Mastery learning

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Mastery Learning (or as it was initially called, "learning for mastery") is an instructional strategy and educational philosophy, first formally proposed by Benjamin S. Bloom in 1968. Mastery Learning maintains that students must achieve a level of mastery (i.e. 90% on a knowledge test) in prerequisite knowledge before moving forward to learn subsequent information. If a student does not achieve mastery on the test, they are given additional support in learning and reviewing the information, then tested again. This cycle will continue until the learner accomplishes mastery, and may move on to the next stage.

Mastery learning methods suggest that the focus of instruction should be the time required for different students to learn the same material and achieve the same level of mastery. This is very much in contrast with classic models of teaching, which focus more on differences in students' ability and where all students are given approximately the same amount of time to learn and the same set of instructions.

In **Mastery learning**, there is a shift in responsibilities, so that student's failure is more due to the instruction and not necessarily lack of ability on his or her part. Therefore, in a mastery learning environment, the challenge becomes providing enough time and employing instructional strategies so that all students can achieve the same level of learning.[1][2]

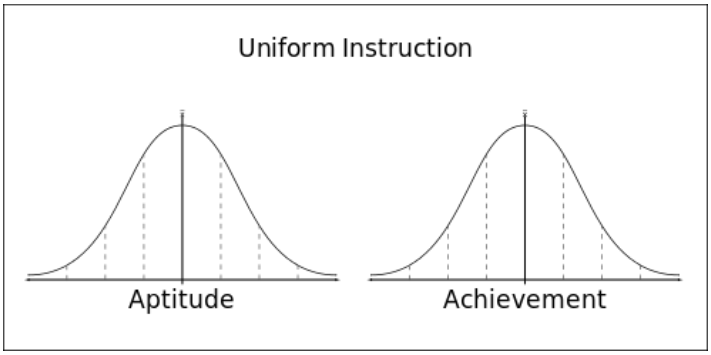
Contents

Definition

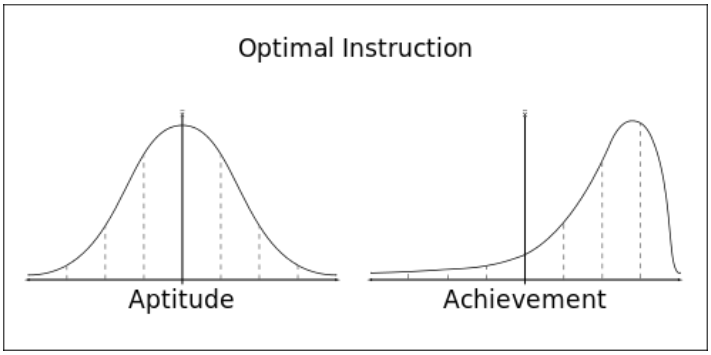
Mastery learning is a set of group-based, individualized, teaching and learning strategies based on the premise that students will achieve a high level of understanding in a given domain if they are given enough time.[3]

Motivation

The motivation for Mastery Learning comes from trying to reduce achievement gaps for students in average school classrooms. During the 1960s John B. Carroll and Benjamin S. Bloom pointed out that, if students are normally distributed with respect to aptitude for a subject and if they are provided uniform instruction (in terms of quality and learning time), then achievement level at completion of the subject is also expected to be normally distributed. This can be illustrated as shown below:



Mastery Learning approaches propose that, if each learner were to receive optimal quality of instruction and as much learning time as they require, then a majority of students could be expected to attain mastery. This situation would be represented as follows:



In many situations educators preemptively use the normal curve for grading students. Bloom was critical of this usage, condemning it because it creates expectation by the teachers that some students will naturally be successful while others will not. Bloom defended that, if educators are effective, the distribution of achievement could and should be very different from the normal curve. Bloom proposed Mastery Learning as a way to address this. He believed that by using his approach, the majority of students (more than 90 percent) would achieve successful and rewarding learning.[4] As an added advantage, Mastery Learning was also thought to create more positive interest and attitude towards the subject learned if compared with usual classroom methods.[5]

Related terms

Individualized instruction has some elements in common with mastery learning, although it dispenses with group activities in favor of allowing more capable or more motivated students to progress ahead of others while maximizing teacher interaction with those students who need the most assistance.

Bloom's 2 Sigma Problem is an educational phenomenon observed where the average student tutored one-to-one (using mastery learning techniques) performed two standard deviations better than students who learn via conventional instructional methods.

More recently, the idea of "Flipped Mastery" gained some popularity. The term was coined by Jon Bergmann and Aaron Sams, both chemistry teachers. They suggest an implementation model for Mastery Learning that is mixed with flipped classroom. The idea is to use technology to time-shift the individual instruction and eliminate whole-class lectures. The students watch online lectures and move through the content at their own pace. In this way technology frees up the teachers to individualize the learning for each student.[6]

History

The idea of learning for mastery is not new. In the 1920s there were at least two attempts to produce mastery in students' learning: the Winnetka Plan, by Carleton Washburne and associates, and another approach by Henry C. Morrison, at the University of Chicago Laboratory School. Both these projects provided school situations where mastery of particular learning tasks - rather than time spent - was the central theme. While these ideas were popular for a while, they faded due primarily to the lack of technologies that could sustain a successful implementation.[5]

The idea of mastery learning resurfaced in the late 1950s and early 1960s as a corollary of programmed instruction, a technology invented by B.F. Skinner to improve teaching.[5] Underlying programmed instruction was the idea that the learning of any behavior, no matter how complex, rested upon the learning of a sequence of less-complex component behaviors.[7]

Around that same time, John B. Carroll was working on his "Model of School Learning". This was a conceptual paradigm which outlined the major factors influencing student success in school learning, indicating also how these factor interacted.[8] Carroll's model stemmed from his previous work with foreign language learning. He found that a student's aptitude for a language predicted not only the level to which he learned in a given time, but also the amount of time he required to learn to a given level. Carroll then suggests that aptitudes are actually a way to measure the amount of time required to learn a task up to a certain level (under ideal instructional conditions). So Carroll's model is actually suggesting that, if each student was allowed the time they needed to learn to some level, then he could be expected to attain that level.[5]

Later in the 1960s Benjamin Bloom and his graduate students were researching individual differences in school learning. They observed that teachers displayed very little variation in their instructional practices and yet, there was a lot of variation in student's achievements. Bloom used Carroll's conceptual model to create his own working model of Mastery Learning. Bloom realized that, if aptitudes were predictive of the rate at which a student can learn (and not necessarily the level to which), it should be possible to fix the degree of learning expected to some mastery level and then systematically manipulate the variables in Carroll's model such that all or almost all students attained that level.

Also in the 1960s, Fred S. Keller was collaborating with colleagues developing his own instructional methods of Mastery Learning. Keller's strategies were based on the ideas of reinforcement as seen in operant conditioning theories. Keller formally introduced his teaching method, Personalized System of Instruction (PSI) - sometimes referred to as Keller Plan), in his 1967 paper, "Engineering personalized instruction in the classroom".[9]

From the late 1960s to the early 1980s, there was a surge of research on both Keller's and Bloom's instruction methods.[10] Most of these studies showed that mastery learning has a positive effect on achievement, for all subjects and at all levels. Also, mastery learning brings positive affective outcomes for both students and teachers. These studies also showed that there are many variables that are either affected by mastery learning or that influence it somehow: student entry variables, curriculum, type of test, pacing, level of mastery, and time.[11]

Despite those mostly positive research results, interest in mastery learning strategies decreased throughout the 1980s, as reflected in publication activity in professional journals and presentations at conferences. Many explanations were put forward to justify this decline, like alleged recalcitrance of the educational establishment to change,[12] or the ineffective implementations of mastery learning methods,[13] or the extra time demanded in setting up and maintaining a mastery learning course[12] or even concerns that behavioristic-based models for teaching would conflict with the generally humanistic-oriented teachers and the surrounding culture.[14]

Mastery learning strategies are best represented by Bloom's Learning For Mastery (LFM) and Keller's Personalized System of Instruction (PSI). Bloom's approach was focused in the schoolroom, whereas Keller developed his system for higher education. Both have been applied in many different contexts and have been found to be very powerful methods for increasing student performance in a wide range of activities. Despite sharing some commonalities in terms of goals, they are built on different psychological principles.

Learning For Mastery (LFM)

Variables of LFM

Bloom, when first proposing his mastery learning strategy in 1968, was convinced that most students can attain a high level of learning capability if the following conditions are available:

- instruction is approached sensitively and systematically
- students are helped when and where they have learning difficulties
- students are given sufficient time to achieve mastery
- there is some clear criterion of what constitutes mastery.[15]

Many variables will influence achievement levels and learning outcomes:

Aptitude

Aptitude, measured by standard aptitude tests, in this context is interpreted as "the amount of time required by the learner to attain mastery of a learning task".[16] Several studies show that majority of students can achieve mastery in a learning task, but the time that they need to spend on is different.[17][18] Bloom argues that there are 1 to 5 percent of students who have special talent for learning a subject (especially music and foreign languages) and there are also around five percent of students who have special disability for learning a subject. For other 90% of students, aptitude is merely an indicator of the rate of learning.[19] Additionally, Bloom argues that attitude for a learning task is not constant and can be changed by environmental conditions or learning experience at school or home.[20][21]

Quality of instruction

The quality of instruction is defined as the degree to which the presentation, explanation, and ordering of elements of the task to be learned approach the optimum for a given learner.[16] Bloom insists that the quality of instruction has to be evaluated according to its effect on individual students rather than on random groups of students. Bloom shows that while in traditional classrooms, the relationship between students aptitude test for mathematics and their final grade in algebra is very high, this relationship is almost zero for students who are receiving tutorial instruction in the home. He argues that a good tutor tries to find the quality of learning best fit to the given students, thus majority of students would be able to master a subject if they have access to a good tutor.[15]

Ability to understand instruction

According to Bloom the ability to understand instruction is defined as the nature of the task that a learner is to learn and the procedure that the learner is to follow. Verbal ability and reading comprehension are two language abilities that are highly related to student achievements. Since the ability to understand instruction varies significantly among students, Bloom recommends that teachers modify their instruction, provide help, and teaching aids to fit the needs of different students. Some of the teaching aids that could be provided according to the ability of the learner are:

- Alternative Textbooks
- Group Studies and Peer Tutoring
- Workbooks
- Programmed Instruction Units
- Audiovisual Methods
- Academic Games
- Laboratory experiences
- Simple demonstrations
- Puzzles[15]

Perseverance

Perseverance in this context is defined as the time the learner is willing to spend in learning. According to Bloom, a student who demonstrate low level of perseverance in one learning task might have a very high level of perseverance in a different learning task. He suggests that perseverance of students could be enhanced by increasing the frequency of reward and providing evidence of success in learning. He recommends that teachers use frequent feedback accompanied by specific help to improve the quality of instruction, thus reduce the perseverance required for learning.[15]

Time allowed for learning

According to the International Study of Education in 12 countries, if the top 5% of students are omitted, the ratio of the time needed for slower and faster learners of a subject such as mathematics is 6 to 1 while there is zero or slightly negative relationship between the final grades and the amount of time spent on homework.[22] Thus, the amount of time spent on homework is not a good indicator of mastery in a subject. Bloom postulates that the time required for a learner to achieve mastery in a specific subject is affected by various factors such as:

- the student's aptitude for that subject,
- The student's verbal ability,
- the quality of instruction, and
- the quality of the help provided.[15]

LFM strategy

LMF curricula generally consists of discrete topics which all students begin together. After beginning a unit, students will be given a meaningful and formative assessment so that the teacher can conclude whether or not an objective has been mastered. At this step, instruction goes in one of two directions. If a student has mastered an objective, he or she will begin on a path of enrichment activities that correspond to and build upon the original objective. Students who do not satisfactorily complete a topic are given additional instruction until they succeed. If a student does not demonstrate that he or she has mastered the objective, then a series of correctives will be employed. These correctives can include varying activities, individualized instruction, and additional time to complete assignments.[23] These students will receive constructive feedback on their work and will be encouraged to revise and revisit their assignment until the objective is mastered.

Preconditions

There are some preconditions for the process of mastery learning. First, the objectives and content of instruction have to be specified and clarified to both the students and the teacher. Another precondition is that the summative evaluation criteria should be developed and both the teacher and the learner should be clear about the achievement criteria. Bloom suggest that the using absolute standards rather than competitive criteria, help students to collaborate and facilitates mastery.[15]

Operating procedures

The operating procedures are the methods used to provide detailed feedback and instructional help to facilitate the process of mastery in learning. The main operation procedures are:

- Formative Evaluation, and
- Alternative Learning Resources[15]

Formative evaluation

Formative Evaluation in the context of mastery learning is a diagnostic progress tests to determine whether or not the student has mastered the subject unit.[24] Each unit is usually is a learning outcome that could be taught in a week or two of learning activity. The formative tests are administered at the learning units. Bloom insists that the diagnostic process has to be followed by a prescription and the result of formative assessment is better to express in not-grade format since the use of grades on repeated progress evaluations prepare students for accepting a level of learning less than mastery.[15]

Alternative learning resources

The progress tests should be followed by detailed feedback and specific suggestions so that the students could work on their difficulties. Some of the alternative learning resources are:

- Small groups of students (two or three) meet and work together
- Tutorial help
- Reviewing the instructional material
- Reading alternative textbooks
- Using workbook or programmed texts
- Using selected audiovisual materials[15]

Outcomes

The outcomes of mastery learning could be summarized into two groups: 1- Cognitive Outcomes 2- Affective Outcomes[15]

Cognitive outcomes

The cognitive outcomes of mastery learning are mainly related to increase in student excellence in a subject. According to one study, applying the strategies of mastery learning in a class resulted in the increase of students with the grade of A from 20 percent to 80 percent (about two standard deviation, and using the formative evaluation records as a base for quality control helped the teacher to improve the strategies and increase the percent of students with a grade of A to 90% in the following year.[25]

Affective outcomes

Affective outcomes of mastery are mainly related to the sense of self-efficacy and confidence in the learners. Bloom argues that when the society (through education system) recognizes a learner's mastery, profound changes happen in his or her view of self and the outer world. The learner would start believing that he or she is able to adequately cope with problems, would have higher motivation for learning the subject in a higher level of expertise, and would have a better mental state due to less feeling of frustration. Finally. it is argued that in a modern society that lifelong learning is a necessity, mastery learning can develop a lifelong interest and motivation in learning.[15]

Personalized System of Instruction (PSI)

Personalized System of Instruction, also known as the Keller Plan was developed in the mid 1960s by Fred Keller and colleagues. It was developed based on the idea of reinforcement in teaching processes.

Keller gives the following description to a group of psychology students enrolled in his course developed using mastery learning theory: "This is a course through which you may move, from start to finish, at your own pace. You will not be held back by other students or forced to go ahead until you are ready. At best, you may meet all the course requirements in less than one semester; at worst, you may not complete the job within that time. How fast you go is up to you" (Keller, 1968, pg 80-81).[26]

Five elements of PSI

There are five main elements in PSI as described in Keller's paper from 1967:

1. "The go-at-your-own-pace feature, which permits a student to move through the course at a speed commensurate with his ability and other demands upon his time.
2. The unit-perfection requirement for advance, which lets the student go ahead to new material only after demonstrating mastery of that which preceded.
3. The use of lectures and demonstrations as vehicles of motivation, rather than sources of critical information.
4. The related stress upon the written word in teacher-student communication.
5. The use of proctors, which permits repeated testing, immediate scoring, almost unavoidable tutoring, and a marked enhancement of the personal-social aspect of the educational process".[9]

Assessment

In a mastery learning environment, the teacher directs a variety of group-based instructional techniques, with frequent and specific feedback by using diagnostic, formative tests, as well as regularly correcting mistakes students make along their learning path. Assessment in the mastery learning classroom is not used as a measure of accountability but rather as a source of evidence to guide future instruction. A teacher using the mastery approach will use the evidence generated from his or her assessment to modify activities to best serve each student. Teachers evaluate students with criterion-referenced tests rather than norm-referenced tests. In this sense, students are not competing against each other, but rather competing against themselves in order to achieve a personal best.

Criticism

Time-achievement equality dilemma

The goal of mastery learning is to have all students reach a prescribed level of mastery (i.e. 80-90% on a test). In order to achieve this, some students will require more time than others, either in practice or instruction, to achieve success. The Time-Achievement Equality Dilemma refers to this relationship between time and achievement in the context of individual differences. If you hold achievement constant, time will need to vary. If time is held constant (as with modern learning models), achievement will vary. Mastery Theory doesn't accurately address this relationship.[27]

Bloom's original theory assumes that with practice, the slower learners will become faster learners and the gap of individual differences will disappear. Bloom believes these differences in learning pace occur because of lack of prerequisite knowledge and if all children have the same prerequisite knowledge, then learning will progress at the same rate. Bloom places the blame on teaching settings where students aren't given enough time to reach mastery levels in prerequisite knowledge before moving on to the new lesson. He also uses this to explain why variance in student learning is smaller in the first grade when compared to students in the 7th grade (the smart get smarter, and the slower fall further behind). He referred to this learning rate variance as the Vanishing Point.[28]

Studies have found support for both sides of Bloom's argument.

A four-year longitudinal study by Arlin (1984) [29] found no indication of a vanishing point in students who learned arithmetic through a mastery approach. Students who required extra assistance to learn material in the first year of the study required relatively the same amount of additional instruction in the 4th year. Individual differences in learning rates appear to be impacted by more than just method of instruction, contrary to Bloom's opinions.

Methodology errors in research

Experimental vs. control groups

In studies investigating the effectiveness of mastery learning, control and experimental groups were not always valid. Experimental groups typically consisted of courses that were developed to adhere to the best principles of mastery. However, control groups were sometimes existing classes to use as a comparison. This poses a problem since there was no way to test the effectiveness of the control group to begin with - it could have been a poorly constructed course being compared against a strictly designed mastery course.

Measurement tools

In studies where the largest effect sizes were found, experimenter made tests were used to test the mastery levels of students in the experiments. By using tests designed for the experiment, the mastery instruction intervention may have been able to better tailor the learning goals of the class to align with the measurement tool.[30] Conversely, these dramatic effect sizes essentially disappeared when standardized tests were used to measure mastery levels in control and experimental groups

Study duration

There are very few studies that investigate the long-term effects of mastery learning. Many studies included an arbitrary 3-4 week intervention period and results were based on findings from this time period. It's important to consider the length of time students were immersed in a mastery learning program to get a greater understanding of the long-term effects of this teaching strategy.[29]

General concerns and opinions

Typical mastery programs involve providing class instruction then testing using reliable tools (i.e. multiple choice unit test). This format of learning may only be beneficial to learners who are interested in surface rather than deep processing of information.[31] This contradicts many of today's modern learning approaches which focus less on direct assessment of knowledge, and more on creating meaningful applications and interpretations of the obtained knowledge (see Constructivism (philosophy of education))

The value of having all children achieve mastery brings into question our general view of success. If the goal of education became having children become experts, grades would become much less varied. That is, you would theoretically have a high school graduating class all with grades above 90%. Universities would have to make selections from a pool of applicants with similar grades, how would admission requirements have to change to account for uniform ratings of intelligence? Would time it took to reach mastery become a new measure of success? These questions about the wider implications of mastery as a new standard raise discussion about its actual value.[27]

Mastery learning today

Mastery Learning is one of the most highly investigated teaching methods over the past 50 years. While it has been the subject of high criticism, it has also been found to have resounding success when implemented correctly.[32] A meta-analysis by Guskey & Pigott (1988)[33] looked at 46 studies that implemented group-based mastery learning classrooms. Results found consistently positive effects for a number of variables including "student achievement, retention of learned material, involvement in learning activities, and student affect".[33] However, a notable variation was found within student achievement and it was believed this was due mainly to the subject being taught. Courses such as science, probability, and social studies yielded the most consistent positive results, while other subjects were varied.[33]

Another large-scale meta analysis conducted by Kulik et al. (1990) [30] investigated 108 studies of mastery programs being implemented at the elementary, secondary, and post-secondary level. Results revealed positive effects in favour of these teaching strategies, with students also reporting positive attitudes toward this style of learning. This study also found mastery programs to be most effective for weaker students.

Despite the empirical evidence, many mastery programs in schools have been replaced by more traditional forms of instruction due to the level of commitment required by the teacher and the difficulty in managing the classroom when each student is following an individual course of learning.[34] However, the central tenants of mastery learning are still found in today's teaching strategies such as differentiated instruction[35] and understanding by design.[36]

See also

- Flip teaching
- Instructional design
- Khan Academy
- Taxonomy of education objectives
- Bloom's 2 Sigma Problem

References

1. Benjamin S. Bloom (1981). *All Our Children Learning - A Primer for Parents, Teachers, and Other Educators*. McGraw-Hill. ISBN 9780070061187.
2. Daniel U. Levine (1985). *Improving student achievement through mastery learning programs*. Jossey-Bass. ISBN 9780875896458.
3. Anderson, Lorin W. (March 1975). "Major Assumptions of Mastery Learning". *Annual Meeting of the Southeast Psychological Association*.
4. Bloom, Benjamin S. (March 1968). "Learning for Mastery" (PDF). *UCLA - CSEIP - Evaluation Comment*.
5. James H. Block (1971). *Mastery learning: theory and practice*. Holt, Rinehart and Winston.
6. "In 'Flipped' Classrooms, a method for mastery". *The New York Times*. 2013. Retrieved 18 June 2015.
7. Skinner, B. F. (1954). "The Science of Learning and the Art of Teaching". *Harvard Educational Review* **24**: 86–97.
8. Carroll, John B. (1963). "A Model of School Learning". *Teachers College Record* **64** (8): 723–723.
9. Keller, Fred S. (1967). "Engineering personalized instruction in the classroom". *Rev. Interamer de Piscol* **1**: 189–197.

10. Grant, Lyle; Spencer, Robert (2003). "The Personalized System of Instruction: Review and Applications to Distance Education". *The International Review of Research in Open and Distributed Learning* **4**.
11. Anderson, Stephen A. (1994). "Synthesis of Research on Mastery Learning" (PDF). *ERIC Archives*.
12. Buskist, W.; Cush, D.; DeGrandpre, R. J. (1991). "The life and times of PSI". *Journal of Behavioral Education* **1**: 215–234. doi:10.1007/bf00957005.
13. Sherman, J. G. (1992). "Reflections on PSI: Good news and bad". *Journal of Applied Behavior Analysis* **25**: 59–64. doi:10.1901/jaba.1992.25-59.
14. Horton, Lowell (1979). "Sound In Theory, But...". *Educational Leadership* **37**: 154–156.
15. Bloom, Benjamin S. (1976). *Human characteristics and school learning*. McGraw-Hill. ISBN 9780070061170.
16. Carroll, J (1963). "A model of school learning". *The Teachers College Record* **64** (8): 723–723.
17. Glaser, R. (1968). Adapting the elementary school curriculum to individual performance. Learning Research and Development Center, University of Pittsburgh.
18. Atkinson, R. C. (1968). "Computerized instruction and the learning process". *American Psychologist* **23** (4): 225–239. doi:10.1037/h0020791.
19. Bloom, B. S. (1968). Learning for Mastery. Instruction and Curriculum. Regional Education Laboratory for the Carolinas and Virginia, Topical Papers and Reprints, Number 1. Evaluation comment, 1(2), n2.
20. Bloom, B. S. (1964). Stability and change in human characteristics. New York, 1.
21. Hunt, J. M. (1961). Intelligence and experience.
22. Husén, T. (1967). INTERNATIONAL STUDY OF ACHIEVEMENT IN MATHEMATICS, A COMPARISON OF TWELVE COUNTRIES, VOLUME I.
23. Guskey, T.R. (2007). "Closing Achievement Gaps:Revisiting Benjamin S. Bloom's "Learning for Mastery". *Journal of Advanced Academics* **19**: 8–31.
24. Scriven, M. (1967). The methodology of evaluation (AERA Monograph series on curriculum evaluation, No. 1). New York: Rand Mc Nally.
25. Bloom, B. S., & Carroll, J. B. (1971). Mastery learning: Theory and practice. J. H. Block (Ed.). New York: Holt, Rinehart and Winston.
26. Keller, Fred S. (1968). "Good-Bye, Teacher…". *Journal of Applied Behavior Analysis* **1**: 79–89. doi:10.1901/jaba.1968.1-79.
27. Arlin, Marshall. (1984). "Time, Equality, and Mastery Learning". *Review of Educational Research* **54** (1): 65–86. doi:10.3102/00346543054001065.
28. Bloom, Benjamin S. (1971). *Individual differences in school achievement: A vanishing point?* **4**. Education at Chicago.
29. Arlin, Marshall (1984). "Time variability in mastery learning". *American Educational Research Journal* **21**: 103–120. doi:10.3102/00028312021001103.
30. Kulik, C. L.; Kulik, J.A.; Bangert-Drowns, J (1990). "Effectiveness of mastery learning programs: A meta-analysis". *Review of Educational Research* **60** (1): 265–299. doi:10.3102/00346543060002265.
31. Lai, Patrick; Biggs, John (1994). "Who benefits from Mastery Learning?". *Contemporary Educational Psychology* **19**: 13–23. doi:10.1006/ceps.1994.1002.
32. T.R. Guskey (2009). *Mastery Learning in 21st Century education: A reference handbook, vol 1 ed. T.L. Good*. Thousand Oaks, CA: Sage Publications.
33. Guskey, T.R.; Pigott, T.D. (1988). "Research on group-based mastery learning programs: A meta-analysis". *Journal of Educational Research* **4** (81): 197–216. doi:10.1080/00220671.1988.10885824. **Cite error: Invalid `<ref>` tag; name "Guskey1988" defined multiple times with different content (see the help page).**
34. Grittner, F. M. (1975). "Individualized instruction: An historical perspective". *The Modern Language Journal* **59**: 323–333. doi:10.1111/j.1540-4781.1975.tb04708.x.
35. Tomilson, C. (2003). "Fulfilling the promise of the differentiated classrooms: Strategies and tools for responsive teaching". *Alexandria, VA: Association for Supervision and Curriculum Development*.
36. Wiggins, G.; McTighe, J. (2005). "Understanding by design (2nd ed).". *Alexandria, VA: Association for Supervision and Curriculum Development*.

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