

Impact of Using One-Minute Paper in Civil Engineering Courses

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Abstract

There are many challenging courses in a typical ABET accredited Civil Engineering curriculum. An example of such a course is the Structural Steel Design Course. This course is offered in structural engineering, architecture, construction management, and architectural engineering programs in general. This course is theory intensive and basically there is so much to do within the limited time. Students take this course in their senior year. Students commonly complain that they do not have enough time to comprehend what was covered in class or to focus more on some areas. This paper presents an effort performed in the Civil Engineering Department to teach the Structural Steel Design course more effectively. For each topic covered, students were asked to submit one-minute paper through which they list areas that they desire to understand more. The instructor subsequently compiles the information in the submitted one-minute papers to create a list of items that the instructor should address before starting a new topic. Using this technique was found to be rewarding as it improved students' experience and learning. A comparison was conducted of course outcomes evaluation results and online course evaluation results between two groups of students; one group had the advantage of using the one-minute paper technique and the other did not experience this technique. It was found that using the one-minute paper technique led to higher ratings in both of course outcomes evaluation and online course evaluation.

Introduction

The one-minute paper is commonly used in classroom. It is usually assigned at the end of class if the instructor is interested to receive the feedback of students with respect to a particular topic that was covered in class. This is an opportunity for the students to reflect on what the instructor has covered and to provide the instructor with their feedback. It is an opportunity for personal reflection and active involvement of the students. It provides a quick feedback on whether students understand all of the concepts that were presented in class. The one-minute paper typically takes a minute to complete. This class assessment technique was invented by a physics professor at the University of California, Berkeley [1] while later it was widely used by Cross and Angelo [2]. Most of the time, students respond anonymously to a question assigned by the instructor asking them about what they learned in class.

To implement the one-minute paper strategy, a few minutes before class ends the instructor requests students to respond to questions such as "What was the most important thing you learned during this class?" and "What important question remains unanswered?" [2]. When an instructor assigns one-minute papers, it is important to ensure that students' feedback is addressed and answered. If an instructor is not planning to respond to students' feedback, it may not be a good idea to ask students to write one-minute papers.

Using One-minute Paper

In what follows, I will describe (1) the questions that students were asked in the one-minute papers and (2) what was done to address students comments.

I have adopted the one-minute paper strategy in the Steel Design course in order to obtain students' feedback at the end of each topic that is covered in class. The Structural Steel Design course, similar to other engineering design courses, contains a large number of topics. It includes design of tension member, compression member, beam, beam-column, and simple connections. The Steel Design course is a required course and is usually offered every year in the Fall semester. In the beginning of the semester, I announced to the students that I will use this technique in an effort to obtain their feedback frequently and to improve their learning. I assign the one-minute paper at the end of the class, which helps students to give more attention and focus their attention on what they need to understand better. I tend to alternate between the following questions:

- What is the muddiest point in this topic?
- What do you need to understand better in this topic?

A few minutes before class ends, I ask students to respond to the question briefly and write their responses on the distributed cards. I used the one-minute paper as a strategy to permit students to reflect on what was covered in a particular topic and to inform me of what difficulty they have in this particular topic. Since this strategy was designed to help students to understand materials better and improve their experience, I did not have students to write one-minute papers anonymously. But, I asked them to identify themselves by writing their names on the submitted assignments in order to understand what each one in the class lacks. I used this feedback to design in-class assignments to cover all of the points that were raised by the students. I expected students to provide similar feedback. Most of the time, students provide similar concerns so assigning the same in-class assignment to the entire class was a good idea. Sometimes, they surprisingly do not present the same concerns. When students' feedback is not the same, it becomes very hard to design a single in-class assignment to address all of the concerns. The in-class assignments become lengthy to cover all concerns; therefore, students will not be able to finish the in-class assignments in class. I wanted all of the students to be able to finish the in-class assignments in class. Thus, when feedback varies from one group of students in class to another, there was a need to design more than one in-class assignment. When this happened, I designed a number of in-class assignments and divided the class to groups according to similarity in difficulty that they have in a given topic, then provided each group with the appropriate in-class assignment.

I repeatedly asked students to write one-minute papers after each topic covered and also designed and provided students with in-class assignments to address their concerns. I found this to be rewarding for both myself and the students. Students who submit one-minute paper receives full credit even if the student left the card blank; it means that the student does not have any difficulty or concerns about the topic in question. Also, there is no correct or incorrect answer to the assigned question in the one-minute paper. Once I receive their feedback, I summarize the results then start to address them. To respond to the assigned question, students should first recall what was covered, evaluate their level of understanding, and then reflect on the question. Going

through all of these steps will definitely improve the way that students perceive the information. I found many advantages of using this technique in class.

- (1) This technique made me aware of what concepts are more challenging to students, what students need to learn better, and if I need to spend more time discussing a particular topic.
- (2) It helps instructors to decide if they need to apply any changes to the course or to the way that they teach the course.
- (3) Also, it helped students as it improves their learning and course experience.
- (4) Also, the one-minute paper strategy provides students, who are afraid of participating in class and asking questions, with a way to communicate their concerns and questions to the instructor.
- (5) The students who are already active in class will also benefit from this technique as they will have another opportunity to express their opinions and present their concerns.
- (6) In addition, the one-minute paper allows students to think about what they did not understand well as the topic is presented.
- (7) In the course syllabus, a percent of the final course grade is assigned to completing all of the assigned one-minute papers; therefore, assigning one-minute paper improves the class attendance and makes students more involved in class.
- (8) Assigning the one-minute paper at the end of class ensures that students will remain in class for the full duration of class period.

Responding to one-minute papers submitted papers usually does not take much time. In this course, I designed in-class assignments to respond to their comments. On average, it took about 15 minutes to design each in-class assignment that would contain enough questions to cover all of the concerns that were raised by the students.

Course Learning Outcomes

At the end of the semester, students were asked to rate the seven course outcomes on a scale from 1 to 5. The options were ratings of 1,2,3,4, or 5 indicating strongly agree, partially agree, indifferent, partially disagree, or strongly disagree, respectively. The Steel Design course is designed to enable students to:

- (1) understand the Load and Resistance Factor Design (LRFD) concept and ability to use AISC-Steel Manual,
- (2) Analyze and design tension members,
- (3) Analyze and design compression members,
- (4) Apply the concepts of elastic behavior, yielding, fracture and buckling in design and analysis of steel members. This outcome is basically the limit states that are used to design tension and compression members, beams, beam-columns, and connections,
- (5) Analyze and design members in flexure (design of beams),
- (6) Analyze and design members subjected to combination of axial and bending (design of beam-columns), and
- (7) Analyze and design simple connections.

The course outcomes fulfill some of the ABET outcomes a-K (Table 1), presented below. To assess the impact of using the one-minute paper technique on students' learning, the results of course outcomes evaluations of this year at which the one-minute paper technique was used and those of the previous year at which the technique was not used were compared (Table 2). It can be observed that students learning have improved as per the numerical values, which can be owing to the use of the one-minute papers.

- a) an ability to apply knowledge of mathematics, science and engineering
- b) an ability to design and conduct experiments, as well as to analyze and interpret data
- c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- d) an ability to function on multidisciplinary teams
- e) an ability to identify, formulate, and solve engineering problems
- f) an understanding of professional and ethical responsibility
- g) an ability to communicate effectively
- h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- i) a recognition of the need for, and an ability to engage in life-long learning
- j) a knowledge of contemporary issues
- k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Table 1. Relation between course outcomes and ABET a-k outcomes

	Student Outcomes										
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
CO 1	X										
CO 2	X	X									
CO 3	X	X									
CO 4	X				X						
CO 5	X	X									
CO 6	X	X									
CO 7	X	X									

Table 2. Comparison of Course Outcomes Evaluation Results

Course Outcome Number	Fall 2012-2013 (19 students)	Fall 2013 – 2014 (20 students)
1	4.7	4.9
2	4.6	4.7
3	4.6	4.7
4	4.0	4.4
5	4.3	4.6
6	3.9	4.2
7	3.7	4.2

Online Course Evaluation

Throughout the entire University, students are usually asked at the end of each semester to fill out an online course evaluation to evaluate the course, the instructor, and their learning. The online course evaluation contains about 15 – 25 questions. For most of the questions, students are asked to provide ratings of 1, 2, 3, 4, or 5 indicating strongly disagree, disagree, neutral, agree, or strongly agree. In here, a comparison between the online course evaluation results for last year and this year, when the one-minute paper strategy is implemented, will be presented. It is important to note that the same instructor taught the course in both of the years. It is noteworthy to mention that the online course evaluation format and questions have substantially changed this year therefore it becomes difficult to present such comparison. In what follows, I will attempt to provide results for similar questions between the two online course evaluation reports (Table 3).

Table 3. Online course evaluation results

Fall 2012 – 2013 (20 students)		Fall 2013 – 2014 (18 students)	
Question	Rating	Question	Rating
The course, overall	3.7	The course, overall	4.5
The professor, overall	3.4	The professor, overall	4.6
The classroom environment enhanced my learning	3.2	The course was designed to foster leaning of the course material	4.5
Overall, my learning experience has been	3.2	Provided me with an important skill set needed for further studies in this field.	4.5
The professor used teaching methods that helped me learn.	3.3	communicated the course material effectively using clear and appropriate language and terminology.	4.1

Conclusions

In order to assess the impact of using one-minute paper strategy in Civil Engineering courses, this study was conducted. This year, the one-minute strategy was implemented in the Steel Design course; however, the previous year when this course was taught the strategy was not used. To demonstrate the impact of using one-minute paper technique, a comparison was done between the results of course outcomes evaluation and online course evaluation of this year and the previous year. From the conducted study, the following conclusions are drawn:

- 1- Using the one-minute paper strategy is found beneficial and students found it rewarding.
- 2- The one-minute paper strategy was found effective. Also, it was determined that it is an excellent way to involve students and make them active learners.
- 3- A noticeable improvement in evaluation ratings was achieved. This can be owing to the implementation of the one-minute paper strategy.
- 4- When the course is taught next time, the one-minute paper strategy will still be used to evaluate whether the improvement in evaluation ratings will continue.

References

[1] Davis, B. G., Wood, L., & Wilson, R. C. (1983). *ABCs of teaching with excellence*. Berkeley: University of California.

[2] Cross, K. P., & Angelo, T. A. (1988). *Classroom assessment techniques: A handbook for faculty*. Ann Arbor, MI: National Center for Research to Improve Postsecondary Teaching and Learning.