



Learning Time and Teaching for Mastery

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What is Mastery Learning?

Despite the considerable differences in the rates at which students learn, almost all pupils can satisfactorily understand and be proficient in school subjects if

1. conditions are made appropriate for learning by providing instruction which is systematic and well organized;
2. students can be motivated so that they are willing to work at the required learning;
3. students are provided with adequate help and assistance when and where they encounter learning difficulties, and
4. they are given enough time.

Introduction

This idea of MASTERY LEARNING has had a long history: individualized instruction plans were devised by H.C. Morrison and C.B. Washburne in the 1920s and 1930s. These fixed the minimum level of performance required to reach mastery, required a demonstration of the mastery of a unit before students were advanced to the next unit and provided the extra time required for the relearning of unlearned material. The principles have not changed but they have been filled out and

techniques have been devised to help put them into practice.

J.B. Carroll in 1963, using the principles of modern learning theory, produced an influential paper entitled 'A model of school learning'. He began with the idea that a student's aptitude predicts either the level which learning will reach in a fixed time OR the amount of time which will be needed to reach a given level of understanding. He argued that if sufficient time is not spent then the learning will fall short of the mastery criterion level. But when the time spent equals the time needed learning will reach the mastery level.

The time needed by a learner was seen as influenced not only by the aptitude of the learner but also by the quality of the teaching and the ability of the learner to understand the instruction.

B.S. Bloom extended these ideas and provided details for a teaching strategy. This involved specifying objectives, constructing and using diagnostic tests and providing alternative instruction to overcome the difficulties identified.

In later work Bloom elaborated his ideas and presented research evidence which stresses the attitudes, skills and knowledge which students bring to each new learning task. He emphasized that the quality of instruction was very important and described further the prominent role of both feedback and corrective procedures in such a learning program. What has been learnt becomes the base on which new learning builds. But in addition, the task of learning becomes easier with practice, from unit to unit.

Is Mastery Learning Practical in Classrooms?

A number of teaching strategies have been devised. They are all based on the premise that all the students are capable of achieving the objectives of the course. They have several common characteristics:

1. they require the objectives to be developed and stated in specific terms beforehand;

2. they divide the course of instruction into small units, for example, into units taking about two weeks;
3. they prescribe the level of performance which a student is required to reach before being permitted to proceed;
4. they employ diagnostic tests at regular intervals throughout the course to determine whether a student has or has not achieved mastery and if not, why not;
5. they provide help for learners who have not reached the mastery criterion level.

It is the last two characteristics which are perhaps the most important. The original teaching might be of a whole class and paced by the teacher, or it might be individualized and paced by the student, but diagnostic testing will be used after the initial instruction to identify areas of difficulty so that remedies can be employed. As Bloom pointed out:

The key to the success of mastery learning strategies largely lies in the extent to which students can be motivated and helped to correct their learning difficulties at the appropriate points in the learning process.

Those students who initially fail to reach the mastery criterion level must spend additional time re-learning so that they can overcome their difficulties. Extra time means extra learning: this is the centre of mastery learning.

Research Project

In 1979 I carried out an investigation into the effects of a diagnostic and re-learning procedure on achievement. The time taken and the efficiency of the learning over a sequence of three units in a self paced learning program was evaluated. Fifty-nine students at Year 8 level in an independent boys' school were randomly assigned to two groups, one of which became the experimental

group and the other the control group. The groups were taught by different teachers. A three-part programmed textbook on matrix algebra was used as the teaching material. Students in the experimental group were required to reach a mastery criterion level of 85 per cent on each unit before proceeding to the next unit in the sequence; they were set the task of reviewing and relearning material not mastered during the initial presentations; they were provided with sufficient time and help so that each got to the mastery criterion level eventually. The control group students went straight on to the next unit whatever their score. In both groups the materials were studied at the student's own pace and the times spent in the original learning and in any re-learning were recorded. Both the experimental and control groups were required to relearn the third unit to the mastery standard. The review material consisted of a more detailed programmed text and was supplemented by tutoring for those students who still failed to reach the criterion level after using the written material. The classroom conditions and the teachers' roles were kept as similar as possible in the two groups.

An examination of previous research studies showed that there was a considerable body of experimental evidence showing the positive effect of mastery teaching, but, there were only a few studies which examined the time taken or which related achievement and time taken.

Results of the Study

1. There were significant differences in achievement between the experimental and control groups. The scores of the experimental group increased despite evidence to suggest that the material of the third unit was more difficult. The experimental group scored higher than the control group in both Unit 2 and Unit 3 tests.

2. There was evidence that the increased knowledge and skills brought to the study of later units by the students in the experimental group was a factor in explaining their higher scores in those units.

3. The experimental group took longer to study the learning materials in the later units (first time through) than did the control group. It may be that the review procedure was disliked and that students saw that it could be avoided or reduced by a more careful and complete initial study of the materials; or it could be that the students were encouraged to invest more energy and time in the study by the higher scores they obtained when they did so.

4. As the units proceeded fewer students in the experimental group needed to re-learn and the time spent on re-learning became progressively less as a proportion of total time and in relation to initial learning time. However, just over half the students in the group were still required to re-learn after Unit 3.

5. There were many students for whom the re-learning, which involved a lot of time, was necessary to maintain mastery levels.

6. The control group took almost as long in relearning the material of Unit 3 as the experimental group spent in the review of all units.

7. The efficiency of the initial learning was measured for each unit. The score on the test was divided by the time spent on the unit (adjusted for the length of the unit). Learning efficiency rose in the experimental group but declined in the control group. The increase in initial learning efficiency was gained in part at the cost of the time spent in the review of the previous unit. When this time was taken into account the differences between the units were not so marked. Efficiency fell markedly in the experimental group in Unit 2 due to the time spent in the review of Unit 1, but rose again in Unit 3. Although Unit 3 efficiency was higher in the experimental group the difference was not statistically significant. It was concluded that the higher scores were gained at the cost of the additional time spent. Extra time was exchanged for increased achievement. The experiment was a short one. It is interesting to speculate what the result might have been had the experiment extended to further units.

8. Despite the fact that both groups learned Unit 3 to the same mastery level the experimental group scored higher than the control group on both a summing-up test at the end of the work and on a retention test presented ten days later.

9. The effects of ability were tested by dividing each group into two ability subgroups. The experimental treatment appeared to be equally effective for both levels of ability. However, in two ways the lower ability sub-group in the experiment became more like the higher ability group: the decline in the total time they spent per frame was greater and their score per unit of time spent in initial learning increased more rapidly.

Implications for Practice

Providing a diagnostic review procedure, requiring students to reach mastery before permitting them to proceed to later units in a hierarchical learning sequence, and giving sufficient time for students to undertake the relearning that is necessary, will *significantly increase achievement*. This will be so whether the learning is measured during, or at the end of the learning sequence, or some time after.

There is evidence that the diagnostic review procedure encourages students to do their initial learning of new material (after the experience of reviewing and re-learning) more carefully, and that this expenditure of time and effort contributes toward higher test scores in later units. The time required for re-learning in later units is thereby decreased. The higher scores and the reduced need for re-learning may both act as reinforcers for more high effort learning. The students bring to the study of later material better knowledge, skills and attitudes and so do significantly better. This emphasizes the importance of teaching to high levels of understanding in the early stages of a learning sequence. As the level of prior learning increases so too does the effectiveness of the later learning based on this.

Remedial work plays an important role in maintaining

high levels of learning. The opportunity to review and re-learn is of most value when provided early in the learning sequence. The regular provision of help and assistance in overcoming difficulties and misunderstandings throughout the learning program appears to be more effective than such assistance provided at the end of a sequence of units. Having a working system for getting information about how much has been learnt and where difficulties are arising is most important.

There are considerable differences in the amount of time and effort different students require for both learning and re-learning. Teachers must provide opportunities for new or extended learning for those students who finish the material before others do so. These extension activities will be required especially if the initial instruction is individualized or self-paced. There will be a need to distinguish the subject material and the skills which require mastery from enrichment material and activities. There are, therefore, important implications for the curriculum.

Discussion

Mastery learning assumes that what is to be learned can

be analysed into components and that learning is sequential: what is taught at any one stage facilitates (or is a prerequisite to) what is to be taught later. Is mastery learning appropriate only to teaching the basic skills, concepts and facts? These the student cannot afford not to learn and they are, therefore, important enough to justify the allocation of the time, effort and resources required for their successful mastery. There are also many subjects where knowledge is complex, where tasks are virtually unlimited and where learning can seldom proceed through a neat sequence of stages. These subjects have goals to work toward rather than goals to be achieved. Is mastery learning less appropriate in these subjects?

There is strong evidence to suggest the re-learning time declines for many students as they proceed. There will be, however, some students who require a lot of re-learning time if they are to maintain the high mastery standard. The teaching strategy used will need to provide all students with the time that they require for learning and with incentives to use that time profitably. But time invested in the earlier stages of a learning sequence will increase the effectiveness of later related learning.

Notes

The influential paper by J.B. Carroll can be found in Carroll, J.B. "A Model of School Learning". **Teacher's College Record**, Vol. 64, No. 8, May 1963.

The first work by Bloom on teaching strategies for mastery learning can be found in Bloom, B.S. "Learning for Mastery". **UCLA Evaluation Comment**, Vol. 1, No. 2, 1968. It is easier to find, reprinted, with some alterations, as Chapter 3 in Bloom, B.S., Hastings, J.T. and Madaus, G.F.: **Handbook on Formative and Summative Evaluation of Student Learning**, New York, McGraw-Hill, 1971. His later work can be found in the following book, from which the quotation comes. Bloom, B.S. **Human Characteristics and School Learning**, New York, McGraw-Hill, 1976.

The research project carried out by the author can be found written up in Ward, G. **Learning Time and Teaching for Mastery**, Hawthorn, ACER. Occasional Paper No. 15, ACER, 1979.

Those interested in following up mastery learning will find the following books interesting:

Block, J.H. and Anderson, L.W. **Mastery Learning in Classroom Instruction** New York, Macmillan, 1975.
Torshen, K.P. **The Mastery Approach to Competency Based Education** New York, Academic Press, 1977.