Productive, Quick, and Enjoyable Assessment

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ABSTRACT

The primary purpose of classroom assessment is to determine how well students are learning on a continuous basis and to take necessary corrective measures as soon as possible to improve their learning. This paper describes an assessment technique which has been tested over the last three years in different courses. The technique involves asking a few multiple choice questions at the end of a class period. The paper also describes several variations and combinations of this technique that have been recently developed. Data have been collected from multiple classes and multiple instructors over the last three years. Eighty to ninety percent of students find that this method allows them to pay better attention in a classroom and helps them in retaining the material discussed in the earlier class periods. Instructors indicate that the method allows them to quickly identify the material that is not clear to students and take necessary corrective actions. The method also improves classroom attendance significantly. Forms and procedures that have been developed over the years have reduced the amount of instructors' time and resources in conducting this assessment. Above all, students and instructors indicate that this assessment technique is easy, effective, and enjoyable.

INTRODUCTION

Frank Huband, Executive Director of the American Society for Engineering Education (ASEE), recently reported that, "Pressures from corporate leaders, legislators, taxpayers, parents, and educators themselves are directing attention to assessment of the quality of educational programs in general and to engineering education specifically."[1] He also noted that, "If engineering schools do not assemble their own assessment process, someone else will. An externally imposed evaluation process will not be as effective as one developed and implemented by educators themselves." John Prados, Editor of the ASEE Journal of Engineering Education and Accreditation Board for Engineering and Technology (ABET) Criteria 2000 have also put special emphasis on effective assessment techniques.[2]

This paper focuses on an instructional method which can be implemented by educators themselves to a) improve assessment of what students are learning, b) increase students' attention in a classroom, and c) improve retention of material taught in classes. Background information in the above three areas is briefly given in the next section. The third section summarizes an attention quiz (AQ) method, developed earlier by the author[3]. The fourth section describes the modification of the AQ method called an Attention-Retention Quiz (ARQ) Method. The fifth

section gives helpful hints on managing the ARQ method so it can be implemented without substantial commitment of time and resources. The concluding remarks are given in the last section of the paper.

II BACKGROUND

Assessment: The primary purpose of teaching is to improve student learning. We often assume that our students are learning what we are trying to teach them. However, when we grade quizzes and tests, we realize that students have not learned as much as we expected. Very often it is too late to correct the problem.

To avoid such disappointment, faculty and students need to monitor learning throughout the semester[4]. The primary purpose of classroom assessment is to determine how well students are learning on a continuous basis and to take necessary corrective measures as soon as possible to improve their learning. Many methods like the Minute Paper, Muddiest Point, and One-Sentence Summary are suggested by Angelo and Cross[4]. An Attention Quiz technique, developed by the author, was also reported in a recent ASEE Conference Proceedings[3].

Attention: Several researchers have described the need for improving student attention in the classroom[5,6]. They indicate that when students are actively involved in learning, they learn more than when they are passive recipients of instructions. Researchers have also indicated that[7,8], a) while teachers are lecturing, students are not attending 40 percent of the time, b) in the first ten minutes of lecturing, students retain 70 percent of the information, in the last 10 minutes 20 percent, and c) the concentration of medical students in one study rose sharply to reach a maximum in 10 to 15 minutes and fell steadily thereafter. Improving students' attention in the classroom is one of the objectives of this paper.

Retention: It has been reported that students fail to apply their knowledge or skills acquired in one course to other areas or to subsequent courses[9]. Discussion with other educators and personal experiences indicate that many students fail to apply the knowledge or skills learned a few weeks ago in the same course. The ARQ method helps students retain knowledge they have acquired in the earlier class periods.

I SUMMARY OF THE AQ METHOD

The attention quiz is given at the end of each class session. The quiz contains two to four multiple choice questions covering the main ideas and concepts discussed in the class. For example, after critically discussing different methods of temperature measurement, one can ask in an AQ the advantage of a thermistor over a platinum resistance thermometer. The students can choose an answer from the given choices of A) linearity, B) sensitivity, and C) larger range. The students who have paid proper attention in the class can easily identify the correct choice. If many students do not get the right answer, then the instructor can go over that topic in the next class.

The main advantage of the AQ is that the students pay better attention and try to understand and clarify the concepts discussed in each class as they have to answer the quiz at the end of the class. The AQ gives the instructor an assessment of student learning at the end of every class. Discussing AQ solutions at the beginning of the class session provides a brief review and highlights of the previous class.

A small portion of the total grade (about 10%) is kept for the AQs. This encourages students to come to all the classes. As they attend almost all the classes, they have good continuity and better understanding of the subject. It takes an average student much longer to comprehend missed material and if the material is not studied quickly, it may affect the understanding of the next topic.

The AQ was used in eight different courses over a two year period. In each course at the end of the term, the students were asked to evaluate the AQ concept. Specifically they rated three questions, namely to what extent did the AQ help them in paying attention, in retaining the material, and in understanding the subject. The results of the students' response are shown in Table 1.

Table 1 Effect of AQ on Attention, Retention and Understanding

EFFECT OF AQ ON	% OF STUDENTS RESPONSE*				
	5 very helpful	4 helpful	3 neutral	2 wasteful	1 very wasteful
Attention	50	47	3	0	0
Retention	27	52	19	2	0
Understanding	23	57	19	1	0

* Total number of respondents in the eight courses = 167
Total enrollment in the eight courses = 181

The results indicate that 97 percent of the students thought that the AQ was 'helpful' or 'very helpful' to make them pay more attention in the classroom. Seventy-nine percent of the students indicated that the AQ helped them retain the subject material. To further improve retention of the subject matter, a variation of the AQ method, called the Attention-Retention Quiz (ARQ), was developed over the last year. This method is described in the next section.

IV ATTENTION-RETENTION QUIZ (ARQ)

The ARQ method involves two steps which allow students to recall and integrate material taught in the pervious lectures. The first step consists of asking three or four multiple choice questions at the end of each class. Two or three of these questions are based on the material covered in the current class period while the remaining one or two questions are based on material taught in the last two lectures.

The second step involves asking seven to nine multiple choice questions every 2 to 3 weeks. These questions are based on the previous portion that has been covered in the class. Some of the questions can be the same or similar to the ones asked earlier in the daily quiz. Others can be based on material which requires integration of the topics taught earlier.

The ARQ method has all the advantages of the AQ method described earlier and in addition it allows students to recall and integrate previously taught material. The method was used in two courses, 'Measurements' and 'Automatic Controls', during the last year. The students were asked to evaluate the ARQ method by rating the three questions described earlier. Their responses are shown in Table 2. The results indicate that about 95 percent of the students thought that the ARQ method was 'helpful' or 'very helpful' in paying attention and retaining the material taught in the classroom. Comparing the results of the ARQ method with that of the AQ method indicates that there is a significant improvement in the retention aspect. Forty-six percent of the students thought the ARQ was 'very helpful' for retention. This response is nineteen percent higher than the results of the AQ method. The students also perceived that the ARQ compared to the AQ was slightly better for understanding the subject.

Table 2 Effect of ARQ on Attention, Retention and Understanding

EFFECT OF ARQ ON	% OF STUDENTS RESPONSE*				
	5 very helpful	4 helpful	3 neutral	2 wasteful	1 very wasteful
Attention	49	47	4	0	0
Retention	46	49	5	0	0
Understanding	35	53	11	1	0

* Total number of respondents in the two courses = 102
Total enrollment in the two courses = 108

The above results indicate that most of the students rate this technique as being helpful in improving the teaching-learning process. This may raise a question: Are college students competent judges of assessing their learning? Several studies confirm the correlation between self-assessment by college students versus objective measurement in scholastic areas. A meta-analysis (aggregating results from 55 published studies) by Mabe and West[10] includes several studies relevant to this question. The correlation is indeed high and positive, with coefficients typically averaging 0.5 and extending up to 0.8.

V MANAGEMENT OF THE ARQ

This section describes how to manage the ARQ method on a daily basis without substantial commitment of time and resources. The students use a specially designed ARQ sheet to answer quiz questions. The top portion of the sheet is shown in Figure 1. The first row has five rectangles. One side of the sheet contains five such rows. One rectangle for each lecture is used to answer the quiz questions. Thus, one sheet with two sides is good for up to fifty quizzes.

Course: ME 412 Term, Year: Spring 96 **ARQ Sheet** Class ID: 15

Date: 1-15 1. C 2. B 3. E 4. A	Date:	Date:	Date:	Date:

Figure 1 Top Portion of the ARQ Sheet

On the first day of the class, each student receives a blank ARQ Sheet. The students are also given their class ID numbers, say from 1 to 30. The students complete the information on the top of the sheet as shown in Figure 1. At the end of the class, each quiz question along with the multiple choices is displayed using an overhead projector. The answers given by a student at the end of the first day are shown in the first rectangle in Figure 1. When leaving the classroom, students deposit the ARQ sheet in a specified orientation in a box kept near the door. This allows the instructor to pick up a box at the end of the class with all the sheets arranged in a specific manner.

The instructor grades each quiz and keeps a count of wrong responses on a separate paper. The count allows the instructor to assess student learning. For example, in a class of thirty students, an instructor may find that there were two wrong responses each for the first, third, and fourth questions and thirteen wrong responses for the second question. In this situation, the topic related to the second question should be clarified in the next class. After grading the quizzes, the sheets are arranged in ascending order based on the class ID number. This complete process takes about seven to eight minutes for a class of thirty students.

In the next class period the ARQ sheets are passed back to the students. Since the sheets are arranged in a sequential order everyone gets their own sheet in less than five minutes. While the sheets are being circulated, the instructor can go over the quiz solution, the overall results, and the corrective strategy if necessary.

When the number of students in a class is more than thirty, say up to sixty, then ARQ sheets of different colors are used. For example, green sheets are used for ID numbers 1 to 15, blue sheets for ID numbers 16 to 30, and so on. The different sheet colors save the instructor's time in arranging the sheets in sequential order. This strategy also helps in giving the sheets back to the students as they will pass all other colored bunches directly and look only into the bunch belonging to them. When the number of students exceeds 70 the present approach becomes too time consuming. An automated assessment method using optical scan sheets is being developed on a UNIX system. This method can be used for large classes with several hundred students. A trial version of this method is currently being tested in a class of 170 students. The method and the results will be described in the near future.

VI CONCLUSIONS

The ARQ method has been developed to improve assessment, attention, and retention in the classroom. The method has been tried in two classes during the last year. Instructors have indicated that this method provides them a daily assessment of student understanding of specific concepts and allows them to take corrective steps, if required. For example, if the results of the ARQ indicates that the majority of the students had difficulty with a certain concept, that concept can be explained in the next class. Another advantage of this method is that the attendance in the class is in the range of 90 to 100%. Romer[11] has provided quantitative evidence that absenteeism in classes is a major problem and it affects student performance. Romer, based on his results, indicates that serious consideration should be given to increasing attendance. Implementing the ARQ method does result in higher attendance.

Students reactions to this method are positive. Ninety-five percent of the students indicated that the ARQ method helped them pay better attention in the classroom and helped them retain the subject matter taught in the earlier class periods. Besides the numerical ratings, a large number of students wrote that they appreciated the spirit of continuous improvement and the learning environment the method creates.

Finally, a word of caution may be necessary. This method is only a tool to improve the teaching-learning process. The use of this method by itself does not guarantee successful outcomes. The method cannot replace, but it can augment, the essential teaching skills of presenting the material clearly and logically, having positive regards for students, and relating the material being taught to other courses and to practical applications.

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REFERENCES

1. Huband, F. L., "Matters of Assessment," *ASEE Prism*, p 4, September 1994.

2. Prados, J. W., “What Are We Looking For,” The Editor’s Page, *Journal of Engineering Education*, p. 173, July 1996.

3. Mehta, S. I., "An Attention Quiz; A Low-Tech, High Yielding Teaching Tip," *Proceedings of the 1993 ASEE Annual Conference*, Urbana, IL, pp. 1897-1901.

4. Angelo, T. A., and K. P. Cross, *Classroom Assessment Techniques: A Handbook for College Teachers*, Jossey Bass Publisher, San Francisco, CA, 1993.

5. Cross, K. P., "Teaching for Learning," *AAHE Bulletin*, 1987, 39:3-7. ED 283446.6, pp. MF-01; PC-01.

6. Association of American College, Task Group on General Education, 1988, A New Vitality in General Education, Washington, DC., ED 290387.64, pp. MF-01; PC-01.

7. Bonwell, C. C., and J. A. Eison, *Active Learning: Creating Excitement in the Classroom*, ASHE-ERIC Higher Education Report No. 1, Washington, DC., 1991.

8. Meyers, C., and T. B. Jones, *Promoting Active Learning: Strategies for the College Classroom*, Jossey Bass Publisher, San Francisco, CA, 1993.

9. Gronhovd, S. and S. Danielson, "Encouraging Learning Transfer: From the Communication Classroom to Engineering Courses," *Proceedings of the 1994 ASEE Annual Conference*, Edmonton, Canada, pp. 745-747, 1994.

10. Mabe, P. A. III, and S. G. West, "Validity of Self-Evaluation Ability: A Review and Meta Analysis," *Journal of Applied Psychology*, 67, (3), pp. 280-296, 1982.

11. Romer, D., "Do Students Go To Class? Should They?" *Journal of Economic Perspectives*, 7, (3), pp. 167-174, 1993

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