

***USING ONE-MINUTE PAPERS FOR IMMEDIATE FEEDBACK OF
STUDENT COMPREHENSION OF MATHEMATICS
IN THE CLASSROOM***

by

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Abstract.

A problem in teaching is the assessment of the students comprehension. The earlier the problem areas can be identified, the easier it is to correct the problems and to proceed on to new concepts successfully. The One-Minute paper technique can be used to evaluate the students understanding of the concepts and their ability to apply them. This quick and easy process allows the instructor to alter teaching methods at the earliest possible moment.

Introduction.

Teaching mathematics classes for ERAU at the military base residence centers creates a unique challenge. The condensed terms of 16 class meetings in eight weeks doesn't allow much time to present the material, discuss the applications and to review the trouble areas. The students seem to run short of time to learn to use the concepts and to do sufficient practice. Their military/job/family commitments will cause several to be absent for any given class meeting.

Mathematics is a structured subject in which the students continually build on the preceding concepts they have learned. If they do not have a good foundation of the preceding concepts, the new concepts will not be fully comprehended. This problem is compounded when large quantities of material are presented in a relatively short period of time. The instructor must be more aware of the students comprehension and be willing to make midcourse corrections or changes in teaching methods. To do this, the instructor needs immediate feedback from the students. One way of getting some of this feedback in a non-threatening manner is by using the "One-Minute Paper" assessment technique.

Cross and Angelo (1988) define the "One-Minute Paper" assessment technique as follows:

"The One-Minute Papers, a technique also known as the Half-Sheet Response, provide a quick and extremely simple

way to collect written feedback on student reactions. The teacher stops class a few minutes early and poses one or two questions to which students are asked to react. The students write their reactions on half-sheets of paper, or index cards, the teacher has handed out."

(pp. 148-150)

An example of my application of this technique follows: Two One-Minute Papers were written for each class meeting. The students were not requested to put their name on the paper. The only information requested was the course name/number, date and comments on the stated question.

The One-Minute Paper that I collected at the start of the period was written at home as part of their assignment. The topic of this One-Minute Paper was "the muddiest concepts of the last class session". As they did their homework, they kept track of the problem areas/concepts. This is not a list of problems they were unable to solve, but the concepts they think are involved in those problems. These One-Minute Papers were either left in my mailbox or on my desk before the class started. Prior to the beginning of class, I took a few minutes to review what the students had written in their One-Minute Papers. Their comments were used as the starting point for the class review and discussion.

The second One-Minute Paper was written at the end of the period. The topic

of this One-Minute Paper was "the three most important concepts of the class period". I also wrote a One-Minute Paper at the same time. My paper was compared to the students' papers to see if my presentation emphasized the main concepts so the student could readily follow the discussion.

Project proposal to use the One-Minute Paper technique.

A project was attempted to gather information on the students' weakest areas/concepts at the earliest possible time. It was designed to be able to plot the course of the students comprehension of class activities closer to the time the problems occur. The "muddiest points" and "most important concepts" One-Minute papers were used to keep track of the students' perception of their progress. It was composed of several parts.

a) Pretest was given at the first meeting of the term (MA-111, College Math for Aviation I).

This test was constructed with questions and problems covering the entire spectrum of the course. It was checked and the scores recorded for comparison at the end of the term. This comparison was made with their scores from the final test and their average for the quarter. Each student was compared only against his/her own scores. The pretest was not used, in any way, for calculating the course grade.

b) Two One-Minute papers were to be submitted each class meeting.

The MA-111 (College Math for Aviation I) class contained 18 students and the MA-112 (College Math for Aviation II) class contained 28 students. I had the MA-111 and MA-112 classes write a One-Minute

paper on the "muddiest points of the last class meeting". This can be done at home before they came to class and left either in my mail box or on my desk before class. A few minutes were taken prior to the start of the class to do a quick summary of their comments. The results of the papers were the starting point for that class period.

The other One-Minute paper was written on the "most important concepts of that class meeting" at the end of the class period. These papers were summarized after each class for analysis. While the students were writing their One-Minute papers, I also wrote what I thought were the three or four most important concepts that I would expect the students to list/learn. I used this information to do some comparison between my list and their responses.

The students did not put their name on any of the One-Minute papers. Only the course name or number and date was asked.
c) End of term evaluation.

The final test grade and course averages of each student were compared to the pretest given at the start of the quarter. A matched pair statistical analysis method was used to compare the students' end of term score to his/her own pretest score.

Results of the Project.

The pretest in MA-111 provided the students with a better idea of what they would be learning during the course. It provided me with some clues about each of the students' background. The pretest scores were poor for the class as a whole. They did show the potential of the students that had taken Algebra and/or Trigonometry sometime in the past. These students would work parts of the problems correctly but couldn't put it all together to get the

problem completely correct.

The pretest was not used for the MA-112 class, since nineteen of the twenty eight were students from the MA-111 class. None of them had any calculus background. The nine additional students also indicated that they had no calculus background.

Both One-Minute papers were used in the MA-111 class. The "muddiest concept" papers that were written while doing their homework soon became a regular part of the students' assignment. They spent minimal time and extra work doing them. With my focusing on the ones that were turned in at the start of the period, the students soon discovered that they could put a "highest priority" on getting their problems addressed by turning in a "muddiest concept" paper. The class organization had a smoother flow from start to finish by taking problems/concepts in sequence in stead of the random order that exists from questions being ask.

The One-Minute papers on the "most important concepts" did not seem to produce any significant results to add to the evaluation of teaching methods or learning style. The students were able to identify the most important concepts without always being able to understand the concepts. The concepts were identified by a name, such as the quadratic formula, or an example used to demonstrate the concept. These papers were discontinued before the term was over.

This immediate feedback helped me discover which teaching methods were the most effective and which were least effective for the ERAU mathematics classes. The collected information helped me revise/improve my teaching methods and increase communication between the

students and the instructor in a non-threatening manner. I knew specifically what many of the problems were and when they occurred before test time.

Statistics

All of the paired statistical methods supported the hypothesis that something was done appropriately in the MA-111 class since for every student their final test scores and course averages were above their score on the pretest. The following table lists the scores.

Student Number	MA 111 Pretest Percent	MA 111 Final Test Percent	MA 111 Course Average	MA 112 Course Average
1	54	100	96	94
2	24	92	91	87
3	52	62	84	I
4	60	98	90	82
5	8	70	80	I
6	70	72	84	83
7	46	82	90	83
8	6	64	80	67
9	38	64	84	81
10	10	84	82	82
11	38	88	88	84
12	10	54	61	62
13	2	78	79	84
14	36	90	86	87
15	60	82	90	I
16	10	72	78	74
17	54	84	83	81
18	22	90	86	86
19	42	74	Audit	I
20				66
21				80
22				61
23				90
24				80
25				I
26				I
27				I
28				I
Mean Score	32	79	84	80

The audit was not used in the calculation of the mean for the MA-111 course, but the pretest and final test scores were included in the means.

	MA-111 Pretest Percentage	MA-111 Final test Percentage	MA-111 Course Average	MA-112 Course Average
Mean	31.7	78.9	84.0	79.7
Standard Deviation	22.4	12.8	7.5	9.1

All of the class means and standard deviations, in the above table, were calculated using only the grades of the students receiving a grade of D or better. The F grades were dropped because the primary reason for the failures was the students not finishing the course. The course averages contain both the averages of the homework and the tests. The more than doubling of the mean from the pretest to the final test or course average for MA-111 was expected due to the low scores on the pretest. The MA-112 course average and standard deviation will probably change when the eight incompletes are finished.

Course	MA-111	MA-111	MA-111	MA-111	MA-111	MA-111
Starting Dates	Jan 89	Jan 90	Jan 91	Jan 92	Oct 92	Oct 93
Location	Norton AFB	Norton AFB	Ft. Lewis	Ft. Lewis	Ft. Lewis	Ft. Lewis
Class Mean	78.1	77.8	76.4	81.7	78.7	84.0
Standard Dev.	15.2	9.6	19.8	5.8	8.6	7.5
Number of Completions	15	8	17	12	10	19
Number of W's and F's	1	4	2	2	3	1

A comparison of the six sections of MA-111 that I have taught for ERAU showed that the method was beneficial to the students. It was the largest MA-111 class I have taught for ERAU with the least number of W's or F's. They also had the highest class mean and one of the better standard deviations. The students at the bottom of the grade scale did a better job in the course.

Course	MA-112	MA-112	MA-112	MA-112	MA-112
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*Using One-Minute papers for Immediate feedback of Student
Comprehension of Mathematics in the Classroom*

Starting Dates	Mar 90	Mar 91	Mar 92	Jan 93	Jan 94
Location	Norton AFB	Norton AFB	Ft. Lewis	Ft. Lewis	Ft. Lewis
Class Mean	67.6	80.9	79.1	81.9	79.7
Standard Dev.	24.9	7.1	8.9	8.3	9.1
Number of Completions	10	17	15	15	20
Number of W's and F's	0	2	3	1	8 Incompletes

A comparison of the five sections of MA-112 that I have taught for ERAU showed similar results. It was also the largest MA-112 class I have taught for ERAU with the most completions and no W's or F's. There are currently 8 Incompletes. They also had the median class mean. The bottom four students on the grade scale caused the larger standard deviation. Of these four students, two struggled with their algebra skills (they were not in the previous MA-111 course), a third missed over half of the classes and the fourth was usually about a week behind. These problems limited their ability to take advantage of the One-Minute papers for the extra help.

General observations

The students appreciated the One-Minute paper of the "muddiest concept". The first meeting of the MA-112 class, they asked if "we could continue submitting them at the start of each class meeting". With a show of hands, all nineteen of the MA-111 students who were continuing on to the calculus course supported the process. The remaining MA-112 students soon picked up the process. The process seemed to encourage the students when they discovered that several other classmates had asked the same question. They were not the only one struggling with a particular concept. Some students would use their own paper to write their questions and sign their name while others wanted to remain anonymous by using the form provided. The number of students that would turn in a "muddiest concept" paper was consistently above one-half of the number of students in attendance that class meeting. Since some of the students, after the first two or three

meetings, would be an assignment behind due to an absence, it was difficult to tell how many who had worked on the current assignment didn't turn in an One-Minute paper. The general attitude of the students seemed more positive than in previous classes. It left the students with the feeling that I really cared if they learned the mathematics. They still commented on the amount of homework or time required, but they came to class with specific questions to be answered. The class meetings were better sequenced by concept.

As a result of this project, the students benefitted by my improved teaching methods/style in the ERAU mathematics classes. In addition, I hope this assessment process may encourage other ERAU instructors to do similar projects in their classes.

References

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