

# A Study of the Effectiveness of Using Innovative Teaching Methods to Enhance Student Learning in Lecture and Laboratory Courses

J. Mark Taylor, PhD, JD and Roger Killingsworth, MS

Auburn University  
Auburn, Alabama

Technological advances in education have changed the way that classroom materials can be delivered. Even with these advances, the traditional 50-minute lecture remains the most widely used presentation method. Maintaining student attention for the entire 50 minutes remains a problem. Needed is an innovative combination of traditional lecture methods and advanced technology tailored to student's attention limitations to improve student learning. Over the years many studies have been done to define the student attention problem. Middendorf and Kalish summarize the findings of these studies reporting that this phenomenon occurs in a set pattern. They report that it takes about five minutes for the students to settle down and get focused. Then they pay attention for 15 to 20 minutes before their attention begins to wander. After the initial period the students can only focus for increasingly shorter periods of time falling to around 5 minutes by the end of the lecture. They suggest that the lecture "be punctuated with periodic activities" such as problem solving sessions, models, experiments, different presentation methods, etc., to hold student attention and improve learning. They report that breaking up a class in this manner often has the effect of "restarting the attention clock" enabling the students to pay attention for an additional 15 to 20 minutes after the activity. The purpose of this research is to test this hypothesis with building science students in two of our required classes – one a sophomore level class and the other a senior level class.

**Keywords:** assessment, flipping the class, short instructional segments, teaching effectiveness

## Introduction

Technological advances, including the use of computers, tablets, e-readers, projectors, specialty software, telecommunications, etc. in the classroom have changed the delivery of educational materials over the years. However, even with these advances, the traditional 50-minute lecture remains as the most widely used presentation method in a university setting. An often-reported problem is that of maintaining student attention for the entire 50 minutes and the negative impact student inattention has on learning. Our hypothesis is that an innovative combination of traditional lecture methods and advanced technology tailored to student's attention limitations is needed to improve learning.

Over the years many studies have been done to define the student attention problem. Middendorf (1993, 2011) and Kalish (1996) summarize the findings of these studies reporting that this phenomenon occurs in a set pattern. They report that it takes about five minutes for the students to settle down and get focused. Then they pay attention for 15 to 20 minutes before their attention begins to wander. After the initial period the students can only focus for increasingly short periods of time falling to around 5 minutes by the end of the lecture. They suggest that the lecture "be punctuated with periodic activities" such as problem solving sessions, models, experiments, different presentation methods, etc. to hold student attention and improve learning. They report that breaking up a class in this manner often has the effect of "restarting the attention clock" allowing the students to pay attention for an additional 15 to 20 minutes after an activity has started.

A current application that acknowledges students attention limits and breaks down subjects to bite sized chunks are the Kahn Academy (Kahn 2013) videos. These videos cover a limited topic in lessons of no more than 10 minutes. They have been well received and have proven to be very effect in teaching a variety of topics.

The researchers propose to test this hypothesis on university construction management students by developing a combination of shortened traditional lectures, class exercises, discussions, assignments, and Kahn Academy type videos. Student assessment in the form of a multiple-choice questionnaire will be used to assess the accuracy of the hypothesis.

## **Project Objective**

The objectives of this project include:

- Determining what combinations of traditional lectures and new activities are appropriate for construction management lecture and lab courses.
- Determining if these combinations improve student attention and learning.

## **Methodology**

The hypothesis that short instructional modules are effective will be tested by:

1. Developing course materials incorporating short lectures, class exercises, class discussions, instructional videos, etc., for Construction Communications, a sophomore level lab course and Construction Law, a senior level lecture course.
  - Adapt lecture materials for 15-minute lecture modules
  - Develop in-class student activities
  - Develop videos, readings, and notes for in-class and out-of-class use
2. Testing the course materials.
  - Course materials are presented in class
  - Periodic tests are given to test student learning
3. Using qualitative and quantitative studies to determine students' perception of and the effectiveness of the new course materials and teaching approach.
  - A quantitative study of students' perception of the new course materials and teaching approach will be performed by means of a questionnaire administered at the end of the semester
- Student learning will be measured by the grades of periodic tests during the semester
4. Revising class materials and procedures for use during subsequent terms.
  - The results of the questionnaire and the quizzes will be analyzed to determine what changes need to be made to increase the effectiveness of the course
  - Develop and revise new materials, as needed
5. Implement and test the revised course materials.
6. Using qualitative and quantitative studies to evaluate student's perception of and the effectiveness of revised course materials and teaching approach.
  - A qualitative study of students' perception of the new course materials and teaching approach will be performed by means of a questionnaire administered at the end of the semester
  - Student learning will be measured by the grades of periodic tests during the semester

## **Outcomes and Assessment – Construction Communications**

Construction Communications, is a second semester sophomore level class teaching the reading and interpretation of construction specifications and plans. Both paper copies and electronic copies of construction plans are used in the course along with virtual models. This course incorporates both lecture periods and in-class lab assignments. This class met from 7:30 am to 9:45 am on Tuesdays and Thursdays, and from 1:30 pm to 3:45 pm on Mondays and Wednesdays for 2 hours and 15 minutes.

The first implementation of short modules was during the fall semester of 2012. The student population consisted of 15 students in the morning section and 21 students in the afternoon section. The classroom was a traditional lecture style classroom. The original plan for the semester was to divide each class period into segments as follows:

- 5 minutes – Class roll, take up exercises and assign next exercise
- 20 minutes – Learning Segment 1 (Lecture/Demonstration)
- 5 minutes – Health Break
- 20 minutes – Learning Segment 2 (if necessary)
- 5 minutes – Health Break
- 20 minutes – Learning Segment 3 (if necessary)
- 60 to 105 minutes – Lab Segment

During the semester approximately half of the classes required only the first learning segment (for simple concepts and exercises that were easy for the students to understand) and half the classes required a second learning segment (for more advanced material that was more difficult for the students to understand). Only one class required the third learning segment. The students were not required to stay for the lab segment. Those who did stay were allowed to leave when they had completed the exercise.

Class grades were as follows:

Morning section: 4 A's (27%), 6 B's (40%), 4 C's (27%), and 1 Incomplete (6%)

Afternoon Section: 2 A's (10%), 15 B's (71%), 4 C's (19%)

It was noticed that those students who did stay for the lab segment generally did better on both the exercises and the exams because the professor was in the classroom to answer questions.

The schedule seemed to work well and was continued in the second semester. The only change was to modify the time where student in-class exercises were required to be turned in. It was decided not to require the students to remain for the lab segment, but to comment on the high grades earned by those who did and to allow the students to decide for themselves.

The second implementation of the short modules was during the Spring Semester of 2013. The class met at 7:30 am section and only this section was included in the study. This section also met in a traditional style classroom.

Class grades were as follows:

2 A's (14%), 9 B's (65%), 2 C's (14%), 1 D (7%).

At the end of this term a survey was prepared and used to assess the student's thoughts about a traditional lecture class versus a class broken into shorter learning segments. The results of the survey for this class were:

1. What is your class standing? 3% Freshman, 24 % Sophomores, 4% Juniors, 66% Seniors
2. Is a Traditional class too long to sit at one time?
  - 1 = Yes it is too long
  - 5 = No it is not too long
  - Average = 2.00
3. Is a Traditional class too long to concentrate?
  - 1= Yes it is too long
  - 5 = No it is not too long
  - Average = 1.69
4. Is a Traditional class too long to effectively learn?
  - 1 = Yes it is too long
  - 5 = No it is not too long
  - Average = 2.15
5. Does a Segmented class aid in maintaining ones concentration for this particular subject?
  - 1 = Does Not Work Better
  - 5 = Works Better
  - Average = 4.62
6. Does a Segmented class aid in a better understanding of the material for this particular subject?

- 1 = Does Not Work Better  
 5 = Works Better  
 Average = 4.23
7. In general does a Segmented class work better for this particular subject?  
 1 = Does Not Work Better  
 5 = Works Better  
 Average = 4.62
8. Does your class standing (sophomore, junior, etc.) have any impact on your answers?  
 1 = No  
 5 = Yes  
 Average = 1.77
9. A Segmented class structure might work better with \_\_\_\_\_ classes.  
 1 = Freshman Level  
 5 = Senior Level  
 Average = 2.54
10. A Segmented class disrupts the flow of the class.  
 1 = Disrupts Class  
 5 = Does Not Disrupt  
 Average = 4.00

The percentage of juniors and seniors is explained by the fact that there are a number of students who transfer into the program after taking courses in other majors.

Results of the questionnaires shows that the students definitely believe that a traditional lecture approach is too long to optimize student learning and that the segmented approach experienced in this class was much superior.

### **Outcomes and Assessment – Construction Law**

Construction Law is a senior level lecture-based course. The typical delivery of this course is for a 75-minute lecture on Tuesdays and Thursdays, beginning at 8:00 am. This course is traditionally taken along with the construction management capstone course during the students' final semester.

The first implementation of short modules was first implemented during the fall semester of 2012. The student population consisted of 44 students and the classroom was a traditional lecture style classroom without computer access for the students. The original plan for the semester was to divide each class period into four learning segments. Roughly each class was to consist of:

- 5 minutes – Introduction
- 15 minutes – Learning Segment 1 (Lecture)
- 20 minutes – Discovery Segment 1 (Individual/Group Exercise)
- 15 minutes – Learning Segment 2 (Lecture)
- 20 minutes – Discovery Segment 2 (Individual/Group Exercise)

In this class most of the “Discovery Segment” exercises require the students to access legal information on databases or through search engines available to university students through the main library. Lexis/Lexis and WestLaw are the two most frequently used tools allowing students to access state and federal codes and cases.

The first two weeks of the semester were devoted to providing an introduction to the legal system and the tools the students would use to perform their “discovery”. As the classroom was not equipped with computers for student access, the students would have to leave the classroom and perform their searches at computer stations located throughout the building. The instructor quickly found that this was not a viable option. Too much disruption was evident by the students exiting the classroom to go to computer workstations to perform their discovery and return to the classroom in the allotted time. In addition, the instructor was not readily available for questions when the students are out of the classroom. A review of the 2<sup>nd</sup> discovery segment would take place at the beginning of the next class and the instructor was not convinced that the students were actually using the allotted time for this purpose.

As a result, and in an attempt to minimize these problems, the instructor modified the class structure after two weeks whereby each class would consist of:

- 5 minutes – Introduction
- 20 minutes – Learning Segment (Lecture)
- 25 minutes – Discovery Segment (Individual/Group Exercise)
- 25 minutes – Discussion/Learning Segment (Discussion/Recap/Lecture)

The revised schedule worked better than the original plan but still had the problem of students being involved with their discovery without the assistance of an instructor. Reading statutes and cases is a new adventure for these students and is not an easy task to master. However, the students appeared to be making a good faith effort at their discovery without too much complaining. In the third week of this schedule, the instructor noticed that some students began to come back for the last class segment at a later and later time and a few students were not coming back at all.

Eight weeks into the semester the instructor revised the schedule once again. The overall schedule remained the same but the discovery segment was modified to allow the students to remain in the classroom. For the final seven weeks of the semester the discovery segment consisted of the instructor handing out a quick legal exercise. This might be a statute the students would review, a short case they might analyze, or a portion of traditional construction documents; for example a section of AIA/A201 – General Conditions. While the instructor thought the students would be missing something by not actually self-discovering; the advantage of keeping the students in one place appeared to outweigh the alternative.

Performance in this class was similar to previous classes with 12 A's (27%), 19 B's (43%), 12 C's (12%) and 1 D (2%).

During the spring term of 2013, at the instructor's request, the class was moved to a lecture classroom with computers at each student workstation. With this setup, the instructor went back to the revised schedule of the previous term whereby the typical class would consist of:

- 5 minutes – Introduction
- 20 minutes – Learning Segment (Lecture)
- 25 minutes – Discovery Segment (Individual/Group Exercise)
- 25 minutes – Discussion/Learning Segment (Discussion/Recap/Lecture)

Having access to computers in the classroom is a distinct advantage for this class in an attempt to break up the lecture into more palatable time components. Students could engage in their discovery segment with the instructor readily available to answer questions or help with the legal research or deciphering the "legalese." The instructor also learned that it is imperative to have a discussion/learning segment as the last segment of the class. It is not feasible to try and carry this over to the start of the next class. Each class needs to stand on its own with the course continuity being derived from the overall organization rather than the carry over of a topic from one class to the next.

Performance in this class was somewhat lower than previous classes and the previous semester with 4 A's (14%), 10 B's (36%), 11 C's (39%) and 3 D's (11%). The instructor has no explanation for the lower class performance.

At the end of this term a survey was prepared and used to assess the student's thoughts about a traditional lecture class versus a class broken into shorter learning segments. The results of the survey for this class were:

1. What is your class standing? Senior
2. Is a Traditional class too long to sit at one time?
  - 1 = Yes it is too long
  - 5 = No it is not too long
  - Average = 3.48
3. Is a Traditional class too long to concentrate?
  - 1 = Yes it is too long
  - 5 = No it is not too long

- Average = 3.44
4. Is a Traditional class too long to effectively learn?  
 1 = Yes it is too long  
 5 = No it is not too long  
 Average = 3.32
5. Does a Segmented class aid in maintaining ones concentration for this particular subject?  
 1 = Does Not Work Better  
 5 = Works Better  
 Average = 3.36
6. Does a Segmented class aid in a better understanding of the material for this particular subject?  
 1 = Does Not Work Better  
 5 = Works Better  
 Average = 3.36
7. In general does a Segmented class work better for this particular subject?  
 1 = Does Not Work Better  
 5 = Works Better  
 Average = 3.16
8. Does your class standing (sophomore, junior, etc.) have any impact on your answers?  
 1 = No  
 5 = Yes  
 Average = 2.80
9. A Segmented class structure might work better with \_\_\_\_\_ classes.  
 1 = Freshman Level  
 5 = Senior Level  
 Average = 2.52
10. A Segmented class disrupts the flow of the class.  
 1 = Disrupts Class  
 5 = Does Not Disrupt  
 Average = 2.28

The results from the survey were somewhat surprising and contradictory. The class, in general, responded that the traditional class is too long to effectively concentrate and learn and that a segmented class works better and aids in the understanding of class material. However, the class also felt that a segmented class did not work better for this senior level class and that breaking the class into the differential segments acted as a disruption rather than an enhancement to the class.

In comparison, it can be said that the material covered and the class work for Construction Communication lends itself better to the segmented approach than that for Construction Law. It should also be noted that the purpose of the academic program is not just to teach course material, but also to prepare our students to excel in the construction industry. A large part of what our graduates will do is to participate in lengthy planning and review meetings. Having developed the ability to pay effective attention for lengthy periods of time is of benefit. An appropriate implementation of the segmented teaching approach might be to use it exclusively in freshman level courses and gradually lengthen lecture segments during the sophomore, junior and senior years.

## Conclusions

Our hypothesis was that short learning segments would be beneficial to university construction management students in their ability to concentrate and learn more effectively. This was tested in two classes; one a sophomore level lab class, the other a senior level lecture class. Not surprisingly, the sophomore level class agreed with the hypothesis and we will continue to explore ways to enhance the student's academic experience through such methods.

However, the survey responses from the senior level lecture class resulted in a mixed message. The class, in general, thought the hypothesis had merit, but not for this particular class. There could be a number of reasons for this. One, the final semester of the academic program is truly focused on the student's capstone project. Most

students are required to take two additional classes along with their capstone and these classes do receive less attention from the students. Secondly, and most obvious, senior level students are expected to be more mature and attuned to maintaining ones' attention for the period of a traditional class. And lastly, the makeup of the material has an impact on the outcomes. In law school, there really is no concept of a "lab" class (with exception of moot court experiences). The subject of law may simply be delivered more effectively in a lecture atmosphere without the disruption of short discovery segments.

The researchers intend to continue exploring this hypothesis in order to more effectively meet the students' needs and provide a more conducive learning experience.

## **Appendix A: Student Questionnaire as distributed to students in Construction Communication and Construction Law**

Student Questionnaire

Course: \_\_\_\_\_

Please answer the following questions to the best of your ability in light of the course you are currently taking. All answers are on a scale of one to five. If you are neutral or have no opinion regarding a question – 3 is the proper response. This survey is anonymous – please do not place your name on it.

1. What is your class standing?

Sophomore

Junior

Senior

Preface: Some research indicates that a one-hour class period (assume that a one-hour class period includes anything from 50 minutes to 115 minutes) is too long a period for effective learning. An alternative to the traditional class is to break a class into 3 or 4 segments, where alternative teaching methods are utilized in each segment. For example: Segment 1: 20 minute lecture; Segment 2: 20 minute problem solving or research; Segment 3: 20 minute discussion. The following questions will be phrased as pertaining to a "Traditional" class or a "Segmented" class.

2. Is a Traditional class too long to sit at one time?

Yes it is too long

1

2

3

No it is not too long

4

5

3. Is a Traditional class too long to concentrate?

Yes it is too long

1

2

3

No it is not too long

4

5

4. Is a Traditional class too long to effectively learn?

Yes it is too long

1

2

3

No it is not too long

4

5

5. Does a Segmented class aid in maintaining ones concentration for this particular subject?

Does Not Work Better

1

2

3

4

Works Better

5

6. Does a Segmented class aid in a better understanding of the material for this particular subject?

Does Not Work Better

1

2

3

4

Works Better

5

7. In general does a Segmented class work better for this particular subject?

Does Not Work Better

1

2

3

4

Works Better

5

8. Does your class standing (sophomore, junior, etc.) have any impact on your answers?				
No				Yes
1	2	3	4	5
9. A Segmented class structure might work better with _____ classes.				
Freshman Level		No Opinion		Senior Level
1	2	3	4	5
10. A Segmented class disrupts the flow of the class.				
Disrupts Class			Does Not Disrupt	
1	2	3	4	5

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