From Guskey, T.R., 2015. Mastery Learning. In: James D. Wright (editor-in-chief), International Encyclopedia of the Social & Behavioral Sciences, 2nd edition, Vol 14. Oxford: Elsevier. pp. 752–759.
ISBN: 9780080970868

Mastery Learning

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Abstract

Over the last four decades, few programs have been implemented as broadly or evaluated as thoroughly as those associated with mastery learning. This article describes how mastery learning originated and the essential elements involved in its implementation. It discusses the improvements in student learning that typically result from the use of mastery learning and how this strategy provides practical solutions to a variety of persistent instructional problems. Finally it explains the common misinterpretations of mastery learning and summarizes the results of research on its effects.

Over the last four decades, few programs have been implemented as broadly or evaluated as thoroughly as those associated with mastery learning. Programs based on mastery learning principles operate today in nations throughout the world and at every level of education. When compared to traditionally taught classes, students in mastery learning classes consistently have been shown to learn better, reach higher levels of achievement, and develop greater confidence in their ability to learn and in themselves as learners (Anderson, 1994; Guskey and Pigott, 1988; Klecker and Chapman, 2008; Kulik et al., 1990a; Miles, 2010).

This article describes how mastery learning originated and the essential elements involved in its implementation. It discusses the improvements in student learning that typically result from the use of mastery learning and how this strategy provides practical solutions to a variety of persistent instructional problems. Finally it explains the common misinterpretations of mastery learning and summarizes the results of research on its effects.

John B. Carroll's 'Model for School Learning'

Although the basic tenets of mastery learning can be traced to such early educators as Comenius, Pestalozzi, and Herbart, modern versions were inspired by a 1963 article by John B. Carroll of Harvard University entitled, 'A Model for School Learning.' In his article, Carroll challenged long-held perceptions of student *aptitude*. He pointed out that student aptitude traditionally had been viewed as the *level* to which a child could learn a particular subject. Children with high aptitude would be able to learn the most complex aspects of that subject, while those with low aptitude would be able to learn only the most basic elements. When aptitude is viewed in this way, children are seen as either good learners (high aptitude) or poor learners (low aptitude) with regard to the subject.

Carroll argued, however, that student aptitude more accurately reflects an indicator of *learning rate*. That is, all children have the potential to learn quite well, but differ primarily in terms of the time they require to do so. Some children are able to learn a subject very quickly while others may take much longer. When aptitude is viewed as an indicator of learning rate, children are seen not simply as good and poor learners, but rather as fast and slow learners.

Carroll then proposed a model for school learning based on this alternative view of aptitude. He believed that if each child was allowed the time needed to learn a subject to some criterion level, and if the child spent that time appropriately, then the child probably would attain the specified level of achievement. But if not enough time were allowed or if the child did not spend the time required, then the child would learn much less. The degree of learning attained by a child, therefore, could be expressed by the following simple equation:

$$\text{Degree of learning} = f\left(\frac{\text{time spent}}{\text{time needed}}\right)$$

In other words, degree of learning is a function of the time a child actually spends on learning, relative to the time he or she needs to spend. If the time spent was equal to time needed, the learning would be complete and the equation would equal 1. If the time spent was less than the time needed, however, the learning would be incomplete by that proportion.

Carroll further identified the factors that, he believed, influenced the time spent and the time needed. He argued that both of these elements were affected by characteristics of the learner and by characteristics of the instruction. Specifically, he believed that the time spent was determined by a child's *perseverance* and the *opportunity to learn*. Perseverance is simply the amount of time a child is willing to spend actively engaged in learning. Opportunity to learn is the classroom time allotted to the learning. In other words, time spent is determined by the child's persistence at a learning task and the amount of learning time provided. Time needed, on the other hand, Carroll believed was determined by the child's *learning rate* for that subject, the *quality of the instruction*, and the child's *ability to understand the instruction*. Specifically:

$$\text{Degree of learning} = f\left(\frac{\begin{array}{l}\ast\ \text{perseverance}\\ \ast\ \text{opportunity to learn}\end{array}}{\begin{array}{l}\ast\ \text{learning rate}\\ \ast\ \text{quality of instruction}\\ \ast\ \text{ability to understand the instruction}\end{array}}\right)$$

Again, a child's learning rate is a measure of the time required by the child to learn the concepts or skills under ideal instructional conditions. If the quality of the instruction was high, then the child would readily understand it and would

International Encyclopedia of the Social & Behavioral Sciences, Second Edition, 2015, 752–759

probably need little time to learn. If the quality of the instruction was not as high, however, then the child would have greater difficulty understanding and would require much more time to learn. In other words, the quality of the instruction and the child's ability to understand the instruction interact to determine how much time is needed for the child to learn the concepts or skills.

Carroll's article made a significant contribution to learning theory. It set forth new guidelines for research into the concept of aptitude and identified specific factors that influence learning in school settings. His ideas about learning rate also prompted the development of numerous 'individualized instruction' programs that allowed students to progress through a series of learning units at their own, self-determined pace. Two of the best known of these 'continuous progress' programs were Individually Prescribed Instruction, developed at the University of Pittsburgh (Glaser, 1966) and Individually Guided Education, developed at the University of Wisconsin (Klausmeier et al., 1968). Carroll himself, however, did not address the problem of how to provide sufficient time or how to improve instructional quality. These issues were left unresolved.

Benjamin S. Bloom's 'Learning for Mastery'

Benjamin S. Bloom, Distinguished Service Professor at the University of Chicago, was impressed by the optimism of Carroll's perspective on learners and particularly by the idea that students differ in terms of the *time required* for learning rather than their *ability to learn*. If aptitude was indeed predictive of the time a child would require to learn, Bloom believed it should be possible to set the degree of learning expected of each child at some mastery performance level. Then by attending to the instructional variables under teachers' control – the opportunity to learn and the quality of the instruction – teachers should be able to ensure that every child attain that specified level.

To determine how this might be practically achieved, Bloom first considered how teaching and learning take place in typical group-based classroom settings. He observed that most teachers begin by dividing the concepts and skills that they want students to learn into smaller learning units. These units are usually sequentially ordered and often correspond to the chapters in the textbook used in teaching. Teachers then teach the unit concepts to all students in the same way, provide all students with the same amount of time to learn, and evaluate students' learning at the end with some form of test or assessment. The few students for whom the instructional methods and time were ideal learn excellently and perform well on the unit assessment. The largest number of students for whom the methods and time were only moderately appropriate learns less well. And students for whom the instruction and time were inappropriate due to differences in their backgrounds or learning styles, learn very little and perform poorly on the unit assessment. In other words, little variation in the teaching resulted in great variation in student learning. Under these conditions the pattern of student achievement was similar to the normal curve distribution shown in Figure 1.

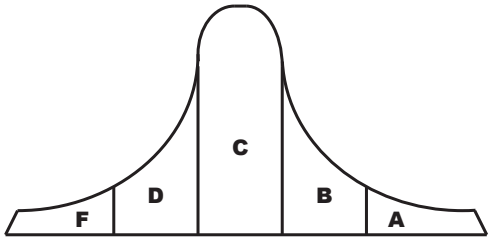

Figure 1 Distribution of achievement in traditional classrooms.

To attain better results and *reduce* this variation in student achievement, Bloom reasoned that we would have to *increase* variation in the teaching. In other words, because students varied in their learning styles and aptitudes, teachers must diversify and differentiate instruction to better meet students' individual learning needs. The challenge was to find practical ways to do this within the context of group-based classrooms so that *all* students learn well.

In searching for such a strategy, Bloom drew primarily from two sources of evidence. First, he considered the ideal teaching and learning situation in which an excellent tutor is paired with each student. He was particularly influenced by the work of early pioneers in individualized instruction, especially Washburne (1922) and his Winnetka Plan, and Morrison (1926) and his University of Chicago Laboratory School experiments. In examining this evidence, Bloom sought to determine what crucial elements in one-to-one tutoring and individualized instruction could be transferred to group-based classroom settings.

Second, Bloom looked at studies of the learning strategies of academically successful students, especially the work of Dollard and Miller (1950). From this research he tried to identify the activities of high-achieving students in group-based classrooms that distinguish them from their less successful classmates.

Bloom saw value in teachers' traditional practice of organizing the concepts and skills they want students to learn into learning units. He also considered it important for teachers to assess student learning at the end of each unit. But the classroom assessments most teachers used seemed to do little more than show for whom their initial instruction was and was not appropriate.

Bloom believed that a far better approach would be for teachers to use their classroom assessments as learning tools, and then to follow those assessments with a *feedback and corrective* procedure. In other words, instead of using assessments only as evaluation devices that mark the end of each unit, Bloom recommended using them as part of the instructional process to *diagnose* individual learning difficulties (feedback) and to *prescribe* remediation procedures (corrections).

This is precisely what takes place when an excellent tutor works with an individual student. If the student makes an error, the tutor first points out the error (feedback) and then follows up with further explanation and clarification (correctives) to ensure the student's understanding. Similarly, academically successful students typically follow up the mistakes they make on quizzes and assessments. They ask the teacher about the items they missed, look up the answer in the textbook or other

resources, or rework the problem or task so that they do not repeat those errors.

With this in mind, Bloom outlined an instructional strategy to make use of this feedback and corrective procedure, labeling it 'learning for mastery' (Bloom, 1968), and later shortening it to simply 'mastery learning' (Bloom, 1971a). With this strategy, teachers first organize the concepts and skills they want students to learn into learning units that typically involve about a week or two of instructional time. Following initial instruction on the unit, teachers administer a brief quiz or assessment based on the unit's learning goals. Instead of signifying the end of the unit, however, this assessment's purpose is to give students information, or 'feedback,' on their learning. To emphasize this new purpose Bloom suggested calling it a *formative assessment*, meaning 'to inform or provide information.' A formative assessment identifies for students precisely what they have learned well to that point, and what they need to learn better (Bloom et al., 1971).

Paired with each formative assessment are specific 'corrective' activities for students to use in correcting their learning difficulties. Most teachers match these 'correctives' to each item or set of prompts within the assessment so that students need work on only those concepts or skills not yet mastered. In other words, the correctives are 'individualized.' They may point out additional sources of information on a particular concept, such as page numbers in the textbook or workbook where the concept is discussed. They may identify alternative learning resources such as different textbooks, learning activities, alternative materials, CDs, digital lessons, or web-based instructional materials (DeWeese and Randolph, 2011). Or they may simply suggest sources of additional practice, such as study guides, computer exercises, independent or guided practice activities, or collaborative group activities.

With the feedback and corrective information gained from the formative assessment, each student has a detailed prescription of what more needs to be done to master the concepts or skills from the unit. This 'just-in-time' correction prevents minor learning difficulties from accumulating and becoming major learning problems. It also gives teachers a practical means to vary and differentiate their instruction in order to better meet students' individual learning needs. As a result, many more students learn well, master the important learning goals in each unit, and gain the necessary prerequisites for success in subsequent units.

When students complete their corrective activities after a class period or two, Bloom recommended they take a *second* formative assessment. This second, 'parallel' assessment covers the same concepts and skills as the first, but is composed of slightly different problems or questions, and serves two important purposes. First, it verifies whether or not the correctives were successful in helping students overcome their individual learning difficulties. Second, it offers students a second chance at success and, hence, has powerful motivational value (Changeiywo et al., 2011).

Some students, of course, will perform well on the first assessment, demonstrating that they have mastered the unit concepts and skills. The teacher's initial instruction was highly appropriate for these students and they have no need of corrective work. To ensure their continued learning progress, Bloom recommended that teachers provide these students with special 'enrichment' or 'extension' activities to broaden their learning experiences. Enrichment activities are often self-selected by students and might involve special projects or reports; digital academic games; or any variety of complex, problem-solving tasks. Figure 2 illustrates this instructional sequence.

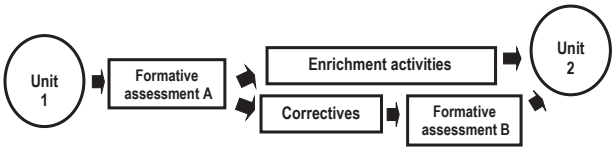

Figure 2 The mastery learning instructional process.

Through this process of formative classroom assessment, combined with the systematic correction of individual learning difficulties, Bloom believed all students could be provided with a more appropriate quality of instruction than is possible under more traditional approaches to teaching. As a result, nearly all might be expected to learn well and truly master the unit concepts or learning goals (Bloom, 1976). This, in turn, would drastically reduce the variation in students' achievement levels, eliminate achievement gaps, and yield a distribution of achievement more like that shown in Figure 3.

In describing mastery learning, however, Bloom emphasized that reducing variation in students' achievement does not imply making all students the same. Even under these more favorable learning conditions, some students undoubtedly will learn more than others, especially those involved in enrichment activities. But by recognizing relevant, individual differences among students and then altering instruction to better meet their diverse learning needs, Bloom believed the variation among students in how well they learn specific concepts or master a set of articulated learning goals could eventually reach a 'vanishing point' (Bloom, 1971b). In other words, *all* students would be helped to learn well the knowledge and skills prescribed in the curriculum. As a result, gaps in the achievement of different groups of students would be closed (Guskey, 2007).

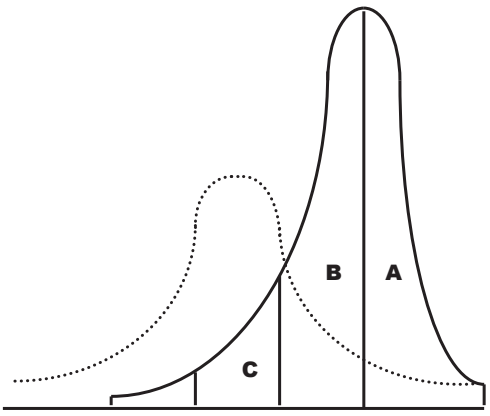

Figure 3 Distribution of achievement in mastery learning classrooms.

The Essential Elements of Mastery Learning

After Benjamin Bloom described his ideas, several of his students took up the task of clarifying mastery learning instructional strategies (e.g., Block et al., 1989) and numerous programs based on mastery learning principles sprung up in schools throughout the United States and around the world (see Postlethwaite and Haggarty, 1998; Reezigt and Weide, 1990; Wu, 1994; Yildiran, 2006; Yildiran and Aydin, 2005). Although differing from setting to setting, those programs true to Bloom's ideas include two essential elements: (1) the *feedback, corrective, and enrichment process*; and (2) *instructional alignment* (Guskey, 1997a).

Feedback, Correctives, and Enrichment

Teachers who use mastery learning provide students with frequent and specific *feedback* on their learning progress through regular, formative classroom assessments. This feedback is both diagnostic and prescriptive. It reinforces precisely what students were expected to learn, identifies what they learned well, and describes what needs to be learned better. The US National Council of Teachers of Mathematics (NCTM) emphasizes this same element in its latest iteration of the standards for school mathematics. To overcome inequities in mathematics instruction, NCTM stresses the use of assessments that support learning and provide useful information to both teachers and students (NCTM, 2000).

Feedback alone, however, does little to help students improve their learning. Significant improvement requires that feedback be paired with *correctives*: activities that offer guidance and direction to students on how to remedy their learning problems. Because of students' individual differences, no single method of instruction works best for all. To help every student learn well, therefore, teachers must differentiate their instruction, both in their initial teaching and especially through the corrective activities (Bloom, 1976). In other words, teachers must *increase* variation in their teaching to *decrease* variation in results.

To be effective, correctives must be qualitatively different from the initial teaching. They must provide students who need it with an alternative approach and additional time to learn. The best correctives present concepts differently and involve students in learning differently than did the initial instruction. They incorporate different learning styles, learning modalities, or types of intelligence. Although developing effective correctives can prove challenging, many schools find that providing teachers with time to work collaboratively, sharing ideas, materials, and expertise, greatly facilitate the process (Guskey, 2008).

Most applications of mastery learning also include *enrichment* or *extension* activities for students who master the unit concepts from the initial teaching. As described above, enrichment activities offer students exciting opportunities to broaden and expand their learning. They reward students for their learning success and challenge them to go further. Many teachers draw from activities developed for gifted and talented students when planning enrichment activities, both to simplify implementation tasks and to guarantee these students a high-quality learning experience.

Teachers implement the feedback, corrective, and enrichment process in a variety of ways. Many use short, paper-and-pencil quizzes as formative assessments to give students feedback on their learning progress. But formative assessments also can take the form of essays, compositions, projects, reports, performance tasks, skill demonstrations, oral presentations, or any device used to gain evidence on students' learning progress. In essence, teachers adapt the format of their formative assessments to match their instructional goals.

Following a formative assessment, some teachers divide the class into separate corrective and enrichment groups. While the teacher directs corrective activities, guaranteeing that all students who need the extra time and assistance take part, the other students work on self-selected, independent enrichment activities. Other teachers pair with colleagues and use a team-teaching approach. While one teacher oversees corrective activities, the other monitors enrichments. Still other teachers use cooperative learning activities in which students work together in teams to ensure all reach the mastery level. Since students have their own personal scores on the formative assessment, individual accountability is assured. Offering the entire team special recognition or credit if all members attain mastery on the second formative assessment encourages group responsibility.

Feedback, corrective, and enrichment procedures are crucial to mastery learning, for it is through these procedures that mastery learning differentiates and individualizes instruction. In every learning unit, students who need extended time and opportunity to remedy learning problems receive these through the correctives. Students who learn quickly and find the initial instruction highly appropriate have opportunities to extend their learning through enrichment. As a result, all students experience more favorable learning conditions and more appropriate, higher-quality instruction (Bloom, 1977; Guskey, 2010).

Instructional Alignment

While feedback, correctives, and enrichment are important, they alone do not constitute mastery learning. To be truly effective, Bloom stressed they must be combined with the second essential element of mastery learning: *instructional alignment*. Reducing variation in student learning and closing achievement gaps require clarity and consistency among all instructional components (Bloom, 1971a).

Bloom believed three major components compose the teaching and learning process. To begin there must be specific ideas about what students are expected to learn and be able to do, that is, *learning goals or standards*. Next comes *instruction* that, ideally, results in *proficient learners* – students who have learned well and whose proficiency can be assessed through some form of assessment or evaluation. Mastery learning adds a feedback and corrective component, allowing teachers to determine for whom their initial instruction was appropriate and for whom an alternative approach may be needed.

Although essentially neutral with regard to what is taught, how it is taught, and how learning is assessed or evaluated, mastery learning requires consistency or alignment among these instructional components, as shown in **Figure 4**. For example, if students are expected to learn higher-level skills such as those involved in making applications, solving complex problems, or developing thoughtful analyses, mastery learning stipulates that instructional activities must be planned

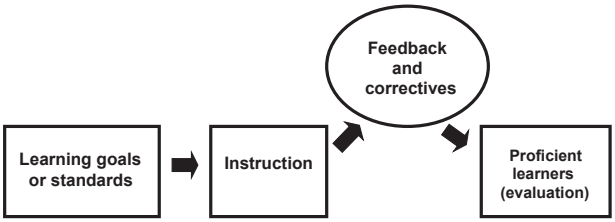

Figure 4 Major components in the teaching and learning process.

to give students opportunities to practice and actively engage in those skills. It also requires that students be given specific feedback on how well they have learned those skills, coupled with directions on how to correct any learning errors. Finally, procedures for assessing or evaluating students' learning should reflect those higher-level skills as well.

To ensure alignment among instructional components, teachers must make a number of crucial decisions. First, they need to decide what concepts or skills are most important for students to learn and most central to students' understanding. Teachers must determine, for example, if they want students to learn only basic skills, or if they want students to develop higher-level skills and more complex cognitive processes. Second, teachers need to decide what evidence best reflects students' mastery of those basic or higher-level skills. Critics sometimes challenge teachers' abilities to make these crucial decisions. But, in essence, teachers at all levels already make these decisions in conducting regular classroom activities. Every time they administer an assessment, grade a paper, or evaluate students' learning, teachers communicate to students what is most important to learn. Using mastery learning simply compels teachers to make these decisions more thoughtfully, intentionally, and purposefully.

Misinterpretations of Mastery Learning

Shortly after Bloom presented his ideas on mastery learning, misinterpretations began to occur. Some early attempts to apply mastery learning, for example, were based on narrow and inaccurate understandings of Bloom's theory. These efforts focused only on low-level cognitive skills, attempted to break learning down into small segments, and insisted that students 'master' each segment before being permitted to move on. Teachers were regarded in these programs as little more than managers of materials and record-keepers of student progress. Unfortunately, similar misinterpretations of mastery learning continue today.

Nowhere in Bloom's writing, however, can this kind of narrowness and rigidity be found. In fact, Bloom emphasized quite the opposite. He considered thoughtful and reflective teachers vital to the successful implementation of mastery learning and continually stressed flexibility in its application. In his earliest description of the process Bloom wrote:

> There are many alternative strategies for mastery learning. Each strategy must find some way of dealing with individual differences in learners through some means of relating the instruction to the needs and characteristics of the learners. … The nongraded school is one attempt to provide an organizational structure that permits and encourages mastery learning.
>
> Bloom, 1968, pp. 7–8

Bloom further emphasized his belief that instruction in mastery learning classrooms should focus on higher-level learning goals, not simply basic skills. He noted:

> I find great emphasis on problem solving, applications of principles, analytical skills, and creativity. Such higher mental processes are emphasized because this type of learning enables the individual to relate his or her learning to the many problems he or she encounters in day-to-day living. These abilities are stressed because they are retained and utilized long after the individual has forgotten the detailed specifics of the subject matter taught in the schools. These abilities are regarded as one set of essential characteristics needed to continue learning and to cope with a rapidly changing world.
>
> Bloom, 1978, p. 578

Modern research studies have shown mastery learning to be particularly effective when applied to instruction focusing on higher-level learning goals such as problem solving, drawing inferences, deductive reasoning, and creative expression (Arredondo and Block, 1990; Kozlovsky, 1990; Mevarech, 1981; Zimmerman and Dibenedetto, 2008). When well implemented, the process helps teachers improve student learning and close achievement gaps in a broad range of learning goals from basic skills to highly complex cognitive processes.

Another misinterpretation comes from educators who believe that the constraint of limited class time will inhibit efforts to implement mastery learning (Guskey, 1997a). They assume that the introduction of feedback, corrective, and enrichment procedures will reduce the amount of material teachers will be able to cover. In other words, teachers will have to sacrifice *coverage* for the sake of *mastery*. But as discussed earlier, minor alterations in instructional pacing typically resolve this concern.

Early mastery learning units usually do require more time. Teachers who allow class time for students to complete corrective activities often find themselves 'behind' other teachers who teach in more traditional ways after the first two or three units. But once students become familiar with the process, mastery learning teachers generally pick up their pace. Since students in mastery learning classes spend a larger portion of their time actively engaged in learning, they make more rapid progress than students in more traditionally taught classes (Fitzpatrick, 1985). As students catch on to the process, they also do better on first formative assessments. With fewer students involved in correctives and less corrective work needed, teachers reduce the class time allocated to corrective activities. And because mastery learning students learn well the concepts and skills from early units, they are better prepared for later, more advanced units. Instruction in later units can therefore be more rapid and include fewer review activities. Most teachers discover that with slight adjustments in the pacing of their instruction – slightly more time spent in early units but less time in later ones – they can cover just as much material using mastery learning, and in

some cases more, as they were able to using more traditional approaches to instruction (Block, 1983).

Research Results and Implications

Teachers who implement mastery learning generally find that it requires only modest changes in their instructional procedures. Excellent teachers use many aspects of mastery learning in their classes already, and others discover that the process blends well with their current teaching strategies. This makes mastery learning particularly attractive to teachers at all levels, especially considering the difficulties associated with new approaches that require major changes in teaching procedures.

Despite the modest nature of these changes, however, extensive research evidence shows that the use of mastery learning can have exceptionally positive effects on student learning (Block et al., 1989; Guskey and Pigott, 1988; Miles, 2010). Evidence gathered in Africa (Changeiywo et al., 2011), Asia (Wu, 1994; Yildiran and Aydin, 2005), Australia (Chan, 1981), Europe (Langeheine, 1992; Mevarech, 1985; Reezigt and Weide, 1990), South America (Cabezon, 1984), and the United States (Walberg, 1990) shows the careful and systematic application of these elements can lead to significant improvements in student learning outcomes. Some researchers even suggest that the superiority of Japanese students in international comparisons of achievement in mathematics operations and problem solving may be due largely to the widespread use in Japan of instructional practices similar to mastery learning (Nakajima, 2012; Waddington, 1995).

Long-term investigations have yielded similarly impressive results. A study by Whiting et al. (1995), for example, representing 18 years of data gathered from over 7000 high school students showed mastery learning to have remarkably positive influence on students' test scores and grade-point averages as well as their attitudes toward school and learning. Another field experiment conducted in elementary and middle school classrooms showed that the implementation of mastery learning led to significantly positive increases in students' academic achievement and their self-confidence (Anderson et al., 1992). Even more impressive, a comprehensive, meta-analysis review of the research on mastery learning by Kulik et al. (1990a) concluded:

> We recently reviewed meta-analyses in nearly 40 different areas of educational research (J. Kulik and Kulik, 1989). Few educational treatments of any sort were consistently associated with achievement effects as large as those produced by mastery learning. … In evaluation after evaluation, mastery programs have produced impressive gains.
>
> Kulik et al., 1990a, p. 292

Similarly, in *Research on Educational Innovations*, Ellis and Fouts (1993) conclude: "the research on mastery learning is about as strong as one can find in the annals of educational investigation. Study after study indicates the superiority of mastery learning over traditional methods of instruction" (p. 112).

Research evidence also shows that the positive effects of mastery learning are not limited to cognitive or achievement outcomes. The process also yields improvements in students' confidence in learning situations, school attendance rates, involvement in class sessions, attitudes toward learning, and a variety of other affective measures (Block et al., 1989; Changeiywo et al., 2011; Guskey and Pigott, 1988; Whiting and Render, 1987). This multidimensional impact has been referred to as the 'multiplier effect' of mastery learning and makes it one of the most cost-effective means of educational improvement.

It should be noted that one review of the research on mastery learning, contrary to all other reviews, indicated that the process had essentially no effect on student achievement (Slavin, 1987). This finding surprised not only scholars familiar with the vast research literature on mastery learning showing it to yield very positive results, but also large numbers of practitioners who had experienced its positive impact first hand. A close inspection of this review shows, however, that it was conducted using techniques of questionable validity (Hiebert, 1987), employed capricious selection criteria (Kulik et al., 1990b), reported results in a biased manner (Bloom, 1987; Walberg, 1988), and drew conclusions not substantiated by the evidence presented (Guskey, 1987, 1988). Most importantly, three much more extensive and methodologically sound reviews published since (Guskey and Pigott, 1988; Kulik et al., 1990a; Miles, 2010) have verified mastery learning's consistently positive impact on a broad range of student learning outcomes and, in one case (i.e., Kulik et al., 1990b), showed clearly the distorted nature of this earlier report.

Conclusion

Researchers today generally recognize the value of the essential elements of mastery learning and their importance in effective teaching at any level of education. As a result, fewer studies are being conducted on the mastery learning process, per se. Instead, researchers are looking for ways to enhance results further, adding additional elements to the mastery learning process that positively contribute to student learning in hopes of attaining even more impressive gains (Bloom, 1984). Recent work on the integration of mastery learning with other innovative strategies appears especially promising (Guskey, 1997b; Guskey and Jung, 2011).

In his later writing Bloom, too, described exciting work on other ideas designed to attain results even more positive than those typically achieved with mastery learning (Bloom, 1984). These ideas stemmed from the work of two of Bloom's doctoral students, Anania (1981) and Burke (1983), who compared student learning under three different instructional conditions. The first was *conventional instruction* in which students were taught in group-based classes that included about 30 students and where periodic assessments were given mainly for the purposes of grading. The second was *mastery learning*, where students again were taught in group-based classes of about 30 students but were administered regular 'formative' assessments for feedback, followed by individualized corrective instruction and parallel second assessments to determine the extent to which they mastered specific learning goals. The third was *tutoring*, where a good tutor was paired with each student. Under tutoring students were also administered regular formative assessments, along with

corrective procedures and parallel second assessments, although the need for corrective work under tutoring was usually quite small.

The differences in students' final achievement under these three conditions were striking. Using the standard deviation (sigma) of the control (conventional) class as the measure of difference, Bloom's students discovered that:

> The average student under tutoring was about two standard deviations above the average of the control class (the average tutored students was above 98% of the students in the control class). The average student under mastery learning was about one standard deviation above the average of the control class (the average mastery learning student was above 84% of the students in the control class). … Thus under the best learning conditions we can devise (tutoring), the average student is 2 sigma above the average control student taught under conventional group methods of instruction.
>
> Bloom, 1984, p. 4

Bloom referred to this as the '2 Sigma Problem':

> The tutoring process demonstrates that *most* students do have the potential to reach this high level of learning. I believe an important task of research and instruction is to seek ways of accomplishing this under more practical and realistic conditions than the one-to-one tutoring, which is too costly for most societies to bear on a large scale. This is the '2 Sigma' problem. Can researchers and teachers devise teaching-learning conditions that will enable the majority of students under *group instruction* to attain levels of achievement that can at present be reached only under tutoring conditions?
>
> Bloom, 1984, pp. 4–5)

Bloom believed that attaining this high level of achievement would probably require more than just improvements in the quality of group instruction. Researchers and teachers might also need to find ways of improving students' learning processes, the curriculum and instructional materials, the home environmental support of students' school learning, and providing a focus on higher-level thinking skills. Nevertheless, Bloom remained convinced that careful attention to the elements of mastery learning would allow educators at all levels to make great strides in their efforts to reduce the variation in student achievement, close achievement gaps, and help all children to learn excellently.

See also: Academic Engagement; Motivation and Actions, Psychology of; Motivation, Learning, and Instruction; School Achievement: Motivational Determinants and Processes; School Burnout and Engagement: Lessons from a Longitudinal Study in Finland; Schooling: Impact on Cognitive and Motivational Development; Self-Regulated Learning: Theories, Measures, and Outcomes; Test Anxiety and Academic Achievement.

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