Effective Use of Correctives in Mastery Learning

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Abstract

Mastery learning is a formative assessment strategy that involves the use of specific interventions, called correctives, to address the specific comprehension needs of the learner. Effective correctives are crucial for the effectiveness of mastery learning, so it is important that teachers make good decisions about what activities and strategies are used to address gaps in student knowledge. Correctives are defined as any instruction that present the concepts differently than originally presented, involve students in learning in different ways, and provide students with successful learning. Because of the time constraints inherent in the mastery learning process, not all instructional strategies can be used for correctives. The purpose of this review is to explore the available research and provide teachers the information to choose the most effective strategies and apply them in the most successful way. Tutoring, peer-tutoring, and cooperative learning are recommended for involvement strategies. Computer-based instruction, digital games, concept maps, and flashcards are explored as approaches to change presentation styles. Specific procedures for the appropriate ways and times to use each strategy are presented.

Formative assessment is a useful instructional tool that has the potential for raising the achievement of students in schools (Black & Wiliam, 1998/2010). However, it is important that teachers understand the role of formative assessment and how it can be used to alter instruction, increase learning, and fix student deficiencies. Simply giving quizzes that do not count for a grade is not formative assessment. The assessment is not useful, or formative, unless the teacher does something with the information that is gathered (Black & Wiliam, 1998/2010; Guskey, 2007b; Popham, 2006). Proponents of formative assessment stress the importance of feedback that contains a clearly stated goal, evidence about where the student is at the time of the formative assessment, and a method for the student to reach that goal (Black & Wiliam, 1998/2010). Popham (2006) states that at least half of the benefit of formative assessment is located in the student being incorporated in the learning process. This involvement changes the student on cognitive and affective levels that result in greater achievement. Teachers need guidelines that they can use to adjust instruction so the student is involved in the learning process and have a clear pathway to reach that goal (Black & Wiliam, 1998/2010). Mastery learning is a structured system that provides many useful components to help make formative assessment an instrument for increasing student achievement (Guskey & Pigott, 1988; Kulik, Kulik, & Bangert-Drowns, 1990).

Mastery learning is an extremely flexible strategy with broad applications in the classroom, and as a result teachers can apply mastery learning in many different ways (Guskey, 1997). The adaptable nature of mastery learning makes it attractive for use in the classroom, but within the wide array of strategies available for corrective instruction some strategies will be more effective than others. Because of the importance of mastery learning in increasing student

achievement and the copious amount of literature on different learning strategies, a systematic

review of the research on various strategies that are applicable for correctives was undertaken.

The various suggestions for correctives made by Bloom (1968), Block and Anderson (1975), and

especially Guskey (1997 & 2007b) were used as the foundations for the research. Articles were

located through database searches and by tracing the citations of mastery learning articles and

articles about differentiation. Meta-analyses and reviews of research were used whenever

possible to provide the broadest applications of the various strategies. Research on special

populations, English as a second language (ESL) or special education, was not considered due to

the less generalizable nature of such research. In the following sections of this review the reader

will find research-based strategies and suggestions to make corrective activities more effective.

By using techniques that are supported by research, teachers using mastery learning will be more

likely to reap greater benefits.

<div align="center">**Mastery Learning and Correctives**</div>

Mastery Learning

        Initially developed by Benjamin Bloom, mastery learning is a strategy of assessment and

differentiation that addresses the needs of individual students so they can receive almost the

same quality of instruction as provided by an individual tutor (Bloom, 1968). Mastery learning

involves both formative and summative assessments as part of the instructional process.

Formative assessment is the more important of the two forms of assessment because it is used to

determine appropriate feedback, correctives, and enrichment for students that are the essential

elements of mastery learning (Bloom, 1968; Guskey, 1997). Bloom originally called this

strategy "learning for mastery" but later shortened it to mastery learning (Guskey, 1997; Guskey,

2007a).

In group-based mastery learning the process is as follows: students learn the material as a whole group, they are tested once, they are assigned correctives based on their first test, and then students are tested again to show growth (Guskey, 2007a). Mastery learning starts after instruction has taken place on a particular unit and a formative assessment aligned to the learning goals of that unit is administered. That first formative assessment is used to provide feedback to the students about where they stand in relation to the learning goals (Guskey, 1997). This feedback can be used to assign corrective activities the student should complete to reach those learning goals, or, in the case of the student who has met all of the learning goals, to provide enrichment opportunities (Guskey, 1997). Correctives are assignments that present the material to the students in a different way from when they learned the material during the initial group instruction (Block, 1977; Block, 1980; Guskey, 1997). A second test motivates the student by providing a second chance for success and provides the teacher information to determine if the correctives were helpful (Guskey, 2007a).

Correctives

Correctives have certain qualities that need to be met if they are to qualify as true correctives and help students. These qualifications have developed over the years, and have become more specific in terms of what is necessary to fix deficiencies in student understanding. Bloom (1968) originally recommended small study groups where students meet outside of class to review the original formative assessments and help each other overcome recognized weaknesses. He also suggested various learning resources that included rereading of original instructional materials, alternate textbooks and instructional materials, workbooks and programmed texts, and selected audio-visual materials.

Block and Anderson (1975) coined the term "corrective" and introduced the key idea that correctives must teach the same material that was originally presented to the whole group, but should be presented to or involve the student in a different way than the original presentation. Block and Anderson categorized correctives as either individual or group directed and as alternate ways of either presenting or involving students. They also presented a more exhaustive list of corrective resources including alternate textbooks, workbooks, flashcards, reteaching, audio-visual materials, token economies, academic games, group affective exercises, programmed instruction, tutoring, and small group study sessions. Guidelines for creating correctives from scratch were also included in their guidelines.

Guskey (1997) presents three essential characteristics of corrective activities. Correctives must present the concepts differently than originally presented, involve students in learning in different ways, and provide students with successful learning. The first two correspond with Block and Anderson's (1975) recommendation, but are stated separately to stress that changes in both presentation and involvement should take place. The last requirement is subtler but just as important as it spells out the need for the corrective to be a method for a student to reach a specific learning goal (Black & Wiliam, 1998/2010). Guskey (1997; 2007b) also presents a list similar to Block and Anderson's (1975) but adds peer tutoring, cooperative teams, learning kits, learning centers and laboratories, and computer activities, which were not common in 1975.

Block and Anderson (1975) recommend different types of correctives for different groups. Small-group study sessions are suggested for their flexibility at all age levels. They also recommend that individual correctives be used for older students as opposed to younger students. Involvement correctives are defined as more popular and engaging than presentation correctives, more than likely due to the tendency for teachers to teach whole groups with a teacher-centered

style, so students are more likely to become engaged with a corrective in which they are more active. However, these recommendations are based on the observations of the authors, and do not provide a research-based approach to determine what types of correctives are most likely to produce success. If mastery learning is to be used as an effective instructional tool, then teachers need to know what corrective activities are likely to be the most effective for their students in different situations.

Tutoring

Bloom (1984) originally recognized the effectiveness of individual tutoring and proposed mastery learning as a method to approach the effectiveness of individual tutoring in a group setting. Tutoring as a primary instructional method is prohibitive due to cost and resources, but that does not mean that it should be abandoned altogether. Once students in need have been identified using formative assessments, individual tutoring becomes more feasible. Tutoring is most effective when used in a structured program, for short periods of time (0-4 weeks), to correct lower level skills, and is most helpful in mathematics (Cohen, Kulik, & Kulik, 1982).

Older students can be used to increase the number of tutors available in the classroom. Topping and Bryce (2004) paired 11-year-old tutors with 7-year-old tutees to determine the effect of peer tutoring on thinking skills. Students incorporated tutoring in the paired-thinking (PT) group and were compared to a control group of students involved in a peer reading (PR) program. This study effectively isolated the tutoring aspect since it equalized the interactions of the peers and the time on task between the PT and the PR groups. The tutored students from the PT in this experiment showed significant improvement in thinking skills compared to the students involved in the PR group. The tutors in the PT group received a short training on tutoring and some guidance from coaches during their sessions.

Training student tutors is an important element of this intervention strategy for successful use in the classroom. Medcalf, Glynn, and Moore (2004) trained their writing cross-age peer tutors for three 45-minute sessions and included specific behaviors that were expected from the tutors. The training incorporated discussions, practice in tutoring skills, practice in proofreading and writing strategies, role-playing with the instructor, and three feedback sessions during their first two weeks of tutoring. With this amount of training cross-age tutors were able to produce gains in writing output, punctuation and spelling accuracy, and audience ratings of enjoyment and clarity compared to a control group that received regular class instruction without tutoring. In addition, both the tutors' and the tutees' enjoyment of writing increased. Tutors writing ability did not decrease in most measures and increased in some (punctuation and spelling) when comparing pre- and post-measures. This indicates that tutors also receive benefits from the experience and their achievement did not suffer from loss of class time. The key to implementing peer tutoring, whether same-age or cross-age, is to develop a program that is successful in producing positive changes in the tutees while still being straightforward enough to implement within the school (Medcalf et al., 2004).

Using students within the classroom is another strategy to increase the tutoring force that is available to students. One strategy for implementing peer tutoring within the classroom is Total Class Peer Tutoring (TCPT) (Lo & Cartledge, 2004). TCPT includes training in specific procedures for the tutors such as the tutor huddle, prompting and praising, and testing and charting. The TCPT strategy allows for multiple opportunities for engagement with the material and practice in its use, and has been used successfully to increase achievement in social studies and several aspects of reading in low-achieving urban populations (Kourea, Cartledge, & Musti-Rao, 2007; Lo & Cartledge, 2004).

The review of research by Cohen et al. (1982) and similar research on tutoring (Kourea, Cartledge, & Musti-Rao, 2007; Lo & Cartledge, 2004; Medcalf et al., 2004; Topping & Bryce, 2004) indicates that for peer tutoring to effect gains in achievement student tutors need to be trained before they are utilized in this method in the classroom. Successful use of peer tutoring needs to involve some form of training for the tutor and continued supervision and instruction by a teacher experienced with tutoring methods. This needs to be a consideration before teachers use peer tutoring as a corrective. Teachers should not simply pair students and direct the older or more proficient student to help the other student complete a task. Peer tutoring needs to be a regular part of classroom instruction, and potential tutors need to be trained in the proper techniques before it is used in the corrective phase. Combining tutoring with other corrective, such as workbooks or hands-on materials, provides a task for the tutor and tutee to work on together as well as changing the presentation of the material. Teachers should also consider allowing students to choose peer tutoring as an option and choose their partners to avoid nonproductive pairings (Guskey, 2007b).

Grouping Students

Instead of working one-on-one with each other, students may also be placed in small groups within the class. Forming small groups within the class has been shown to be effective for promoting student learning and works best when students are physically grouped into small groups of three to four members, teachers are trained in grouping strategies, and when materials and instruction are adapted for small groups (Lou et al., 1996). The effects are most pronounced in large classes and in the subjects of math and science. Using cooperative learning strategies also assists the learning of students.

Cooperative learning is a more specific application of within-class groupings that contains certain conditions for the members of the group and can take many forms. Slavin (1991) recommends Student Team Learning, variations, Jigsaw, Learning Together, and Group Investigation. A meta-analysis of cooperative learning research found positive effect sizes for eight different cooperative learning methods (Johnson, Johnson, & Stanne, 2000). While all of these methods are excellent for the initial whole group instruction, in applications they tend to be too broad for the corrective phase of mastery learning. However, two key aspects of these cooperative learning techniques have been identified as necessary components of cooperative learning. Students working in cooperative groups need to have group goals and individual accountability (Slavin, 1991). Cooperative teams need to have a concrete goal towards which they are working and that goal can only be considered reached when every individual member of the group has met the goal. Students should also receive a group reward or recognition when the goal is reached. When using cooperative learning as an organizational approach to correctives, teachers should make sure that they incorporate group goals and individual accountability in the presentation and arrangement of groups.

Teachers should also consider classroom management techniques when grouping students that will minimize the demands on the teacher to be in seven places at once and reduce classroom chaos. Students should be encouraged to speak at low levels and ask other students for help before asking the teacher, which can be encouraged with phrases such as "six-inch voices" and "ask three before me" (Adams & Pierce, 2004).

Grouping or pairing students with other students or adults provides teachers with alternate strategies for involving the students in learning, but there also needs to be variety in the presentation of the material. Workbooks, textbooks, and the Internet are a good source for

alternate materials that can be used to present the information differently to students. However,

some activities will work better than others. Which type of activity works best might depend on

the age of the students, the subject matter, and the composition of the classroom. Teachers might

use a trial and error approach to determine what works and what doesn't, but there are some

forms of instruction that are supported by research and should be primary considerations.

Technology Correctives

The use of technology, such as hypermedia, games, and online content, provides a viable

and engaging alternative to paper and pencil activities, but should not be applied as a corrective

without careful consideration. Students need guidance towards activities that have meaningful

learning goals and some technology works best in certain situations and with certain groups of

students.

Hypermedia includes searches with the World Wide Web, hypertext, and isolated non-

internet programs.   Dillon and Gabbard (1998) have several recommendations for the

appropriate times to use hypermedia for instruction. Hypermedia is most suitable for searching

through large amounts of information and when comparing or manipulating discrete pieces of

information. It is best applied with higher ability students and students with a willingness to

explore. This indicates that hypermedia might be best applied for enrichment activities as

opposed to correctives. Using computer technology is more effective with small groups than

individually (Lou, Abrami, & d'Apollonia, 1996). These effects are more pronounced when

students have experience with group work, cooperative learning strategies are used, and groups

consisted of two members. The most effective types of computer technology for small groups

are tutorials, practice software, or programming languages within the context of social sciences,

computer skills and social studies. The students that receive the most benefit tend to be either

low or high ability students. Students of middle ability show the least benefit from using

computer technology in small groups.

Digital educational games are abundant and useful presentations of material that involve

students in learning a different way and are likely to engage learners. Teachers should consider

several factors when choosing a digital game. Hong, Cheng, Hwang, Lee, and Chang (2009)

developed an instrument that evaluates games based on their ability to produce a change in

mentality, emotional fulfillment, knowledge enhancement, develop thinking skills, interpersonal

skills, spatial ability development, and bodily coordination. Using such a tool provides a well-

rounded assessment of games and is available for use in the published article. Current uses of

video games involve rich storylines, role-play, interactive environments, and even allow teachers

and students to create their own games with a drag-and-drop format (Annetta, 2008). Garris,

Ahlers, and Driskell (2002) recognize the duality of play and work and how that creates a fine

line that must be walked when creating an educational game. They have identified correctly the

challenge of creating games that meet instructional goals that doesn't remove enjoyable aspects

of gaming so players can be drawn into the "gaming cycle" that involves sustainable and self-

determined interest in the game (Garris, Ahlers, & Driskell, 2002, p. 459). Future uses of games

that might address this problem include haptics (sensory touch feedback), textbook replacement,

distance education, and virtual school (Annetta, 2008).

Paper-Based Correctives

The more traditional paper-based assignments can also be used for correctives. Concept

maps have been found to be beneficial across age levels and subject areas for increased learning

(Nesbit & Adescope, 2006). As a study tool, concept maps have been found to be superior to

text passages, lists, and outlines, especially for central ideas. Concept maps that are

preconstructed and filled in by the student work better for individual learning and for students with low verbal skills. Students can also construct their own concept maps individually or in small groups, but this strategy only shows a slight improvement over other involvement activities such as when a student creates their own summaries or outlines.

Flashcards are another common study tool that can be used for correctives. Flashcards naturally incorporate spaced practice and testing, which support efficient learning and metacognitive monitoring (Kornell & Bjork, 2008). The student or the teacher can create flashcards, which can contain text, pictures, or both and can be used individually or in pairs. Digital forms of flashcards are also available online and can be tailor-made to meet the needs of an individual course or student. When using flashcards, students should be encouraged to consistently use the whole set for studying, as dropping items that they feel they have mastered is not an effective strategy (Kornell & Bjork, 2008). Students frequently make poor decisions about when to stop studying a concept, and dropping cards results in smaller amounts of material that decreases the benefits of spaced practice that is an inherent benefit of flashcards.

Other specific presentational materials will differ depending on the subject matter, age, of the students, and the setting. Possible choices include alternate textbooks, workbooks, audio-visual materials, academic games, programmed instruction, and learning kits (Block, 1975; Guskey, 1997; Guskey, 2007b). Determining which methods are preferable is an individual choice of the teacher. When choosing or designing particular corrective activities the teacher should make sure that the assignments align with the leaning goals, but should also look for instructional techniques that are particularly effective for increasing knowledge. Techniques that show the greatest effect sizes that are applicable for correctives are ones that have students create analogies between known and new content, focus on vocabulary, interact with manipulatives

including computer simulations, use graphic representations, and take notes (Marzano &

Educational Resources Information Center (U.S.), 1998).

Summary

To get the maximum benefits from correctives teachers should use techniques that

combine differing engagements (tutoring/cooperative/reteaching) with original presentation

techniques. The best corrective courses combine several strategies into a single corrective

session (Guskey, 2007b). A teacher might reteach a specific deficient area, have students work

in cooperative groups to complete a concept map or computer activity, and then have students

work individually on problems and provide individual tutoring as needed. It is important for

teachers to remember that correctives are only a small part of the mastery learning cycle; the

initial group instruction needs to be high quality, research-based, and effective as well.

Nevertheless, quality correctives can make or break the effectiveness of a round of mastery

learning, and incorporating strong, research grounded instructional techniques gives students a

greater chance for success.

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