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Educating Educators on Mastery Learning and Spiral Learning

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EDUCATING EDUCATORS ON MASTERY LEARNING

AND

SPIRAL LEARNING

by

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ABSTRACT

Educating Educators on Mastery Learning and Spiral Learning

There are many barriers that hinder teachers from educating themselves on effective teaching and learning methods they can use in the classroom. Along with shortness of time and energy, the inaccessibility of reliable information and the time it takes to sift through all of the extensive amount of information all pose as problems. For this project, information and research on two methods of teaching and learning: mastery and spiral learning will be collected and summarized and the advantages and disadvantages of each will be presented in order to help educate teachers and educators on effective methods of teaching.

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Chapter 1

INTRODUCTION

Today, teachers have to address a variety of issues including changes in the law, scarce funds for books and materials, communication problems within the hierarchy of schools and districts, standardized testing, and school reform programs, to name just a few. All of the concerns listed above, although important, do not even begin to include the issues that teachers have to address in their own classrooms, specifically, issues that concern their students. While it is true that all of the issues listed do, in fact, impact students, teachers should not let the general politics of being a teacher blind them from their first and foremost duty: to aid students in their growth academically, socially, and individually.

Statement of the Problem

One of the ongoing problems for educators is to determine the most effective method to teach students. The problem is that educators and especially teachers do not always have the time or energy to research methods that might prove to be just what they need. Two of these methods of teaching and learning, spiral and mastery learning, are used in some form in most schools today. The dilemma is that the literature, in which these two methods are compared, is very limited, so that even if teachers wanted to find more information, the task would be difficult and time consuming. Therefore, teachers do not know the advantages and disadvantages of both of these methods

Purpose of the Project

The purpose of this project will be to develop an inservice presentation for teachers and educators about mastery and spiral learning. This author will inform the target audience about the history and background of each as well as the advantages and disadvantages of both methods of learning. The goal is that teachers and educators will be better equipped to make an educated decision for their own classrooms and schools.

Chapter Summary

To effectively serve students, it is essential for teachers to be knowledgeable about the different teaching and learning methods that are available for use in the classroom. In this author's opinion, neither spiral, mastery, nor any other single method of teaching is the best way to teach the diverse students in schools today. However, it is only when educators are well informed that they be able to take full advantage of the method or methods that best suit their classroom.

In Chapter 2, the history and background for both mastery and spiral learning and a review of the literature and research on both of these two topics will be presented. Based on the literature, the advantages and disadvantages of each learning method will be discussed. In Chapter 3, Method, detailed descriptions of the rationale for the procedures of this project will be presented along with the intended target population and the goals of this project.

Chapter 2

REVIEW OF LITERATURE

The purpose of this project will be to provide educators with information on mastery learning and spiral learning. The goal of this project will be to deepen the knowledge of educators in these two types of learning with the hope that the information will be taken into their classrooms in order to help them decide which method of teaching and learning would best serve their students.

It is somewhat ironic that teachers, proponents of education and knowledge in their students, can reach a state of stagnancy in their own education. For most teachers, this stagnant state of education does not come from a lack of want or desire for ongoing education, but from shortness of time and energy. Another notable barrier to ongoing education for teachers is inaccessibility to quick, reliable, and relevant research and information on effective teaching. For example, according to Martinez and Martinez (1999), in a search of the Education Resources Information Center (ERIC) database, over 2,000 articles on mastery learning were listed. All of these articles are potential sources that teachers have to take the time to sift through in order to find the information they need. Confronted with these barriers, inadvertently, teachers may choose to put a hold on their own education, which detracts from their opportunities to become better teachers and, unintentionally, cheats their students of a possibly more effective method of learning.

Spiral learning and mastery learning are two types of learning and teaching that, with a better understanding, could make a notable difference for teachers and students. Even though it is likely that some form of each method is already being utilized by most teachers today, a deeper look at the research and advantages and disadvantages would help teachers decide which method would be best suited for the different lessons and topics taught in the classroom.

History and Definitions

Mastery Learning

Benjamin Bloom is a name that many researchers (Guskey & Gates, 1986; Lai & Biggs, 1994; Livingston & Gentile, 1996) associate with mastery learning. However, according to Bloom, in his 1976 book *Human Characteristics and School Learning*, the earliest forms of mastery learning can be traced back as far as Comenius in the 17th C., Pestalozzi in the 18th C., and Herbart in the 19th C. Bloom stated that, although there are many forms of mastery learning, they are all rooted in a similar premise:

> Most students can attain a high level of learning capability if instruction is approached sensitively and systemically, if students are helped when and where they have learning difficulties, if they are given sufficient time to achieve mastery, and if there is some clear criterion of what constitutes mastery. (p. 4)

Bloom's own definition of mastery learning was greatly influenced by Carroll's Model of School Learning (1963, as cited in Bloom, 1976). Carroll concluded that students, when learning time and quality of teaching was controlled for, were found to be normally distributed in their achievement. For Bloom, Carroll's findings suggested that, if learning time and quality of teaching were adjusted to meet the needs of each

individual student, then the majority of the students would achieve mastery of a subject. This was the origin of Bloom's Learning for Mastery (LFM) model of learning.

According to Livingston and Gentile (1996), the LFM model is based on three tenets:

1. specific instructional objectives known to the student (i.e., "mastery not mystery" learning)
2. a standard of passing that defines mastery, and
3. the delivery of corrective feedback and remedial instruction to require students who did not master the material on initial attempts to achieve the objectives (p. 67)

As cited by Livingston and Gentile, Bloom (1974, 1976, 1981) believed that, when the LFM model was correctly implemented into classrooms, the following results would be observed in the students: "(a) They will feel better about school, teacher, subject, and self; (b) they will learn to persevere to complete tasks to a high level; and (c) they will be better prepared cognitively and emotionally for subsequent learning tasks" (p. 67). In addition to these three results, Bloom (1981, as cited in Livingston & Gentile) included what he called the *decreasing variability hypothesis*:

1. where the same students are followed over a series of learning tasks, we find that students who are given feedback and corrective individualized help as they need it. . . [i.e., under the favorable conditions of mastery learning]. . . become more and more similar in their learning rate until the difference between fast and slow learners becomes very difficult to measure except by the most exact measurements of time.
2. if students are normally distributed with respect to aptitude, but the kind and quality of instruction and the amount of time available for learning are made appropriate to the characteristics and needs of *each* student, the majority of students may be expected to achieve mastery of the subject. And, the relationship between aptitude and achievement should approach *zero*. (p. 67)

In other words, Bloom believed that regardless of a student's initial learning rate and aptitude, the use of mastery learning would eventually decrease the differences between both of these variables until they became virtually undetectable.

Spiral Learning

According to Harden and Stamper (1999), Jerome Bruner, the founder of spiral learning or spiral curriculum, first introduced the concept in his 1960's book, *The Process of Education*. According to Bruner (1960), the concept of spiral teaching and learning is based on the premise that "the foundation of any subject may be taught to anybody at any age in some form" (p. 12). Bruner elaborated on this premise and explained:

> Though the proposition may seem startling at first, its intent is to underscore an essential point often overlooked in the planning of curricula. It is that the basic ideas that lie at the heart of all science and mathematics and the basic themes that give form to life and literature are as simple as they are powerful. To be in command of these basic ideas, to use them effectively, requires a continual deepening of one's understanding of them that comes from learning to use them in progressively more complex forms. (p. 12)

As an example, Bruner described fourth grade students' understanding of tragedy and the basic human plights represented in mythology, but they are unable to express their understanding in formal language or manipulate the information like adults. In order to reach the adult level of mastery, Bruner believed curricula should be designed to "spiral" so that it constantly "turns back on itself at higher levels" (p. 13).

According to Bruner (1960), central to the idea of spiral learning is an understanding of both intuition and analytic thinking. Characteristically, intuition does not advance in careful, well defined steps but rather by an implicit feeling of the total problem in a process that is unknown. In contrast, analytic thinking proceeds step by

step, and each step is intentional and well thought out, especially in the use of mathematics or logic. In order to successfully teach higher level topics to young students, Bruner believed teachers should teach with the use of students' intuition, based on the idea that a more analytic thought process would develop in the later years.

Advantages of Mastery Learning

According to Guskey and Gates (1986), researchers have continually shown the two main reasons why mastery learning has become so popular and widely used in schools today. Guskey and Gates cited Brophy (1979) and Leinhardt and Pallay (1982) and stated that "research studies on the quality of instruction and highly effective schools consistently point to elements of mastery learning as an integral part of successful teaching and learning" (p. 73). The second reason for the attention that mastery learning has received is "reports from school systems throughout the United States and around the world indicate that the use of mastery learning strategies can lead to striking improvements in a wide range of student learning outcomes" (Block & Burns, 1976, p. 73, as cited in Guskey & Gates). These two reasons are very broad, but a closer look at the research that has been done on mastery learning will identify the areas in which mastery learning can be most advantageous.

Cognitive Effects

Whiting, Van Burgh, and Render (1995) discussed their mastery learning study that spanned 36 semester hours (i.e., 18 years) and included 7,179 participants. The focus of their study was primarily on the: (a) cognitive effects of mastery learning, (b) affective attitudes toward mastery learning, and (c) benefits that can be obtained when learning styles and mastery learning are combined to work together cohesively. The

researchers concluded that the use of mastery learning can benefit students in many ways.

One advantage that Whiting et al. (1995) found was that the use of mastery learning increased the cognitive achievement of students. Whiting et al. used an average of the student's grade point averages (GPA) collected over the 36 semester study by the senior author. Upon enrollment in the mastery learning class for the first time, the average cumulative GPA for students was 2.34 on a 4.0 point scale. After students received mastery learning instruction in their class, the average GPA of the students in the mastery learning class was 3.92. Translated into a letter grade, these results indicated that the students increased their grade by two letter grades, from a grade of C to an A-. Also, according to Martinez and Martinez (1999) who conducted a research study on the cognitive effects of mastery learning, the findings of Whiting et al. supported the work of many other researchers (Block & Burns, 1976; Burns, 1986; Guskey & Gates, 1986; Guskey & Pigott, 1988; C.C. Kulik, Kulik, & Bangert-Drowns, 1990) who found that there are substantial positive effects on student achievement when this method of teaching is used.

Learning Time

In contrast to mastery learning, Palardy (2001) described an approach in which "given X amount of time, we will teach the learner to the best of his [/her] ability" (p. 424). This style of learning is used in the majority of the schools today because time is the fixed variable. Palardy described a mastery learning classroom as, "the learner will master X number of reading skills, [s/] he will differentiate among geometric forms with Y percent accuracy, [s/] he will know Z number of economic concepts, and so on"

(p. 424). In this classroom, time is the dependent variable that can be adjusted to meet the needs of the individual students. A logical concern for educators who want to implement mastery learning in their schools or classrooms is that too much time may be spent in order to reach mastery. However, according to Bloom (1968, as quoted in Davis & Sorrel, 1995), "Although students taught for mastery may need more time to reach proficiency in the initial stages of a course, they should need less time to master more advanced material because of the firm grasp of fundamentals they should gain from their initial efforts" (p. 2). Whiting et al. (1995) found evidence to support Bloom's claim and included it as an advantage of mastery learning.

Whiting et al. (1995) collected data on the amount of study time that high school students used to prepare for a test. They compared the times over a series of units and found evidence that, over time in the first year, the amount of time decreased from 134 minutes for Unit 1, to 73 minutes for Unit 10, to 42 minutes for Unit 20. In the second year of the implementation of the mastery learning program, the time spent on studying decreased even more to 71 minutes for Unit 1, to 38 minutes for Unit 10, to 31 minutes for Unit 20. Arlin (1984) conducted a similar research study with elementary students and had similar results which suggested that, over the course of instructional units, the time used to bring students to the mastery level was dramatically decreased. A logical conclusion would be to assume that, over time, the students spent less time in study because they became disinterested or unmotivated; but in this case, that conclusion is false.

In addition to the data collected on study time, Whiting et al. (1995) concurrently collected data on how many students had to retake the tests over the time

period between Unit 1 and Unit 20. In this experiment, in order for students to achieve mastery, they had to attain at least 80%, or they would go through remediation and retake the test. During the first year, the percentage of students who had to retake the Unit 1 test was 62%, for Unit 10, 28% had to retake the test, and 17% for Unit 20. In the second year, 23% had to retake the test for Unit 1, 8% for Unit 10, and 8% for Unit 20. Whiting et al. concluded that "Students become better at learning, more aware of their learning styles, and expect to learn" (p. 8). Also, "Over time, mastery learning virtually eliminates the need for prescribed correctives. . . this allows more time for enrichment, more units, etc." (p. 8).

Retention

According to Guskey and Gates (1986), who compiled a synthesis of research conducted on mastery learning, retention is another advantage to the implementation of this learning program. Anderson, Scott, and Hutlock (1976, as cited in Guskey & Gates) tested the long term retention of elementary students over a period of 4 months and found that the mastery learners were able to retain more information than those students in the control group.

Wentling (1973) tested the effects of mastery learning on four variables: (a) immediate achievement, (b) cognitive retention, (c) attitude toward instruction, and (d) time spent on instruction. The study was conducted with 116 high school males enrolled in a general automotive class. Although all of the results were important, the findings for the retention of cognitive material showed that mastery learning increased retention in students from a mean of 22.8 with nonmastery teaching strategies to 26.7 with the use of mastery learning. In a similar study conducted by Aviles (1998),

university sociology students were presented with 26 items on their final examination that they had been tested on during their first examination. Aviles found that, in contrast to the nonmastery students who showed a difference of 6.75 from the first to the final examination, the difference for the mastery students on the two examinations was 5.56. The lesser score of the mastery students showed that they were able to retain more information from the first examination than did the nonmastery students.

The advantages of mastery learning are numerous and sometimes subjective; what one educator views as an advantage might be inconsequential to another and may even be viewed as a disadvantage. Regardless of the advantages identified by researchers, there are always two sides to be investigated before educators can make a decision about the usefulness of a program like mastery learning.

Disadvantages of Mastery Learning

Although the research shows there are definite advantages when mastery learning is implemented, also, there are notable disadvantages. Two research studies that focused on some of the considerable disadvantages of mastery learning were conducted by Lai and Biggs (1994) and Martinez and Martinez (1999).

Who Benefits?

In the study conducted by Lai and Biggs (1994), they found that mastery learning showed a substantial benefit to only a certain type of learner, but other students did not do as well. Lai and Biggs based their research study on the findings from two previous research studies. In their 1976 study, Marton and Saljo (as cited in Lai & Biggs) identified two types of learners. The first type of learner was the *surface* learner, students who focused on easily testable signs of learning, but did not integrate content

or apply personal meaning to what they learned. In contrast to the surface learners, Marton and Saljo concluded that, also, there were *deep* learners. These learners searched to find a connection between what was being learned and themselves and strove to find its meaning and relevance.

The second study was conducted by Biggs (1982, as cited in Lai & Biggs, 1994). The participants for the study were science and art graduate students. Biggs implemented a mastery learning program from the start of the class, he informed the students they were allowed to move at their own pace, and as long as they passed the tests, they could move as quickly as they desired. Biggs found that the science students excelled in this type of program whereas the art students performed very poorly. According to Biggs, the cause of this result was that "Art students typically respond to deep items on a study process inventory at a significantly higher level than do Science students" (p. 16). For Lai and Biggs, these two studies raised the question "Who benefits from mastery learning?"

Lai and Biggs (1994) conducted their own study with 189 secondary students in Hong Kong. First, they determined the group to which the participants belonged: (a) surface learner, (b) deep learner, or (c) unbiased. Then they set up a control group and experimental group. In contrast to the control group of students who were taught in an expository style throughout the unit with only one cumulative test at the end of the unit, the experimental group of students were taught in four stages. The first stage was initial instruction. In this stage, instruction was given by the teacher in an expository style. The second stage was formative test A, which was a short quiz that covered the material learned in the first stage. For those students who did not pass with at least an 80%,

stage three was corrective instruction in which the teacher designed exercises that helped the students to gain the correct information in order to reach mastery. For students who reached a level of mastery during stage two, they were given the opportunity to tutor the other students. The fourth stage was formative test B. In this stage, all the students who had not reached a level of mastery were assessed again to make sure they had progressed. After the four stages, the teacher went on to the next unit and, when all the units were completed, a final cumulative test was given to all students.

Lai and Biggs (1994) concluded that, overall, the results for the use of mastery learning were favorable but that mastery learning was more beneficial for surface learners. In fact, for surface learners, the treatment effect was an 18 point difference between the experimental group and the control group. For the deep learners and the no bias learners, the difference was only 6 points. Although these results cannot be generalized to all populations, they showed that the effectiveness of mastery learning was limited in regard to the students it benefited. This means that mastery learning should not be used as the sole strategy to teach students in the diverse classrooms of today.

Lai and Biggs' (1994) findings suggest another disadvantage to mastery learning; that is, students will begin to feel the purpose of learning is not to understand what is being taught, but to regurgitate it on a test. Briefly, Lai and Biggs discussed their findings in regard to this finding.

Trivializing Learning

After Lai and Biggs (1994) conducted their study, they interviewed the students to determine their views on mastery learning. They found, in accordance to Bloom's (1971, as cited in Lai & Biggs) claim, some students were positively motivated when they realized they could pass by sheer diligence. However, contrary to Bloom's claim, there were many students who were not motivated in this way. Lai and Biggs concluded that, for the most part, surface learners were motivated by success through diligence but deep learners were not. According to Lai and Biggs, the reason that surface learners were motivated was:

> These students are reacting to the unusual experience of being in a position where they can pass a test. They are then motivated to mark down important points, and revise by rote "bit by bit" a classic surface strategy, in which meaning and understanding are irrelevant. (p. 19)

Bloom (1971, as quoted in Lai & Biggs) acknowledged and agreed that mastery learning could result in a move toward rote learning:

> Retest may help me to improve my learning attitude. One would be more attentive during lessons and mark down important points. I prefer mastery learning for it can help me to revise those parts which are unfamiliar…drive me to revise the chapters bit by bit. (Although) after the retesting, it will be easy to forget the materials since they are tackled by rote learning. Yet I still prefer this method of teaching. (p. 19)

In contrast to the surface learners who favored mastery learning, Lai and Biggs (1994) found that deep learners felt the constant tests and retests were tedious and trivialized the material being learned. One student who was interviewed remarked, "Mastery learning and retesting are meaningless. . . If one is attentive enough, I think I can still pass. . . in one test. It is more rewarding than getting a pass through retesting" (p. 19). According to Lai and Biggs, this student felt that rote learning was not the point

of learning, even if it allowed the students to progress to the next unit, because no understanding was gained.

Teacher Time

Martinez and Martinez (1999) found that, regardless of the advantages of the mastery learning program, the notable amount of time the teachers had to invest was disproportional to what was gained. Their sample included 80 students in a college mathematics course. The students were equally divided into four sections with two groups assigned to the control and two to the experimental groups. Martinez and Martinez found that the use of a mastery learning program did not produce substantial differences in achievement and, in fact, the only notable difference was in the time the mastery teacher spent in preparation for the lessons. "The mastery classes required more than twice as much of the teacher's time as the control classes, without commensurate increases in student achievement, as represented by final examination performance" (p. 7).

Whiting et al. (1995), in their 36 semester study, repeatedly remarked on the clear advantages of mastery learning but, even they identified the amount of time teachers must invest as a clear disadvantage. According to their study, approximately 15 hours was needed in order to write one complete unit and prepare the materials for it. "Daily preparation is extensive whether it is preparing an entertaining presentation of the objectives, organizing an activity or grading 150 short answer tests in one night" (p. 10). In view of the results from these studies (Martinez & Martinez, 1999; Whiting et al., 1995), the implementation of a mastery learning program, when it requires so much time and effort, seems like an enormous endeavor. Spiral learning is another option to

consider for optimal learning in the classroom especially if mastery is not appropriate as in the following example provided by Jackson (1983, as quoted in Palardy, 2001):

> To direct a class to the activity of reading For Whom the Bell Tolls by Hemingway makes great sense as a statement of direction. To direct the study of the novel by determining mastery objectives ahead of time would be to lose the point. The "objectives" are inherent in the material. They involve the meaningful relationships of individual pupils to the whole word or to parts of the work. In other words, this work as an art form transcends the bits and pieces of it. The meaning of this work can be known only as individuals interact with it . . . and not according to a mastery learning format. (p. 427)

Advantages of Spiral Learning

Although both mastery learning and spiral learning became well known during the 1960s and 1970s, spiral learning, unlike mastery learning, has not been as frequently implemented in the educational system (Dowding, 1993, as cited in Harden & Stamper, 1999). Even though spiral learning did not attract the initial attention that mastery learning did, in recent years, it has become a topic of interest to many educators, and it is being utilized more frequently in classrooms. The amount of research on spiral learning is not as extensive as the research on mastery learning but there are clear advantages and disadvantages that are important for educators to be aware of when they consider spiral learning for use in their schools.

Retention

Kryzanowski and Carnine (1980), along with a number of other researchers (Greeno, 1984; Peterson, Wamper, Kirkpatrick, & Saltzman, 1963; Shaughnessy, Zimmerman, & Underwood, 1974; all cited in Kryzanowski & Carnine) found that the use of spaced formats of teaching were more effective than massed formats of teaching. Kryzanowski and Carnine based their study on a similar one conducted by Greeno

(1984, as cited in Kryzanowski & Carnine) in which he found that college students were better able to recall word pairs when they were taught in a spaced format as opposed to a massed format. Kryzanowski and Carnine conducted their study to determine whether the same results would occur in a younger population with the use of educationally relevant stimuli.

Kryzanowski and Carnine (1980) utilized a random sample of first grade students. A control group and an experimental group were determined and presented with the educationally relevant stimuli. All the participants were tested on their retention of the letters e, i, c, m, and s after learning the letters in either a spaced format or a massed format. Kryzanowski and Carnine found that, similar to the results of Greeno (1984, as cited in Kryzanowski & Carnine), the younger sample showed a greater retention rate when they were trained with the spaced format. In addition to the research that Kryzanowski and Carnine conducted, Suydam (1984), in regard to the role of review in mathematics instruction, stated that "Long-term retention is best served if assignments on a particular skill are spread out in time, rather than concentrated within a short interval" (p. 2). Again, the statement supports the effectiveness of the use of a spaced format in retention.

Undoubtedly, increased retention is a clear advantage of any program. For educators, who weigh the advantages and disadvantages of mastery and spiral learning, researchers have found that retention has been increased with the use of both methods (Aviles, 1998; Guskey & Gates, 1986; Kryzanowski & Carnine, 1980; Suydam, 1984; & Wentling, 1973). An area which will show a greater degree of comparison between

mastery learning and spiral learning is in the understanding of the material to be learned.

Understanding vs. Regurgitation

As stated earlier in the disadvantages of mastery learning, Bloom (1971, as quoted in Lai & Biggs, 1994), the founder of mastery learning, was aware that mastery learning could facilitate a move toward rote learning. In regard to rote learning, Lai and Biggs stated: "They (surface learners/mastery students) are then motivated to mark down important points, and revise by rote 'bit by bit' a classic surface strategy, in which meaning and understanding are irrelevant" (p. 19). In contrast to the mastery approach to learning, the focus of spiral learning is to teach students in a manner that revisits the topic more than once and over an extended amount of time so that students will reach a high level of understanding.

Everyday Mathematics (EM) is a curriculum that has been adopted by an increasing number of schools and classrooms every year (University of Chicago School Mathematics Project, 2003). According to the University of Chicago Everyday Mathematics Leadership Institute (UCEMLI; 2003), EM is a spiral curriculum and was "designed to take advantage of the spacing effect" (p. 1). According to the authors of the Everyday Mathematics Center website, "Over 175,000 classrooms and 2.8 million students are currently using EM, and it is being adopted by a steadily increasing number of schools each year" (UCSMP, 2003, p. 1). In Isaacs, Carroll, and Bell's, *A Research-Based Curriculum: The Research Basis of the UCSMP Everyday Mathematics Curriculum* (2001), the authors validated the EM structure and curriculum through past

research and showed support for the claim that the end goal of spiral learning in EM is comprehension.

According to Isaacs et al. (2001), "one of the perennial arguments in education is between those who want students to develop skill in carrying out procedures and those who want students to understand why those procedures work" (p. 5). For the developers of EM, and unlike mastery learning, understanding is just as important as skill development if not more so. Isaacs et al. cited several researchers (Baroody & Ginsburg, 1986; Resnick, 1987; Skemp, 1978) who have found evidence to support the need for a balance between skill and understanding.

Isaacs et al. (2001) conducted a study of students in classrooms that had adopted an EM spiral curriculum balanced with both rote learning and comprehension. Their first conclusion was that EM students were able to perform equally as well on traditional mathematical topics such as facts and paper and pencil computations. One advantage that the EM students had in comparison to the control group, was their strength in mental computation as well as the flexibility and variety they showed in computational methods. Their second conclusion was that EM students were able to perform better on topics that, traditionally, are not taught in the elementary curriculum like geometry and algebra. These findings led the researchers to the conclusion that the use of the EM spiral learning curriculum, in which both meaning and skills are emphasized, would result in higher levels of achievement for students.

Metacognition

According to Cowan, Morrison, and McBride (1998), "metacognition is the act of *thinking about thinking*" (p. 209). In Bruner's (1996) book, *The Culture of Education*, he stated:

> Modern pedagogy is moving increasingly to the view that the child should be aware of her own thought processes, and it is crucial for the pedagogical theorist and teacher alike to help her to become more metacognitive—to be as aware how she goes about her learning and thinking as she is about the subject matter she is studying. Achieving skills and accumulating knowledge are not enough. The learner can be helped to achieve full mastery by reflecting as well upon how she is going about her job and how her approach can be improved. (p. 64)

Cowan et al. conducted a study in which a spiral curriculum was implemented to determine its effects on a mathematical computer program called Zeno. Also, the researchers studied the effectiveness of the spiral curriculum on students' metacognition.

Cowan et al. (1998) found that use of the spiral curriculum, with its structure that continually revisits topics so that students continually attain a higher understanding, strongly promotes increased metacognition in the students. For part of the project, the students were required to keep a journal of their thought processes when they were presented with a problem to solve. With each spiral, the student could reread how he or she had solved a similar problem before and, in that way, improve their metacognitive skills. Also, the students were given running evaluations which provided "information for the student to reflect upon, thereby encouraging the development of metacognitive skills" (p. 222). The ability of students to think about their own thinking is a skill that is clearly developed in the spiral curriculum and holds many advantages for students. As

Cowan et al. proposed, "This control and regulation—metacognition—distinguishes experts from novices, successful from unsuccessful problem solvers" (p. 209).

Disadvantages of Spiral Learning

Similar to mastery learning, and like most learning programs, spiral learning can be advantageous to learners; however, also, there are negative aspects for educators to consider as well. One main disadvantage is in how the spiral curriculum is implemented into the classroom and how the philosophy behind spiral learning has changed.

Skill Acquisition

As reported by Isaacs et al. (2001), *Everyday Mathematics* is a curriculum in which there is an effort to balance skill acquisition and understanding of the material. To qualify the EM claim, Braams (2003) believes that one of the major disadvantages to a spiral curriculum is not based on lack of balance, but that "mastery and fluency in basic skills is only aimed for long after concepts are first introduced" (p. 1). In fact, Braams' claim was supported by a quote in the *First Grade Everyday Mathematics* teacher's manual as cited by the UCEMLI (2003) in their *Distributed Practice: The Research Base*:

> If we can, as a matter of principle and practice, avoid anxiety about children "getting" something the first time around, then children will be more relaxed and pick up part or all of what they need. They may not initially remember it, but with appropriate reminders, they will very likely recall, recognize, and get a better grip on the skill or concept when it comes around again in a new format or application—as it will! (p. 1).

Although, originally, EM was designed to take advantage of the positive aspects of spiraling and spacing (UCEMLI, 2003, as cited in Braams, 2003), its philosophy

seems to be in contrast with Bruner's original idea of a spiral curriculum. Bruner (1960, as quoted in Harden & Stamper, 1999) stated:

> I was struck by the fact that successful efforts to teach highly structured bodies of knowledge like mathematics, physical sciences, and even the field of history often took the form of a metamorphic spiral in which at some simple level a set of ideas or operations were introduced in a rather intuitive way and, once mastered in that spirit, were then revisited and reconstrued in a more formal or operational way, then being connected with other knowledge, the mastery at this stage then being carried one step higher to a new level of formal or operational rigour and to a broader level of abstraction and comprehensiveness. The end state of this process was eventual mastery of the connexity and structure of a large body of knowledge. (p. 1)

As evidenced by this quote, Bruner intended for each level of the spiral to be mastered before the student moved on to the next one instead of reaching mastery only long after the spiral began.

Overlap

As stated earlier, Bruner (1960) defined the spiral curriculum as one that constantly "turns back on itself at higher levels" (p. 13). Although this may serve as an advantage in the promotion of metacognitive skills, also, it is regarded as a disadvantage because of the overlap that occurs. According to Flanders (1987, as cited in Jensen, 1990), who conducted a study on the amount of new material presented to students every year, only 44% of the material found in three popular fourth grade mathematics textbooks was new, and only 31% of the material in eighth grade mathematics texts had not been introduced in earlier years. In Jensen's opinion, "Such a repetitious curriculum robs both students and teachers of the excitement and motivation that is inherent in anticipating learning something new" (p. 4).

Beccue and Rariden (1997) conducted a study in which a spiral curriculum was adopted in the entire Computer Systems program at Illinois State University. In the design and preparation for their study, Beccue and Rariden found many instances in which the students might feel the information was repetitious from the year before. The researchers took many steps to assure that "the students would approach the material with a fresh perspective, and not as if it were a rehash of their previous course" (p. 104). As an example, one step the researchers took to minimize repetition was to tailor design a new text from various other sources. Despite the attempts the researchers took in order to control for repetition, nevertheless, students who had completed the first part of the spiral complained that there was not enough new material in the new classes.

Lack of Research

Dempster and Farris (1990) stated "The challenge to teacher education programs is to develop and field-test specific procedures and practices that take advantage of research-based knowledge about effective learning" (p. 100). Dempster and Farris mentioned that, in the case of the spacing effect and spiral learning, there would be substantial gains to more research and field tests but unfortunately, there is a great lack in research. These conclusions were consistent with those of Dowding (1993, as quoted in Harden & Stamper, 1999) who stated "although the concept of a spiral curriculum is good, it has not been successfully implemented on any large-scale basis over a substantial period of time" (p. 2). As opposed to the over 2,000 ERIC articles that Martinez and Martinez (1999) found on mastery learning, a basic search for spiral learning or spiral curriculum yields approximately 650 articles on the ERIC database.

In this author's opinion and after much time spent collecting information in order to synthesize the research and provide teachers with a quick and reliable reference on both mastery and spiral learning, the lack of information could make it difficult for teachers and educators to form an opinion on the merits of spiral learning. Beccue and Rariden (1997) succinctly summarized the state of spiral learning after their study in which they transitioned from a traditional method of teaching to a spiral approach. They stated, "After teaching the two follow-up courses, it is apparent that more planning and development work needs to be done in order to affect a smoother transition along the spiral" (p. 106).

Chapter Summary

Provided in Chapter 2 is a review of the research that has been completed on mastery learning and spiral learning. To begin, a brief history along with the definitions were provided for both mastery and spiral learning. This was followed by a review of the advantages and disadvantages of both mastery learning and spiral learning. There were clear advantages and disadvantages to both strategies that educators must take into consideration when they determine the most effective method of teaching for their classroom.

In Chapter 3, this author will detail the method by which this project will be developed. The goals of the project will be stated, along with the procedures to achieve the goals, and the population that is targeted.

Chapter 3

METHOD

With increasing pressure from schools, districts, parents, and the government, today, teachers are given increasing responsibilities every year. Recent legislation (U.S. Department of Education, 2005) and the emphasis on standardized testing have required many district administrators and staff to find the most effective methods of teaching. The dilemma is, that in order to find the answers they seek, and with all the responsibilities teachers have today, they do not have time to research and determine teaching methods to best serve their students.

The idea for this project came to the author during a semester of student teaching in an intermediate classroom. While in the classroom, the author observed how different the curriculum was compared to the way in which students used to be taught. This sparked the question, "which method of teaching was more effective and would yield the best results from students?" Upon questioning a variety of teachers, the author found that many of them did not know very much about the methods with which they taught, but were interested to learn more. The purpose of this project was to provide educators with information gathered and synthesized from past research on the mastery learning and spiral learning methods of teaching in order to save them time and help them to choose the most effective method of teaching.

Target Audience

The groups or individuals who would be interested in this information would be any educators including: teachers, administrators, curriculum developers, and parents. This information will provide them with the background knowledge and best practices for both mastery and spiral methods of teaching to optimize the teaching and learning in classrooms.

Goals

There were two main goals to this project. The first goal was to successfully share the gathered information with the intended audience. This author imparted the information in a user friendly manner and assessed the understanding of the audience.

The second goal of this project was to have the members of the audience review their current classroom curriculum and with the use of their new knowledge, assess whether their methods are effective for their students. If the students would be better served with the use of another type of learning method, the audience members had to decide upon which one and take the correct steps to implementation of that teaching method in their classroom.

Procedures

To achieve the first goal of this project, a Power Point was presented to detail the background of each of the methods of teaching. Along with the background, the advantages and disadvantages of both the mastery and spiral methods of teaching were detailed. Also, a bibliography of the research used to compile the lists of pros and cons were included as well. After sharing the information with the audience, the next step was to make sure the audience understood the difference between the two and in what

situations each method of teaching would be ideal. The audience will engaged in an activity in which working as a group, they were given lessons which they changed in order to fit the mastery learning guidelines and the spiral learning guidelines. After assessing the understanding of the audience, the next step was to complete the second goal.

To complete the second goal, the audience had time to look at the curriculum currently in use in their classrooms and break it down to determine what methods are being used to teach individual lessons. With their new understanding of mastery and spiral learning, the audience then determined which method would be most effective for their students and how to change their lessons to fit the teaching method.

Chapter Summary

In this chapter, the author described the methods by which this project was conducted. She detailed the purpose of the project and how it came to be, the target audience, the two goals of this project, and the procedures that were followed in order to achieve the set goals. The project that was described in this chapter will be presented in full in Chapter 4.

Chapter 4

RESULTS

The purpose of this project was to develop an inservice presentation about mastery and spiral learning for teachers and educators. This project was developed in order to educate teachers on two types of learning they use in their classrooms daily. Following Chapter 3, which detailed the purpose of the project, the target audience, the two goals of this project and the procedures that were followed to complete the project, this chapter includes the Power Point presentation that was created to inform the teachers and educators. The presentation also included a classroom application component that assisted educators in making their learning more applicable to their own classroom teaching.

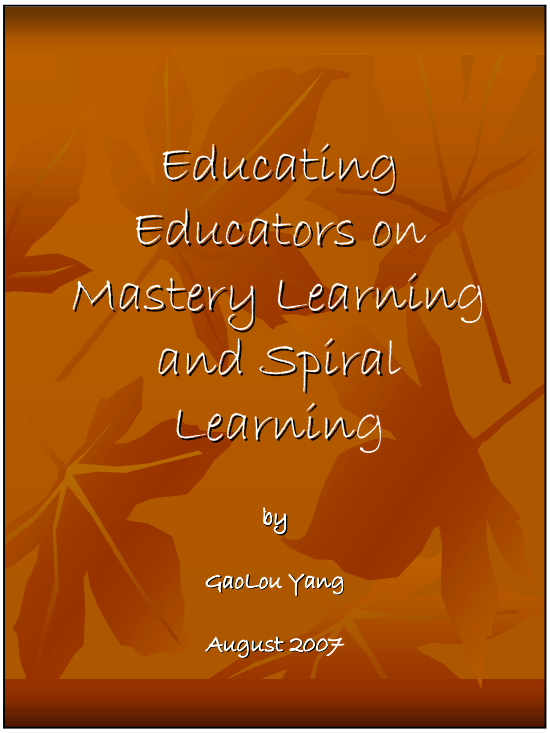
Notes:

- The room will be set up with tables with at least 5 chairs at each table.
- On each table there will be names of teachers so that at each table there is a representative from each grade level.
- The tables will be equipped with sticky notes, two sheets of poster paper, and writing utensils.
- Refreshments will be provided.
- The room will be equipped with a screen, Power Point projector, and white board.

Commentary:

Thank you all for coming today. Before we begin, let me tell you a little bit about myself. First of all, my name is GaoLou Yang and I am Hmong. (Point to picture of Laos) Like my parents, Hmong people are primarily from Laos which is a small country in southeast Asia. (Point to picture of teacher and students) I am a teacher and have been for the last two years. I am currently teaching 1st grade which has been great but I would someday like to experience other grade levels as well. (Point to picture of family) I love my family a lot and although I have known them my whole life, I still like to spend lots of time with them. (Point to child reading) I am an avid reader and enjoy nothing better than a good book, a comfy couch, and lots of free time. (Point to mountains) I love the mountains which makes Colorado a great fit for me. (Point to student) And lastly, I am a student. Not just in the literal sense of

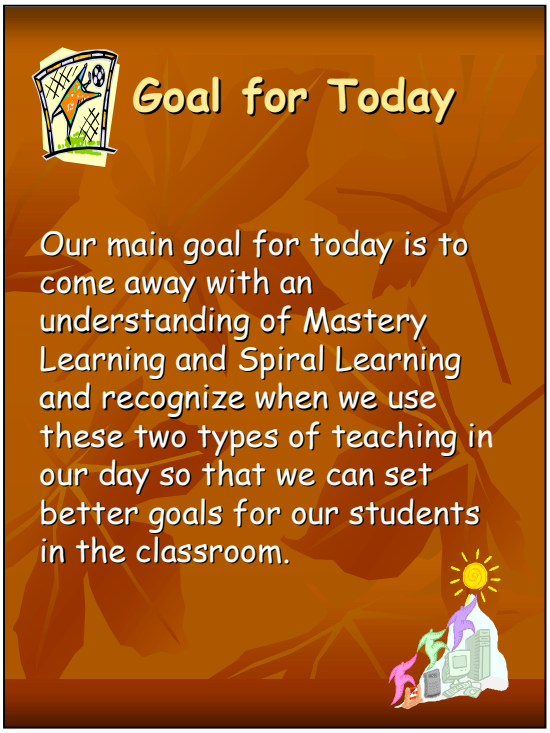
actually being enrolled in school but also a student because I believe that in my every day there is something new I learn and that I will never be too full of knowledge.



Commentary:

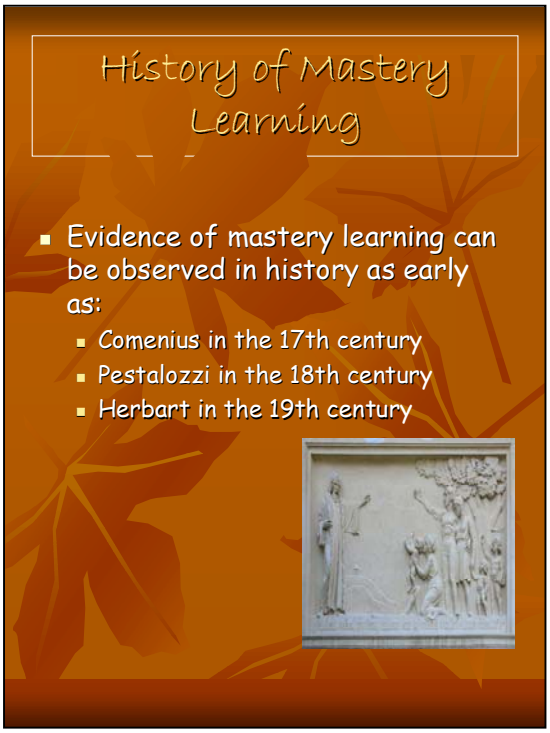
The idea to research mastery learning and spiral learning came to me during my required observations in my graduate program. In the process of going to a variety of schools and being in a number of classrooms, I noticed that classrooms had changed a great deal since my days in school. When teachers used mastery learning in their classrooms, I was able to identify with it because that strategy was used when I was in school. But especially in math, I did not understand spiraling at all and I could not see how students who were unable to grasp a certain concept would eventually come to understand it because of the nature of the spiral. Truthfully, when I started asking questions about the two strategies, many teachers were unable to give me much information or feedback on how the strategy was working with their students. To find out for myself what mastery and spiral learning are and which method of teaching and

learning is more beneficial to students, I decided to research and write my thesis on this topic.



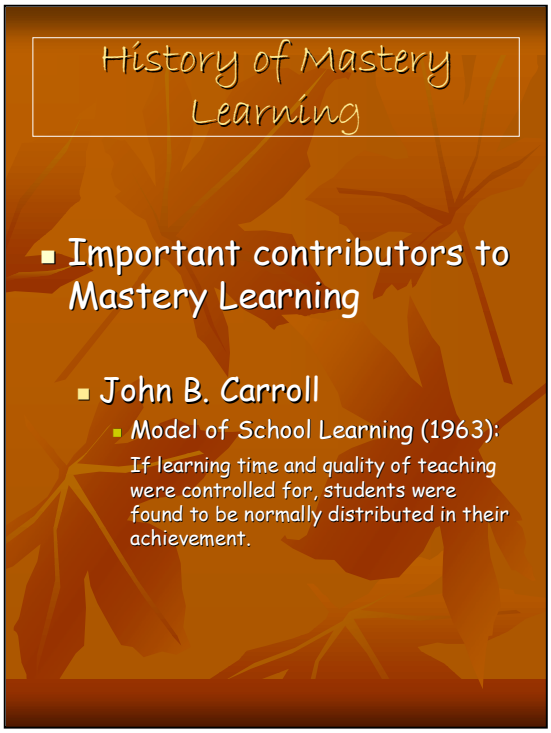
Commentary:

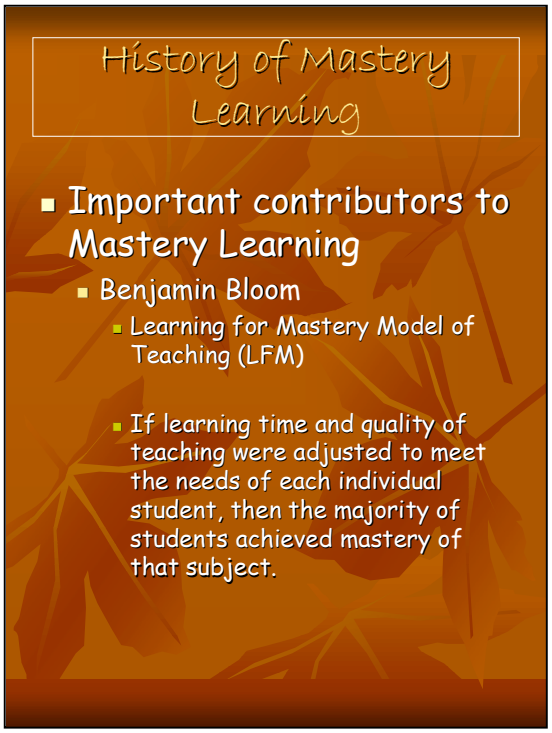
To be clear on what I want for all of you to achieve today, here is the goal that I hope you can all say you accomplished at the end of our time. (Read the goal out loud)



Commentary:

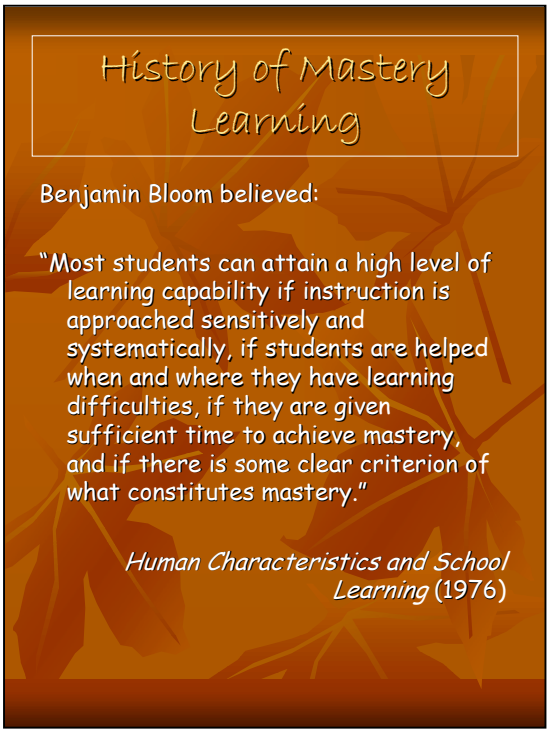
These are just three of the more famous teachers who used mastery learning in teaching. These three historical figures had their own schools and made great contributions to education.


History of Mastery Learning
Important contributors to Mastery Learning
John B. Carroll
Model of School Learning (1963):
If learning time and quality of teaching were controlled for, students were found to be normally distributed in their achievement.



Commentary:

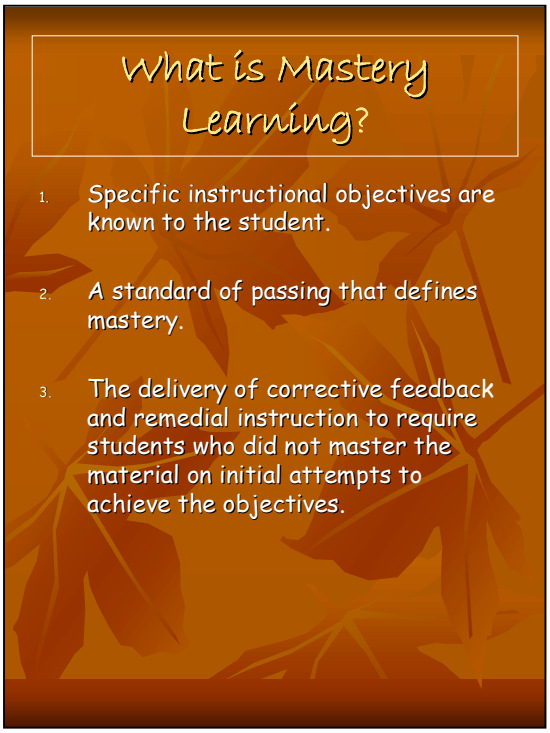
Although Benjamin Bloom based his definition of Mastery Learning on Carroll's Model of School Learning, his name and the LFM model are the most widely known form of Mastery Learning. Benjamin Bloom has published numerous books and articles that support and encourage the use of Mastery Learning.



Activity:

With a neighbor, take a minute to discuss what feelings you have about this statement.

(At the end of the discussion time) Would anybody like to quickly share what you and your partner talked about?

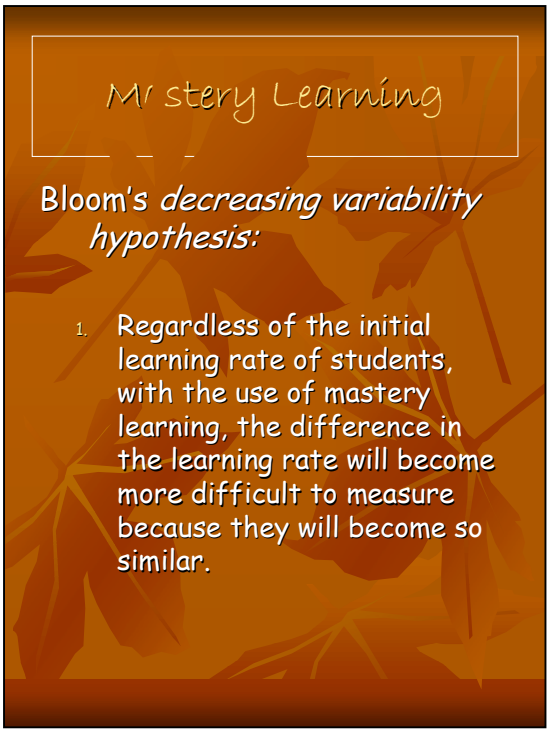


Activity:

Leave the definition of Mastery Learning on the screen and have the table groups take 5 minutes to think about and list what subjects or activities are taught in their classrooms using Mastery Learning. Have groups share findings at the end of the discussion time.

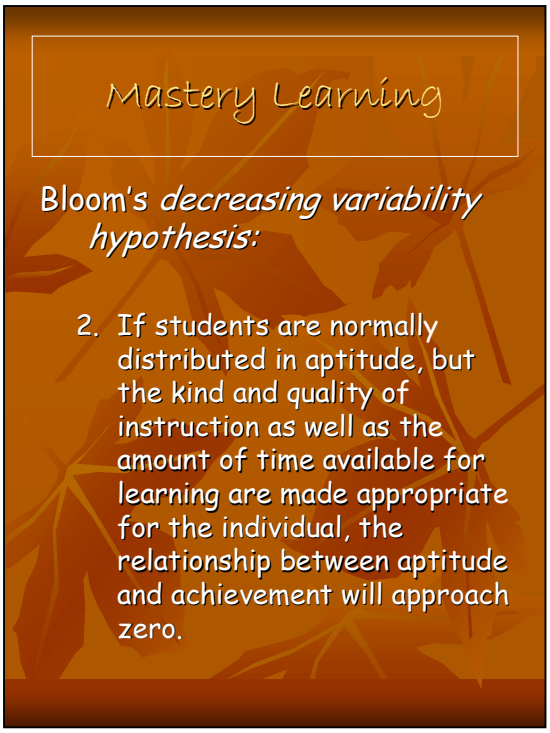
Mastery Learning Outcomes

- According to Bloom, with the use of LFM, students will:
  - Feel better about school, teacher, subject, and self;
  - learn to persevere to complete tasks to a high level; and
  - be better prepared cognitively and emotionally for subsequent learning tasks.



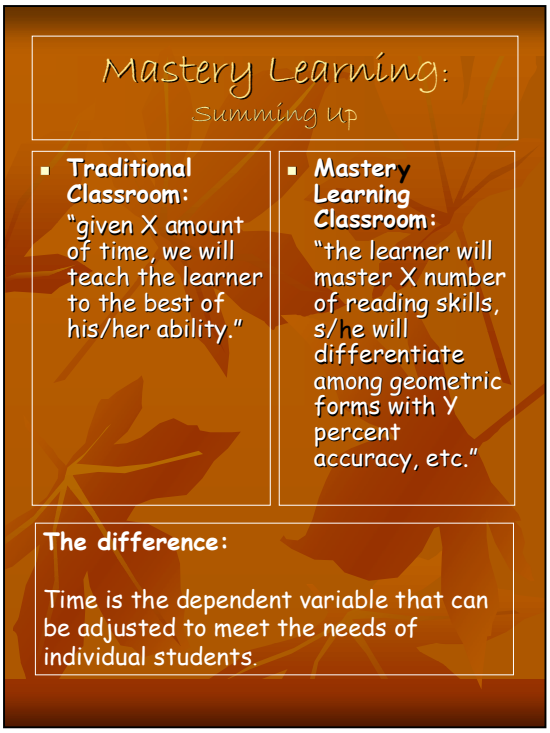
Commentary:

Bloom also believed that with the use of Mastery learning, a trend would be observed which he called the decreasing variability hypothesis is which…(refer to number 1 on the slide above and read out loud).



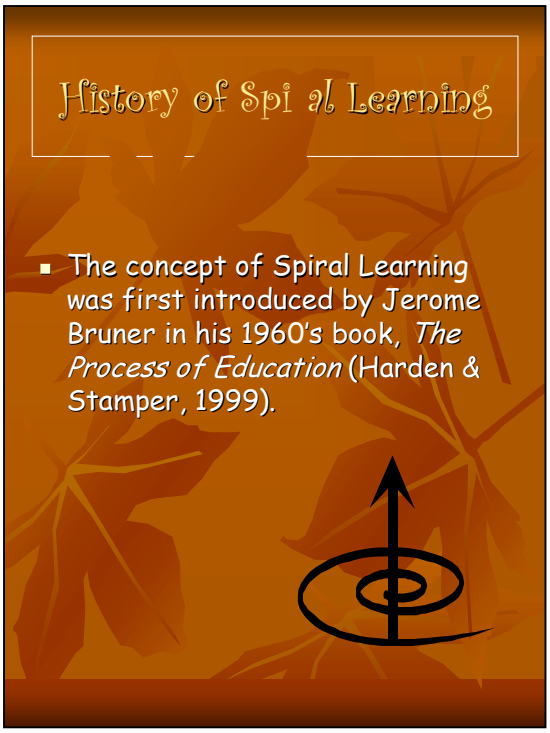
Commentary:

Basically, Bloom's premise was that regardless of where a student starts from in terms of how fast they learn and how smart they are, with the use of Mastery Learning, all students will receive the individual assistance they need and eventually educators will begin to see that the variability in learning rate and aptitude among their students will decrease.



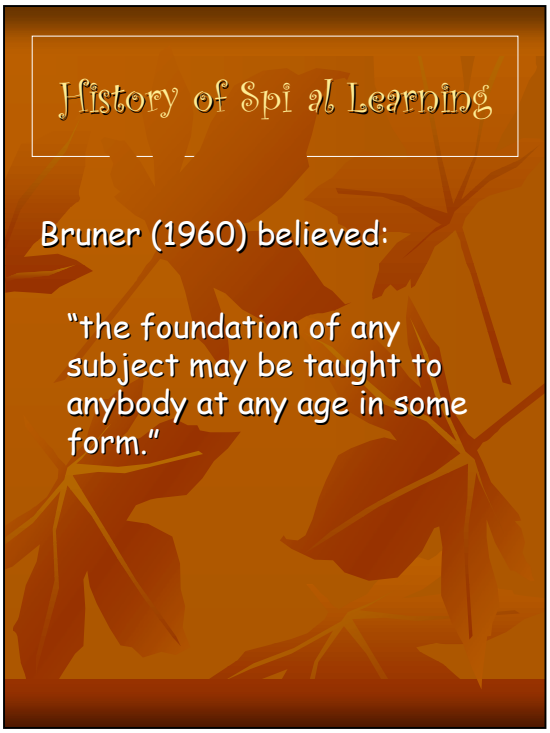
Activity:

Take a minute and discuss with a different neighbor what your thoughts are about this slide and how feasible mastery learning sounds for today's schools. (At the end of the minute) Would anyone like to share what you talked about?



Commentary:

Jerome Bruner is an American psychologist who has published a large amount of research on cognitive psychology and cognitive learning theory. Bruner was a strong believer in a hierarchy of learning in which people started with a broader base of knowledge which became more and more specific. This makes it no surprise that he is said to be the founder of spiral learning which is based on gradually deepening the understanding of concepts.

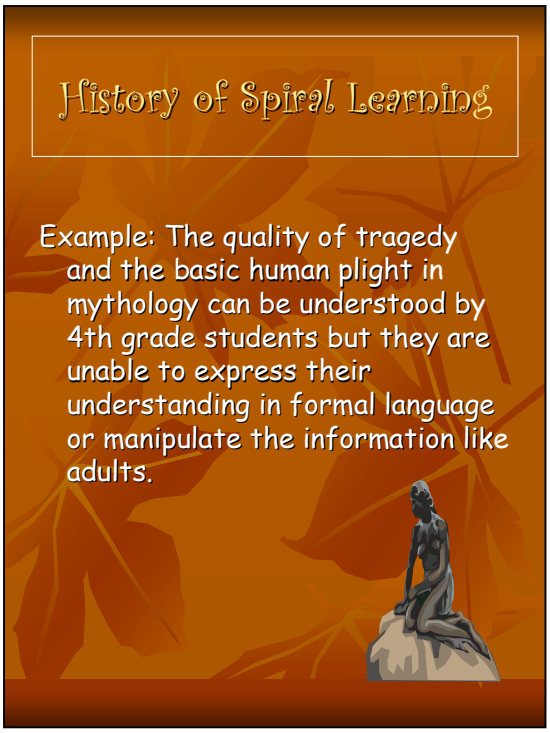


Activity:

Have table groups quickly discuss and list some other subjects that students can learn about but are unable to fully understand. Have one person share with the whole group their findings. Help them come to the conclusion that the understandings of some concepts are not only dependent on age but also on the individual experiences of the student.

Example:

Some students are able to understand death and dying because they have experienced it in their own life.



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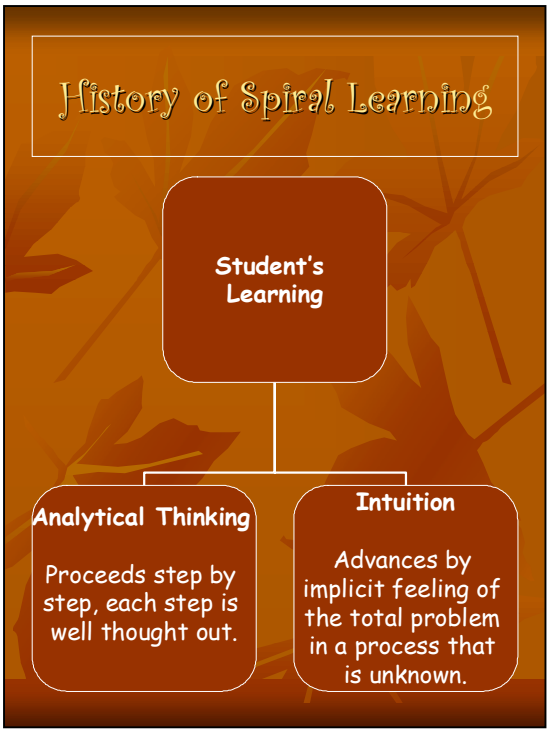
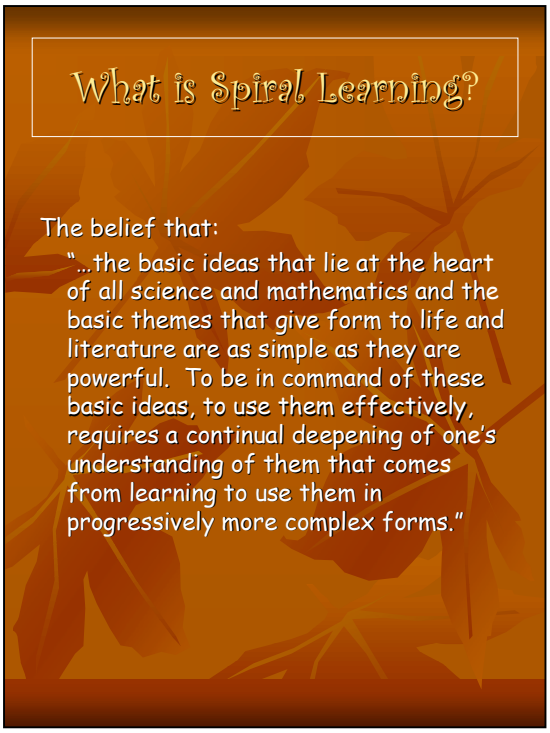


Commentary:

Bruner believed that in order to teach higher level topics to young students, teachers should teach using a students' intuition, based on the idea that a more analytic thought process would develop in later years.

Example:

A child intuitively catching a ball that is thrown to them when they are young. As they get older, they are able to judge the distance they need to move in order to successfully catch the ball and how to position their bodies to receive the ball depending on its size and the force with which the ball was thrown (or if they should just get out of the way).

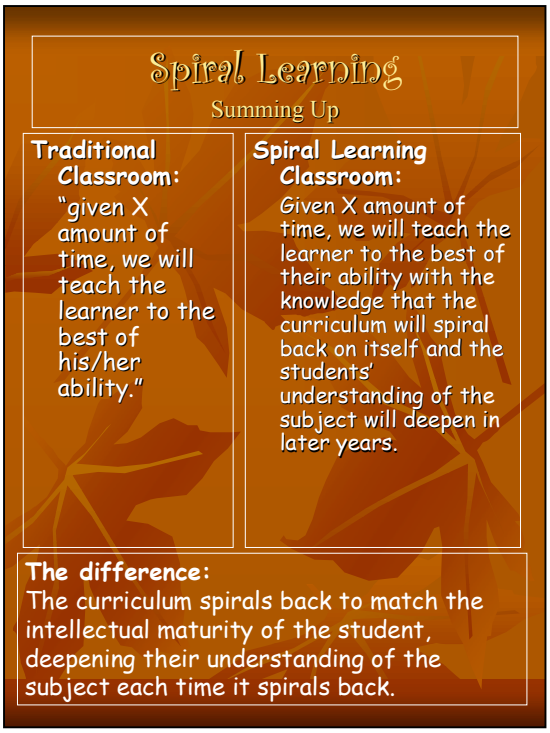


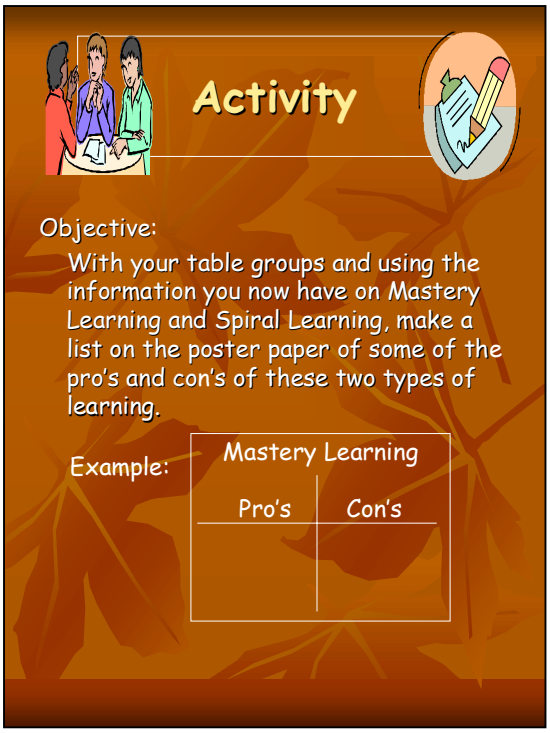
Commentary:

Bruner believed that curricula should be designed to "spiral" so that it constantly "turns back on itself at higher levels."

Activity:

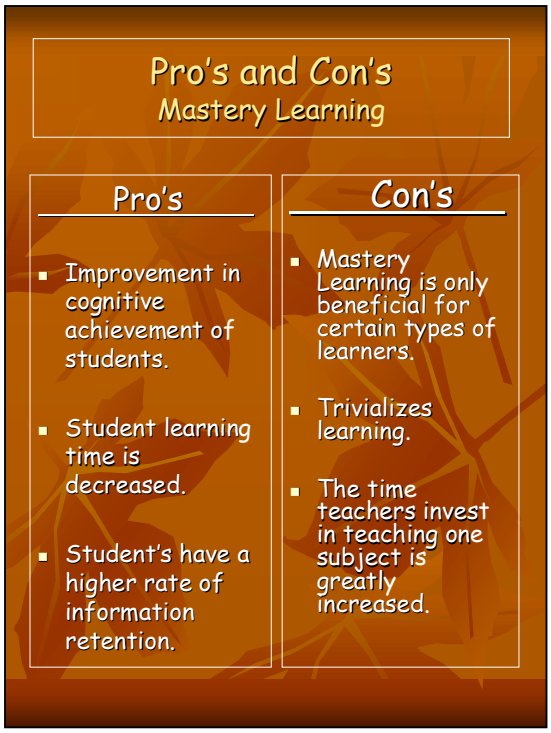
Leave the description of Spiral Learning on the screen. Have the table groups take 5 minutes to discuss and list subjects and activities that are taught using Spiral Learning. Have groups share their findings with the whole group.


Spiral Learning
Summing Up
Traditional Classroom:
"given X amount of time, we will teach the learner to the best of his/her ability."
Spiral Learning Classroom:
Given X amount of time, we will teach the learner to the best of their ability with the knowledge that the curriculum will spiral back on itself and the students' understanding of the subject will deepen in later years.
The difference:
The curriculum spirals back to match the intellectual maturity of the student, deepening their understanding of the subject each time it spirals back.



Notes:

Groups will be given 15 minutes to do their two charts and put them up around the room. When groups are through, individuals may take time to take care of themselves and take a break. Groups will begin sharing their pro's and con's in 25 minutes. When everybody has returned, ask for representatives from each group to share their pro's and con's. When everyone is done sharing, ask for any observations or recurring findings.



Commentary:

- Cognitive Achievement: In a study conducted by Whiting, Van Burgh, and Render on over 7,000 participants over a span of 18 years, they found that with the use of mastery learning, the grade point averages increased from a 2.34 to 3.92.
- Learning Time: Whiting et al. also found in their study that over a one year span, learning time decreased from 134 minutes in Unit 1 to 42 minutes in Unit 20.
- Information Retention: Wentling found that mastery students were able to retain more information from the beginning of the year than the control group.
- Who Benefits?: Marton and Saljo in their 1976 study identified two types of learners: surface learners who focus of testable signs of learning and deep

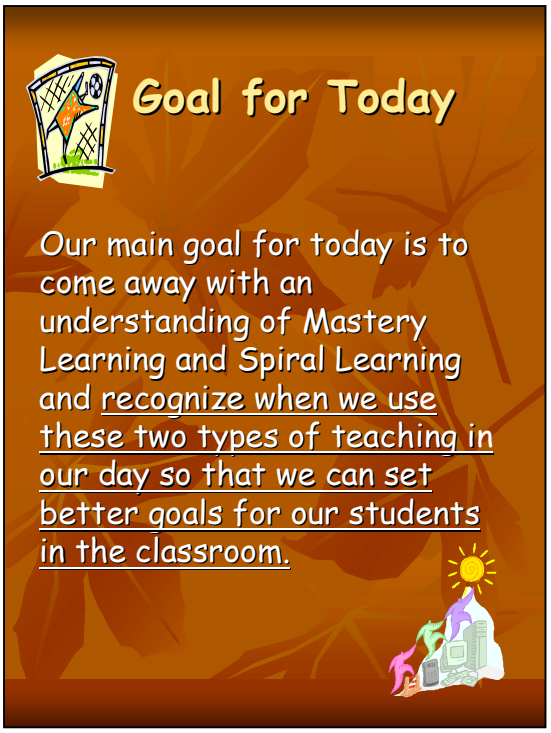
learners who search for a connection between the content and themselves. Lai and Biggs found that mastery learning only benefits surface learners.

- Trivializes Learning: Lai and Biggs also found in their study that contrary to surface learners, deep learners felt the constant tests were tedious and trivialized the material because no understanding or connection was gained.
- Teacher Time: Martinez and Martinez found in their study that the only notable difference in a mastery classroom is the amount of time a teacher invests in teaching the material which still does not entail greater success.

Commentary:

- Retention: Kryzanowski and Carmine found in their study of first graders that learning using the spaced format of spiral learning, which is a type of teaching in which concepts are taught in intervals instead of receiving all of the information at one time, increased the retention of information.
- Deeper Understanding: Isaacs, Carroll, and Bell did research on *Everyday Mathematics,* which is a spiral curriculum. They found that when both meaning and skills are emphasized in teaching, students achieve higher levels of learning.
- Metacognitive Skills: Cowan, Morrison, and McBride concluded in their study that the revisiting of topics allowed students the opportunity to analyze their thinking and problem solve earlier obstacles.

- Skill Acquisition: One of Braam's critiques of spiral learning is "mastery and fluency in basic skills is only aimed for long after concepts are first introduced."
- Overlap of Material: Beccue and Rariden conducted a study in which they intentionally tried to provide a fresh perspective on a spiral curriculum but found that students still reported a lack of new material being taught.
- Limited Research: Dempster and Farris stated, "The challenge to teacher education programs is to develop and fieldtest specific procedures and practiced that take advantage of research-based knowledge about effective learning. In the case of spiral learning, not enough research has been completed or published to get a clear picture of its effects on classroom teaching.

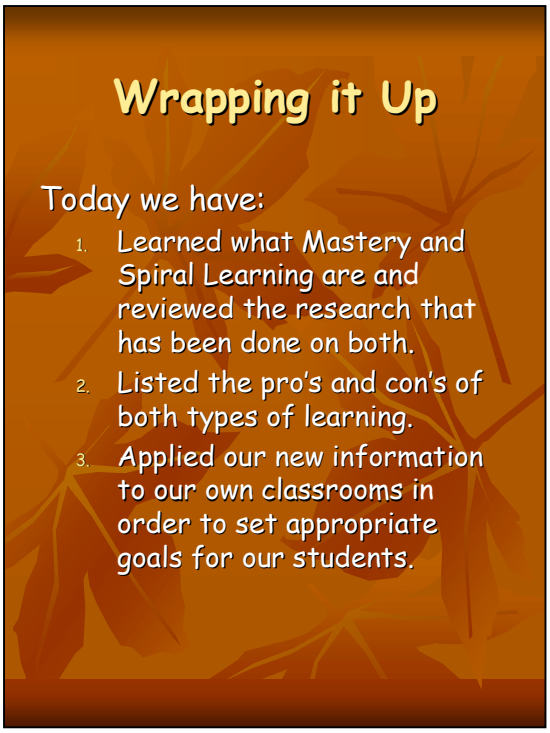


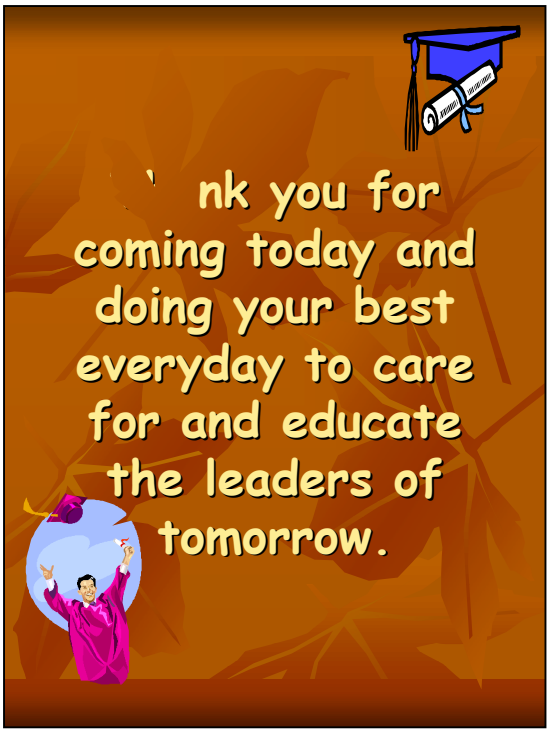
Commentary:

Now that we have achieved the first part of our goal, we will be using our new knowledge to complete the last part of our goal.

Commentary:

Because knowing what learning you want your students to be able to demonstrate at the end helps you to set realistic goals for them and plan appropriately for the lesson, we will be taking the next 20-25 minutes to review your daily schedule and the curriculum you use in order to determine into which category it falls into. Keep in mind that it does not necessarily have to be only one. If you find any "Ah Ha's" or great revelations during this activity, write them down on a sticky note so you can share them when we are through. I will be walking around to assist you if you have any questions.


Wrapping it Up
Today we have:
1. Learned what Mastery and Spiral Learning are and reviewed the research that has been done on both.
2. Listed the pro's and con's of both types of learning.
3. Applied our new information to our own classrooms in order to set appropriate goals for our students.



Commentary:

I appreciate all of your efforts and contributions today. Thank you so much for coming and for everything you do. Before you leave, I will be passing out the list of references I used for this presentation so you can find out more about Mastery and Spiral learning if you wish. I will be around after for any further questions you might have. Thank you again and have a great afternoon.

Chapter Summary

In this chapter, the author presented the Power Point presentation that was used to achieve the two goals detailed in Chapter 3 which were, to educate educators on Mastery and Spiral learning and have the members of the audience review their current classroom curriculum to better meet the needs of their students. In Chapter 5, the author will provide the contributions of the project, the limitations of the project, recommendations for future study, and a project summary.

Chapter 5

DISCUSSION

Due to the busy schedules of today's teachers, it is virtually impossible for them to fully research and understand the teaching methods that they use daily in their own classrooms. The intention of this author was to provide an in-service for teachers and educators that would provide information and an understanding of two widely used methods of teaching, mastery and spiral learning.

Contribution of the Project

The first goal of this project was to successfully share information about mastery and spiral learning. The second goal was to have the educators take time to review their own curriculum and identify where the two methods were being used and if the current method was the most effective for their students. The successful achievement of these two goals has equipped educators with a deeper understanding of the teaching methods they use in their classrooms and enabled them to effectively switch from one method to another depending on the needs of their students.

Strengths

After viewing the presentation, one strength that was noted by the reviewers was the nice flow of information and the organization. Another strength was the clearly defined goals of the day and the revisiting of the goal as the day progressed. The reviewers also agreed that the information was very relevant and informative and that the "summing up" slides were helpful in bringing all of the information together. The

reviewers felt that the activities and discussion questions were appropriate and would help to keep the audience engaged throughout the presentation.

Limitations of the Project

The limitations noted by the reviewers were largely aesthetic. One limitation pertained to the inconsistency in font size on the different slides. The other limitation that was noted was in the amount of words and information on each individual slide.

A limitation this author found was, even though mastery and spiral learning are greatly used in many schools, there are still some schools that use different methods of teaching. For those educators, although the information provided in the in-service would be beneficial, the curricular review would not be as applicable.

Suggestions for Further Study

Due to the fact that spiral learning was more recently founded, authors have only begun to publish curricular texts that incorporate spiral learning. Some of these texts have found their way into classrooms but longitudinal studies on the effectiveness of spiral learning are only in their early stages. A research project conducted when more information is available on the long term results of spiral learning would provide a more complete picture.

Project Summary

This project was created to provide educators with an understanding of the teaching methods they utilize in their classrooms. The author researched and compiled information on two widely used methods of teaching, mastery and spiral learning. The next step was to create an in-service in which the gathered information was shared with educators. Lastly, the educators showed their understanding of the presented material

with their review of their own curriculum and the adjustments they made to meet the needs of their students. This author was pleased to find that the information was beneficial to the intended audience and that a full understanding of the material was achieved.

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APPENDIX A

Handout of List of References Used for Power Point Presentation

List of References

Mastery and Spiral Learning
Presented by GaoLou Yang

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APPENDIX B

Questionnaire for Review of Power Point Presentation

Questionnaire for Review of Power Point Presentation

Mastery Learning vs. Spiral Learning
Presented by GaoLou Yang

1. What were the strengths of the presentation?

2. What were the weaknesses of the presentation?

3. How could this presentation be improved?

Further comments:

☺ Thank you very much for your time. ☺