	1981	106	—	723	0.767	—	54%	Auditory perception
309	Curricula	Kavale	1982	161	325,000	1571	0.81	0.008	57%	Visual perceptual skills in reading
310	Curricula	Kavale	1984	59	—	173	0.09	0.014	6%	Frostig developmental training in reading
311	Curricula	Kavale	1984	59		173	0.18	0.028	13%	Visual perceptual skills
312	Curricula	Kavale & Forness	2000	267	50,000	2294	0.76	0.012	54%	Auditory-visual processes
Vocabulary programs										
313	Curricula	Kavale	1982	36	—	240	0.38	—	27%	Psycholinguistic training
314	Curricula	Stahl & Fairbanks	1986	41	—	41	0.97	0.127	69%	Vocabulary interventions
315	Curricula	Arnold, Myette, & Casto	1986	30	—	87	0.59	0.090	42%	Language intervention
316	Curricula	Nye, Foster, & Seaman	1987	61	—	299	1.04	0.107	74%	Language intervention
317	Curricula	Poirier	1989	61	—	61	0.5	—	35%	Language intervention
318	Curricula	Marmolejo	1990	33	—	33	0.69	—	49%	Vocabulary interventions
319	Curricula	Klesius & Searls	1990	39	—	39	0.50	—	35%	Vocabulary interventions
Phonics instruction										
320	Curricula	Wagner	1988	16	—	1766	0.38	—	27%	Phonological processing abilities
321	Curricula	Fukkink & de Glopper	1998	12	—	21	0.43	0.120	30%	Deriving word meaning from context
322	Curricula	Metsala, Stanovich, & Brown	1998	17	1,116	38	0.58	0.060	41%	Spelling to sound regularities and reading
323	Curricula	Miller	1999	18	882	18	1.53	0.231	108%	Phonemic awareness programs
324	Curricula	Bus & van IJzendoorn	1999	70	5,843	1484	0.73	—	52%	Phonological awareness training

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
325	Curricula	Thomas	2000	8	715	10	1.02	—	72%	Phonemic awareness
326	Curricula	National Reading Panel	2000	52	—	96	0.53	—	37%	Phonemic awareness
327	Curricula	National Reading Panel	2000	38	—	66	0.44	—	31%	Phonics instruction
328	Curricula	National Reading Panel	2000	14	—	14	0.41	—	29%	Fluency
329	Curricula	Ehri, Nunes, Stahl, & Willows	2001	34	—	66	0.41	—	29%	Systematic phonics instruction
330	Curricula	Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh, & Shanahan	2001	52	—	72	0.53	—	37%	Phonemic awareness on reading
331	Curricula	Swanson, Trainin, Necoechea & Hammill	2003	35	3,568	2257	0.93	0.473	65%	Rapid naming, phonological awareness
332	Curricula	Camilli, Vargas, & Yirecko	2003	40	—	40	0.24	—	17%	Phonics instruction
333	Curricula	Torgerson, Brooks, & Hall	2006	19	—	20	0.27	—	19%	Phonics instruction
Sentence combining programs										
334	Curricula	Neville & Searls	1991	24	—	29	0.09	—	7%	Sentence combining on reading
335	Curricula	Fusaro	1993	11	—	11	0.20	0.087	14%	Effects of sentence combining
Repeated reading programs										
336	Curricula	Therrien	2004	33	—	28	0.65	0.080	46%	Repeated reading
337	Curricula	Chard, Vaughn, & Tyler	2002	21	—	128	0.68	—	48%	Repeated reading without a model
Comprehension programs										
338	Curricula	Pflaum, Walberg, Karegiances, & Rasher	1980	31	—	341	0.60	—	43%	Reading instruction
339	Curricula	Rowe	1985	137	—	1537	0.70	0.044	49%	Reading comprehension interventions
340	Curricula	Yang	1997	39	—	162	0.33	—	23%	Programs to enhance reading fluency
341	Curricula	O'Shaughnessy & Swanson	1998	41	1,783	161	0.61	0.069	43%	Normal vs. LD on memory processing of information
342	Curricula	Swanborn & de Glopper	1999	20	2,130	20	0.15	—	11%	Incidental word learning
343	Curricula	Swanson	1999	112	3,895	334	0.77	0.055	54%	Reading interventions
344	Curricula	Burger & Winner	2000	9	378		0.10	—	7%	Visual arts programs on reading
345	Curricula	Sencibaugh	2005	15	538	23	1.15	—	81%	Visual or auditory programs to improve comprehension
346	Curricula	Guthrie, McRae, & Klauda	2007	11	2,861	75	0.78	—	55%	Concept-oriented reading programs
Whole language										
347	Curricula	Stahl & Miller	1989	15	—	117	0.09	0.056	6%	Effects of whole language instruction

Appendix A continues

Appendix A continued

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
348	Curricula	Gee	1995	21	—	52	0.65	—	46%	Effects of whole language instruction
349	Curricula	Stahl, McKenna, & Pagnucco	1994	14	—	14	0.15	—	11%	Effects of whole language instruction
350	Curricula	Jeynes & Littell	2000	14	630	14	–0.65	—	–46%	Effects of whole language instruction
Exposure to reading										
351	Curricula	Bus, van IJzendoorn, & Pellegrini	1995	29	3,410	33	0.59	—	42%	Joint book reading
352	Curricula	Blok	1999	11	—	53	0.63	0.140	45%	Reading to young children
353	Curricula	Torgerson, King & Sowden	2002	8	—	8	0.19	—	13%	Volunteers helping to read
354	Curricula	Yoon	2002	7	3,183	7	0.12	0.040	8%	Sustained silent reading
355	Curricula	Lewis & Samuels	2003	49	112,000	182	0.10	—	7%	Time on reading
356	Curricula	Burger & Winner	2000	10	—	10	0.52	—	37%	Visual arts on reading readiness
Second/Third chance programs										
357	Curricula	Elbaum, Vaughn, Hughes & Moody	2000	16	—	16	0.66	—	47%	Reading recovery programs
358	Curricula	D'Agostino & Murphy	2004	36	5,685	1379	0.34	—	24%	Reading recovery programs
Writing programs										
359	Curricula	Hillocks	1984	60	11,705	73	0.28	0.020	20%	Teaching writing
360	Curricula	Atkinson	1993	20	—	55	0.40	0.063	28%	Writing projects
361	Curricula	Gersten & Baker	2001	13	—	13	0.81	0.031	57%	Expressive writing
362	Curricula	Bangert-Drowns, Hurley & Wilkinson	2004	46	5,416	46	0.26	0.058	18%	School-based writing to learn interventions
363	Curricula	Graham & Perin	2007	123	14,068	154	0.43	0.036	30%	Writing programs
Drama/Arts programs										
364	Curricula	Kardash & Wright	1987	16	—	36	0.67	0.090	47%	Creative dramatics
365	Curricula	Podlozny	2000	17	—	17	0.31	—	22%	Drama on reading
366	Curricula	Moga, Burger, Hetland, & Winner	2000	8	2,271	8	0.35	—	24%	Arts programs on creativity
367	Curricula	Winner & Cooper	2000	31	—	24	0.06	—	4%	Arts programs on achievement
368	Curricula	Keinanen, Hetland, & Winner	2000	527	69,564	527	0.43	—	30%	Dance on Reading
369	Curricula	Butzlaff	2000	30	5,734,878	30	0.35	—	24%	Music programs on reading
370	Curricula	Hetland	2000	15	1,170	15	0.80	—	56%	Music programs on spatial reasoning
371	Curricula	Hetland	2000	15	—	15	0.06	—	4%	Music programs on intelligence
372	Curricula	Vaughn	2000	20	—	20	0.30	—	21%	Music study/listening and math
373	Curricula	Hetland	2000b	36	—	36	0.23	—	16%	Listening to music

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
Math and sciences										
Mathematics										
374	Curricula	Athappilly	1978	134	—	810	0.24	0.030	17%	Modern vs. traditional math
375	Curricula	Parham	1983	64	—	171	0.53	0.099	37%	Manipulative materials
376	Curricula	Fuchs & Fuchs	1985	16	—	17	0.46	0.009	33%	Use of graphing paper
377	Curricula	Moin	1986	na	—	na	0.23	—	16%	Self-paced method of calculus instruction
378	Curricula	Friedman	1989	136	—	394	0.88	—	62%	Spatial effects in math
379	Curricula	LeNoir	1989	45	—	135	0.19	—	14%	Manipulative materials
380	Curricula	Sowell	1989	60	—	138	0.19	—	13%	Manipulative materials
381	Curricula	Fischer & Tarver	1997	7	277	22	1.01	—	71%	Videodisc math
382	Curricula	Lee	2000	61	5,172	97	0.60	0.100	42%	Math programs on LD students
383	Curricula	Baker, Gersten, & Lee	2002	15	1,271	39	0.51	—	36%	Feedback and peer tutoring with low achieving students
384	Curricula	Haas	2005	35	—	66	0.38	0.141	27%	Teaching methods in algebra
385	Curricula	Malofeeva	2005	29	1,845	29	0.47	0.047	33%	Math programs for K-2
386	Curricula	Hembree	1987	75	—	452	0.16	—	11%	Non-content variables
Use of calculators										
387	Curricula	Hembree & Dessart	1986	79	—	524	0.14	—	10%	Use of calculators in pre-college students
388	Curricula	Smith	1996	24	—	54	0.25	—	17%	Use of calculators
389	Curricula	Ellington	2000	53	—	305	0.28	—	20%	Use of calculators in pre-college students
390	Curricula	Nikolaou	2001	24	—	103	0.49	0.092	35%	Use of calculators on problem solving
391	Curricula	Ellington	2006	42	—	97	0.19	—	13%	Use of Non-CAS graphing calculators
Science										
392	Curricula	El-Nemr	1979	59	—	250	0.17	—	12%	Traditional vs. inquiry method for biology
393	Curricula	Bredderman	1980	50	—	17	0.12	—	8%	Textbooks vs. process curricula
394	Curricula	Weinstein, Boulanger, & Walberg	1982	33	19,149	33	0.31	—	22%	Science curriculum effects
395	Curricula	Bredderman	1983	57	13,000	400	0.35	—	25%	Activity-based methods
396	Curricula	Shymansky, Kyle, & Alport	1993	105	45,626	341	0.43	—	30%	New science curricula
397	Curricula	Wise & Okey	1983	160	—	400	0.34	—	24%	Science teaching strategies
398	Curricula	Shymansky	1984	47	6,035	43	0.64	—	45%	Biology science curricula
399	Curricula	Horak	1985	40	—	472	0.57	—	40%	Learning science from textual materials
400	Curricula	Guzzetti, Snyder, Glass, & Gamas	1993	23	—	35	0.29	—	21%	On misconceptions in reading

Appendix A continues

Appendix A continued

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
401	Curricula	Guzzetti, Snyder, Glass, & Gamas	1993	70	—	126	0.81	—	57%	Conceptual change in science
402	Curricula	Wise	1996	140	—	375	0.32	—	23%	Strategies for science teaching
403	Curricula	Rubin	1996	39	—	39	0.22	0.018	16%	Laboratory component in college science
404	Curricula	Schroeder, Scott, Tolson, Huang, & Lee	2007	61	159,695	61	0.67	—	47%	Teaching strategies in science
Other curricula programs										
Values/Moral education programs										
405	Curricula	Schlaefli, Rest, & Thoma	1985	55	—	68	0.28	—	20%	Effects on moral judgments
406	Curricula	Berg	2003	29	27,064	29	0.20	—	14%	Character education programs on knowledge
Perceptual-Motor programs										
407	Curricula	Kavale & Mattson	1983	180	13,000	637	0.08	0.011	6%	PM programs on learning disabled
Integrated curriculum programs										
408	Curricula	Hartzler	2000	30	—	30	0.48	0.086	34%	Integrated curriculum programs
409	Curricula	Hurley	2001	31	7,894	50	0.31	0.015	22%	Integrated science and math programs
Tactile stimulation										
410	Curricula	Ottenbacher, Muller, Brandt, Heintzelman, Hojem, & Sharpe	1987	19	505	103	0.58	0.145	41%	Tactile stimulation
Social skills programs										
411	Curricula	Denham & Almeida	1987	70	—	70	0.62	—	44%	Social problem solving programs
412	Curricula	Hanson	1988	63	—	586	0.65	0.034	46%	Social skill training
413	Curricula	Schneider	1992	79	—	12	0.19	—	13%	Enhancing peer relations
414	Curricula	Swanson & Malone	1992	39	3,944	366	0.72	0.043	51%	SS of learning disabled and non-disabled students
415	Curricula	Beelmann, Pfingsten, & Losel	1994	49	—	23	–0.04	—	–3%	Social competence training on achievement outcomes
416	Curricula	Forness & Kavale	1996	53	2,113	328	0.21	0.034	15%	SS with learning difficulties
417	Curricula	Kavale & Forness	1996	152	—	858	0.65	0.015	46%	SS of learning disabled and non-disabled students
418	Curricula	Quinn, Kavale, Mathur, Rutherford, & Forness	1999	35	1,123	35	0.20	0.03	2%	SS with emotional and behavioral disorders
Creativity programs										
419	Curricula	Rose & Lin	1984	158	—	158	0.47	0.054	33%	Long term creativity programs

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
420	Curricula	Cohn	1986	106	—	177	0.55	—	39%	Creativity training effectiveness
421	Curricula	Bangert-Drowns & Bankert	1990	20	—	20	0.37	—	26%	Explicit instruction of creativity
422	Curricula	Hollingsworth	1991	39	—	39	0.82	—	58%	Creativity programs
423	Curricula	Conard	1992	na	—	na	0.48	—	34%	Creative dramatics
424	Curricula	Scope	1998	30	—	40	0.90	0.188	64%	Instructional influences on creativity
425	Curricula	Scott, Leritz, & Mumford	2004	70	—	70	0.64	—	45%	Creativity programs
426	Curricula	Bertrand	2005	45	—	45	0.64	0.10	45%	Creativity programs
427	Curricula	Higgins, Hall, Baumfield, & Moseley	2005	19	—	19	0.62	—	44%	Thinking programs on achievement
428	Curricula	Huang	2005	51	—	62	0.89	0.098	63%	Creativity programs
429	Curricula	Berkowitz	2006	23	5,000	39	0.46	0.050	—	Various creative communication strategies
430	Curricula	Abrami, Bernard, Borokhovski, Surkes, Wade, & Zhang	2006	124	18,299	168	1.01	—	71%	Interventions to improve critical thinking skills
Outdoor programs										
431	Curricula	Cason & Gillis	1994	43	11,238	10	0.61	0.051	43%	Outdoor education on high school achievement
432	Curricula	Hattie, Marsh, Neill, & Richards	1997	96	12,057	30	0.46	—	33%	Outward bound
433	Curricula	Laidlaw	2000	48	3,550	389	0.49	0.020	35%	Outdoor education on achievement
Play										
434	Curricula	Spies	1987	24	2,491	24	0.26	—	19%	Impact of play on achievement
435	Curricula	Fisher	1992	46	2,565	46	0.74	—	52%	Impact of play on achievement
Bilingual programs										
436	Curricula	Powers & Rossman	1984	16	1,257	16	0.12	—	8%	Bilingual programs
437	Curricula	Willig	1985	16	—	513	0.10	—	7%	Bilingual programs
438	Curricula	Oh	1987	54	6,207	115	1.21	0.140	86%	Bilingual programs for Asian students in NY
439	Curricula	Greene	1997	11	2,719	11	0.18	—	13%	Bilingual programs
440	Curricula	McField	2002	10	—	12	0.35	—	25%	Bilingual programs
441	Curricula	Rolstad, Mahoney, & Glass	2005	4	—	43	0.16	—	11%	Bilingual programs in Arizona
442	Curricula	Slavin & Cheung	2005	17	—	17	0.45	—	32%	Bilingual and English-only reading programs
Extra-curricular activities										
443	Curricula	Scott-Little, Hamann, & Jurs	2002	6	—	—	0.18	—	5%	After-school care programs
444	Curricula	Lewis	2004	10	—	10	0.47	0.101	33%	General activities

Appendix A continues

Appendix A continued

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
445	Curricula	Lewis	2004	5	—	5	0.10	0.058	7%	Sports on achievement
446	Curricula	Lewis	2004	8	—	8	–0.01	0.058	5%	Work on achievement
447	Curricula	Durlak & Weisberg	2007	73	—	45	0.13	—	9%	After-school programs
Career interventions										
448	Curricula	Baker & Popowicz	1983	18	—	118	0.50	0.050	35%	Evaluating career education on outcomes
449	Curricula	Oliver & Spokane	1988	58	—	58	0.48	—	34%	Career education interventions
450	Curricula	Evans & Burck	1992	67	159,243	67	0.17	—	12%	Career education interventions
Teaching		**Strategies emphasizing learning intentions**								
		Goals								
451	Teaching	Chidester & Grigsby	1984	21	1,770	21	0.44	0.030	31%	Goal difficulty
452	Teaching	Fuchs & Fuchs	1985	18	—	96	0.64	—	45%	Long vs. & short term goals
453	Teaching	Tubbs	1986	87	—	147	0.58	0.030	41%	Goal difficulty, specificity and feedback
454	Teaching	Mento, Steel, & Karren	1987	70	7,407	118	0.58	0.018	41%	Goal difficulty
455	Teaching	Wood, Mento & Locke	1987	72	7,548	72	0.58	0.149	41%	Goal difficulty
456	Teaching	Wood, Mento & Locke	1987	53	6,635	53	0.43	0.063	30%	Goal specificity
457	Teaching	Wright	1990	70	7,161	70	0.55	0.018	39%	Goal difficulty
458	Teaching	Donovan & Radosevich	1998	21	2,360	21	0.36	—	25%	Goal commitment
459	Teaching	Klein, Wesson, Hollenbeck & Alge	1999	74	—	83	0.47	—		Goal commitment
460	Teaching	Burns	2004	55	—	45	0.82	0.089	58%	Degree of challenge
461	Teaching	Gollwitzer & Sheeran	2006	63	8,461	94	0.72	—	51%	Goal intentions on achievement
Behavioral objectives/advance organizers										
462	Teaching	Kozlow	1978	77	—	91	0.89	0.017	63%	Advance organizers
463	Teaching	Luiten, Ames & Ackerman	1980	135	—	160	0.21	—	15%	Advance organizers
464	Teaching	Stone	1983	29	—	112	0.66	0.074	47%	Advance organizers
465	Teaching	Lott	1983	16	—	147	0.24	—	17%	Advance organizers in science
466	Teaching	Asencio	1984	111	—	111	0.12	—	8%	Behavioral objectives
467	Teaching	Klauer	1984	23	—	52	0.40	—	28%	Intentional learning
468	Teaching	Rolheiser-Bennett	1986	12	1,968	45	0.80	—	57%	Advance organizers
469	Teaching	Mahar	1992	50	—	50	0.44	—	31%	Advance organizers
470	Teaching	Catts	1992	14	—	80	–0.03	0.056	–2%	Incidental learning
471	Teaching	Catts	1992	90	—	1065	0.35	0.013	25%	Intentional learning
472	Teaching	Preiss & Gayle	2006	20	1,937	20	0.46	—	33%	Advance organizers

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
Concept mapping										
473	Teaching	Moore & Readence	1984	161	—	161	0.22	0.050	16%	Graphics organizers in mathematics
474	Teaching	Vásquez & Caraballo	1993	17	—	19	0.57	0.032	40%	Concept mapping in science
475	Teaching	Horton, McConney, Gallo, Woods, Senn, & Hamelin	1993	19	1,805	19	0.45	—	32%	Concept mapping in science
476	Teaching	Kang	2002	14	—	14	0.79	—	56%	Graphics organizers in reading with learning disabled
477	Teaching	Kim, Vaughn, Wanzek, & Wei	2004	21	848	52	0.81	0.081	57%	Graphics organizers in reading
478	Teaching	Nesbit & Adesope	2006	55	5,818	67	0.55	0.040	39%	Concept and knowledge maps
Learning hierarchies										
479	Teaching	Horon & Lynn	1980	24	—	24	0.19	—	13%	Learning hierarchies
Strategies emphasizing success criteria										
Mastery learning										
480	Teaching	Block & Burns	1976	45	—	45	0.83	—	59%	Mastery learning
481	Teaching	Willett, Yamashita & Anderson	1983	130	—	13	0.64	—	45%	Mastery teaching in science
482	Teaching	Guskey & Gates	1985	38	7,794	35	0.78	—	55%	Group-based mastery learning
483	Teaching	Hefner	1985	8	1,529	12	0.66	—	47%	Mastery learning/competency-based methods
484	Teaching	Kulik & Kulik	1986	49	—	49	0.54	0.055	38%	Mastery testing
485	Teaching	Slavin	1987	7	—	7	0.04	—	3%	Mastery learning
486	Teaching	Guskey & Pigott	1988	43	—	78	0.61	—	43%	Group-based mastery learning
487	Teaching	Hood	1990	23	—	23	0.56	—	40%	Mastery learning
488	Teaching	Kulik, Kulik, & Bangert-Drowns	1990	34	—	34	0.52	—	37%	Mastery learning
Keller personalized system of instruction										
489	Teaching	Kulik, Kulik, & Cohen	1979	61	—	75	0.49	—	35%	PSI and achievement
490	Teaching	Willett, Yamashita & Anderson	1983	130	—	15	0.60	—	42%	PSI in science
491	Teaching	Kulik, Kulik, & Bangert-Drowns	1988	72	—	72	0.49	—	35%	PSI in college students
Worked examples										
492	Teaching	Crissman	2006	62	3,324	151	0.57	0.042	40%	Worked examples on achievement
Strategies emphasizing feedback										
Feedback										
493	Teaching	Lysakowski & Walberg	1980	39	4,842	102	1.17	—	83%	Classroom reinforcement

Appendix A continues

Appendix A continued

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
494	Teaching	Wilkinson	1980	14	—	14	0.12	—	8%	Teacher praise
495	Teaching	Walberg	1982	19	—	19	0.81	—	57%	Cues and reinforcement
496	Teaching	Lysakowski & Walberg	1982	54	15,689	94	0.97	—	69%	Cues, participation, and corrective feedback
497	Teaching	Yeany & Miller	1983	49	—	49	0.52	—	37%	Diagnostic feedback in college science
498	Teaching	Schimmel	1983	15	—	15	0.47	0.034	33%	Feedback from computer instruction
499	Teaching	Getsie, Langer, & Glass	1985	89	—	89	0.14	—	10%	Rewards and punishment
500	Teaching	Skiba, Casey, & Center	1985	35	—	315	0.68	—	48%	Nonaversive procedures
501	Teaching	Menges & Brinko	1986	27	—	31	0.44	0.115	31%	Student evaluation as feedback
502	Teaching	Rummel & Feinberg	1988	45	—	45	0.60	—	42%	Extrinsic feedback rewards
503	Teaching	Kulik & Kulik	1988	53	—	53	0.49	—	35%	Timing of feedback
504	Teaching	Tenenbaum & Goldring	1989	15	522	15	0.72	—	51%	Cues and reinforcement
505	Teaching	L'Hommedieu, Menges, & Brinko	1990	28	1,698	28	0.34	—	24%	Feedback from college student ratings
506	Teaching	Bangert-Drowns, Kulik, Kulik, & Morgan	1991	40	—	58	0.26	0.060	18%	Feedback from tests
507	Teaching	Wiersma	1992	20	865	17	0.50	0.086	35%	Intrinsic vs. extrinsic rewards
508	Teaching	Travlos & Pratt	1995	17	—	17	0.71	0.010	50%	Knowledge of results
509	Teaching	Azevedo, R., & Bernard, R.M.	1995	22	—	22	0.80	—	57%	Computer-presented feedback
510	Teaching	Standley	1996	98	—	208	2.87	—	203%	Music as reinforcement
511	Teaching	Kluger & DeNisi	1996	470	12,652	470	0.38	—	27%	Feedback
512	Teaching	Neubert	1998	16	744	16	0.63	0.028	45%	Goals plus feedback
513	Teaching	Swanson & Lussier	2001	30	5,104	170	1.12	0.093	79%	Dynamic assessment (feedback)
514	Teaching	Baker & Dwyer	2005	11	1,341	122	0.93	—	66%	Field independent vs. field dependent
515	Teaching	Witt, Wheeless, & Allen	2006	81	24,474	81	1.15	—	82%	Immediacy of teacher feedback
Frequent/effects of testing										
516	Teaching	Kulik, Kulik, & Bangert	1984	19	—	19	0.42	0.080	30%	Practice testing
517	Teaching	Fuchs & Fuchs	1986	22	1,489	34	0.28	—	20%	Examiner familiarity effects
518	Teaching	Bangert-Drowns, Kulik, & Kulik	1991	35	—	35	0.23	—	16%	Frequent testing
519	Teaching	Gocmen	2003	78	—	233	0.40	0.047	29%	Frequent testing
520	Teaching	Kim	2005	148	—	644	0.39	0.016	28%	Formative assessment
521	Teaching	Kim	2005	148	—	622	0.39	—	28%	Performance assessment on achievement
522	Teaching	Lee	2006	12	—	55	0.36	0.061	25%	Test driven external testing
523	Teaching	Hausknecht, Halpert, Di Paolo, & Gerrard	2007	107	134,436	107	0.26	0.016	18%	Practice and retesting effects

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
Teaching test taking										
524	Teaching	Messick & Jungeblut	1981	12	—	12	0.15	—	11%	Coaching for SAT
525	Teaching	Bangert-Drowns, Kulik & Kulik	1983	30	—	30	0.25	—	18%	Training in test taking skills
526	Teaching	DerSimonian & Laird	1983	36	15,772	36	0.07	—	5%	Coaching on the SAT-M/V
527	Teaching	Samson	1985	24	—	24	0.33	0.039	23%	Training in test taking skills
528	Teaching	Scruggs, White, & Bennion	1986	24	—	65	0.21	—	15%	Training in test taking skills
529	Teaching	Kalaian & Becker	1986	34	—	34	0.34	0.010	24%	Coaching for SAT
530	Teaching	Powers	1986	10	—	44	0.21	—	15%	Coaching for college admission
531	Teaching	Becker	1990	48	—	70	0.30	—	21%	Coaching for SAT
532	Teaching	Witt	1993	35	—	35	0.22	—	16%	Training in test taking skills
533	Teaching	Kulik, Bangert-Drowns, & Kulik	1984	14	—	14	0.15	—	11%	Coaching for SAT
Providing formative evaluation to teachers										
534	Teaching	Fuchs & Fuchs	1986	21	3,835	21	0.70	—	49%	Formative evaluation
535	Teaching	Burns & Symington	2002	9	—	57	1.10	0.079	78%	Use of pre-referral intervention teams
Questioning										
536	Teaching	Redfield & Rousseau	1981	14	—	14	0.73	—	52%	Teacher questioning
537	Teaching	Lyday	1983	65	—	65	0.57	—	40%	Adjunct questions
538	Teaching	Hamaker	1986	61	—	121	0.13	0.009	9%	Factual adjunct questions
539	Teaching	Samson, Strykowski, Weinstein, & Walberg	1987	14	—	14	0.26	0.086	18%	Teacher questioning
540	Teaching	Gliesmann, Pugh, Dowden, & Hutchins	1988	26	—	26	0.82	—	58%	Teacher questioning
541	Teaching	Gayle, Preiss, & Allen	2006	13	—	13	0.31	0.108	22%	Teacher questioning
542	Teaching	Randolph	2007	18	—	18	0.38	—	27%	Response cards to questioning
Teacher immediacy										
543	Teaching	Allen, Witt, & Wheeless	2006	16	5,437	16	0.16	—	8%	Immediacy on cognitive outcomes
Strategies emphasizing student perspectives in learning										
Time on task										
544	Teaching	Bloom	1976	11	—	28	0.75	—	53%	Time on task
545	Teaching	Fredrick	1980	35	—	35	0.34	—	24%	Time on task
546	Teaching	Catts	1992	18	—	37	0.19	0.101	13%	Time on task

Appendix A continues

Appendix A continued

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
547	Teaching	Shulruf, Keuskamp & Timperley	2006	36	—	36	0.24	—	17%	Taking more coursework
Spaced vs. mass practice										
548	Teaching	Lee & Genovese	1988	—	—	—	0.96	—	—	Spaced vs. massed practice
549	Teaching	Donovan & Radosevich	1999	63	—	112	0.46	—	—	Spaced vs. massed practice
Peer tutoring										
550	Teaching	Hartley	1977	29	—	50	0.63	0.089	44%	Effects on tutees in math
551	Teaching	Hartley	1977	29	—	18	0.58	0.201	41%	Effects on tutors in math
552	Teaching	Cohen, Kulik, & Kulik	1982	65	—	52	0.40	0.069	28%	Effects on tutees
553	Teaching	Cohen, Kulik, & Kulik	1982	65	—	33	0.33	0.090	23%	Effects on tutors
554	Teaching	Phillips	1983	302	—	302	0.98	—	69%	Tutorial training of conservation
555	Teaching	Cook, Scruggs, Mastropieri & Casto	1985	19	—	49	0.53	0.106	37%	Handicapped as tutors
556	Teaching	Cook, Scruggs, Mastropieri & Casto	1985	19	—	25	0.58	0.120	41%	Handicapped as tutees
557	Teaching	Mathes & Fuchs	1991	11	—	74	0.36	—	25%	Peer tutoring in reading
558	Teaching	Elbaum, Vaughn, Hughes & Moody	2000	32	1,248	216	0.41	—	29%	Peer tutoring in reading
559	Teaching	Elbaum, Vaughn, Hughes & Moody	2000	29	325	216	0.67	0.067	47%	One-one tutoring programs in reading
560	Teaching	Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller	2003	90	—	90	0.59	0.095	42%	Peer assisted learning in elementary students
561	Teaching	Erion	2006	32	—	32	0.82	0.156	58%	Parent tutoring children
562	Teaching	Ginsburg-Block, Rohrbeck & Fantuzzo	2006	28	—	26	0.35	0.040	25%	Peer-assisted learning
563	Teaching	Kunsch, Jitendra, & Sood	2007	17	1,103	17	0.47	—	33%	Peer-mediated instruction in math with LD students
Mentoring										
564	Teaching	Eby, Allen, Evans, Ng, & DuBois	2008	31	10,250	31	0.16	0.04	11%	Mentoring on performance outcomes
565	Teaching	DuBois, Holloway, Valentine, & Cooper	2002	43	—	43	0.13	0.05	9%	Mentoring on academic outcomes
Strategies emphasizing student meta-cognitive/self-regulated learning										
Meta-cognition strategies										
566	Teaching	Haller, Child & Walberg	1988	20	1,553	20	0.71	0.181	50%	Meta-cognitive training programs in reading
567	Teaching	Chiu	1998	43	3,475	123	0.67	—	47%	Meta-cognitive interventions in reading
Study skills										
568	Teaching	Sanders	1979	28	6,140	28	0.37	—	26%	Reading-study programs

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
569	Teaching	Kulik, Kulik, & Shwalb	1983	57	—	57	0.27	0.042	19%	Study skills preparation programs
570	Teaching	Crismore	1985	100	—	100	1.04	—	74%	Summarizing strategies
571	Teaching	Henk & Stahl	1985	21	—	25	0.34	0.129	24%	Note taking
572	Teaching	Rolheiser-Bennett	1986	12	1,968	78	1.28	—	90%	Memory training
573	Teaching	Runyan	1987	32	3,698	51	0.64	—	45%	Mnemonic keyword recall program
574	Teaching	Mastropieri & Scruggs	1989	19	—	19	1.62	0.18	115%	Mnemonic keyword recall program
575	Teaching	Burley	1994	27	7,285	40	0.13	—	9%	College programs for underprepared
576	Teaching	Hattie, Biggs, & Purdie	1996	51	5,443	270	0.45	0.030	32%	Study skills
577	Teaching	Purdie & Hattie	1999	52	—	653	0.28	0.007	20%	Study skills
578	Teaching	Robbins, Lauver, Le, Davis, Langley, & Carlstrom	2004	109	476	279	0.41	0.240	29%	Study skills at college
579	Teaching	Lavery	2008	30	1,937	223	0.46	0.060	33%	Self-regulated learning
580	Teaching	Kobayashi	2005	57	—	131	0.22	—	16%	Effects of note taking
581	Teaching	Dignath, Buettner, & Langfeldt	2008	30	2,364	263	0.69	0.030	49%	Self-regulation strategies
Self-verbalization/Self questioning										
582	Teaching	Rock	1985	47	1,398	684	0.51	0.060	36%	Special ed self-instructional training
583	Teaching	Duzinski	1987	45	—	377	0.84	—	59%	Self-verbalizing instruction training
584	Teaching	Huang	1991	21	1,700	89	0.58	—	41%	Student self-questioning
Student control over learning										
585	Teaching	Niemiec, Sikorski, & Walberg	1996	24	—	24	–0.03	0.149	–2%	Student control over learning in CAI
586	Teaching	Patall, Cooper, & Robinson	2008	41	—	14	0.10	0.027	7%	Control over learning on subsequent control
Aptitude-treatment interactions										
587	Teaching	Kavale & Forness	1987	39	—	318	0.28	—	19%	Modality testing and teaching
588	Teaching	Whitener	1989	22	1,434	22	0.11	0.070	8%	
Matching style of teaching										
589	Teaching	Tamir	1985	54	—	13	0.02	—	1%	Cognitive preference
590	Teaching	Garlinger & Frank	1986	7	1,531	7	–0.03	—	–2%	Field independence/dependence on achievement
591	Teaching	Sullivan	1993	42	3,434	42	0.75	—	53%	Dunn and dunn learning styles matched to achievement
592	Teaching	Iliff	1994	101	—	486	0.33	0.026	23%	Kolb Learning Style matched to achievement
593	Teaching	Dunn, Griggs, Olson, Beasley, & Gorman	1995	36	3,181	65	0.76	—	53%	Interventions to match learning style on achievement

Appendix A continues

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
594	Teaching	Slemmer	2002	48	5,908	51	0.27	—	19%	Learning styles in hyper/technology environments
595	Teaching	Mangino	2004	47	8,661	386	0.54	0.006	38%	Dunn and dunn learning styles for adults
596	Teaching	Lovelace	2005	76	7,196	168	0.67	—	47%	Dunn and dunn learning styles matched to achievement
Individual instruction										
597	Teaching	Hartley	1977	51	—	139	0.16	0.091	11%	Individualization in math
598	Teaching	Kulik & Kulik	1980	213	—	213	0.33	0.034	23%	Individualized college achievement
599	Teaching	Horak	1981	60	—	129	–0.07	—	–5%	Individualization in math
600	Teaching	Willett, Yamashita & Anderson	1983	130		131	0.17		12%	Individualized science curriculum
601	Teaching	Bangert, Kulik, & Kulik	1983	49	—	49	0.1	0.053	4%	Individualized in high schools
602	Teaching	Waxman, Wang, Anderson & Walberg	1985	38	7,200	309	0.45	—	32%	Adaptive methods (individual, continuous assessment, periodic evaluation)
603	Teaching	Atash & Dawson	1986	10	2,180	30	0.09	0.046	6%	Individualized science curriculum
604	Teaching	Dacanay & Cohen	1992	30	—	30	0.37	—	26%	Individual instruction in medical education
605	Teaching	Elbaum, Vaughn, Hughes & Moody	1999	19	—	116	0.43	—	30%	Special ed in reading
Implementations emphasizing teaching strategies										
Teaching strategies										
606	Teaching	Rosenbaum	1983	235	—	99	1.02	—	72%	Treatment programs for emotionally disturbed students
607	Teaching	O'Neal	1985	31	—	96	0.81	0.155	57%	With cerebral palsy students
608	Teaching	Baenninger & Newcombe	1989	26	—	26	0.51	—	36%	Spatial strategies on spatial outcomes
609	Teaching	Forness & Kavale	1993	268	8,000	819	0.71	0.122	50%	Teaching with low ability students
610	Teaching	Fan	1993	41	3,219	223	0.56	—	40%	Metacognitive training on reading comprehension
611	Teaching	Scheerens & Bosker	1997	228	—	545	0.20	0.030	14%	Various strategies on achievement
612	Teaching	White	1997	222	15,080	1796	0.39	0.046	28%	Cognitive learning strategies in reading with LD
613	Teaching	White	1997	72	8,527	831	0.20	0.039	14%	Cognitive learning strategies in math with LD
614	Teaching	Marzano	1998	4000	1,237,000	4000	0.65	0.014	46%	Classroom instructional techniques
615	Teaching	Swanson & Hoskyn	1998	180	38,716	1537	0.79	0.013	56%	Teaching with low ability students
616	Teaching	Xin & Jitendra	1999	14	—	653	0.89	—	63%	Word problem solving in reading
617	Teaching	Swanson	2000	180	180,827	1537	0.79	0.013	56%	Learning strategies for special ed students

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
618	Teaching	Swanson	2001	58	—	58	0.82	0.087	58%	Programs to enhance problem solving
619	Teaching	Seidel & Shavelson	2007	112	—	1352	0.07	—	5%	Teaching and learning processes
Reciprocal teaching										
620	Teaching	Rosenshine & Meister	1994	16	—	31	0.74	—	52%	Reciprocal teaching
621	Teaching	Galloway	2003	22	677	22	0.74	—	52%	Reciprocal teaching on reading comprehension
Direct instruction										
622	Teaching	White	1988	25	—	24	0.83	0.133	59%	DI in special education
623	Teaching	Adams & Engelmann	1996	37	—	372	0.75	—	53%	DI on reading
624	Teaching	Borman, Hewes, Overman, & Brown	2003	232	42,618	182	0.21	0.020	15%	DI from comprehensive schools reforms
625	Teaching	Haas	2005	10	—	19	0.55	0.135	39%	Teaching methods in algebra
Adjunct aids										
626	Teaching	Readence & Moore	1981	16	2,227	122	0.45	0.020	32%	Adjunct pictures in reading
627	Teaching	Levie & Lentz	1982	23	7,182	41	0.55	—	39%	Text illustrations
628	Teaching	Catts	1992	8	—	19	0.01	0.067	1%	Adjunct aids
629	Teaching	Hoeffler, Sumfleth, & Leutner	2006	26	—	76	0.46	—	33%	Instructional animation vs. static pictures
Inductive teaching										
630	Teaching	Lott	1983	24	—	24	0.06	—	4%	Inductive teaching in science
631	Teaching	Klauer & Phye	2008	73	3,595	79	0.59	0.035	42%	Inductive teaching
Inquiry based teaching										
632	Teaching	Sweitzer & Anderson	1983	68	—	19	0.44	0.154	31%	Inquiry teaching in science
633	Teaching	Shymansky, Hedges & Woodworth	1990	81	—	320	0.27	0.030	19%	Inquiry methods in science
634	Teaching	Bangert-Drowns	1992	21	—	21	0.37	—	26%	Inquiry teaching effects on critical thinking
635	Teaching	Smith	1996	35	7,437	60	0.17	—	12%	Inquiry method in science
Problem-solving teaching										
636	Teaching	Marcucci	1980	33	—	237	0.35	—	25%	Problem solving in math
637	Teaching	Curbelo	1984	68	10,629	343	0.54	0.037	38%	Problem solving on science and math
638	Teaching	Almeida & Denham	1984	18	2,398	18	0.72	0.136	51%	Interpersonal problem solving
639	Teaching	Mellinger	1991	25	—	35	1.13	0.060	80%	Increasing cognitive flexibility
640	Teaching	Hembree	1992	55	—	55	0.33	—	23%	Problem solving instructional methods

Appendix A continues

Appendix A continued

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
641	Teaching	Taconis, Ferguson-Hessler, & Broekkamp	2001	22	2,208	31	0.59	0.070	42%	Problem solving in science
Problem-based learning										
642	Teaching	Albanese & Mitchell	1993	11	2,208	66	0.27	0.043	19%	PBL in medicine
643	Teaching	Vernon & Blake	1993	8	—	28	−0.18	—	−13%	PBL in college level
644	Teaching	Dochy, Segers, Van den Bossche, & Gijbels	2003	43	21,365	35	0.12	—	8%	PBL on knowledge and skills
645	Teaching	Smith	2003	82	12,979	121	0.31	—	22%	PBL in medicine
646	Teaching	Newman	2004	12	—	12	−0.30	—	−21%	PBL in medicine
647	Teaching	Haas	2005	7	1,538	34	0.52	0.187	37%	Teaching methods in algebra
648	Teaching	Gijbels, Dochy, Van den Bossche, & Segers	2005	40	—	49	0.32	—	23%	PBL on assessment outcomes
649	Teaching	Walker & Leary	2008	82	—	201	0.13	0.025	9%	PBL across disciplines
Cooperative learning										
650	Teaching	Johnson, Maruyama, Johnson, Nelson, & Skon	1981	122	—	183	0.73	—	52%	Cooperative learning
651	Teaching	Rolheiser-Bennett	1986	23	4,002	78	0.48	—	34%	Cooperative learning
652	Teaching	Hall	1988	22	10,022	52	0.31	—	22%	Cooperative learning
653	Teaching	Stevens & Slavin	1990	4	—	4	0.48	—	34%	Cooperative learning
654	Teaching	Spuler	1993	19	6,137	19	0.54	—	38%	Cooperative learning in math
655	Teaching	Othman	1996	39	—	39	0.27	—	19%	Cooperative learning in math
656	Teaching	Howard	1996	13	—	42	0.37	—	26%	Scripted cooperative learning
657	Teaching	Bowen	2000	37	3,000	49	0.51	0.050	36%	Cooperative learning in high school chemistry
658	Teaching	Neber, Finsterwald & Urban	2001	12	—	314	0.13	—	9%	Cooperative learning with gifted
659	Teaching	McMaster & Fuchs	2002	15	864	49	0.30	0.070	21%	Cooperative learning
Cooperative vs. competitive learning										
660	Teaching	Johnson, Maruyama, Johnson, Nelson, & Skon	1981	122	—	9	0.56	—	40%	Cooperative with intergroup competition
661	Teaching	Johnson, Johnson, & Marayama	1983	98	—	83	0.82	0.093	58%	Cooperative vs. competition
662	Teaching	Johnson & Johnson	1987	453	—	36	0.59	0.165	42%	Cooperative vs. competition
663	Teaching	Hall	1988	18	—	83	0.28	—	20%	Cooperative vs. competition
664	Teaching	Qin, Johnson, & Johnson	1995	46	—	63	0.55	—	39%	Cooperative vs. competition

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
665	Teaching	Johnson, Johnson, & Stanne	2000	158	—	66	0.55	0.059	39%	Cooperative vs. competition
666	Teaching	Roseth, Johnson & Johnson	2008	129	17,000	593	0.46	0.130	33%	Cooperative vs. competition
Cooperative vs. individualistic learning										
667	Teaching	Johnson & Johnson	1987	453	—	70	0.68	0.139	48%	Cooperative vs. individualistic
668	Teaching	Hall	1988	15	—	77	0.26	—	18%	Cooperative vs. individualistic
669	Teaching	Johnson, Johnson, & Stanne	2000	158	—	82	0.88	0.066	62%	Cooperative vs. individualistic
670	Teaching	Roseth, Fang, Johnson, & Johnson	2006	148	—	55	0.55	0.060	39%	Cooperative vs. individualistic in middle school
Competitive vs. individualistic learning										
671	Teaching	Johnson, Maruyama, Johnson, Nelson, & Skon	1981	122	—	163	0.09	—	6%	Competitive learning
672	Teaching	Johnson, Johnson, & Marayama	1983	98	—	16	0.45	0.288	32%	Competitive vs. individualistic
673	Teaching	Johnson & Johnson	1987	453	—	12	0.36	0.271	25%	Competitive vs. individualistic
674	Teaching	Johnson, Johnson, & Stanne	2000	158	—	12	0.04	0.138	3%	Competitive vs. individualistic
Implementations that emphasize school-wide teaching strategies										
Comprehensive teaching reforms										
675	Teaching	Borman & D'Agostino	1996	17	41,706,196	657	0.12	—	8%	Evaluation of federal title I programs
676	Teaching	Friedrich	1997	33	—	50	0.38	—	27%	Alternative programs for at-risk youth
677	Teaching	Borman, Hewes, Overman, & Brown	2003	232	222,956	1111	0.15	—	11%	Comprehensive school reform
Interventions for learning disabled students										
678	Teaching	Swanson, Carson, & Sachse-Lee	1996	78	—	324	0.85	0.065	60%	Programs for learning disabled students
679	Teaching	Swanson, Hoskyn, & Lee	1999	180	4,871	1537	0.56	0.017	40%	Between-group designs
680	Teaching	Swanson, Hoskyn, & Lee	1999	85	793	793	0.90	0.008	64%	Single-subject designs
Special college programs										
681	Teaching	Kulik, Kulik, & Shwalb	1983	60	—	60	0.27	0.040	19%	College programs for high risk students
682	Teaching	Cohn	1985	48	—	48	0.20	—	14%	Innovative teaching vs. trad lectures in economics
Co-/Team teaching										
683	Teaching	Murawski & Swanson	2001	6	1,617	6	0.31	0.057	22%	Co-teaching
684	Teaching	Willett, Yamashita & Anderson	1983	130	—	41	0.06	—	4%	Co-teaching in science

Appendix A continues

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
Implementations using technologies										
Computer assisted instruction										
685	Teaching	Hartley	1977	33	—	89	0.41	0.062	29%	CAI on achievement
686	Teaching	Aiello & Wolfe	1980	115	—	182	0.08	—	6%	CAI in high school science
687	Teaching	Kulik, Kulik & Cohen	1980	312	—	278	0.48	0.030	34%	CAI on college
688	Teaching	Burns & Bozeman	1981	40	—	40	0.40	—	28%	CAI in mathematics
689	Teaching	Leong	1981	22	—	106	0.08	—	6%	CAI in high school math
690	Teaching	Athappilly, Smidchens, & Kofel	1983	134	—	810	0.10	—	7%	CAI in Modern math vs. trad math
691	Teaching	Kulik, Kulik, & Bangert-Drowns	1985	51	—	51	0.32	—	23%	CAI on high school students
692	Teaching	Kulik, Bangert, & Williams	1983	97	—	97	0.36	0.035	25%	CAI with high school students
693	Teaching	Willett, Yamashita, & Anderson	1983	130	—	130	0.13	—	9%	CAI in science
694	Teaching	Kulik *et al.*	1984	25	—	25	0.48	0.063	34%	CAI with elementary school students
695	Teaching	Bangert-Drowns	1985	74	—	74	0.33	—	23%	CAI with pre-college students
696	Teaching	Bangert-Drowns, Kulik & Kulik	1985	42	—	42	0.26	0.063	18%	CAI in high schools
697	Teaching	Clark	1985	42	—	42	0.09	—	6%	CAI in schools
698	Teaching	Kulik, Kulik, & Bangert-Drowns	1985	32	—	32	0.47	0.055	33%	CAI with elementary school students
699	Teaching	Kulik & Kulik	1986	48	—	48	0.32	0.061	23%	CAI on college
700	Teaching	Kulik, Kulik, & Shwalb	1986	23	—	23	0.42	0.110	30%	CAI with adults
701	Teaching	Schmidt, Weinstein, Niemic, & Walberg	1986	18	—	48	0.67	0.048	47%	CAI with exceptional children
702	Teaching	Shwalb, Shwalb, & Azuma	1986	104	—	4	0.74	0.069	52%	CAI in Japan
703	Teaching	Gillingham & Guthrie	1987	13	—	13	1.05	—	74%	Computer-based instruction
704	Teaching	Kulik & Kulik	1987	199	—	199	0.31	—	22%	CAI on achievement
705	Teaching	Niemiec, Samson, Weinstein & Walberg	1987	48	—	224	0.32	—	23%	CAI with elementary school students
706	Teaching	Cunningham	1988	37	—	37	0.33	—	23%	Computer-generated graphics on achievement
707	Teaching	Roblyer, Castine & King	1988	85	—	85	0.26	—	18%	CAI on achievement
708	Teaching	Wise	1988	26	—	26	0.30	—	21%	CAI in science
709	Teaching	Kuchler	1988	65	—	65	0.44	0.068	31%	CAI to teach high school math
710	Teaching	McDermid	1989	15	—	15	0.57	—	40%	CAI on learning disabled and educably mentally retarded
711	Teaching	Bishop	1990	40	—	58	0.55	—	39%	Computers in elementary schools
712	Teaching	Wen-Cheng	1990	72	—	243	0.38	0.037	27%	CAI in elementary and high

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
713	Teaching	Gordon	1991	84	—	83	0.26	0.030	18%	Computer graphics and math and problem solving
714	Teaching	Jones	1991	40	—	58	0.31	—	22%	CAI on elementary school students
715	Teaching	Kulik & Kulik	1991	248	240	248	0.30	0.029	21%	CAI on achievement
716	Teaching	Liao & Bright	1991	65	—	432	0.41	0.020	29%	Computer programming on achievement
717	Teaching	Palmeter	1991	37	—	144	0.48	0.055	34%	CAI/Logo on higher cognitive processes
718	Teaching	Ryan	1991	40	—	58	0.31	—	22%	Microcomputer applications
719	Teaching	Schramm	1991	12	836	12	0.36	0.110	25%	Word processing on writing
720	Teaching	Cohen & Dacanay	1992	37	—	37	0.41	—	29%	Computer-based in health education
721	Teaching	Liao	1992	31	—	207	0.48	0.163	34%	CAI on achievement
722	Teaching	Bangert-Drowns	1993	32	—	32	0.39	—	28%	Word processing on writing
723	Teaching	Ouyang	1993	79	—	267	0.50	0.038	35%	CAI in elementary schools
724	Teaching	Chen	1994	76	—	98	0.47	0.071	33%	Computer-based in math
725	Teaching	Kulik & Kulik	1994	97	—	32	0.35	0.04	25%	CAI on achievement
726	Teaching	Kulik & Kulik	1994	97	—	97	0.32	—	23%	CAI in high schools
727	Teaching	Christmann	1995	35	3,476	35	0.23	—	16%	CAI in schools
728	Teaching	Fletcher-Flynn & Gravatt	1995	120	—	120	0.17	—	12%	CAI on achievement
729	Teaching	Hamilton	1995	41	—	253	0.66	0.033	46%	CAI in schools
730	Teaching	Ianno	1995		—		0.31	—	22%	CAI on reading of learning disabled
731	Teaching	Cassil	1996	21	—	349	0.29	—	21%	Mobile computers
732	Teaching	Chadwick	1997	41	8,170	41	0.51	—	36%	CAI in high school math
733	Teaching	Christmann, Badgett & Lucking	1997	27	—	27	0.21	—	15%	CAI in high schools
734	Teaching	King	1997	30	—	68	0.20	—	14%	CAI college math
735	Teaching	Christmann & Badgett	1999	11	5,020	11	0.28	—	20%	CAI in high schools
736	Teaching	Soe, Koki, & Chang	2000	17	—	33	0.27	0.022	19%	CAI in reading
737	Teaching	Woolf & Regian	2000	233	—	233	0.39	—	28%	CAI on achievement
738	Teaching	Lou, Abrami & d'Apollonia	2001	100	11,317	178	0.16	0.041	11%	CAI in small groups
739	Teaching	Lou, Abrami & d'Apollonia	2001	22	—	39	0.31	0.117	22%	CAI in small groups
740	Teaching	Yaakub & Finch	2001	21	2,969	28	0.35	—	25%	CAI-based technical education instruction
741	Teaching	Akiba	2002	21	—	21	0.37	—	26%	CAI on achievement
742	Teaching	Bayraktar	2002	42	—	108	0.27	—	19%	CAI in science education
743	Teaching	Blok, Oostdam, Otter, & Overmaat	2002	42	—	42	0.19	—	13%	CAI on beginning reading
744	Teaching	Roberts	2002	31	6,388	165	0.69	—	49%	CAI on achievement

Appendix A continues

Appendix A continued

No.	*Domain*	*Author*	*Year*	*No. studies*	*Total no.*	*No. effects*	*Mean*	*se*	*CLE*	*Variable*
745	Teaching	Torgerson & Elbourne	2002	7	—	7	0.37	—	26%	CAI on spelling
746	Teaching	Waxman, Connell, & Gray	2002	20	4,400	138	0.39	—	28%	Technology vs. traditional teaching on achievement
747	Teaching	Chambers	2002	57	64,766	125	0.51	—	36%	CAI in elementary and high school classrooms
748	Teaching	Chambers & Schreiber	2004	25	—	25	0.40	—	28%	CAI in elementary and high school classrooms
749	Teaching	Torgerson & Zhu	2003	212	—	43	0.26	0.094	18%	CAI on literacy
750	Teaching	Goldberg, Russell & Cook	2003	26	1,507	26	0.50	—	35%	Effects of CAI on writing
751	Teaching	Hsu	2003	25		31	0.43	—	30%	CAI in statistics
752	Teaching	Kroesbergen & Van Luit	2003	58	10,223	58	0.75	—	53%	CAI and math with special education
753	Teaching	Kulik	2003	12	—	12	0.88	—	62%	CAI on college
754	Teaching	Torgerson & Zhu	2003	17	—	17	0.36	—	25%	CAI and literacy outcomes
755	Teaching	Waxman, Lin, Michko	2003	29	7,728	167	0.54	0.061	38%	CAI on achievement
756	Teaching	Bernard, Abrami, Wade, Borokhovski, & Lou	2004	232	3,831,888	688	0.20	—	14%	CAI in distance education
757	Teaching	Lou	2004	71	—	399	0.15	—	11%	Small group vs. individual with CAI on tasks attempted
758	Teaching	Liao	2007	52	4,981	134	0.55	—	39%	CAI in Taiwan
759	Teaching	Pearson, Ferdig, Blomeyer, & Moran	2005	20	—	89	0.49	0.078	35%	Technology on reading
760	Teaching	Abrami, Bernard, Wade, Schmid, Borokhovski, Tamin, Surkes, Lowerison, Zhang, Nicolaidou, Newman, Wozney, & Peretiatkowics	2006	17	—	29	0.17	—	12%	e-learning in Canada
761	Teaching	Sandy-Hanson	2006	23	9,897	23	0.28	—	20%	CAI on achievement
762	Teaching	Shapiro, Kerssen-Griep, Gayle & Allen	2006	12	—	16	0.26	—	—	PowerPoint in the class
763	Teaching	Timmerman & Kruepke	2006	118	12,398	118	0.24	0.020	17%	CAI with college students
764	Teaching	Onuoha	2007	38	3,824	67	0.26	—	18%	Computer-based labs in science
765	Teaching	Rosen & Salomon	2007	32	—	32	0.46	—	33%	Constructivist technology intensive learning
Simulations										
766	Teaching	Dekkers & Donatti	1981	93	—	93	0.33	—	23%	Simulations and achievement
767	Teaching	Remmer & Jernstet	1982	21	—	21	0.20	—	14%	Computer simulations

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
768	Teaching	Szczurek	1982	58	—	58	0.33	—	23%	Simulation games
769	Teaching	VanSickle	1986	42	—	42	0.43	—	30%	Instructional simulation gaming
770	Teaching	Lee	1990	19	—	34	0.28	0.114	20%	Simulations on achievement
771	Teaching	McKenna	1991	26	—	118	0.38	0.070	27%	Simulations in economics
772	Teaching	Armstrong	1991	43	—	43	0.29	—	21%	Computers and simulations and games
773	Teaching	Lee	1999	19	—	19	0.40	—	28%	Computer simulations
774	Teaching	LeJeune	2002	40	6,416	54	0.34	—	24%	Computer simulated experiments in science
Web-based learning										
775	Teaching	Olson & Wisher	2002	15	—	15	0.24	0.150	17%	Web-based learning
776	Teaching	Sitzman, Kraiger, Stewart, & Wisher	2006	96	19,331	96	0.15	—	11%	Web-based and traditional classes
777	Teaching	Mukawa	2006	25	3,223	25	0.14	0.099	10%	Web-based learning principles
Interactive video										
778	Teaching	Clark & Angert	1980	23	4,800	1000	0.65	—	46%	
779	Teaching	Angert & Clark	1982	181	—	2607	0.51	—	36%	Media methods on achievement
780	Teaching	Shwalb, Shwalb, & Azuma	1986	104	—	33	0.49	0.055	35%	Technology in Japan
781	Teaching	Fletcher	1989	24	—	47	0.50	0.080	35%	Interactive video disk technology
782	Teaching	McNeil & Nelson	1991	63	—	100	0.53	0.097	37%	Multimedia technologies
783	Teaching	Liao	1999	46	—	143	0.41	0.073	29%	Hypermedia vs. traditional instruction
Audio/Visual methods										
784	Teaching	Kulik, Kulik & Cohen	1979	42	—	42	0.20	—	14%	Audio-based teaching
785	Teaching	Cohen, Ebeling, & Kulik	1981	65	—	65	0.15	—	11%	Visual-based instruction
786	Teaching	Willett, Yamashita & Anderson	1983	130	—	100	0.02	—	1%	Visual aids in science
787	Teaching	Shwalb, Shwalb, & Azuma	1986	104	—	6	0.09	0.110	6%	Audio-based teaching in Japan
788	Teaching	Blanchard, Stock & Marshall	1999	10	2,760	10	0.16	0.030	11%	Multi-medium using personal and video-game computers
789	Teaching	Baker & Dwyer	2000	8	—	8	0.71	—	50%	Use of visual aids in learning
Programmed instruction										
790	Teaching	Hartley	1977	40	—	81	0.11	0.111	8%	PI in mathematics
791	Teaching	Kulik, Cohen, & Ebeling	1980	57	—	57	0.24	—	17%	PI with college students
792	Teaching	Kulik, Kulik & Cohen	1980	56	—	56	0.24	—	17%	PI in college
793	Teaching	Kulik, Schwalb, & Kulik	1982	47	—	47	0.08	0.070	6%	PI in high schools

Appendix A continues

Appendix A continued

No.	Domain	Author	Year	No. studies	Total no.	No. effects	Mean	se	CLE	Variable
794	Teaching	Willett, Yamashita & Anderson	1983	130	—	52	0.17	—	12%	PI in science
795	Teaching	Shwalb, Shwalb, & Azuma	1986	104	—	39	0.43	0.028	30%	PI in Japan
796	Teaching	Boden, Archwamety, & MacFarland	2000	30	—	30	0.40	0.146	28%	PI in high schools
Implementations using out-of-school learning										
Distance education										
797	Teaching	Machtmes & Asher	2000	19	—	19	–0.01	—	–1%	Effectiveness of telecourses
798	Teaching	Cavanaugh	1999	19	—	19	0.13	—	9%	Interactive distance learning on achievement
799	Teaching	Cavanaugh	2001	19	929	19	0.15	0.106	10%	Interactive distance education
800	Teaching	Shachar & Neumann	2003	72	15,300	86	0.37	0.035	26%	Distance vs. traditional teaching
801	Teaching	Allen, Mabry, Mattrey, Bourhis, Titsworth, & Burrell	2004	25	71,731	39	0.10	—	7%	Distance vs. traditional classes
802	Teaching	Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer	2004	14	7,561	116	–0.03	0.045	–2%	Distance in all classes
803	Teaching	Williams	2004	25	—	34	0.15	—	11%	Distance in allied health science programs
804	Teaching	Bernard, Abrami, Lou, Wozney, Borokhovski, Wallet, Wade, Fiset	2004	232	3,831,888	688	0.01	0.010	1%	Distance education
805	Teaching	Bernard, Lou, Abrami, Wozney, Borokhovski, Wallet, Wade, Fiset	2004	155	—	155	–0.02	0.015	–1%	Presence or not: asynchronous and aynchronous
806	Teaching	Zhao, Lei, Yan, Lai, & Tan	2005	51	11,477	98	0.10	—	7%	Distance vs. traditional classes
807	Teaching	Allen, Bourhis, Mabry, Burrell, & Timmerman	2006	54	74,275	54	0.09	—	7%	Distance vs. traditional teaching
808	Teaching	Lou, Bernard, & Abrami	2006	103	—	218	0.02	—	1%	Distance education in undergraduates
809	Teaching	Zhao, Lei, Yan, Lai, & Tan	2005	51	11,477	98	0.10	0.090	7%	Distance vs. traditional classes
Home-school programs										
810	Teaching	Penuel, Kim, Michalchik, Lewis, Means, Murphy, Korbak, Whaley, & Allen	2002	14	—	14	0.16	—	11%	Laptop programs between school and home
Homework										
811	Teaching	Paschal, Weinstein, & Walberg	1984	15	—	81	0.36	0.027	25%	Homework on learning
812	Teaching	Cooper	1989	20	2,154	20	0.21	—	15%	Homework on achievement
813	Teaching	DeBaz	1994	77	41,828	77	0.39	—	27%	Homework in science
814	Teaching	Cooper	1994	17	3,300	48	0.21	—	15%	Homework on learning
815	Teaching	Cooper, Robinson, & Patall	2006	32	58,000	69	0.28	—	20%	Homework from studies 1987–2004

Appendix B

The meta-analyses by rank order

Rank	Domain	Influence	d
1	Student	Self-report grades	1.44
2	Student	Piagetian programs	1.28
3	Teaching	Providing formative evaluation	0.90
4	Teacher	Micro teaching	0.88
5	School	Acceleration	0.88
6	School	Classroom behavioral	0.80
7	Teaching	Comprehensive interventions for learning disabled students	0.77
8	Teacher	Teacher clarity	0.75
9	Teaching	Reciprocal teaching	0.74
10	Teaching	Feedback	0.73
11	Teacher	Teacher-student relationships	0.72
12	Teaching	Spaced vs. mass practice	0.71
13	Teaching	Meta-cognitive strategies	0.69
14	Student	Prior achievement	0.67
15	Curricula	Vocabulary programs	0.67
16	Curricula	Repeated reading programs	0.67
17	Curricula	Creativity programs	0.65
18	Teaching	Self-verbalization/self-questioning	0.64
19	Teacher	Professional development	0.62
20	Teaching	Problem-solving teaching	0.61
21	Teacher	Not Labeling students	0.61
22	Curricula	Phonics instruction	0.60
23	Teaching	Teaching strategies	0.60
24	Teaching	Cooperative vs. individualistic learning	0.59
25	Teaching	Study skills	0.59
26	Teaching	Direct Instruction	0.59
27	Curricula	Tactile stimulation programs	0.58
28	Curricula	Comprehension programs	0.58
29	Teaching	Mastery learning	0.58
30	Teaching	Worked examples	0.57
31	Home	Home environment	0.57

Appendix B continues

Appendix B continued

Rank	Domain	Influence	*d*
32	Home	Socioeconomic status	0.57
33	Teaching	Concept mapping	0.57
34	Teaching	Goals	0.56
35	Curricula	Visual-perception programs	0.55
36	Teaching	Peer tutoring	0.55
37	Teaching	Cooperative vs. competitive learning	0.54
38	Student	Pre-term birth weight	0.54
39	School	Classroom cohesion	0.53
40	Teaching	Keller's PIS	0.53
41	School	Peer influences	0.53
42	School	Classroom management	0.52
43	Curricula	Outdoor/adventure Programs	0.52
44	Teaching	Interactive video methods	0.52
45	Home	Parental involvement	0.51
46	Curricula	Play programs	0.50
47	Curricula	Second/third chance programs	0.50
48	School	Small group learning	0.49
49	Student	Concentration/persistence/engagement	0.48
50	School	School effects	0.48
51	Student	Motivation	0.48
52	Student	Early intervention	0.47
53	Teaching	Questioning	0.46
54	Curricula	Mathematics	0.45
55	Student	Preschool programs	0.45
56	Teacher	Quality of Teaching	0.44
57	Curricula	Writing Programs	0.44
58	Teacher	Expectations	0.43
59	School	School size	0.43
60	Student	Self-concept	0.43
61	Teaching	Behavioral organizers/Adjunct questions	0.41
62	Teaching	Matching style of learning	0.41
63	Teaching	Cooperative learning	0.41
64	Curricula	Science	0.40
65	Curricula	Social skills programs	0.40
66	Student	Reducing anxiety	0.40
67	Curricula	Integrated Curriculum Programs	0.39
68	School	Enrichment	0.39
69	Curricula	Career Interventions	0.38
70	Teaching	Time on Task	0.38
71	Teaching	Computer assisted instruction	0.37
72	Teaching	Adjunct aids	0.37

Rank	Domain	Influence	d
73	Curricula	Bilingual programs	0.37
74	School	Principals/ school leaders	0.36
75	Student	Attitude to mathematics/science	0.36
76	Curricula	Exposure to reading	0.36
77	Curricula	Drama/Arts programs	0.35
78	Student	Creativity	0.35
79	Teaching	Frequent/effects of testing	0.34
80	School	Decreasing disruptive behavior	0.34
81	Student	Drugs	0.33
82	Teaching	Simulations	0.33
83	Teaching	Inductive teaching	0.33
84	Student	Positive view of own ethnicity	0.32
85	Teacher	Teacher effects	0.32
86	Teaching	Inquiry based teaching	0.31
87	School	Ability grouping for gifted Students	0.30
88	Teaching	Homework	0.29
89	Home	Home visiting	0.29
90	Student	Exercise/relaxation	0.28
91	School	Desegregation	0.28
92	School	Mainstreaming	0.28
93	Curricula	Use of calculators	0.27
94	Curricula	Values/moral education programs	0.24
95	Teaching	Programmed instruction	0.24
96	Teaching	Special college programs	0.24
97	Teaching	Competitive vs. individualistic learning	0.24
98	School	Summer school	0.23
99	School	Finances	0.23
100	Teaching	Individualized instruction	0.23
101	School	Religious Schools	0.23
102	Student	Lack of Illness	0.23
103	Teaching	Teaching test taking	0.22
104	Teaching	Visual/audio-visual methods	0.22
105	Teaching	Comprehensive teaching reforms	0.22
106	School	Class size	0.21
107	School	Charter Schools	0.20
108	Teaching	Aptitude/treatment interactions	0.19
109	Student	Personality	0.19
110	Teaching	Learning hierarchies	0.19
111	Teaching	Co-/ team teaching	0.19
112	Teaching	Web-based learning	0.18
113	Home	Family structure	0.17

Appendix B continues

Appendix B continued

Rank	Domain	Influence	*d*
114	Curricula	Extra-curricular programs	0.17
115	Teaching	Teacher immediacy	0.16
116	School	Within class grouping	0.16
117	Teaching	Home-school programs	0.16
118	Teaching	Problem-based learning	0.15
119	Curricula	Sentence combining programs	0.15
120	Teaching	Mentoring	0.15
121	School	Ability grouping	0.12
122	Student	Gender	0.12
123	Student	Diet	0.12
124	Teacher	Teacher training	0.11
125	Teacher	Teacher subject matter knowledge	0.09
126	Teaching	Distance Education	0.09
127	School	Out of school curricula experiences	0.09
128	Curricula	Perceptual-Motor programs	0.08
129	Curricula	Whole language	0.06
130	School	College halls of residence	0.05
131	School	Multi-grade/age classes	0.04
132	Teaching	Student control over learning	0.04
133	School	Open vs. traditional	0.01
134	School	Summer vacation	−0.09
135	Home	Welfare policies	−0.12
136	School	Retention	−0.16
137	Home	Television	−0.18
138	School	Mobility	−0.34

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Index

Document

Overview of the literature - schooling provision in different settings

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CONTENTS

INTRODUCTION

This paper provides a brief overview of the literature relating to: schooling provision in multi-storey inner city schools, multi-agency and shared use of school sites, and schools using flexible timetabling. It was prepared to inform the Ministry of Education's work programme exploring schooling in different settings.

The overview was compiled from a scan of material published in English between 1994-2014. Papers were identified by searching ERIC, EBSCO MasterFILE, ProQuest, Google Scholar and the websites of various education policy and administrative agencies for academic and professional journal articles, reports, conference papers and working papers using key words associated with schooling settings. Material reflecting on emergency or disaster situations has been excluded.

COMMENT ON THE LITERATURE

Schooling in different settings is contextualised in the literature by:

- Developments in education and society related to environmental sustainability, ICT, inclusive education, changing pedagogical methods and school choice. These developments have led to new ideas about what is considered a good school building, and what can be transformed into a school building.
- Long held views that communities should make the widest possible use of their schools' facilities.
- High quality education as an essential component of urban and metropolitan vitality creating equitable, healthy, and environmentally sustainable cities and schools for all. There is a particular focus in the United States literature on urban schools being small and walkable and reflecting integrated planning (ie, housing, transport, schooling, commercial interests, etc.).

SUMMARY OF FINDINGS

Multi-level inner city schools & limited outdoor and green space

The literature provides only limited discussion of multi-level schools, beyond the design of the spaces within such buildings. Outdoor (and green) space is a prominent concern in the design of multi-level urban schools (as it is with all schools). Students' physical activity is addressed in relation to the availability and types of outdoor space in inner city schools generally, but it is not clear in the literature that multi-level schools as such are associated with lower levels of physical activity. Walking (or use other forms of 'active travel') to and from school may outweigh what schools offer in outdoor and/or recreational space.

Multi-agency use of school sites & shared facilities

There is a considerable amount of material advocating joint use of schools. This material encompasses various models of sharing facilities, including community schools (or extended or full service schools) in Australasia, the United Kingdom and the United States. The material focuses on establishing definitions, providing examples and explaining the challenges and opportunities. Overall, this literature suggests that these various types of joint use make a positive difference to children, families, schools and communities. It is not clear what the outcomes are for stakeholders in the longer term.

Flexible timetabling

Many timetabling options are canvassed in the literature; with much of this material focused on student achievement outcomes and teachers' views. There is scant exploration of the impact on families or the wider community. It is not evident that any particular form of timetabling is superior to another in relation to student achievement, nor whether any improved student achievement is sustained over time. Rather time tabling options are best considered in relation to how they can be used to reflect school and community priorities and values. In making changes, schools need to consider the impact on families, transport, and student employment – areas noted but not explored in the literature.

Overall

There is very little empirical research describing the community impact of delivering schooling from multi-storey inner city schools, schools with limited access to green space, or schools that are in joint use. Similarly, the literature describes many types of flexible timetabling but focuses on students' academic achievement and teachers' views – the impacts on other stakeholders are poorly explored. Overall, the literature provides ideas and examples of schooling in various settings, and many positive case studies – but seldom elaborates on how particular settings affect all of the groups involved, particularly over time.

MULTI-STOREY INNER CITY SCHOOLS

Summary

The literature on multi-storey schools concentrates on design aspects rather than the experience of those using the buildings. This design-focused literature provides examples of both new buildings and retro-fitted older buildings. Although multi-storey schools are common in Asian countries, and not unknown in many other countries, discussion of the experiences of teachers, students and communities is lacking. There is also very little empirical evidence associating learning spaces with teacher practice and student learning, once minimum standards have been achieved (Blackmore et al., 2011; Higgins et al., 2005).[1]

Overall the literature supports multi-level inner city schools as a solution to limited space in cities, and because of the role of quality schools in creating and sustaining desirable urban communities (Fuller et al., 2009; Kendler, 2007; Spector, 2003; Sydney Business Chamber, 2014).

Issues

The issues identified in the literature with multi-storey schools relate to inner city schools generally. These are:

1) Concerns about adequate exposure to natural light and air, green space and physical activity.
2) Student safety in the inner city environment.

Lack of outdoor space

The literature suggests there are generally two solutions to a lack of outdoor space within a school: 1) accessing public open spaces, and 2) building rooftop recreation areas. There is very little material on whether and to what extent concern about a lack of outdoor/green space for students attending multi-storey schools is justified. The literature search found one dated UNESCO study of high rise primary schools in Malaysia, which highlighted the need for specifically designed spaces, and the issues with relying on using public recreation facilities (Educational Planning & Research Division, Ministry of Education, Malaysia, 1995). Additionally, the literature includes one passing mention of the experience of using public green space, from an article describing the construction of a rooftop play space on an existing six storey Montessori school in New York City. 'The children were just not going to the park (one block away) as frequently as I knew they should' (Barron, 1999).

While larger school campuses (compared to smaller) are associated with higher levels of physical activity in students (Cohen et al., 2008; Cradock et al., 2007; Haug et al., 2010) it is not clear from the literature that multi-storey schools as such are associated with lower levels of physical activity. Several studies suggest that the extra physical activity gained when students walk to and from school may outweigh the benefits of schools with large fields and buildings – and having schools closer to population centres may facilitate students walking to school (Cohen et al., 2008; van Sluijs et al., 2009).

[1] The difficulty of describing how design quality can facilitate 'educational transformation' was one of many criticisms levelled at the now defunct British Building Schools for the Future (BSF) programme. See Leiringer & Cardellino (2011) for a description of the BSF programme and case studies of four exemplar schools in Scandinavia that were designed to address changes in the educational curriculum.

Further to this, material from the 2014 New South Wales Inner City Schools Working Party community consultation suggests that parents (and teachers) are open to a range of ideas about the nature of school buildings (and the shape of the school day) but in general do not want their children to have to travel long distances to school (NSW Inner City Schools Working Party, 2014). (The Working Party will issue its report towards the end of 2014.)

Student safety

Concern about students' safety in inner city schools is a minor note in the literature, generally commented on – if at all – in newspaper articles rather than in academic research. This concern is vaguely directed at exposure to a potentially unwholesome urban environment, rather than dangers presented by a high rise environment in particular.

In the only instance found of a proposal for a high-rise primary school being rejected by parents (in Ultimo, NSW in 2012[2]) parents were anxious about child safety (related to objects falling from upper floors and being observed by residents living on the planned upper floors) as well as a lack of natural light (Danks, 2012; McNeilage, 2014). However, in 2010 the Melbourne *Age* reported that there had not been much parental concern about the proximity of a planned city school to an 'infamous nightclub strip' (Tarica, 2010).[3] Christie (2004) outlines specific issues and measures taken at St Andrew's Cathedral School in inner city Sydney 'to ensure the safety and security of the school community', however this article is unavailable.[4]

Examples of multi-storey schools

Australia

St Andrews Cathedral School, Sydney – Anglican school established in 1885, coeducational from Kindergarten to Year 12 [sacs.nsw.edu.au]

Macquarie Grammar, Sydney – private, independent, secular, non-selective, coeducational school, established in 2004 [macquariegrammarschool.edu.au]

United Kingdom

Hampden Gurney Church of England Primary School, London – a six storey school incorporating open-air play decks and residential apartments that funded the redevelopment of the site. (Description in Silverwood, 2010.) [www.hampdengurneyschool.org.uk]

United States

James F. Oyster Bilingual Elementary School, Washington DC – a community led redevelopment funded by dividing the original school property to construct a new school and a residential development. (Description in 21st Century School Fund, 2002.) [oysteradamsbilingual.org].

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[2] This involved the planned redevelopment of an existing school which mixed classrooms in a building with apartments and shops.
[3] This article referred to the Melbourne City School, an independent, co-educational Prep to Year 9 school located in the Melbourne Central Business District, which closed in 2012 due to low enrolments.
[4] Christie, P. (2004) Safety in the city: some insights from a school in the Sydney CBD. In: 'ANZELA 13th annual conference', pages 393-397. Australia and New Zealand Education Law Association

MULTI-AGENCY USE OF SCHOOL SITES & SHARED FACILITIES

Summary

Several types of multi-use of school sites and shared facilities (joint use) are discussed in the literature:

- the co-location of social services providers with schools
- opening school buildings and grounds for the use of the wider community
- schools sharing facilities with other schools.

Community schools & extended or full service schools

The multi-use of school sites through community schools or extended or full service schools is discussed extensively in the Australian, United Kingdom and United States literature. These schools have an integrated focus on academic learning, youth development, family support, health and social services and community development. (Note that these agencies may share facilities in one physical space or occasionally be in partnership but in different spaces.)

There is a considerable literature supporting the benefits of community schools. Evaluation suggests positive effect on students (learning and engagement) and families – particularly those most socially and economically disadvantaged; teachers and communities (Blank et al., 2003; Carpenter & Peters, 2012; Nathan & Thao, 2007; Simons, 2011). An evaluation of health and social services in New Zealand schools (Ministry of Health, 2009) found that a student support service in schools significantly improves student access to health and social services.

It should be noted that much of the United States community school literature makes a case for smaller schools that are closely linked to neighbourhoods (for example, Fuller et al., 2009; McCann & Beaumont, 2003). McDonald (2010) points out that, in contrast, school facility planners generally expect community schools to meet the needs of entire localities. Suggestions for making smaller schools cost effective are discussed in a paper published by a state agency, the Public Schools of North Carolina (2000).

Other forms of community joint use

In addition to joint use directly connected to the mission of the school (student achievement and wellbeing), the literature also describes joint use aimed at wider community wellbeing. In this case, the joint user has the overall community or neighbourhood as its focus; for example, a primary care health clinic located in a school (Vincent, 2010). There is also joint use where the user has no relationship with the school or its families but wants shared access to the location and space in the school or an external shared space (Filardo et al., 2010). An example of this in New Zealand is provided by the Tamaki Recreation Centre partnership between Tamaki College and the Auckland City Council (see tamakirecreation.co.nz).

There is a considerable amount of (mainly United States) material explaining the basic challenges and opportunities and facilitating planning for joint use of schools. While the policy frameworks of jurisdictions outside New Zealand may make detailed guides inapplicable, these works point to the broad areas that need to be considered, such as roles and responsibilities and the criteria for approvals and denials of use (Filardo et al., 2010; Galonski, 1998; Vincent & Cooper, 2008; Vincent, 2010; 21st Century School Fund and Center for Cities & Schools, 2014). In New Zealand, SPARC (now

Sport New Zealand) has produced a guide to territorial authorities and school facilities partnerships (Visitor Solutions, 2011).

Schools sharing facilities with other schools[5]

The literature also describes schools sharing facilities with other schools. Much of this literature focuses on charter schools in the United States sharing the sites or facilities of traditional public school – the success of which is contested (NYC Coalition for Educational Justice, 2010; Sazon, 2011; Trujillo & Rivera, 2014; Winters, 2014).

A number of United States school districts have subdivided large schools into several small 'schools within- a-school.' (Such schools are formally authorised separate and autonomous units, which plan and run their own programme, have their own staff and students, and receive their own separate budget; although they must negotiate the use of common space with a host school, and defer to the building principal on matters of safety and building operation.) Studies, which are focused on academic achievement, have found modest improvement in academic and behavioural outcomes for students at such schools (Page et al., 2002), but robust evidence is lacking. Research indicates that effectiveness relies on each 'sub-school' being completely autonomous and having as much separation as possible (physical and social) between each 'sub-school' (Public Schools of North Carolina, 2000).

Rather less radically, in Australia the 2008 federal *Local Schools Working Together* project has helped to develop shared educational facilities, such as gymnasiums, performance arts centres, libraries and facilities for teaching language, science and music. Chester (2010) describes particular cases positively in terms of expanded opportunities for students and economic efficiencies; however, further evaluative material looking across the programme and exploring longer term outcomes for all stakeholders could not be located.

Benefits of shared use

In addition to the positive outcomes noted above in relation to community schools, the following benefits of joint-use are reported in the literature:

- expanded programmes and services for students
- increased integration of schools and communities; greater reach for programmes serving the community
- expanded opportunities for physical activity
- a reduction in the number of sites needed to deliver public services; decreased traffic and transportation costs through delivery of services in locations that families frequent.
- reduced public expenditure through elimination of duplicated services and costs
- recovery of facilities costs through increased use of facilities and revenues from non-school users.

[5] Note that this overview has excluded material relating to schools using the same site in shifts, or school co-location in emergency situations.

Addressing potential challenges

The literature suggests that, at the higher level, the potential of joint use arrangements requires a policy framework to leverage the resources that are already present in many schools and communities. Additionally school systems must be designed so that they can accommodate school community partnerships (Simons, 2011). At the local level, joint use projects need:

- a champion who can motivate others
- a project team able to focus and to adapt to changing circumstances since much of the process has political dimensions
- staff trained and experienced in asset management who can oversee and negotiate the logistics of terms, legal agreements, scheduling, planning, and communication among multiple users (21st Century School Fund and Center for Cities & Schools, 2014; Galonski, 1998).

There is also an ongoing need for clear guidance on roles and responsibilities. Many of the barriers to the sharing of facilities such as who pays for what and prioritising usage can be addressed through joint use agreements (Spengler et al., 2011). Shared use handbooks[6] typically include discussion of the following:

- the benefits of community use of school facilities, with particular attention given to the role of non-profit or community-based organisations as providers of student programme;
- school-level policies
- the critical role of the school principal in community use
- the role of central agency staff in support of site-level staff
- the responsibilities of users and programme providers
- criteria for approvals and denials of use.

Examples of joint use

Australia

Golden Grove, Adelaide, shared by Gleeson College, Pedare Christian College and Golden Grove High School, as well as the Golden Grove Recreation Centre. (Description in Chester, 2010.) [goldengrovehs.sa.edu.au].

New Zealand

Tamaki College Community Recreation Centre Partnership [tamaki.ac.nz] [tamakirecreation.co.nz]

United States

Urban Assembly School for Law and Justice and **Urban Assembly of Math and Science for Young Women**, New York City – a conversion of a former Family Court House in Brooklyn into two separate 500-student charter high schools. [uainstitute.org]

Tenderloin Community School, San Francisco – site includes a primary school, pre-school, community centre with medical, dental and counselling offices, rooms for adult education, a community kitchen and garden. The community garden and playground are on an open roof top. (Description in Silverwood, 2010.) [tenderloin-sfusd-ca.schoolloop.com]

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[6] For example, Centre for Health Law & Policy Innovation, 2013; Department for Education & Employment, 1999; Filardo et al., 2010; Visitor Solutions, 2011.

FLEXIBLE TIMETABLING

Summary

Flexible timetabling is discussed in the literature as a means of school improvement, that is, more effective use of resources, improvement in school climate and student achievement, and help in establishing desired programmes and practices. The most commonly discussed forms of flexible timetabling are:

Customised learning periods – or flexible (modular) scheduling. This approach customises the routing of students through a curriculum using a mastery-based approach. Those describing it in particular schools (Murray, 2008; Sawchuk, 2009; Ward, 2012; Zoellner, 1999) consider flexible scheduling a success in terms of student outcomes; however no studies larger than single cases could be found.

Changes to the start and finish times of the school day – in particular this literature reports on a later start for senior secondary school students (grounded in research on adolescent sleeping patterns). Wahlstrom et al's (2014) large scale United States evaluation of later start times found improvements in academic outcomes, attendance rates and reduced lateness in high schools; however these schools started at 8:30AM or later (compared to 7.35AM), which is perhaps of limited relevance to the New Zealand situation. While presenting a generally positive picture, Collier (2003) provides a comprehensive list of advantages and disadvantages from his experience implementing a two shift system in an over-crowded school on a small site in New South Wales.

Block scheduling (longer lesson times) – There is a considerable literature on block scheduling, largely from the United States but including a study in New Zealand (Hipkins et al., 2010). Meta-analysis finds that block scheduling is associated with inconsistent results on standardized test scores (Zepeda and Mayers, 2006) and does not generally have a significant impact (Lewis et al., 2005). However, studies consistently show that teachers, students, and administrators view block scheduling positively (Hipkins et al., 2010; McCoy, 1998; Zepeda & Mayers, 2006).

Extended school day or year – numerous United States schools (including many charter schools) have extended the school day or year.[7] There are few high-quality studies available, however two generalisations seem possible: the connection between time and learning is not straightforward, and children from low socio-economic backgrounds have the most to gain from extended learning time in any of its forms (ECONorthwest, 2008; EPI Research Brief 2012).

Implications

Overall there is not robust evidence that any particular time tabling model has a greater impact on student learning than any other. It is clear, though, that the school schedule can have a significant impact on teacher instruction (for example, see studies by Canady & Rettig, 1995; Davis-Wiley & Cozart, 1995; Hipkins et al., 2010; and Pisapia & Westfall, 1997) on families and on communities (Collier, 2003) – although the latter stakeholders are poorly represented in the literature. It is also clear that the schedule reflects a school community's values and priorities (Hipkins et al., 2010).

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[7] By adding hours or days to the regular school schedule using existing staff and facilities; or out-of-school programmes (after-school or summer school) that are operated separately from the regular school day or year.

The literature suggests schools need to consider school goals and priorities, the impact on families, transport, student employment (often noted by Australian commentators) and other factors. These considerations may carry equal or greater weight to arguable educational benefits (Collier, 2003; Galonski, 1998). Drawing on what is generally known about implementing change in schools, the literature offers the following advice for implementing significant timetabling changes:

- determine why a change in the timetable is desirable
- involve all stakeholders
- provide ongoing professional development to support teachers' efforts to change classroom practices
- conduct periodic evaluation of the new schedule.

Note that the literature contains only anecdotal references to schools trying and rejecting flexible timetabling. While the reasons for schools returning to conventional timetabling are not well explored, they appear to be related largely to poor use of unstructured time (Collier, 2003; Murray, 2008; Snyder et al., 2012).

Examples of flexible timetabling

Australia

Separate junior and senior school shifts – Thomas Reddall High School, Ambarvale, NSW (Description in Collier, 2003.) [thomasredd-h.schools.nsw.edu.au]

New Zealand

Block scheduling (or extended learning episodes) – Alfriston College, Auckland (Description in Hipkins et al., 2010.)[alfristoncollege.school.nz]

Later start to the school day – Wellington High School [whs.school.nz]

United States

Flexible Modular Scheduling (differentiated scheduling) – Wausau West High School, Wisconsin (Description in Murray, 2008.)[west.wausauschools.org]

Extended school time – Orchard Gardens (K–8) Massachusetts [orchardgardensk8.org]

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Document

SCHOOLING IN CITY SETTINGS - FINDINGS FROM INTERVIEWS WITH SCHOOL PRINCIPALS & ECE PROVIDERS

February 2015

Paper prepared February 2015 by L Fawthorpe for the Ministry of Education

SUMMARY

The purpose of this paper is to describe New Zealand experiences of providing schooling in a central city location, with limited outdoor space, or in multi-storey buildings. The information presented is a summary of the views of 14 school principals and early childhood care and education (ECE) providers interviewed in February 2015. This paper forms part of a larger piece of work being undertaken by the Ministry of Education to explore schooling in different settings.

The impact on the teaching and learning programme of being in the city

Schools use the city in their teaching and learning programmes. City environments, institutions and events are formally linked to the curriculum. Schools regularly use off-site city amenities, form relationships with tertiary education providers and engage with businesses. The use of off-site amenities is facilitated by the school valuing taking learning out of the classroom, the proximity of the school to the city, and the independence of the students.

ECE centres use their city locations in teaching and learning programmes through drawing on children's interests in what they can see from the centre (views above ground), as well as what they experience outside of it. The extent to which children are taken outside to city amenities depends on child staff ratios on a given day, and the proximity of amenities.

Safety

In general, there is a low level of parental concern about children's safety in the city. Families value the proximity of inner city schools and centres to where they work and live, and the multicultural nature of schools and centres in city locations.

Most schools experience minimal anti-social behaviour from people in the wider city community. Building design and security measures are used to support student safety and protect property. Schools ensure that students (primary and secondary) who freely use the city have the appropriate knowledge and skills to do so.

Parents in Wellington are more concerned about the earthquake safety of multi-storey buildings than others. Principals (and ECE providers) provide information about building standards and emergency procedures. ECE providers are strongly focused on emergency procedures in multi-storey buildings.

Traffic is a prominent safety concern for school principals, particularly in primary schools. Schools supervise arrival and departure times, fence sites to limit where children can step out to the road and negotiate with local authorities for parking and traffic calming.

Access to outdoor space, and the Health and Physical Education (PE) curriculum

Students in all schools have access to the outdoors at breaks, in spaces that allow physical recreation. Children in multi-storey ECE centres have open spaces within the building providing fresh air, sunlight and outdoor activities.

Schools in the study are delivering comprehensive Health and PE programmes (including team sports) to students irrespective of their on-site facilities or grounds. ECE providers have equipment and indoor and outdoor spaces that allow children to develop a range of physical skills.

Sharing facilities

All the schools in this study use external facilities, both hired (pools, sports grounds) and free to the user (parks, libraries). Most schools also open their sites to wider community use, including some which rent out facilities. Formal partnerships and joint use arrangements are less usual.

Multi-storey buildings

Multi-storey buildings provide opportunities for creating interesting teaching and learning and social spaces. Principals and ECE providers reported no issues with having classes in multi-storey buildings.

CONTENTS

INTRODUCTION

This paper presents the findings from interviews with 11 school principals and three ECE providers about providing care and education in city sites with limited grounds and/or multi-storey buildings.[1] This study was carried out for the Ministry of Education in February 2015 to supplement the findings of a literature review[2] exploring schooling in different settings. Both this study and the literature review form part of a larger piece of work being undertaken by the Ministry to explore schooling in different settings.

The schools & ECE centres

The schools and centres in the study are all in or on the fringe of a central city; their urban characteristics are listed in the table below. Most of the schools are state owned, with one private senior secondary school, and one state integrated primary school of special religious character. All ECE centres are owned by commercial providers.

Table 1 Participants in the study

PARTICIPANTS		LOCATION	CONTEXT
Secondary schools			
1	Private co-ed	Auckland	Sole occupancy of multi-storey building, no grounds
2	State single sex (girls)	Hamilton	Limited outdoor space, multi-storey buildings in grounds
3	State single sex (girls)	Wellington	Limited outdoor space, multi-storey buildings in grounds
4	State co-ed	Wellington	Limited outdoor space, multi-storey buildings in grounds
Primary schools			
1	State	Wellington	Limited outdoor space, two level classroom block
2	State	Wellington	Limited outdoor space
3	State	Christchurch	Limited outdoor space, multi-storey building
4*	State	Auckland	Closest primary school to Auckland CBD
5	State	Wellington	Limited outdoor space, close to Wellington CBD
6	State integrated	Auckland	Limited outdoor space
7	State	Auckland	Limited outdoor space
ECE Centres (Commercial)			
1	One centre	Auckland	Multi-storey CBD location (children on two floors)
2	Several centres	Wellington	Sole occupancy of two storey building, and one floor of multi-storey buildings
3	One centre	Auckland	Multi-storey CBD location (children on one floor)

* Although on the Ministry of Education's list of schools with limited grounds, one primary school has comparatively extensive grounds, and as such the interview with the principal was limited.

[1] During February 2015, four secondary school principals, seven primary school principals and three ECE providers were interviewed (generally by telephone). Questions covered: how the site influences the school's teaching and learning programmes, whether the school shares facilities with other organisations, any site specific safety issues and comments from parents and others relating to the site.

[2] In November 2014 the Ministry commissioned a brief overview of the literature relating to schooling (not ECE) provision in multi-storey inner city schools, and schools with limited outdoor space.

FINDINGS

The literature review on schooling in different settings left questions about the opportunities and constraints presented by a city location and how schools manage any difficulties. This study describes principals' and ECE providers' experiences of:

- how being in the city affects the teaching and learning programme
- students' access to open space
- delivery of the health and physical education (PE) curriculum and students' access to sport
- how safe students are in the inner city
- schools sharing facilities
- any issues with schooling in a multi-storey building.

These findings should be read noting that they come from the perspective of principals and ECE providers, and that there is no comparison with schools in other settings.

1) The impact of being in the city on the teaching and learning programme

Schools use the city as an extension of the classroom

School principals in the study consider proximity to city amenities to be the major advantage of their sites. Schools use the city as an extension of the classroom, incorporating city environments, institutions and events into their teaching and learning programmes. On and off-site experiences are formally linked to the curriculum.

Primary and secondary schools regularly use city amenities; for example, theatres, art galleries, cinemas and museums, courts, marae, libraries, and the waterfront. In Wellington, principals also noted using national institutions such as Parliament and National Archives. All schools in the research also have visitors from city based organisations coming into the school.

Both primary and secondary schools form relationships with tertiary education providers – learning about what they do, and taking part in university research. Some secondary school students are taking university classes. Schools also engage students with businesses. For example, students involved in planning school redevelopment go to the architects' offices to see the real process as part of their enquiry.

Factors influencing the extent to which students leave their school site

Several factors influence the extent to which students leave their school site to use city amenities.

- **The values of the school in relation to taking learning out of the classroom**

  Schools that had been established with or had developed a specific emphasis on using the city as a learning resource emphasised building relationships within the city. These schools also built appropriate social skills in their students, teaching them to use the city responsibly. Notably, though, one principal remarked that a school's relationship with the city could change over time. ('As a less usual school you become a magnet for those wanting you to fix their child. The cohort changed massively – our SENCO roll was often about 120 of 200 children and it was challenging to use the city as best we could with them.')

- **The proximity of the school to the city**

  Primary schools further from the city may take several trips a term, while schools in the CBD may use city amenities daily. The cost of activities and transport can limit schools using city amenities. Cost is particularly an issue for primary schools further away from the CBD which make more extensive use of transport. (*'Buses cost up to $170 per bus per trip, and while the older ones may be able to walk sometimes, buses are invariably used.'*)

  Time spent using transport is another factor for schools to consider when going off-site. Time spent on a bus is not necessarily a useful part of the programme. Walking to amenities is preferred as it is free, provides exercise, the opportunity to develop appropriate skills for being in the city, and can be linked to the learning programme. Secondary schools use timetabling to reduce the impact of being off-site on class time, for example, scheduling trips adjacent to the lunch break.

- **The independence of the students**

  Older students require less supervision, and for some activities may leave the school by themselves. In two primary schools senior students (years 6-8 or years 7-8) could earn a trust licence/passport to leave the school in small groups (eg, two or three students) without an adult.

  However, principals report that the need for additional adult help does not limit their ability to go off-site. Schools either do not require extra supervising adults or they are able to get the help they need. One principal noted that parents working in the city meet the students at the venue.

ECE centres also use their city locations in teaching and learning programmes

The city location features in ECE centres' teaching and learning programmes through drawing on children's interests in what they can see from the centre, as well as outside of it. All providers remarked on the views children had from being above the ground floor (eg, children are able to watch cranes working, fire engines driving down streets, etc).

The extent to which children are taken outside to city amenities depends on the centre manager, child staff ratios on the day (having children away could provide an opportunity to take children out, as does parent help), and what amenities are accessible. For example, a provider with two centres located in inner city Wellington, reported that '*children do spend a lot of time outside of the centres ... we've got Te Papa on our doorstep with an amazing playground, and there is a good green belt in Wellington, and the zoo – and free buses for under-fives.*' One centre in Auckland (two year olds and over) planned excursions every month (the zoo, taking the ferry to the beach at Devonport); whereas at another centre in inner city Auckland (0-6 years), 'some children are sometimes' taken outside of the centre, if there is sufficient parent help, to places they could walk to such as a local park.

2) Safety

Generally low level of parental concern about children's safety in the city

School principals and ECE providers noted that parents value having schools and centres close to where they work and live. This allows parents to participate in activities, and drop off and pick up children more easily in relation to work. School principals and ECE providers also consider that parents value the cultural diversity of city schools and centres.

Schools experience minimal anti-social behaviour from people in the wider city community

Some of the school principals in the study had occasionally been asked by parents about the safety of students in the inner city. With the exception of a primary school of special (religious) character with security concerns related to that character, principals do not consider there are safety issues related to being in the city.

Schools sometimes experience people sleeping rough or drinking (leaving bottles and rubbish) on the school grounds or in nearby public areas used by their students. One school sometimes had people from a neighbouring drug and alcohol service being verbally abusive.

Schools with students who can go off-site without adult supervision ensure students have the social skills to navigate the city and to interact with others ('they understood hello and goodbye and stopping before shop doors to let others in and out').

Schools take safety and security measures commensurate with the issues they experience, how open their grounds are and the extent to which other organisations use the site. Schools and ECE centres in CBD multi-storey buildings have a single point of access (only a few schools in the study with grounds have a single point of access). Some have security guards periodically checking the site at nights and on weekends, others have monitored alarms. One primary school has a constant security presence related to the special character of the school, and one secondary school has an on-site custodian due to the extensive use of school facilities by other organisations.

Traffic is a prominent safety concern for school principals

Traffic is the key safety issue for principals. This issue was mentioned by most primary schools and one secondary school (with a special needs unit on the ground floor and an arterial road outside). There are a number of aspects to this concern – heavily trafficked roads, and speeding vehicles (including the proximity of the school to emergency service centres), and the lack of drop off spaces which tempts parents to take risks. Although no school or centre reported incidents, the potential is ever present, with primary schools having staff on traffic duty, and supervising the handover of younger children to caregivers. Schools attempt to mitigate the problem by fencing their sites to limit where children can step out to the road and negotiations with local authorities for parking and traffic calming.

Those schools and centres in the study without traffic related issues had sufficient drop off parking, large proportions of families walking, or are located near a public transport hub and public parking. Secondary school students are more likely to walk or use public transport than younger students, reducing traffic issues around those schools.

3) Access to outdoor space

Students in all schools have access to the outdoors at breaks, in spaces that allow physical recreation

Students at all schools in the study have daily access to outdoor recreation. No schools stagger breaks, but some primary schools timetable access to some spaces; or segregate play spaces by age group.

Primary school students are more likely than secondary school students to be obliged to go outside during breaks – weather permitting. Primary schools maximise use of limited space, incorporating terraces and banks, using several different small areas, and having interesting features in the grounds. Using artificial turf in primary schools expands recreational opportunities.

In the two primary schools in the study where outside space is very limited, schools use neighbouring parks. This is particularly easy for a school with 30-40 parents in the school during the day, and a trust system allowing senior students to leave the premises; it is less straightforward for a primary school of special character with particular security concerns.

One school has responded to their limited on-site open space by having an enquiry with students focused on the recreational potential of facilities within walking distance, in which children designed their own programme within a budget and time period.

Secondary school students have the opportunity to be outside during breaks but may choose to spend time indoors; additionally a lot of school clubs and groups meet in breaks.

In two schools – one secondary and one primary – students (senior primary students) self-manage non-class time and can leave the school premises when not in a class.

Children in multi-storey ECE centres have open spaces within the building providing fresh air, sunlight and outdoor activities

In centres located above the ground floor in multi-storey buildings, outdoor space is provided by having open spaces within the building, for example, a 250 square metre deck two thirds covered by the floor above, and one third open *('that's all outdoor space but when it's raining we have two thirds of the deck completely usable')*. Children are in fresh air and natural light, and have access to typically outdoor activities, such as running around and playing with sand and water.

4) Delivering the Health & PE curriculum & access to team sports

City schools are delivering comprehensive Health and PE programmes

Primary

Primary school principals in the study consider they run comprehensive Health & PE programmes irrespective of the space they have available. Schools with limited grounds make considered use of the space available – several principals noted that installing artificial turf had expanded the range of team sports that are played on-site.

For schools with no or very limited grounds sport and physical recreation is a – not insurmountable – challenge. Principals in schools where curricula physical activities are generally off-site, consider they run comprehensive programmes because of the need for careful planning. This might mean using a combination of local parks and other schools' fields (free), council pools (hired) and a tertiary institution's gymnasium (partnership with the institution's teaching programme).

There are drawbacks to having to go off-site frequently, particularly for primary school children who cannot, as a group, leave the school by themselves. For schools in this situation it meant having a lot of parent help or a cost to parents and also to the school. ('*It would be in the region of $10 per trip per child and there might be eight trips a term so it's a significant expense and the school pays some of it and parents pay some of it.*')

Several primary school principals noted parental engagement in supporting sporting opportunities. This is in the form of parents being in the school 'all day every day' to supervise children's trip off-site, or initiating and supporting a school's involvement in a sport (organising free cricket coaching) or an event (the Weetbix Triathlon). Schools also support students' participation in local club sport, for example, advising parents about registration.

Secondary

City secondary schools in the study with limited grounds can generally deliver the health and PE curriculum on-site, although it requires careful planning around using classrooms, gymnasium space, fields and courts. Swimming is off-site in three of the secondary schools and, in one case, senior PE classes go to a local gymnasium for a fitness unit – the cost of this falls on students and the school. Having a gymnasium that could accommodate several classes mitigates outdoor space constraints. Secondary schools are not sharing other schools' facilities, but are using council sports facilities for swimming, some athletics and some extra-curricular sport.

In the one case where a private secondary school in Auckland had no outdoor space on-site the students use a combination of free and hired facilities in the city, for example, a council swimming pool, running around the bays, soccer on a local field using school equipment. Leaving the school building does not reduce class time because classes are an hour and a half and PE can be scheduled adjacent to lunchtime.

In relation to extra-curricular sport some secondary principals occasionally received comments from parents about limited field space or the need for very early or late sports practice or having to travel to other venues; however, principals consider that parents look at the overall quality of the teaching and learning programme, and accept that schools cannot provide ideal facilities on-site for a wide range of sports.

5) Sharing facilities

All schools use external facilities

All schools in the study regularly use external facilities. This involves hired facilities such as pools and sports grounds, and those free to the user such as public parks and libraries. One secondary school has to hire an auditorium for occasions when the whole school comes together.

Primary schools occasionally use other school's sport and physical recreation facilities such as gymnasia or fields. This happens on an ad hoc basis, and fees are seldom charged. City schools close enough to each other to be easily accessible do not have sufficient capacity to share facilities during the school day on a regular basis.

More formal joint use arrangements are less common. One secondary school has a formal joint use arrangement as the venue for adult community education classes; and one primary school had entered into a formal partnership with a tertiary institution to use their gymnasium. The tertiary institution ran a teacher training course and 'they wanted guinea pigs so we were going to be able to use the gymnasium and their staff would run lessons.' (The Canterbury earthquakes stopped this partnership.)

Schools open their sites to wider community use and rent out facilities

Most of the schools in the study with grounds allowed open community use of these grounds out of school hours. This is considered to centre the school in the community and reduce vandalism. One secondary school had recently put a security fence around the school because the site was being used as a thoroughfare, with other schools' students coming in and occasional rough sleepers on the site leaving rubbish. The fencing prevents community use of the school grounds after hours.

Some schools give community groups regular after hours public good use of their facilities, for example, for language or exercise classes. A small fee might be charged for this to cover the costs of utilities. One school has built relationships with theatre and film groups who use their site and this provides students with links to the industry. Several secondary schools in the study also rent out school facilities such as halls and gymnasia.

6) Multi-storey buildings

Multi-storey buildings provide opportunities for creating interesting spaces

All four of the secondary schools in the study and three of the primary schools had multi-storey buildings; all of the ECE providers had centres in one or more floors of multi-storey buildings.

Table 2 Examples of schools & ECE centres occupancy of multi-storey buildings

Examples	Use of multi-storey buildings
Secondary	
1	On four levels, sole occupancy of building
2	Two-storey and a three-storey block
3	Several connected multi-storey buildings
4	Several connected multi-storey buildings
Primary	
1	Classrooms in a two storey building
2	Three levels of four-storey building (above shops)
3	Four levels (school within congregational building complex)
ECE	
1	Children on 4th & 5th floors of a six storey building
2	Sole occupancy of a two level building, and (a second centre) on the second floor of three storey building
3	5th floor of nine storey building

Schools

Several principals commented that multi-level buildings provide opportunities for creating interesting spaces; for example, having the classrooms on each level opening off a large central open space, or having glass-sided areas linking blocks so there is a significant amount of interior space available to students. Primary school principals emphasised having a mixture of ages working together, irrespective of having classes in a multi-storey building.

The transition between classes could be busy but students are used to going up and down in the prescribed manner, that is, using a particular set of stairs to go up and down or simply staying on the left hand side. Stairs are seen as providing good exercise (for students and staff), and all of the buildings had lifts for those who could not use the stairs, including a two-storey classroom building in a primary school. Transition time between classes is minimal, ('perhaps less than in schools with single level buildings spread across larger sites').

ECE centres

In ECE centres being above ground level provides views that children might not otherwise experience. Children's interest in what they see is built into the learning programme. In centres that occupy more than one floor, the separate floors are used for different age groups (eg, under and over three years). The centre manager is instrumental in planning how the space is used. Providers report that parents are invariably impressed 'when they come up and walk through the doors and see what's here'.

Outside of Wellington, principals and providers had not experienced parents expressing concern over schooling in multi-storey school buildings. In some Wellington schools and centres parents wanted information about the earthquake safety of the buildings concerned. Schools and centres could provide this, with details of emergency procedures. ECE providers are strongly focused on building evacuation procedures, and explained these to parents – although parents do not necessarily enquire.

CONCLUDING REMARKS

The literature on schooling in different settings left questions about the extent to which city schools use city amenities in their teaching and learning programmes, how much access students have to outdoor space and sport, and any issues associated with multi-storey buildings.

This study, from the perspective of school principals and ECE providers, suggests that schools make extensive use of city amenities in their programmes. Off-site use is particularly facilitated by proximity (being able to walk to venues is important); and, to some extent by the independence of the students.

Even where sites have very limited grounds and facilities, schools ensure that students have daily access to outdoor space, and to a comprehensive range of physical recreation and sports. The proximity of external facilities to city schools supports this.

Multi-storey buildings offer possibilities for designing interesting teaching and learning spaces, and do not present issues to schools and centres, or parents.

APPENDIX

Research approach

The Ministry of Education selected four secondary and seven primary schools based on the schools city location, limited grounds or multi-storey buildings. Four ECE providers were selected based on their city location or the use of non-ground floor or multi-storey sites.

The Ministry contacted school principals and ECE providers asking for their participation in the project. All people initially contacted by the Ministry agreed to participate. The principals of four participating schools in Wellington were interviewed face to face; all other interviews were conducted by telephone. Notes were taken by the researcher during the interviews.

The purpose of this research was to describe school principals' and ECE providers' experiences of schooling in a central city location, on-sites with limited outdoor space, and in multi-storey buildings.

The research used a qualitative approach. Questions were semi-structured and open, enabling interviewees to expand their answers, to give examples and clarification. Questions focused on:

1. how the site influences the school's/centre's teaching and learning programmes
2. access to green space and physical recreation
3. whether the school/centre shares any facilities with other organisations
4. opportunities and constraints of the site, including any site specific safety issues and
5. questions or feedback from [prospective] parents, students or staff relating to the site.

The interview data has been summarised into themes from the responses to these questions. These themes were derived from the content of the entire interviews.

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The impact of school size and school consolidations on quality and equity in education

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The impact of school size and school consolidations on quality and equity in education*

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Executive Summary (English)

A well-functioning educational infrastructure is one of the core elements of education policy. When designing education policy, knowledge about the complex effects that can arise with changes in the educational infrastructure is crucial. Currently, the issue of school reform is extremely relevant in the European Union due to both the demographic development and the recent economic crisis. This report discusses the available empirical evidence on the effects of school size and school consolidations on important outcomes such as student performance, inequality, attendance rates and parental involvement.

Taking a theoretical perspective, school size can be viewed as one of many inputs into the production of education. In addition, changes in school size may lead to changes in other inputs, for example class size, and thus affect educational production indirectly as well. Similarly, school consolidation is expected to affect important inputs into educational production such as school size and peer quality. While school size is likely to be related to quality, it is important to keep in mind that changing school size will typically lead to changes in costs as well, for example through economies of scale.

While there is a number of studies on the effects of school size and school consolidations, many of these studies are likely to suffer from biases, for example, due to unobserved factors. This report focuses on evidence from the field of economics of high methodological standard. This implies that the results are more directly informative about the consequences of policy implementation.

The empirical evidence on the effects of school size suggests that school size is an important input into educational production. School size affects as diverse outcomes as student achievement, attendance, parental involvement and youth violence. Most of the existing evidence suggests adverse effects of school size on attendance rates, dropout rates and social outcomes. Particularly, the evidence suggests that larger schools are associated with lower parental involvement, less connectedness and more youth violence. However, especially with respect to student achievement, the empirical evidence is mixed with respect to the direction of the effects. The relationship between school size and student performance is context-dependent. The empirical evidence on school consolidations suggests adverse effects on student achievement in the short run. In addition, displaced students are generally harmed more than receiving students when schools are closed. Finally, the evidence suggests that the effects vary with the types of schools that are closed.

The report also provides a brief discussion of how the existing evidence can be informative for designing future school policy in the European Union. This discussion highlights the importance

of conducting a detailed analysis of the effects of school size that is context-specific. It is crucial that all benefits and costs are taken into account in the process of determining the optimal school size. Furthermore, school size is only one dimension of school policy and is very closely related to grade span, grade size and class size.

The mixed evidence on the effects of school size on academic achievement suggests that optimal school size depends on the context, such as the country, region, degree of urbanization, level of education or student composition. Thus, it is not possible to provide a magic number in the form of an optimal school size. Moreover, if part of the aim of school policy is to reduce inequality, it becomes important to assess the effects of school size on the entire distribution of student achievement. In addition, disadvantaged students tend to be more affected by changes in school size than other students suggesting that school policy is especially important in areas with a large fraction of disadvantaged students. Consequently, changes in school size are likely to lead to changes in inequality. The existing evidence on the effects of school consolidations suggests that there are adverse effects of school consolidations in the form of disruption and changes in school quality - at least in the short run. The presence of these short-run adverse effects suggests that more resources should be devoted to consolidating schools to counter the adverse effects experienced by students who are exposed to consolidation. Finally, closing relatively low-performing schools and moving the displaced students to relatively high-performing schools is potentially a reasonable strategy for policymakers that may help reduce inequality and segregation.

In conclusion, school size is an important determinant of many student outcomes. However, school size is just one dimension of school policy and in the process of reform and improvement of the educational infrastructure in the European Union, all relevant dimensions should be considered. While the reviewed empirical evidence does not provide a clear roadmap for school reform in the EU countries, it does yield valuable insights into the complex problem of understanding the effects of school size and school consolidations. The substantial variation in school size and educational infrastructure in general - both across and within countries – in the European Union warrants the need for further high-quality research on the effects of school size and school consolidations in different contexts.

Executive Summary (German)

Eine gut funktionierende Bildungsinfrastruktur ist ein zentrales Element von Bildungspolitik. Bei der Gestaltung von Bildungspolitik ist es unabdingbar, die komplexen Effekte, die mit Änderungen der Bildungsinfrastruktur einhergehen, zu kennen. Im Moment ist das Thema Schulreform wegen der demographischen Entwicklung und der momentanen Wirtschaftskrise in der Europäischen Union extrem relevant. Dieser Bericht diskutiert die vorhandene empirische Evidenz zum Einfluss von Schulgröße und Schulzusammenlegungen auf wichtige Ergebnisgrößen wie Schülerleistungen, Ungleichheit, Anwesenheitsquoten und die Beteiligung der Eltern.

Aus theoretischer Sicht kann Schulgröße als einer von vielen Bildungsinputs in der Bildungsproduktionsfunktion verstanden werden. Darüber hinaus können Änderungen in der Schulgröße zu Änderungen anderer Bildungsinputs führen, z.B. zu einer Änderung der Klassengröße, was wiederum die Bildungsproduktionsfunktion indirekt beeinflussen kann. Gleichermaßen wird erwartet, dass Schulzusammenlegungen wichtige Inputs in der Bildungsproduktionsfunktion wie etwa Schulgröße und Peer-Qualität beeinflussen. Während Schulgröße wahrscheinlich in einem Zusammenhang mit Bildungsqualität steht, ist es wichtig zu berücksichtigen, dass eine Veränderung der Schulgröße automatisch auch eine Änderung der Kosten herbeiführt, so z.B. durch Skaleneffekte.

Während es viele Studien zu den Effekten von Schulgröße und Schulzusammenlegungen gibt, leiden viele dieser Studien unter einem Schätz-*bias*, unter anderem auf Grund von unbeobachteten Faktoren. Dieser Bericht konzentriert sich auf empirische Evidenz in der ökonomischen Literatur, die einen hohen methodologischen Standard erfüllt. Dies impliziert, dass die Ergebnisse direkter über die Konsequenzen einer politischen Umsetzung der jeweiligen Reformen informieren können.

Die empirische Evidenz zu Effekten von Schulgröße lässt darauf schließen, dass Schulgröße ein wichtiger Faktor in der Bildungsproduktionsfunktion ist. Die Schulgröße beeinflusst unterschiedliche Ergebnisse wie Schülerleistungen, Anwesenheit, elterliche Beteiligung und Jugendkriminalität. Der Großteil der empirischen Evidenz lässt nachteilige Effekte von Schulgröße auf Schulbeteiligung, Abbruchsraten und soziale Ergebnisse vermuten. Im speziellen legt die empirische Evidenz nahe, dass größere Schulen mit weniger elterlicher Beteiligung einhergehen sowie mit weniger Verbundenheit und mehr Jugendkriminalität. Im Gegensatz dazu kommt die empirische Evidenz zu gemischten Ergebnissen, wenn es um die Richtung der Effekte von Schülerleistungen geht. Der Zusammenhang zwischen Schulgröße und Schülerleistungen hängt vom jeweiligen Kontext ab.

Die empirische Evidenz weist auf kurzfristige negative Effekte von Schulzusammenlegungen auf Schülerleistungen hin. Darüber hinaus werden versetzte Schüler stärker getroffen als Schüler in Schulen, die solche Schüler aufnehmen. Schließlich legt die empirische Evidenz nahe, dass die Effekte für unterschiedliche Schultypen, die geschlossen werden, unterschiedlich sind.

Der Bericht beinhaltet außerdem eine kurze Diskussion darüber, wie die vorliegende empirische Evidenz für die Gestaltung von zukünftiger Politik in der Europäischen Union genutzt werden kann. Diese Diskussion betont, wie wichtig es ist, die Effekte von Schulgröße detailliert und kontext-spezifisch zu analysieren. Es ist unabdingbar, Kosten und Nutzen vollständig abzuwägen, wenn es darum geht, die optimale Schulgröße zu bestimmen. Darüber hinaus ist die Schulgröße nur ein Aspekt von Schulpolitik und eng mit Stufenabständen, Stufen- und Klassengröße verbunden.

Die gemischte empirische Evidenz zu den Effekten von Schulgröße auf akademische Leistungen lässt vermuten, dass die optimale Schulgröße vom Kontext, d.h. von Land, Region, Urbanisierungsgrad, Bildungsniveau und Schülerzusammensetzung abhängig ist. Deshalb ist es unmöglich eine magische Zahl in Form von einer optimalen Schulgröße anzugeben. Wenn ein Ziel von Schulpolitik die Reduzierung von Ungleichheit ist, wird es darüber hinaus wichtig, die Effekte von Schulgröße auf die komplette Verteilung von Schülerleistungen zu bewerten. Darüber hinaus sind benachteiligte Schüler von Änderungen der Schulgröße stärker betroffen als andere Schüler, weshalb sich ableiten lässt, dass Schulpolitik in Gegenden mit einem großen Anteil an benachteiligen Schülern besonders wichtig ist. Daraus lässt sich schließen, dass Änderungen in der Schulgröße wahrscheinlich zu Veränderungen der Ungleichheit führen. Die vorliegende empirische Evidenz über die Effekte von Schulzusammenlegungen lässt vermuten, dass die Effekte von Schulzusammenlegungen in Form von Unterbrechungen und Veränderungen in der Schulqualität – zumindest kurzfristig – negativ sind. Die Tatsache, dass es diese kurzfristigen negative Effekte gibt, legt nahe, dass Schulen, die von einer Zusammenlegung betroffen sind, mehr Ressourcen zur Verfügung gestellt werden sollten um diesen negativen Effekten entgegenzuwirken. Relativ leistungsschwache Schulen zu schließen und deren Schüler in relativ leistungsstarke Schulen umzusiedeln ist eine sinnvolle Strategie, die dazu beitragen kann, Ungleichheit und Segregation zu reduzieren.

Es lässt sich zusammenfassen, dass Schulgröße ein wichtiger Bestimmungsfaktor von Schülerleistungen ist. Schulgröße ist aber trotz allem nur ein Aspekt von Schulpolitik. Im Reformprozess und bei der Verbesserung der Bildungsinfrastruktur der Europäischen Union sollten alle relevanten Aspekte betrachtet werden. Während sich aus der betrachteten empirischen Evidenz kein klarer Fahrplan für Schulreformen in EU Ländern ableiten lässt, können wertvolle Einsichten über das komplexe Problem zu den Effekten von Schulgröße und Schulzusammenlegungen gewonnen werden. Die wesentliche Variation in Schulgröße und der Bildungsinfrastruktur im Allgemeinen – sowohl über Länder hinweg als auch innerhalb einzelner Länder – rechtfertigt die Notwendigkeit weiterer qualitativ hochwertiger Forschung über die Auswirkungen von Schulgröße und Schulzusammenlegungen in unterschiedlichen Kontexten.

Executive Summary (French)

La mise en place d'infrastructures scolaires efficaces est un des éléments centraux de la politique éducative. Au moment de mettre au point ces politiques, il est donc crucial de comprendre les effets complexes qui peuvent faire suite à des changements au sein des infrastructures scolaires. Les réformes scolaires sont particulièrement d'actualité en Union Européenne du fait du développement démographique et de la récente crise économique. Ce rapport fait ainsi état des résultats d'études empiriques portant sur les effets de la taille des écoles et des regroupements scolaires sur des indicateurs clés que sont la performance des élèves, les inégalités, le taux d'absentéisme ou encore l'implication des parents d'élèves.

D'un point de vue théorique, la taille des écoles peut être vue comme un des nombreux facteurs affectant l'enseignement. Par ailleurs, les changements de la taille des écoles peuvent affecter d'autres facteurs, comme la taille des classes, et également affecter l'enseignement indirectement. De la même manière, les regroupements scolaires sont susceptibles d'affecter l'enseignement via d'importants canaux que sont la taille des établissements et la qualité des pairs. Bien que la taille des écoles soit vraisemblablement liée à la qualité de l'enseignement, il faut garder à l'esprit qu'un changement de taille est typiquement associé à un changement dans la structure des coûts, avec entre autres des phénomènes d'économie d'échelle.

S'il existe de nombreuses études sur les effets de la taille des écoles et des regroupements scolaires, beaucoup souffrent de biais, notamment à cause de facteurs non-observés. Ce rapport se concentre donc sur des études empiriques issues d'une littérature économique à hauts standards méthodologiques. Les résultats présentés apportent donc de précieuses informations sur les conséquences des politiques éducatives.

Les études empiriques montrent que la taille des écoles est un facteur important dans l'enseignement. Elle affecte la réussite des élève, l'absentéisme, l'implication des parents d'élèves ou encore la violence à l'école. La majeure partie des études suggèrent ainsi que la taille des établissements a des effets néfastes sur les taux d'absentéisme, de décrochage scolaire et sur d'autres dimensions sociales. En particulier, les chiffres suggèrent que de plus grandes écoles sont associées avec une moindre participation des parents, à l'affaiblissement des liens entre l'école et les familles et à davantage de violence chez les élèves. En ce qui concerne les résultats scolaires en revanche, les études sont partagées quant à la direction de l'effet de la taille des écoles. Le lien entre taille de l'établissement et la réussite des élèves dépend en effet grandement du contexte. Pour les regroupements scolaires, l'effet sur les résultats scolaires semble négatif à court terme, les élèves déplacés après la fermeture de leur école étant davantage pénalisés que leurs camarades. Enfin, il semble que l'effet des regroupements scolaires dépende du type d'école qui a dû fermer ses portes.

Ce rapport montre aussi brièvement comment ces résultats peuvent se montrer utiles pour la conception des politiques éducatives au sein de l'Union Européenne. Il y est surtout souligné l'importance de mener des analyses sur les effets de la taille des écoles qui prennent en compte leur contexte. Il est en effet crucial que tous les coûts et bénéfices soient pris en compte pour déterminer la taille optimale pour les établissements scolaires. À noter enfin que la taille des écoles n'est qu'une dimension parmi d'autres des politiques éducatives et que cette question est très liée à celles du nombre de niveaux par établissement et de leur taille ainsi qu'à celle de la taille des classes.

Les résultats mitigés de l'effet de la taille des écoles sur la réussite scolaire suggèrent que le choix optimal doit prendre en compte des facteurs tels que le pays, la région, le degré d'urbanisation, le niveau d'éducation des parents ainsi que la composition des cohortes d'élèves. Il n'est donc pas possible de trouver un nombre magique qui serait la taille optimale pour une école. Par ailleurs, si un des buts d'une politique éducative est de réduire les inégalités, il est important d'évaluer l'effet de la taille des écoles sur la distribution des résultats scolaires toute entière. Les élèves issus de milieux défavorisés tendent ainsi à être plus affectés par la taille des établissements que leurs camarades si bien qu'il semble particulièrement important que la politique éducative se saisisse de ces questions dans les zones les plus pauvres. Les changements dans la taille des établissements peuvent donc avoir des effets sur l'inégalité. Les études disponibles sur les effets des regroupements scolaires montrent qu'ils ont des effets néfastes qui prennent la forme de perturbation et de baisse de qualité de l'enseignement – au moins à court terme. La présence de ces effets néfastes implique que davantage de ressources devraient être employées pour contrer les conséquences négatives du regroupement. Pour finir, fermer les écoles les moins performantes pour déplacer les élèves vers des écoles dont les élèves réussissent mieux peut s'avérer une stratégie payante pour les décideurs qui permettrait de réduire les inégalités et d'atténuer la ségrégation géographique.

En conclusion, la taille des écoles est un facteur important dans la vie scolaire des élèves. Cependant, ce n'est qu'une dimension parmi toutes celles qui sont à considérer dans le processus de réforme et d'amélioration des infrastructures éducatives de l'Union Européenne. Bien que les études mentionnées ici ne fournissent pas un plan d'action clair pour la réforme des systèmes éducatifs en Europe, elles apportent un éclairage constructif sur les problèmes complexes que sont la taille des écoles et les regroupements scolaires. La variabilité substantielle de la taille des établissements scolaires en Union Européenne – à la fois au sein des pays et entre eux – ne fait qu’accroître le besoin de recherche de qualité sur les effets de la taille des écoles et des regroupements scolaires dans différents contextes.

1 Introduction

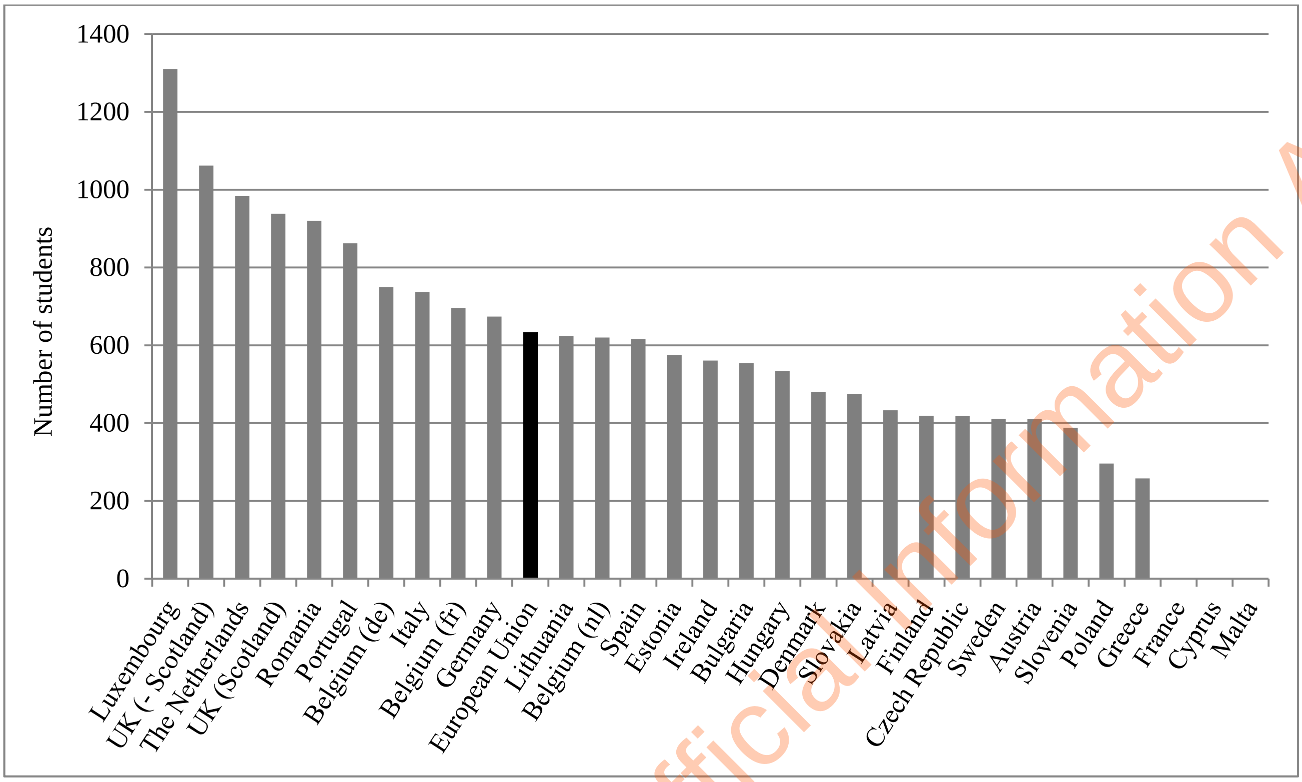
One of the key components of education policy is to set up a well-functioning educational infrastructure. This encompasses the interrelated issues of choosing school size, school location and the number of schools.[1] These choices made by policymakers potentially affect students' academic achievement, but may also affect as diverse outcomes as inequality, attendance rates and parental involvement. In order to design optimal school policy, it is important to have an understanding of the complex effects that can arise with changes in the educational infrastructure. This report focuses on the effects of school size and school consolidations on quality and equity.

The issue of shaping the characteristics of the educational infrastructure is as important as ever. In recent years, many European countries have consolidated schools according to a recent report by the European Commission/EACEA/Eurydice (2013). The demographic development in many European countries is a major contributing factor to the recent consolidations. But many countries also list the economic crisis as a contributing factor to school consolidation. School size varies substantially across the European Union. Figure 1 shows the median school size for 15-year-olds across countries in the European Union. Median school size ranges from 258 students in Greece to 1,310 students in Luxembourg. There is also substantial variation within countries. For example, in Germany the 10th percentile of school size is 186 students while the 90th percentile is 1,253 students.[2]

The demographic development in many of the transition countries in Eastern Europe has implied a substantial reduction of the number of school-aged children and this has fueled a consolidation movement, Coupé et al. (2015). For example, in Bulgaria, reforms and decentralization of the school system (the Bulgaria School Autonomy Reforms) motivated by the desire to increase general economic productivity growth have led to school consolidations, World Bank (2010).[3] In 2008 alone, 15 percent of all schools in Bulgaria were closed. While the aim of the reforms was to promote school autonomy and efficient public spending, the closure of a large number of small rural schools may also have increased dropout rates, World Bank (2010). This example illustrates the unintended, and in this case unwanted, effects that can arise with changes in the educational infrastructure.

[1] In most countries these are issues that policymakers have to address to some degree. To what extent policymakers can fully determine the educational infrastructure varies across countries.
[2] Numbers are taken from EACEA/Eurydice/Eurostat (2012).
[3] Several studies have established a strong link between educational achievement and economic growth; see e.g. Hanushek and Woessman (2012).

Figure 1: Median school size for 15-year-olds across countries in the European Union.



Source: Numbers from EACEA/Eurydice/Eurostat (2012) which are based on the OECD, PISA 2009 database.

This report provides an overview and discussion of the available empirical evidence on the effects of school size and school consolidations within the field of economics. In the following section, the report will give a brief introduction to the theoretical background of the relationship between school size, school consolidations and student outcomes. In section 3, the methodological challenges that arise in the context of estimating effects of school size and school consolidations are discussed. Sections 4 and 5 provide an overview of the empirical evidence for school size and school consolidations, respectively. Section 6 discusses policy implications for the EU policy agenda. Finally, section 7 concludes.

2 What economic theory has to say about school size and school consolidation

In the literature on economics of education, students' academic outcomes are generally considered as being determined from the educational production function.[4] The various inputs into the educational production function determine the output, for example student achievement. Many

[4] See, for example, Pritchett & Filmer (1999), Lazear (2001) and Checchi (2006).

school characteristics can be viewed as examples of inputs. Economic theory predicts that school size and school consolidations in general matter for the production of human capital.

2.1 Costs, quality and school size

While many studies – including this report - focus on how changes in school size may affect educational production through changes in *quality*, it is important to keep in mind that changes in school size, typically lead to changes in *costs* as well. The hypothesis that larger schools have lower costs per student due to economies of scale is probably the most often-heard argument in favor of school consolidation. School size is typically defined as the number of students in a school in the economics of education literature.

Table 1 provides a rough overview of the channels through which school size may affect cost and quality, respectively.[5,6] There is no overall consensus on what are the costs and benefits of small versus large schools. This is probably related to the fact that while some benefits accrue in some settings, in others they do not. For example, for an increase in school size, economies of scale may occur if initial school size is small, but diseconomies of scale may occur if initial school size is large. Changes in costs occur mainly due to economies (or diseconomies) of scale, but changes in the school infrastructure is also likely to affect transportation costs significantly as the distance to school changes for the individual student. The existing empirical evidence suggests that at least for very small schools increasing school size will lead to a reduction in unit costs; see the survey by Ares Abalde (2014).[7] The focus of this report is the effects of school size on quality. In terms of quality, large schools are potentially more diverse in terms of course portfolios, teachers and peers. Diversity generally means more flexibility, for example a more diverse peer composition allows schools to organize peer groups in specific ways that can enhance learning. Finally, large schools make it easier to have teachers that are specialized in a particular subject, for example Math, and are also more likely to be able to attract high-quality teachers, for example due to the increased flexibility within larger schools. On the other hand smaller schools may have a higher quality of social interactions, for example due to a relatively low student-to-teacher ratio. The small number of students can increase the connectedness that each student feels to the school.

[5] In the attempt to provide a relatively general overview, inspiration is taken from Leithwood & Jantzi (2009), Leung & Ferris (2008), Abdulkadiroğlu et al. (2013), Barrow et al. (2013) and Luyten et al. (2014).
[6] Ares Abalde (2014) provides a more detailed description of these channels.
[7] This is under the assumption of reasonable transportation costs.

Table 1: Channels through which increasing school size may affect cost and quality

	Advantages	Disadvantages
Cost	Economies of scale	(diseconomies of scale when size too large)
		Transportation costs
Quality	Diversity and flexibility (courses, teachers and peers)	
	Teacher specialization	
	Teacher hiring	
		Social interactions (e.g. student-to-teacher ratio)

One way to summarize the bottom part of Table 1 is that school size potentially affects both school quality, teacher quality and peer quality. These are generally considered important for student achievement and well-being in economic theory. As such they are important inputs into the educational production function which will be discussed in more detail in the following subsection.

A related issue that is rarely addressed in the literature on school size is that school size is inherently linked to the number of schools. And, the number of schools is important for the degree of competition between schools. For a fixed number of students, the number of schools effectively determines average school size. The literature on school competition hypothesizes that increased competition will improve school performance, but student sorting[8] may lead to adverse - or beneficial depending on the assumptions made - effects on some students, Hoxby (2000). Therefore, an increase in average school size is also expected to affect student performance through decreased school competition.

2.2 The educational production function

The educational production function relates educational inputs to educational output. The functional form of the educational production function is arguable very complex and there is little agreement on the exact form of the function, Krueger (1999). Four main categories of inputs are often considered: parental inputs, peer inputs, school inputs and neighborhood inputs. For given values of inputs, the educational production function gives the educational output. For example, an educational production function can relate student achievement to school size and all other relevant

[8] The concept of 'student sorting' refers to the fact that students with particular characteristics sort into particular schools implying a change in the distribution of student characteristics across schools.

inputs. Other types of outcomes such as attendance, dropout rates, educational attainment and social outcomes can also be analyzed in this type of framework. For reasonable ranges of inputs, it makes sense to think of the marginal product as positive but decreasing. This means that increasing the amount of a particular educational input, for example, books, improves learning, but at a decreasing rate.

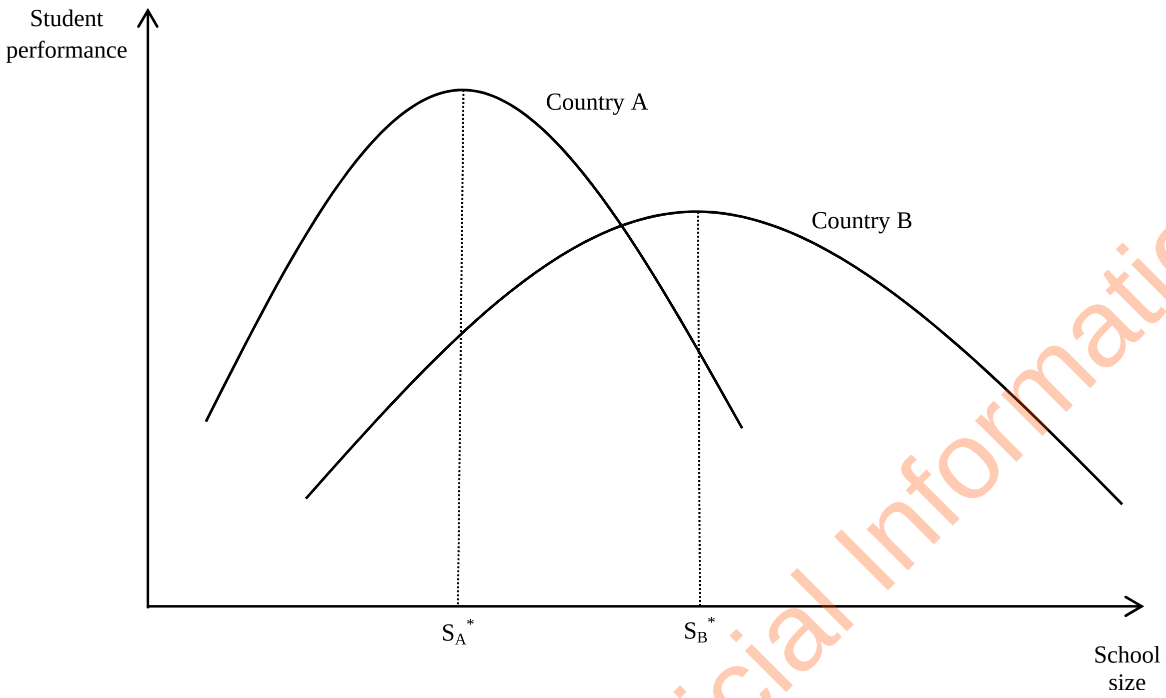
2.2.1 The role of school size

School size is considered one of the key inputs into educational production. School size potentially affects educational production both directly and indirectly since changes in school size may lead to changes in other inputs such as class size. While school size is typically defined as the number of students in the entire school, a student's class size is defined as the number of students in the student's classroom in the economics of education literature. Many educational inputs are heavily interrelated and school size is no exception in that it potentially affects a variety of different educational inputs. The effectiveness of other educational inputs may also vary with school size.

Theoretically, it makes sense that the relationship between school size and academic performance is inversely U-shaped.[9] This implies that an increase in size would lead to improved student performance in relatively small schools and lowered student performance in relatively large schools. Thus, there exists an 'optimal' school size that maximizes student performance. Optimal school size may differ for different types of students, different types of school infrastructure, and different countries and cultures, i.e. for different contexts.[10] Figure 2 shows a graphical illustration of an example where the relationship between school size and student performance varies across two countries. Consequently, optimal school size is smaller for country A (S_A^*) than for country B (S_B^*). For example, in countries such as Norway and Sweden where the population is very geographically dispersed, optimal school size is likely to be lower than in countries such as Luxembourg where the population density is very high.[11]

[9] There is not an overall consensus in the literature on the shape of the relationship between school size and academic performance, see, for example, the discussion in Schütz (2007).
[10] Lazear (2001) sets up a theoretical model where optimal class size differs for different types of students.
[11] Ares Abalde (2014) discusses school size policy and population dispersion.

Figure 2: An illustration of the relationship between school size and student performance.



2.2.2 The role of school consolidation

A number of studies have analyzed the impact of school consolidation. Of course, school consolidation is not an input into educational production *per se*, but since school consolidations are expected to affect school inputs and to some extent also peer, parental and neighborhood inputs, at least in the short run, educational production is expected to be affected by school consolidation.

School consolidations, and school moves in general, are often hypothesized to lead to disruption and changes in school quality for the affected students, Hanushek et al. (2004). School consolidations can affect various aspects of school quality through, for example, changes in school size and peer composition. One can think of a disruption effect as temporary changes in educational inputs such as a lower quality of instruction caused directly by the changes in school infrastructure, for example, due to teacher stress and confusion in the context of consolidation. By definition, the effect is expected to diminish over time. In comparison, changes in school quality are of a more permanent nature and reflect the fact that the students' school inputs have been explicitly changed. Since some types of students may react differently to changes in school quality and disruption, school consolidation may matter more for certain types of students. Thus, school consolidation may also affect inequality. For example, if disadvantaged students are harmed more from the disruption of school consolidation than more advantaged students, inequality will rise.

Summing up on the theoretical literature on the impact of school size and school consolidation, the economic theory of educational production provides an understanding of how and why different inputs may be related to student achievement. However, the sign and size of the effects of increasing school size or consolidating schools are left for empirical research to determine.

3 Methodological challenges

When the aim of the analysis is to inform policy decisions, it is important that the estimated parameters are policy-relevant. While it is simple to estimate the *correlation* between school size and student achievement, it is much more challenging to estimate the *causal* effect of school size on student achievement.[12] For the purpose of making policy recommendations, interest is typically in the latter. The causal effect will be informative about what will happen if school size is increased keeping other things constant. The correlation will not! An observed correlation between school size and student outcomes may simply reflect *unobserved factors* which affect both school size and student outcomes. Thus a policy reform affecting school size may have no impact on student outcomes.

As an illustration, suppose that school size and student achievement are positively correlated in a given population. This may reflect *causality*, namely that increasing school size leads to increases in student achievement. But it may also reflect *endogeneity bias*. Especially, unobserved factors that affect both school size and academic achievement will lead to a bias in the estimated relationship. For example, high-quality schools tend to be larger since they attract more students, but the quality of the school will also affect the academic performance of the students at the school. If the quality of the school is unobserved, this produces a correlation between school size and student achievement - even if school size has no causal effect on student achievement. Only in the theoretical scenario where students are randomly allocated to schools of different size, can the causal effect be identified simply by comparing students in schools of different size. Consequently, recent economic studies use advanced statistical techniques to identify the causal effect of school size.

[12] For a thorough discussion of the specification and estimation of educational production functions and explicit statistical models, see Todd & Wolpin (2003).

A similar issue arises in the analysis of school consolidations. Schools that are closed may not be comparable to schools that are not closed. For example, policymakers may have decided to close low-performing schools. Therefore, it makes no sense to simply compare the performance of students from schools that were closed with the performance of students from schools that were not. If low-performing schools are closed, such a comparison would suffer from a downward bias in the estimated effect of school closings.

While there are a variety of different inputs into the complex educational production function, the empirical literature focuses on estimating the effects of increasing one or maybe a few of these inputs at a time in a reduced-form model based on observational data. The interpretation of the estimated effect depends on the methods applied and the data used. In the following discussion of the empirical evidence, the focus will be on studies where causal parameters of interest are well-identified.

The exposition of the empirical evidence will be split into two sections since part of the literature focuses on effects of school size while another part focuses on effects of school consolidations. While these two strands of literature are related, they also differ along a number of dimensions and a separate treatment is given to ease exposition.

4 Empirical evidence on the effects of school size

There is an extensive literature in economics, sociology and education that covers the topic of school size and its relationship to a variety of outcomes, including student outcomes, social outcomes and costs.[13][14] It is important to be aware that a large part of this literature does not really, or only to a very limited extent, address the methodological challenges mentioned above. Also, it can be challenging to summarize this literature, since the effects of school size potentially vary a lot depending on the context such as type of outcome, age group or level of education, country or region, urban or rural.[15] Since the theoretical effects of school size differ a lot depending on the

[13] Ares Abalde (2014), Luyten et al. (2014), Leithwood & Jantzi (2009), Darling-Hammond et al. (2006), Newman et al. (2006) and Andrews et al. (2002) all provide reviews of the literature on the effects of school size. Many of the studies included in these reviews are more or less correlational in nature.
[14] The choice of school district size and school size are closely related. Empirical studies of the effects of school size and school district size tend to be very similar, and some studies even consider the effects of school size and school district size jointly. If the initial size of the school district is small, then existing evidence suggests that an increase in school district size can lower costs, Andrews et al. (2002) and Duncombe & Yinger (2007). For academic performance, the evidence is more inconclusive. The literature on school district size is too extensive to be reviewed in detail here.
[15] The reviewed evidence stems from contexts where the extent of publicly provided education varies.

outcomes considered and studies often focus on one or two key outcomes, this section will discuss effects on separate outcomes in turn.[16]

4.1 Academic achievement and long-term student success

Aside from costs, the academic performance of students has been the focus of studies analyzing the effects of school size. While the older literature tended to be correlational in nature, a range of recent studies have used more sophisticated empirical strategies to address the methodological issues described above. Some literature reviews that are not particularly critical with respect to the methods applied tend to conclude that students from smaller schools perform better[17], while others are more cautious to draw solid conclusions[18]. In the following, recent key contributions are discussed in more detail. Most of these studies which address causality issues are based on data from the United States.

Primary school level: The majority of studies on the effects of school size tend to focus on secondary school size, i.e. typically children aged 12 to 18. Only a limited number of studies exist on primary school size. Using a relatively sophisticated research design, Kuziemko (2006) employs variation in school size induced by school openings, closings and mergers to identify the causal effect of school size on average 3rd grade math and language scores and average daily attendance. She uses school-level data on elementary schools in Indiana, US. According to her analyses, increasing school size leads to decreases in math scores and attendance rates. The results also suggest that the effect of school size increases in absolute terms over time, implying that the negative effects of attending a large school accumulate over time. Based on the estimates, she performs a back-of-the-envelope cost-benefit evaluation and concludes that the benefits of small schools outweigh the costs.

The other studies of elementary school size are less well-identified. In a study of elementary school size in the United States focusing on 6th and 8th grade students, Lee & Loeb (2000) also find that smaller schools increase students' learning as measured by test scores. The setting is Chicago inner-city elementary schools (K-8) and consequently results are probably mostly relevant for large urban school districts. Ready & Lee (2006) use a nationally representative survey from the United

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16 Some studies consider less standard types of outcomes that are not discussed in the following. Examples include Monk (1987) who finds that increasing school size up until a certain level had beneficial effects on curriculum comprehensiveness, Lee & Loeb (2000) who show teachers in larger schools have more positive attitudes regarding their responsibility for student learning, and Falch & Strøm (2005) who find that the relationship between school size and the probability of a teacher quitting his job is U-shaped.

17 Leithwood & Jantzi (2009) and Andrews et al. (2002).

18 Luyten et al. (2014), Darling-Hammond et al. (2006) and Newman et al. (2006).

States and find no significant effects of school size on literacy and mathematics tests in kindergarten class. They find statistically significant effects of school size for the first grade and these results suggest that students in smaller schools perform better. Finally, Driscoll et al. (2003) find a negative relationship between elementary school size and student performance using school-level data from California. A particularly interesting feature of their study is that they also estimate relationships between the size of middle school and high school and student performance and they only find a statistically significant negative estimate for elementary school size. While there is likely to be a number of differences between the different levels of schooling that make it hard to make meaningful comparisons, the results suggest that the effects of school size may vary across level of education.[19] The existing evidence suggests that there is a negative relationship between school size and academic performance at the primary school level.

Secondary school level: Some studies have considered the effect of secondary school size on academic performance in different parts of Europe and the United States and have come to different conclusions. Generally, these studies are not able to identify parameters that can be given a causal interpretation and therefore the results should be interpreted as reflecting correlations. Barnett et al. (2002) and Foreman-Peck & Foreman-Peck (2006) find positive relationships between school size and academic performance for Northern Ireland and Wales, respectively. In the first case, the academic performance is measured relative to cost-constrained benchmarks. Bradley & Taylor (1998) find that the relationship between school size and academic performance is inversely U-shaped in the United Kingdom while Sawkins (2002) finds that the relationship is U-shaped in Scotland. Lee & Smith (1997) suggest an optimal secondary school size of about 600-900 students based on nationally representative survey data from the United States. Also using nationally, representative survey data from the United States, Schneider et al. (2006) fail to find evidence that supports small schools. Bukowska & Siwińska-Gorzelak (2011), Capita (2012) and Coupé et al. (2015) all find a positive relationship between secondary school size and school performance in Poland, Moldova and Ukraine, respectively.

In the United States there has been a movement towards smaller schools or schools-within-schools in recent years. And, especially in the larger cities, e.g. New York City, Chicago and Philadelphia, reforms have introduced more small high schools during the 1990s and 2000s, Schwartz et al. (2013). This has spurred a number of high-quality evaluations of these types of

[19] Based on their literature review, Leithwood & Jantzi (2009) conclude that optimal school size differs across level of education. They conclude that optimal school size is lower for lower levels of education.

reforms.[20] Schwartz et al. (2013) evaluate the effects of small high school reform in New York City using variation in distance to schools to estimate the effect of attending a small high school. They find inconclusive evidence in terms of the effects of school size, since the effects of attending a small high school vary substantially depending on when the high school was founded – and newer high schools have additional resources and other specific characteristics that do not make them directly comparable to older high schools. Also, analyzing the effect of attending a small high school in New York City, but taking advantage of the fact that small high school attendance to some extent depends on admission lotteries; Abdulkadiroğlu et al. (2013) find beneficial effects of attending a small high school on a range of measures of academic performance. In addition, they show that small high schools have more engagement, monitoring, safety, collaboration among others. Barrow et al. (2013) use a strategy similar to that of Schwartz et al. (2013) and find that attending a small high school in Chicago increases persistence in school and the probability of graduation. They find no effects on academic achievement. Overall, the introduction of small high schools appears to have been beneficial for students along a range of dimensions. However, the estimated effect can generally not be interpreted as reflecting only the effect of size as these new small high schools often had other features that distinguished them from larger high schools, Iatarola et al. (2008). Overall, for secondary schools, a number of studies indicate a positive or insignificant effect of school size on student achievement.

Long-term effects: While it is of course of interest how school size is related to in-school outcomes such as academic performance, it is of ultimate interest to see whether school size has long-lasting effects on the educational and labor market careers. The evidence on the long-term effects of school size is very limited which is probably related to a lack of data since it is generally a challenge to link data on schooling with later outcomes. One exception is Humlum & Smith (2015) who estimate the effect of school size on students' long-term outcomes in Denmark. Using different empirical strategies taking advantage of variation within schools over time, variation within families over time, population variation in the school district, and school openings and closings, they conclude that school size has a very small positive, but statistically significant effect on long-term measures of student success such as high school completion and annual earnings at age 30.

For the United States, Berry & West (2010) use variation in the timing of school consolidations across states to analyze the effects of school size on the wages and educational attainment of white males born in the period 1920 to 1949. Students who attended smaller schools

[20] Schwartz et al. (2013), Barrow et al. (2013) and Abdulkadiroğlu et al. (2013).

had higher wages, higher returns to schooling and completed more years of schooling. In comparison, using a much more recent sample, Schneider et al. (2006)[21] find no significant effects of school size on students' college plans, but they do find that students from small schools are more likely to act on their college plans, for example in terms of actually filling out a college application.

Cross-country studies: As described above, the existing empirical evidence on the effects of school size does in no way provide a systematic picture of the school systems at different levels across Europe, and many of the research results stem from US data. Therefore, a crucial question is to what extent the results of the studies from some countries can be applied to other countries or settings. It may therefore be highly valuable to look at the results from cross-country studies which compare the same types of outcome variables and relate to measures of average school size though these studies typically are not able to address causality issues. In a large cross-country comparison including 51 countries and regions, Schütz (2007) shows that the shape and strength of the relationship between school size and achievement vary substantially across countries. The analysis is based on TIMSS (Trends in International Mathematics and Science Study) 2003 data on students in about 4th and 8th grade and considers the effect of school size on students' mathematics scores. This study is not able to identify parameters that can be given a causal interpretation. Nonetheless, the results demonstrate that the relationship between school size and student achievement can be either inversely U-shaped, U-shaped or linear depending on the country of analysis. To some extent this can be caused by differences in the range of school sizes in different countries, since one cannot estimate an inversely U-shaped relationship with data that covers only the 'linear' part of the relationship, see Figure 2. Estimating the relationship separately for students with different sociocultural and socioeconomic backgrounds suggests that in many countries the relationship between school size and achievement differs for disadvantaged students and advantaged students. However, the evidence is mixed with respect to the direction of the effect.

4.2 Heterogeneous effects and inequality

Most education inputs vary in effectiveness depending on the characteristics of the students. This also appears to be the case for school size. Since advantaged and disadvantaged students may respond very differently to changes in, for example, peer diversity and social interactions, they are also potentially differentially affected by changes in school size. Generally, the abovementioned studies suggest that

[21] Schneider et al. (2006) basically rely on controlling for observables so the results should not be given a strong causal interpretation.

school size tends to be more important for relatively disadvantaged students.[22] However, as suggested by the cross-country analysis of Schütz (2007), the evidence is mixed with respect to the direction of the effect. Consequently, changes in school size can lead to changes in inequality if certain groups of students are harmed or benefit more from changes in school size than others.

Lee & Smith (1997) find that school size is especially important for students in schools with many disadvantaged students defined as low-socioeconomic status or language-minority students, i.e. the adverse effect on student learning of deviation from the optimal school size is higher for disadvantaged students. If schools are relatively small, this suggests that inequality would be reduced by increasing school size. They also find that there is more equity in small schools, since student socioeconomic status has a lower impact on learning. Similarly, Barrow et al. (2013) find evidence that students with a learning disability benefited more than other students. The results of Humlum & Smith (2015) suggest a positive effect of school size and this effect is stronger for students from families with a low educational level. The latter two studies also analyze whether the effects of school size vary by gender and find that boys are more affected than girls.

4.3 Attendance, dropout rates and distance to school

Academic performance is arguably the outcome of main interest when considering the effects of educational inputs or interventions. Academic performance is closely linked to other types of educational outcomes such as attendance and dropout rates.[23] School size may affect attendance and dropout rates through several channels.

First, it is more or less self-evident that if policy-makers decide that schools in general should be larger, then some schools will have to be closed and average home-to-school distances will increase. While the likely higher transportation costs incurred with larger schools are often private costs, it is important to take these into account when determining the optimal school infrastructure, Kenny (1982) and Hanley (2007). Moreover, basic economic theory would predict that increasing distance to school and thereby the cost of attending school on any given day, lowers the probability of attending school. Consequently, an increase in distance to school can affect academic performance, for example, through fatigue effects or lower attendance.

Second, if school size adversely affects the nature of social interactions and relationships at the school, then attendance and dropout rates may also be affected.

[22] See Lee & Smith (1997), Humlum & Smith (2015) and Barrow et al. (2013). This is also confirmed by the literature review in Leithwood & Jantzi (2009).

[23] For example, Durden & Ellis (1995) show that class attendance affects academic performance in college.

Third, to the extent that larger schools can improve the learning environment due to increased flexibility and diversity, an increase in school size may have a positive impact on attendance and dropout rates. Theoretically, if the perceived gain of attending school increases, the probability of attending school also increases.

Three recent studies, Kuziemko (2006), Jones et al. (2008), both using data from the United States, and Foreman-Peck & Foreman-Peck (2006) all document negative relationships between school size and attendance at the primary or secondary levels. This is consistent with a hypothesis that the increase in transportation costs and any adverse changes in the school environment caused by an increase in school size dominate any potential beneficial effects.

The same type of result is found at the secondary level in most studies. For the United States, Schwartz et al. (2013) and Abdulkadiroğlu et al. (2013) find that attending a new small high school increases graduation rates. Interestingly, studies that find negative effects of school size on student performance also find negative effects on attendance or dropout, Foreman-Peck & Foreman-Peck (2006), Kuziemko (2006) and Abdulkadiroğlu et al. (2013). This suggests that if a particular size of school is preferred then it is preferred both in terms of academic performance and attendance. One exception from these results is a recent study by Humlum & Smith (2015) from Denmark which analyses dropout rates and completion of high school. Humlum & Smith (2015) find a positive relationship between school size and the probability of high school completion in Denmark.

4.4 Social outcomes

The majority of studies of the effects of school size focus on students' academic performance or related outcomes. However, the decision of school size may have more far-reaching consequences. In particular, public schools are also viewed as promoting some forms of social outcomes or social capital, such as social cohesion, trust and civic identity, for example through effects on parental interactions, Dee et al. (2006). From the more general perspective of behavioral economics, larger groups have also been shown to be associated with less cooperation and more free-riding, see Alencar et al. (2008).

A few studies investigate how the size of the school relates to certain social outcomes.[24] Dee et al. (2006) use data on American high school students and find negative relationships between school size and parental involvement and certain measures of social capital. Their results are only reliable for schools in rural areas. They acknowledge the potential selection bias in their estimates

[24] All of the studies on the effects of school size on social outcomes are based on data from the United States and Canada.

and estimate bounds on the estimates. Walsh (2010) compares outcomes in families over time and finds that an increase in school size leads to lower parental involvement. Theoretically, the extent of free-riding is expected to grow when the school gets larger implying that public good provision in the form of parental involvement decreases. In addition, Walsh (2010) finds evidence that suggests that parental involvement substitutes for school quality in the sense that parental involvement is higher for low-quality schools. Relatedly, Brunner and Sonstelie (2003) find that voluntary financial contributions are lower in larger schools.

The association between school size and youth violence is the subject of investigation in Ferris & West (2004) and Leung & Ferris (2008). Both studies find a positive correlation between school size and youth violence. Leung & Ferris (2008) argue that students in larger schools are more likely to be alienated from the other students and the teachers leading to frustration and eventually violent behavior. This hypothesis is supported by the findings of McNeely et al. (2002) who document a negative relationship between school size and school connectedness.

Overall, the available evidence suggests that larger schools are associated with less favorable social outcomes which is also the conclusion based on a large literature review in Luyten et al. (2014). However, it is not clear how important this relationship is in economic terms, making it hard to weigh these potential costs.

4.5 Other aspects of the effects of school size

This section will discuss two important aspects of the school size literature that are important to keep in mind, when discussing policy implications based on the existing evidence. First, as discussed in section 2.2.1, the general relationship between school size and academic achievement is likely to be nonlinear – and it is widely believed to be inversely U-shaped. Thus – at least theoretically – there exists an optimal school size. This reflects that schools that are very small have less flexibility etc., while schools that are too big suffer from bureaucracy, alienation, etc. In practice, the relationship between school size and academic achievement must to some extent be context-dependent. If the relationship between school size and academic achievement is inversely U-shaped then the vast majority of results in the literature can be reconciled, since studies with most schools below the optimal school size will tend to find positive effects, while studies with most schools above optimal school size will tend to find negative effects. Nonlinear effects are most likely to be found where there is a lot of variation in the size of the schools. In fact, when, for example, a positive effect of school size is found, it is often argued that this is a reasonable result because schools in the sample were relatively small; see for example, Humlum & Smith (2015) and

Coupé et al. (2015). Another reason why the effects of school size may be context-dependent is that for a fixed school size, the number of students at each grade level varies with the number of grade levels. Since the number of grade levels in schools vary widely across countries, this could generate substantial differences in the effects of school size if, for example, the number of students at each grade level is important.

Second, it can be somewhat confusing that studies on the effect of school size on academic achievement frequently discuss the implications for optimal school size without taking the costs of changing school size into account. Of course, the optimal school size must also depend on costs. Harris (2006) specifically argues that one cannot discuss the optimal allocation of resources without taking the costs into account – and decreasing school size generally increases costs. For example, small schools will typically have relatively high fixed costs, because even a small school needs to provide certain facilities for their students and the most productive use of resources may not be possible in small schools. Furthermore, one should take all costs into account including the private transportation costs that are likely to arise when school size is increased, Kenny (1982).[25] There is a substantial literature on the effects of school size on costs which is not reviewed here, see, for example, Andrews et al. (2002) and Falch et al. (2008).

5 Empirical evidence on the effects of school consolidation

The issues of school size and school consolidation are highly interrelated. One cannot implement school consolidation without changing the size of schools. And, one cannot fundamentally change the size of schools without opening, closing or merging schools. Part of the effect of school consolidation will therefore typically be attributed to the accompanying change in school size. Like school size, school consolidations potentially affect a variety of outcomes, including academic achievement, equity, attendance, school quality and peer composition. Since school consolidation is something that happens at a particular point in time, the effects hereof are likely to vary over time. From the perspective of the individual student, one can think of part of the effect of school consolidation as being temporary, also sometimes termed a disruption effect, and the other part as being more permanent and caused by the changes in school quality.[26] School consolidation does not only affect school size, it also potentially affects both the available choice sets, the degree of competition between schools and student sorting into different schools, de Haan et al. (2014). When

[25] Duncombe et al. (1995), Kuziemko (2006), Stiefel et al. (2009) and the reviewed studies in Andrews et al. (2002) suggest that cost savings can be incurred from school or school district consolidation if initial sizes are not too high.
[26] A similar terminology is used by Hanushek et al. (2004) who study voluntary student mobility.

considering the effects of school consolidation, it is therefore important to keep in mind that there are several potential channels through which student outcomes may be affected. Most studies are not able to disentangle the effects, but simply estimate the overall effect of school consolidation.

5.1 Academic achievement

The existing evidence on school consolidations is not as extensive as for school size.[27] However, recent studies from the United States, China, Netherlands and Denmark[28] use advanced statistical methods to uncover causal effects of school consolidation. One important aspect of school consolidations is that the effects of consolidations are likely to differ in the short and long run. In the short run, students, teachers and schools in general experience disruption of their usual tasks, networks etc. The existing evidence focuses on very short-run effects with de Haan et al. (2014) being a noteworthy exception.

It is generally acknowledged that students originating from closing schools and students originating from receiving schools face different changes when school consolidation is implemented. Whether or not school consolidation involves closings, mergers or both, it affects the composition of the student body. If a school is closed, students are *displaced*. Displaced students are sent to other schools where the existing student body constitutes the *receiving* students. The displaced and the receiving students are potentially differentially affected by the school closings since both disruption and changes in school quality are likely to differ for these groups. Specifically, the changes in peer composition are likely to be different. For example, closing low-performing schools would imply that displaced students experience an increase in school quality whereas the receiving students experience a decrease in school quality where school quality reflects peer group composition. As will be clear from the discussion of the evidence below, it is important to allow for heterogeneous effects of school consolidations on these two types of students.

Studies on the short-term effects of school consolidation on student achievement find that the effects of school consolidation vary considerably for displaced and receiving students, by years since consolidation, and by type of school closed. Engberg et al. (2012) and Brummet (2014) study the effects of school closings on math and reading scores in an anonymous urban district in the United States and in Michigan, respectively. Beuchert et al. (2015) analyze the effects of school consolidations in Denmark on reading scores. Liu et al. (2010) study the effects of a large-scale

[27] While the studies of the effects of school size were dispersed in the sense that they looked at effects of both primary and secondary school size, the studies of school consolidation are focused on consolidation at the level of primary education.
[28] The Dutch and Danish studies are unpublished at the time of writing this report.

merger program in two Chinese provinces. Academic achievement of the primary school students is measured by math and Chinese language scores. The nature of school consolidations in rural China is arguably very different from a European setting making the comparison with the European and US studies less useful. For example, the school consolidations in rural China implied sending some young children to boarding school.

The empirical strategies pursued in these studies are somewhat similar and use repeated observations of student test scores over time to eliminate endogeneity bias – in some cases combined with instrumental variables approaches. The general idea is that the achievement growth of students exposed to a school consolidation is compared with the achievement growth of students who were not exposed to a school consolidation. Differences in achievement growth are then attributed to the school consolidation. All of these studies are based on the assumption of parallel trends, i.e. in the absence of mergers or closings, the students who experienced a merger or closing would have had the same achievement growth as the students that did not experience a merger or closing.

While the abovementioned studies all agree that there are differential effects of school consolidation for displaced and receiving students, the conclusions vary slightly. Generally, displaced students are more adversely affected by school consolidations than receiving students. This could reflect a larger disruption effect on displaced students, who are forced to change schools, teachers and peers. This is to a lesser extent the case for receiving students. Brummet (2014) finds that both displaced and receiving students are adversely affected by school consolidation, while Engberg et al. (2012) and Beuchert et al. (2015) find that displaced students are adversely affected by school consolidation, but receiving students are not – or at least to a smaller extent.[29] In their study of primary school consolidation in rural China, Liu et al. (2010) do not find evidence of adverse effects on average student performance and if anything they actually find that receiving students benefit from the consolidations.

In line with the hypothesis that at least part of the short-run effect of school consolidations is caused by disruption, the adverse effects of school consolidation tend to diminish over time, Engberg et al. (2012), Brummet (2014), and Beuchert et al. (2015). The adverse effects of consolidation appear to be largest around the time of consolidation. Within 2-3 years, the effects

[29] There is a vast literature on peer effects that can be informative about what happens when student composition changes. For example, Angrist & Lang (2004) study a desegregation program in Boston and find little effect of sending students from Boston schools to more wealthy suburbs. Imberman et al. (2012) analyze the effects of displaced students after the hurricanes Katrina and Rita and find limited effects on the achievement of receiving students.

typically diminish considerably and become statistically indistinguishable from zero, Brummet (2014) and Beuchert et al. (2015). Engberg et al. (2012) find a large temporary negative effect on attendance, but this disappears after the first year suggesting that this reflects some form of disruption effect.

If policymakers decide to consolidate schools, they must also decide *which* schools to close and *where* to send the displaced students. While displaced students are harmed from school consolidations on average, Brummet (2014) finds that displaced students actually benefit from school consolidation if the closed schools are relatively low-performing. Similarly, Engberg et al. (2012) find that displaced students that were allocated to higher-performing schools were less adversely affected by school closings.[30] Closing relatively low-performing schools is likely to imply a positive change in school quality for the displaced students, at the very least in terms of an increase in peer quality. Correspondingly, the receiving students in the relatively high-performing schools are likely to face a decrease in peer quality. The results in Brummet (2014) also suggest that closing schools that perform similarly to neighboring schools has no effect after three years while closing relatively high-performing schools has negative effects on student performance – even after three years. In some cases displaced students are all sent to the same school, and in other cases displaced students are scattered across different neighborhood schools. The short-term effects of school consolidation are higher when fewer students are sent to the modal receiving school which is consistent with a hypothesis that the disruption in peer networks generates adverse effects, Brummet (2014).

While school consolidation typically involves the physical relocation of students from one school to another, Beuchert et al. (2015) study a type of administrative school merger where two or more, typically smaller, schools are merged but remain at separate physical locations. They find little initial effect of these administrative mergers, but after a couple of years there is some suggestion that the beneficial effects of these mergers begin to materialize.

de Haan et al. (2014) provide a detailed analysis of the effects of a large school consolidation reform in the Netherlands. The reform was implemented in the years 1994 to 1996 and as a consequence the number of primary schools was reduced by 15 percent and average school size increased from 162 to 216 students. The reform changed how the minimum required school size

[30] The same type of result is found by Sacerdote (2012) and Imberman et al. (2012) who study the effects of student displacement in the wake of hurricanes Katrina and Rita on displaced and receiving students, respectively. The displacement meant that students from relatively low-performing schools were moved to relatively high-performing schools. It led to increases (after an initial decrease) in the achievement of displaced students and no effects on receiving students on average.

was determined as a function of municipality characteristics. They investigate how changes in the number of schools affect mean achievement at the school level. To address endogeneity concerns they compare schools within the same municipality and use variation in the minimum required school size to identify the effect of the number of schools. Their main result is that an average reduction in the number of schools by 15 percent increased average achievement by about 6 percent of a standard deviation. Of particular interest is the fact that they are able to explore four potential channels through which the change in the supply of schools affects student achievement: segregation, school size, pure supply and closing of low-performing small schools. The conclusion is that the estimated achievement effects to a large extent are induced by increases in school size. Since initial school sizes were relatively low, it seems plausible that economies of scale were not fully utilized in the Dutch system prior to the reform. Compared to other studies, de Haan et al. (2014) focus on students that are fully exposed to the effects of school consolidation and their study is probably the one that comes closest to estimating long-term effects of school consolidation.

5.2 Heterogeneous effects and inequality

Often one of the main aims of school consolidation – besides reducing costs - is to promote equality of opportunity by providing the same type of high-quality education for all. In an education system with many small schools, the quality of inputs received by students in different schools is likely to vary considerably. School consolidation tends to reduce this variation. In addition, decreasing the number of schools generally reduces the possibilities of student sorting and thereby potentially school segregation.

The discussion above suggested that displaced students are generally harmed more than receiving students from school consolidations. If displaced students tend to be relatively disadvantaged students then these results imply that school consolidation increases inequality in terms of achievement gaps. The results in Engberg et al. (2012) and Brummet (2014) suggest that any adverse effects of consolidation on displaced students are minimized in the context where students from relatively low-performing schools are moved to relatively high-performing schools. Therefore, this type of consolidation would also tend to minimize any increases in inequality.

The effectiveness of educational interventions may be very dependent on the life-stage at which they are implemented, Heckman (2000). The analyses of Liu et al. (2010) support the hypothesis that school consolidation has effects that vary with the age of the child. Specifically, younger students – both displaced and receiving – are actually adversely affected by the school mergers in rural China while the academic performance of older students is improved. However, the findings of Beuchert et al. (2015) suggest that effects are stronger for older students. Why results differ across these two studies is not clear; the differences may be related to the very different settings of the two studies.

Whether the effects of school consolidations vary with other school and student characteristics, is more uncertain. The results of Engberg et al. (2012) indicate that whites may be less adversely affected than African Americans. Heterogeneity of effects is investigated for a variety of subgroups in Beuchert et al. (2015), but in many cases the estimated effects for subgroups are statistically indistinguishable from each other. They find that effects on displaced students tend to be larger if the closed school was small or located in a rural area.

In an attempt to study the relationship between school consolidation and wage inequality, Berry (2006) finds little evidence that the school consolidation movement in the United States in the period 1930 to 1970 affected wage inequality. However, the study does not explicitly study the effects of school consolidation and the sample is limited to white males.

In countries or regions with large minority groups, some extent of school segregation is common, for example, Roma and non-Roma in some Central and Eastern European countries, Kertesi & Kézdi (2010, 2012), blacks and whites in the United States, Guryan (2004), and immigrants and natives in many European countries, Schneeweis (2011). If the school system is segregated then this poses an additional challenge for school policy. Specifically, one could hypothesize that school consolidation in a very segregated school system may lead to different types of effects than those discussed above depending on the dimensions of segregation. The effects of school consolidation in segregated school systems are of particular interest since school consolidations are a potential policy instrument for desegregation, Kertesi & Kézdi (2013).[31][32] Iatarola et al. (2008) show that the introduction of small high schools in New York City was related to changes in segregation. Their analysis is inconclusive in the sense that some groups of students became more segregated while others became less segregated. Segregation often involves a relatively high-performing population group and a relatively low-performing population group. As such, some of the results discussed above pertaining to, for example, the closing of low-performing schools may be informative about the effects of consolidation in the presence of school segregation.

[31] Kertesi & Kézdi (2012) document a positive relationship between the number of schools and Roma/non-Roma primary school segregation in Hungary.

[32] Kertesi & Kézdi (2013) show that Roma/non-Roma primary school segregation has been increasing from 1992 to 2006. They find that the level of segregation is significantly related to student mobility, the share of Romani population and the local educational policies. They hypothesize that the introduction of free school choice has increased inequality due to the fact the high-status students have higher mobility.

For example, the raw test score gap between Roma and non-Roma students is substantial, but almost disappears when socioeconomic background is taken into account suggesting that socioeconomic background and not ethnicity is the most important dimension, Kertesi & Kézdi (2011, 2014). The effects of closing relatively low-performing schools may therefore to some degree be informative about the effects of closing schools with a high concentration of Romani students.[33] Of course, the existing evidence cannot inform about any culture-specific effects that may arise in a particular cultural context.

5.3 Attendance, dropout rates and distance to school

There is very limited evidence on the effects of school consolidation on attendance and dropout rates. Only one of the abovementioned studies include attendance as an outcome measure and they find a large negative effect on attendance rates of displaced students but the effect disappears within the first year, Engberg et al. (2012). Overall, there is not sufficient evidence on the effects of school consolidations on attendance and dropout rates to draw policy conclusions.[34] What can be said is that school consolidation will typically increase distance from home to school and any potential effects of this should be weighed when considering school consolidations as a policy tool.[35]

5.4 Other aspects of the effects of school consolidations

In the literature on the effects of school consolidations, the focus has undoubtedly so far been on the effects on students' academic achievement. While this perspective is obviously important – especially since deteriorating academic performance is sometimes the primary motivation for school consolidation – there are other issues that deserve a short mention. First of all, studies tend to ignore effects on costs making it hard to evaluate the entire policy of school consolidation. Second, school closings are often believed to have detrimental effects on the surrounding neighborhood in terms of population flight, reduced housing values among others.[36] Third, the narrow focus on

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[33] Kirshner et al. (2010) present some qualitative evidence from a high school closure in the United States that suggests that policies that target specific types of schools for closings may cause stigmatization of the students from the closed school.

[34] Liu et al. (2010) has some information on educational inputs and characteristics of the school before and after the merger. As expected, the school consolidation program led to an increase in the distance from home to school, increases in class size and for the displaced students in particular: increases in teacher quality, building quality and the prevalence of modern teaching facilities in the classroom. While the increase in distance to school is likely to decrease attendance, this is not addressed in the paper and therefore it remains speculation.

[35] There is plenty of empirical evidence linking distance to school in general with attendance and enrollment in developing countries, for example, Burde & Linden (2013) show that introducing village-based schools increases school enrollment substantially in Afghanistan and Vuri (2010) show that distance to primary school increases school attendance in Ghana.

[36] Egelund & Lausten (2003) provide a qualitative study and discussion of the effects of school closings in Denmark on the local communities.

academic achievement is not directly informative about potential effects on non-cognitive skills which have repeatedly been argued to be important in the context of educational interventions, see for example, Heckman (2000). Finally, school consolidation generally affects the market forces in education. For example, by decreasing the supply of schools, competition between schools and the choice sets of parents are potentially reduced. Reduced parental choice can lead to higher private school enrollment, Hoxby (2000).

6 Conclusions and implications for school policy in the European Union

There are two reasons why changes in school infrastructure in the EU countries have been particularly pressing in recent years. First, the demographic development in many EU countries implies that the number of school-aged children has been decreasing. Second, resources are scarce – especially in the wake of the economic crisis – implying that many countries and local governments are eager to reduce costs. It is important for policymakers to consider whether the current school infrastructure is optimal in this new context. This report has reviewed the existing economic literature on the effects of school size and school consolidations. It has found that school size is an important determinant of student outcomes, for example as measured by achievement and attendance. However, school size is just one dimension of school policy and any attempt to reform and improve school systems in EU countries should consider all relevant dimensions. In this section, implications of the reviewed empirical evidence for school policy in the EU countries are discussed.

First, it is important for policymakers to take all the potential benefits and costs of changing school size into account. In order to assess whether the current school infrastructure is optimal, one must weigh the benefits and costs of changing school size carefully. While it seems obvious that all costs must be taken into account, a simple thing such as the transportation costs incurred by students is often not included in analyses of the costs of changing school size. From the perspective of society, these costs are important. In addition, the existing empirical evidence suggests that any analysis of a policy that affects school size should consider that school size potentially does not only affect costs, but also academic performance and attendance in school, long-term educational success and social outcomes such as parental involvement. Particularly, the reviewed evidence suggests that larger schools are associated with lower parental involvement, less connectedness and more youth violence.

Second, it is not possible to provide a magic number in the form of an optimal school size. On the contrary, it is well-documented that one size does not fit all in regard to this question. That being said there seems to be a consensus in the literature that schools should be neither 'too big' nor 'too small'. Optimal school size is context-dependent and is likely to vary with country, region, degree of urbanization, level of education, student composition, student background to mention a few. There is substantial variation in school size both within and between EU countries. This warrants a need for further high-quality research on the effects of school size in different contexts to inform policy decisions.

Third, the choice of school size is ultimately intertwined with the choices of grade span, grade size and class size. One cannot change school size holding all of these variables constant. Therefore, changes in school policy should not focus on changing one narrow dimension like school size. A broad perspective is valuable. Generally, large-scale implementation should always be accompanied by considerations about general equilibrium effects to avoid situations like the shortage of qualified teachers in California after a large-scale reduction in class sizes documented by Jepsen & Rivkin (2009).

Fourth, there is considerable evidence that students who are generally considered disadvantaged, for example students with low socioeconomic status, language-minority status, low parental education level etc., are more affected by changes in school size than other students. This suggests that school size considerations are especially important in areas with a large fraction of disadvantaged students. In particular, if the aim of school policy is to lower inequality, it becomes important to assess the impact of school size on the distribution of student achievement. Unfortunately, given that the relationship between school size and student achievement is context-dependent, the existing evidence does not inform about the direction of the effect of school size. If the effect of school size is positive, then increasing school size would reduce inequality, but if the effect of school size is negative then increasing school size would increase inequality. This further underlines the need for high-quality research that can provide evidence on the effects of school size in different countries and for different groups of students.

Fifth, in order to fundamentally change average school size, policymakers will have to implement school consolidations or open new schools. Besides changing school size, school consolidations can have other important effects through changes in school quality and disruption effects - especially in the short run. Existing evidence suggests that especially displaced students are harmed in the short run. The short-run adverse effects of consolidations suggest that more resources should be allocated to consolidating schools to counter the adverse effects experienced by students who are exposed to consolidation. Furthermore, the possibility of spill-over effects on students in receiving schools should be taken into account.

Finally, the existing evidence suggests that closing relatively low-performing schools and moving the displaced students to relatively high-performing schools is potentially a reasonable strategy for policymakers. This type of strategy also has the advantage of potentially reducing inequality and segregation.

Thus, while the existing empirical evidence on the effects of school size and school consolidations does not provide a clear roadmap for school reforms in EU countries, it does provide important insights into the different dimensions of the effects of school size and school consolidations which are important for analyzing and understanding the consequences of future reforms of the educational infrastructure. There is a large scope for future research in this area to investigate how and why the effects of school size differ for different contexts and relatedly to explore the mechanisms through which school size affects academic performance and other important outcomes. In addition, recent school consolidations in the European Union provide an excellent opportunity for analyzing the complex effects of school consolidations.

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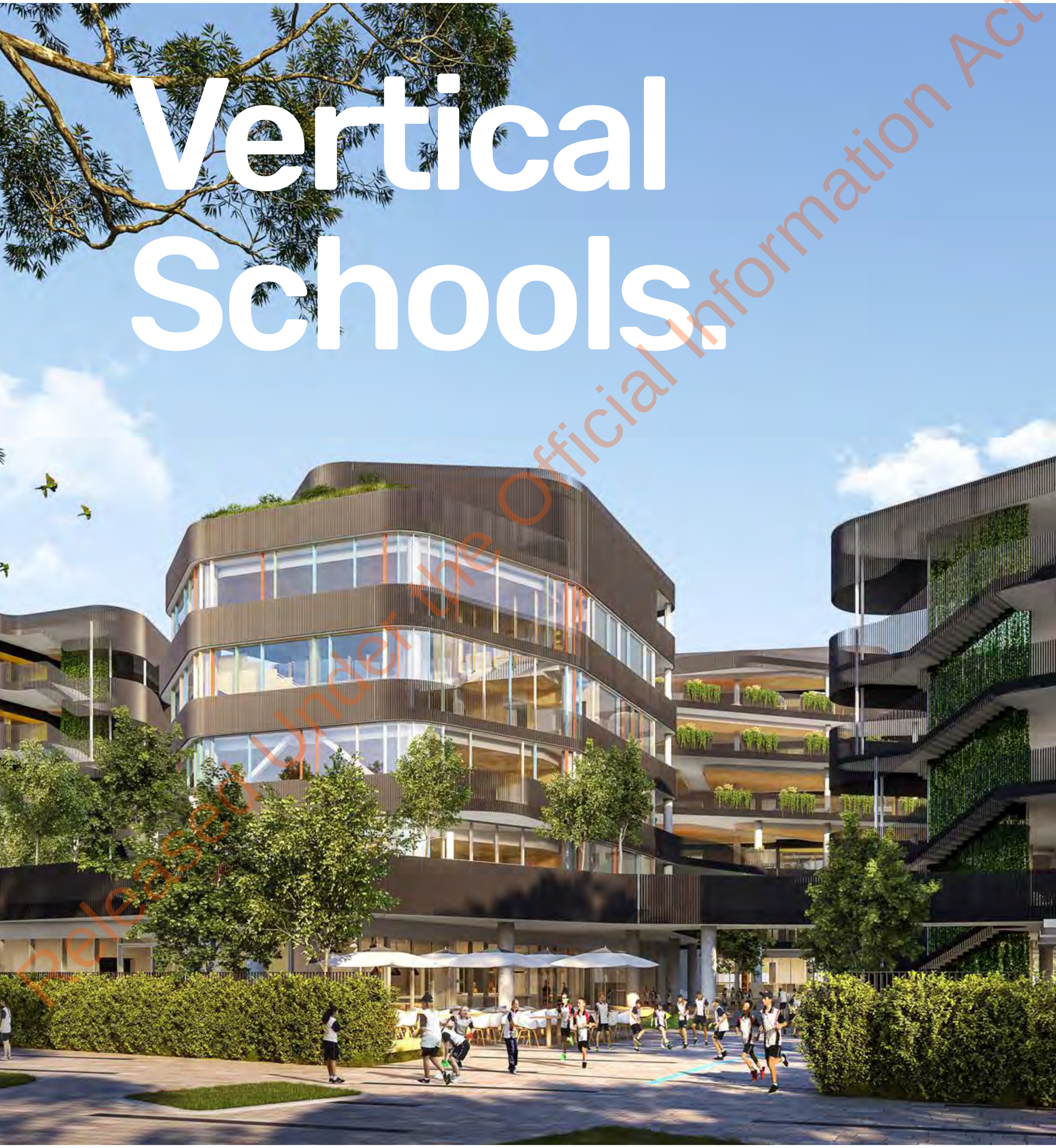
TSA

Vertical Schools.



Best for Project

2020

The Centre Of Our Communities.

2019

3,948,811 Students

9,503 Schools

65.7% Government Schools

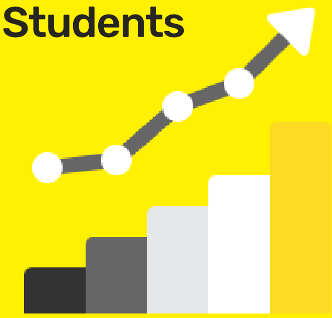
19.5% Catholic Schools

14.8% Independent Schools

13 students
7 Teachers

2026

Increase of 650,000 Students



Vertical schools are a recent phenomenon in Australian state education. High land prices and a scarcity of suitable sites make vertical schools an economic alternative to our longstanding cultural preference for low-rise schools.

New vertical schools, ranging in height from four to seventeen storeys, are now starting to be commissioned across all Australian mainland states. Peter Goss from the Grattan Institute wrote that Australia can anticipate an increase of around 650,000 students in the decade to 2026. This number would require the construction of seven new twenty-five-student classrooms every day for ten years.

The six-storey South Melbourne Primary School, opened in 2018 and caters to 525 students. Within the high-rise structure of Arthur Phillip High School by Grimshaw Architects with BVN, students will be divided into multi-year communities. A vertical layout, as at Adelaide Botanic High School, provides opportunities for collaboration and connections that are not available in traditional low-rise school buildings.

Vertical schools have been around for some time, examples of multistorey primary schools in the UK include an 1870s five-storey Manchester school and a seven-storey Hackney school from 1898 however, design and development considerations in an Australian context are relatively new.

Maximising the investment is all in the planning, and you can't just re-stack a horizontal school, you need to re-think the entire approach. In the past, people thought of vertical schools purely as a solution to space constraints where schools simply didn't have the necessary horizontal space for expansion, therefore were required to build