

Mastery Quiz

Quizzes were prepared in advance by the instructor. A quiz was created for each chapter of the textbook, and the quizzes were based entirely on material presented in the book. The class covered approximately one chapter every week and a half and thus had one quiz in as much time. Quizzes were available to students about a week to a week and a half prior to when that chapter would be covered in class and were made unavailable at the start of that class period.

Quizzes usually consisted of 10 questions, mostly in multiple choice, true/false, and fill in the blank formats. Students could take the quiz as many times as they wanted but were expected to have a minimum grade of 80% before coming to class. The highest grade the student achieved on a quiz was recorded for his/her grade. The total score of mastery quizzes was worth 6% of the students' overall course grade.

Student Feedback

Although I am embarrassed to say this, without the mastery quizzes I probably would not be properly prepared for class.

The quizzes are very helpful. I wish we had something similar to them in all classes.

The mastery quizzes helped me because I am able to study the material for that class before class. I come to class. They were a very useful experience and study guide.

I like being able to take them over until they are right.

I think that they will definitely help my grade in the class and they really do help with preparation for class.

I think that the mastery quizzes will only be helping my overall grade, but they are helping my test and quiz grade.

Mastery quizzes were useful to get an idea what material I might be asked to study. I really think it is a really helpful.

The quizzes help prepare us for topics which will be presented in class for that day. They are a great idea.

I think they definitely help students to see what the main concepts are in the chapters and help to tie together some.

Student Reaction to the Mastery Quizzes and Minute Papers

About two thirds of the way through the course students were given a survey. Of 45 respondents, the results are:

	SA	A	N	D	SD
The Mastery Quizzes have helped me to better learn the course content.	5	31	7	2	0
I think my grade is higher than it would have been without the Mastery Quizzes.	11	12	7	12	3
Because of the Mastery Quizzes I came to class better prepared.	3	25	9	8	0
The number of Mastery Quizzes was appropriate for the amount of content covered in this class.	9	25	9	2	0
Having 4% of my overall grade attributed to Mastery Quizzes is fair.	13	24	4	4	0
ANGEL was an easy way to take the Mastery Quizzes.	32	11	1	1	0

Mr. DelPorto's use of the Minute Papers to find out what I didn't understand and then cover it again in class helped me to better learn the course content.

I think my grade is higher than it would have been without the Minute Papers and Mr. DelPorto's subsequent revisiting of material in class.

The number of Minute Papers was appropriate for the amount of content covered in this class.

SA = strongly agree A = agree N = neither agree nor disagree D = disagree SD = strongly disagree

PENN STATE



Erie The Behrend College

Applying Mastery Learning in the College Classroom

Ron DelPorto
Faculty in Computer Science
Penn State Erie, The Behrend College
ecp@psu.edu (814) 898 6197

Carla Torgerson
Instructional Designer & Faculty in Computer Science
Penn State Erie, The Behrend College
cnt2@psu.edu (814) 898 7596

A Background from Educational Research

Mastery learning is an educational theory that suggests students will learn best if they fully understand, or master, one concept before going on to the next. As Bloom writes, the key to mastery learning is this:

if students are normally distributed with respect to *aptitude* for some subject and all students are given exactly the *same instruction*..., then achievement measured at the completion of the subject will be normally distributed.... Conversely, if students are normally distributed with respect to aptitude, but the kind and quality of instruction and learning time allowed are made appropriate to the characteristics and needs of each learner, the majority of students will achieve mastery of the subject. (1976, p. 4)

Because this is based on the assumption that students learn at different rates, the process of mastery learning involves regular evaluation of student learning and then providing enough time and additional educational experiences to allow all students to reach the desired level of mastery for that concept (Lefrancis, 1994).

According to Bloom, mastery learning techniques are effective at all levels of education and allow about 80% of students to reach a level of achievement with a given concept that less than 20% would reach in a non mastery environment (1976, p. 5). Most importantly, however, is the idea that mastery of individual concepts enhances a student's ability in overall course performance:

[Bloom's research] shows increasing differences between the mastery and non mastery classes on the *original* achievement over each learning task as well as on the final summative measure. The use of corrective procedures... appears to increasingly differentiate the achievement of the mastery students from that of a comparable group of non mastery students. (p. 64 65)

This should make sense. If a student achieves mastery with one concept, then his/her understanding of the next concept can presumably begin at a higher level. If mastery learning techniques are also used with the subsequent concept, then the process continues and deep understanding of all concepts can be achieved, ultimately resulting in a stronger understanding of all concepts and their relationships at the end of a course or unit.

In their meta analysis, Block and Burns (1976) found that students taught using Bloom's mastery learning model exhibited greater learning than students taught using nonmastery approaches:

In 97 comparisons of average achievement test scores, comparisons involving various types and numbers of students and various subject matter areas, mastery taught students scored higher than nonmastery taught students 89% of the time, and significantly higher 61% of the time. (p. 19)

It was found that students taught with these mastery approaches also have better long term retention of the material: in 27 studies, 26 showed students' average scores on a delayed test were higher than students taught using nonmastery approaches, and in 17 of these studies (63%), the increase in score was statistically significant (Block & Burns, p. 19 20).

How We Implemented These Ideas

The Learning Environment

Mr. DelPorto taught an intermediate computer programming course in C++ during the first semester of the 2002-2003 school year. The class initially consists of 60 undergraduate students. For the most part, students are traditional students in their 2nd or 3rd year of a Computer Science or Management Information Systems (business applications) degree. Students meet as a group for lecture for two 50 min. sessions every week. The group is divided into three groups of 20 students for a lab that meets for 2h each week. A course textbook was utilized to augment instructor-prepared lectures and instructor-developed lab assignments.

Mastery Quiz

Students who read the text in advance are better able to process material as it is presented in class. In previous semesters the instructor found students often came to class having not done the course reading in advance and thus were unprepared for the lecture. In an effort to combat this problem, the instructor decided to use mastery quizzes. With 60 students, however, the logistics of test taking and grading are very time intensive. Additionally, with the goal of mastery quizzing being that the student retakes a quiz until mastery is achieved, the problem is aggravated.

Our solution was to provide the mastery quizzes in an electronic format using a course management system (CMS). Penn State uses a program called ANGEL for their course management system. Using a CMS such as ANGEL to provide the mastery quizzes was advantageous in several ways. The most important advantage was that ANGEL was used to automatically grade students' responses. Thus there was no grading time for the instructor. Further, feedback was instant; students reached the end of the quiz and knew instantly what their score was. In some cases the instructor also provided feedback for each of the questions and that would also be seen immediately after completing the quiz.

Because the quiz was provided electronically, students took the quiz outside of class. Thus the instructor did not use any class time for the quizzes and there were no logistical issues to allowing students to take a quiz more than once. This also gave students great flexibility in taking the quiz at a time that was convenient for them, which allowed them to pace their reading assignments as they wanted. Finally, ANGEL allows the instructor to make items available for certain periods of time. The quiz would automatically become available at the chosen time and, more importantly, would automatically become unavailable at the exact time the class for that concept was starting. So the instructor spent little time managing the quizzes and also didn't have problems with people skipping class or coming late on the day the mastery quiz was to be completed.

Minute Paper

Traditionally it is difficult for an instructor to gauge student understanding - and misunderstanding in class. Angelo and Cross (1993) developed the Minute Paper, a short questionnaire given to students at the end of class that asks what the important things they learned were and what things they are having difficulty with. By reviewing students' responses to these questions, the instructor gets a much better understanding of any problems students may be having.

Minute Paper

Mr. DelPorto had his students do a minute paper at the end of each lecture where a new major topic had been presented (about once every two to three weeks). The instructor then reviewed the minute paper responses and used the results to modify the content of the next lecture.

These questionnaires were distributed in the last few minutes of class and students returned them before leaving for the day. Questionnaires were paper based and anonymous.

Sample Student Responses in the Minute Paper

What was the most important thing you learned in this class?

- I understood a lot more about things than I did before
- How to set priorities among the functions when
- The process of using pointers
- Practice is important when

What important question remains unanswered?

- will get some of the new for pointers yet
- I just to go
- How to add things into vectors

What was the "muddiest point" in today's lecture?

- I don't know my head
- What is the main application of a delimiter
- How does it work long

*These questions are from Angelo, 2002.

Student Feedback

Mastery quizzes are a great idea. The material is hard and the quizzes are a great way to see if you really understand it.

They are helpful since they think of questions I have, but forget to ask!

I think they are a great learning tool. They allow you to prepare and ultimately help me do better in the course. I like getting the answers right.

The minute papers allow you to ask questions you may not want to ask during the lecture. The responses to them allow me to know what I need to know.

I think the minute papers are very helpful and they don't help in quality. If you are a student that you don't know it is important that you are aware of gaps in class instead of having to struggle through an understanding of a concept.

Another good idea because sometimes students are afraid to actually ask a question.

Keep the minute papers. They let me know that I am not the only one who doesn't understand a concept.

References

Angelo, T.A. (2002). *Keynote address at TIC Calloway VII: Assessment strategies to stimulate student learning*. Penn State University: May 8, 2002.

Angelo, T.A., & Cross, K.P. (1993). *Classroom Assessment Techniques: A handbook for college teachers*. San Francisco: Jossey-Bass.

Block, J.H., & Burns, R.B. (1976). *Mastery Learning*. In L.S. Shulman (Ed.), *Review of research in education* (pp. 3 49). Itasca, Ill: FE. Peacock Publishers.

Bloom, B.S. (1976). *Human Characteristics and School Learning*. New York: McGraw Hill Book Company.

Lefrancis, G.R. (1994). *Psychology for Teaching*. Belmont, CA: