REMODELING CLASS PREPARATION ACTIVITIES TO LEVERAGE TECHNOLOGY

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Abstract

Engineering instructors should pursue creative ways to promote preparation prior to class to include videos, reading, as well as analyzing charts and figures. In the Department of Geography and Environmental Engineering, instructors of Environmental Decision Making (EV450) used a series of class preparation exercises to achieve this goal. Due to the demanding curriculum, motivating cadets to prepare for ungraded events can be a challenge. Students were given a 5-point assignment before half of all lessons throughout the semester. Utilizing Blackboard Learn® as the delivery method, students were given three questions, one review and two requiring class preparation. The results of the class preparation exercises were plotted against overall course grades, listed below in Figure 2.

It showed that the outcome of a student’s class preparation generally correlates to the student’s performance in the class. The wide range in course grades for students with similar course preparation scores (effort). The students who earned an A+ on all course preparation assignments had final grades range from an A+ to a C. Students who gave a strong effort by preparing for class routinely were either doing well or failed to meet expectations on major graded events. Early identification of these students is paramount to the success of improving student performance earlier in the semester to affect student motivation. Using Blackboard or a similar technological tool is an excellent method to identify the A students and intervene on the C and below students who may need more one-on-one instruction to help them understand the material. The class preparation exercises alone improved the quality and depth of learning by serving as a springboard for class discussion. Student survey results confirmed that students spent more time preparing for class. The Future changes based on lessons learned are to increase Blackboard preparation assignments in the first few lessons, identify those students who are not preparing for class or who are struggling with comprehension of the material, and creating a model for faculty to improve the lesson instruction and determining the proper methods to increase student motivation.
Purpose: Research Question

In the fall of 2011, instructors of EV450: Environmental Decision Making were frustrated with the lack of effort by the students showing up to class. Students were unprepared for the lesson and had not completed the required reading. What is the best method to motivate students to prepare for class without significantly increasing teacher workload?

Literature Review

Motivation as applied to students is addressed across many types of studies. Much of this work has related student motivation to the completion of reading assignments or in preparing for class. Several of these studies will be reviewed to help define why students have so little motivation to prepare for class. With the increased propensity of students to utilize technology and the internet in their daily lives, recent studies have focused on the relationship between using technology and the internet to provide motivation for a student to engage in active class preparation. Reviews of this work will be included to display the use and success of technology in increasing the pre-class preparation conducted by students. As part of a group study within Literature Review: Lack of Class Preparation

According to the Bureau of Labor and Statistics’ American Time Use Survey, from 2007 to 2011 college students spent on average only 3.3 hours per weekday engaged in educational activities, which includes attending class (BLS). Conversely, those same students spent 3.7 hours per day on average socializing or participating in athletics. A time use study of undergraduate students was conducted by Hanson et al. (2010) which produced similar results. Students studied for approximately 12 hours per week and attended class for another 12 hours per week, on average. The remainder of their time was spent on non-educational activities to include sleeping, working, or leisure activities (Hanson et al. 2010). The results from both time studies of recent generations of undergraduate students support the results observed by Connor-Greene (2000) and Burchfield and Sappington (2000). In a study by Connor-Greene (2000) utilizing daily essay quizzes as checks on pre-class reading, 72% of students responded that they rarely, if ever, read the assigned reading prior to the start of each respective lesson. Around the same time period, an analysis by Burchfield and Sappington (2000) yielded similar results in which the assigned readings were completed by only one-third of the students. These results speak to the fact that students have several competing demands on their time and place less emphasis on using their free time for academics or to adequately prepare for class. When given the choice, college students will most often choose to socialize or do some activity other than prepare for class or study.

Instructors overwhelmingly agree that performance in the classroom, both during in-class discussions and on exams, is ultimately degraded due to a lack of class preparation by the student
Sappington states that those students who put forth the effort to read the assignments have a marked advantage in test-taking over those who do not. During their longitudinal study, Burchfield and Sappington (2000) found that the number of students who read assignments as measured by performance on surprise quizzes precipitously dropped from approximately 80% in 1981 to approximately 20% in 1997. This is surprising because of the inherent connection that links class preparation to performance on exams. In his 2002 study, Sappington et al. (2002) reported that despite learning that most tests utilize questions from the textbook test bank, the majority of students fail to believe that reading the textbook was a worthwhile use of their time. Taking this one step further from exams to final course grades, Howard (2004) presents evidence that those students who earned an A or B in his class completed the assigned reading 78.2% of the time as opposed to those who scored a C, D, or F who only read 56.2% of the time.

The question persists as to why students fail to see the importance of completing the daily assigned reading. Brost and Bradley (2006) found that most instructors automatically assume that most students do not complete the reading. To compensate for this and still have a meaningful in-class discussion, instructors provide a full account of each lesson’s assigned reading and directly outline everything that the students need to know. Additionally, they found that instructors are highly unlikely to directly refer to the textbook during class, which was echoed by Sappington et al. (2002). These actions portray to students that the assigned readings are unimportant and unnecessary for their success. One student goes so far as saying, “It’s hard to get students to read, because we know that the material will be summed up in class anyway” (Brost and Bradley 2006). The issue may not solely be with failing to see the importance but also with having to deal with competing demands. Schouwenberg and Groenewoud (2001) explain that students are in a constant state of compromise by having to decide between their long-term future of academic success and the immediate future of their social life. Students may be placed in a difficult situation where they have to lend a higher priority to one goal over the other (Schouwenberg and Groenewoud).

Literature Review: Motivational Factors in Class Preparation

In his discussion of teaching, Angelo (1995) showed that when students are fully invested and engaged with the instructor and the lesson material, the result is an improved learning environment. The difficulty in achieving full academic investment and engagement lies in the hierarchy of goals and their associated motives that each person rank orders within him or herself. The state of academic and social compromise that students find themselves in and their subsequent decisions of prioritization as explained by Schouwenberg and Groenewoud (2001) is very much a function decided upon by each situation’s extrinsic and intrinsic motivational factors (Lowman 1990). Instructors would argue that the intrinsic values of gaining knowledge or advancing in the classroom that are commonly associated with studying or preparing for class
should be enough to convince any student in any situation to choose to study over the alternative. This, however, is simply not the case. Students have no desire to read textbooks in order to fulfill their intrinsic interests (Carkenord 1994). Rather, course assignments must demand a student’s attention of the textbook in order for him or her to actually read and study the assigned reading (Hanson et al. 2011). Likewise, Connor-Greene (2000) stated that the format of a course will determine a student’s study habits. Because of this, extrinsic motivational techniques are utilized in order to create a class environment that requires a student to properly prepare for class with specific attention directed at the textbook in order to be successful. These extrinsic techniques typically include “carrots” and “sticks”, or positive and negative reinforcement (Lowman 1990). Grades are one of the predominant extrinsic motivational methods. By using grades as either a carrot or a stick, the instructor is able to shape the type of class preparation that he or she desires the students to complete.

Literature Review: Using Technology as a Means to Encourage Class Preparation

A significant amount of literature exists on the merits of using in-class quizzing, either surprise or scheduled, to provide extrinsic motivation for the student to complete all reading assignments in his or her preparation for class (Mawhinney et al. 1971; Carney et al. 2008; Kugel 1989; Sappington et al. 2002; Burchfield and Sappington 2000). With today’s students being constantly connected to the internet or social media, a significant opportunity exists to determine the effects of using technology to encourage class preparation. Additionally, with the multitude of programs and user interfaces currently available, the cost in terms of instructor time associated with implementing a technological solution would be minimal.

Retelny et al. (2012) examined the effect of Twitter on class preparation motivation. The study required students to tweet questions, examples, and reflections concerning the assigned reading and future lesson material. Each lesson’s collection of Tweets was presented during the lesson and was also used to tailor each respective lesson’s presented material. This work found that using Twitter helped to increase students’ motivation and boost the depth of class preparation through reading and critical thinking.

Carlisle (2010) investigated the linkage between using an online media source to help reduce lecture length on the overall preparation of students for class and exams. The study used short YouTube® videos to help supplement course material so that lectures could be reduced in length and additional class time could be spent on practice problems. It was determined that not only did the inclusion of YouTube® videos aid in class preparation on their own, they also motivated students to complete the assigned reading more frequently.

A recent study by Hulbert-Williams (2010) utilized online wikis to help group collaboration in formulating a research question and proposed outline. A wiki is simply an online centralized chalkboard that can be used much like a scratch book to maintain ideas or
thoughts over time. The author tracked progress of the research groups by monitoring each respective group’s wiki and then provided verbal feedback. In an end-of-course student evaluation, all fourteen respondents stated that the online wiki was a good teaching method to guide students in their class preparation. Additionally, all fourteen respondents stated that they benefitted to varying degrees from using the online wiki process with no one stating that it was not at all beneficial.

Al-Fadda and Al-Yahya (2010) determined that online blogs are effective at encouraging students to prepare for class by doing the assigned readings. In their study, the authors began an online blog with a posting that included a required reading assignment. Students were then able to post questions or comments to create a less imposing forum for discussion than face-to-face in a classroom. By allowing students to contribute, they found that students were more actively engaged. In a course-end survey, students generally agreed that the blog was effective in encouraging them to complete the assigned reading prior to class.

In a similar effort, Lineweaver (2010) studied the effects of utilizing an online discussion group on the completion of assigned readings. The study was conducted in a conventional face-to-face course with the discussions being completed through Blackboard®. Upon posting discussion prompts online prior to each class, the instructor required students to submit at least three related in-depth comments or develop a new thread regarding the reading. Lineweaver determined that the online discussion groups developed a culture that emphasized not only completing the assigned reading but reading more carefully to improve retention.

Howard (2004) examined the use of web-based Just-in-Time quizzing to motivate students to complete the pre-assigned readings. Howard used Indiana University’s OnCourse® system to host the quizzes. The study found that Just-in-Time quizzing caused a significant increase in the number of students who read the assigned reading in preparation for class. In the study’s first two semesters, the number of students who “usually” or “always” completed the assigned readings increased by over 30% to approximately 98%.

**Methods**

**Course Description:**

To study the ability of technology to influence class preparation, we collected data from 167 students taking EV450, Environmental Decision Making during the fall semester of 2012. We also collected data from 171 students in EV450 during the fall semester of 2011. EV450 course is the third and capstone course of the environmental engineering sequence. The course consisted of three blocks. The first block (Lessons 1-12) was a study of multi-objective decision making, the second block delved into environmental engineering technologies used in developing countries (Lessons 13-29), and in the final block (Lessons 30-40), economic analysis
and solution implementation were completed. Throughout the course students developed a term project for their assigned community in the developing world using values-based decision making. By the end of the course the students’ project is a preliminary solution that addresses how to improve the quality of life for the area through improved water, sanitation, and energy.

An additional important factor in the course was that none of the students were engineering majors. All students that do not major in engineering must take an engineering sequence in addition to their chosen major. Because of this unique population where the students did not elect to study engineering, instilling intrinsic motivation of the material could be difficult. However in EV450, because all cadets would be commissioned as officers in the United States Army, motivation is improved somewhat due to the potential for job relevance after graduation. Instructors use anecdotal evidence and tie in Army themes whenever possible to provide linkage to cadets and sustain interest. Many cadets understand they could soon find themselves in a developing country at some point in their Army careers where the technologies and instruction of the course would be beneficial.

**Preparation Exercises:**

To increase student preparation for this course and understanding of the material, students were assigned 19 class preparation exercises between Lesson 1 and Lesson 36. Students were encouraged to complete these assignments prior to class. Of these assignments, the first two were short essays on a case study, one was an instructor survey, and 16 were delivered via Blackboard Learn® quizzes that required either mathematical solving of problems or checks on reading, and one response to a video. The students were informed during the first day of class that only the top 15 scores on these events would be counted and thus make up 75 points, or 7.5% of their final grade.

The quizzes that relied on mathematical solutions were such that the students entered the answer in a space provided (not multiple choice). The students were surveyed at the end of the course on their perception about the class preparation assignments.

Additionally, in an effort to increase motivation and class preparation, all instructors projected an anonymous sample of student scores on the preparation assignments to date after 33% of the class preparation points were completed. In doing so, the instructors had the ability to highlight student’s motivation thus far in the course. During this presentation, instructors highlighted students who were doing well (completed assignments to date and scored well) and students who were in the “danger zone” (those who had already used their available dropped grades by not completing assignments). Scheduling a benchmark a third of the way through the class allowed instructors to stratify students into four basic categories:

- Students who completed all assignments and performed well.
- Students who completed all assignments and did poorly.
- Students who are not doing the work at all and show an apathy for the course
• Students who did not do the work, but performed well on the assignments they completed.

The anticipated response was that students would re-engage in class preparation exercises after this point, especially those who had not attempted all of the possible activities. This was true in the short term. However, the data supports that there was no significant change in behavior by the end of the course. An example of the presentation of current class preparation grades to students during lesson 14 is shown below as Figure 1.

![Figure 1: Sample presentation of grades of class preparation exercises, Fall Term in 2013.](image)

While the goal of this study was to determine the effectiveness of Blackboard Learn® as a technological tool to increase student preparation and decrease instructor workload, other interesting results were obtained that support the coupling of student motivation and performance.

**Results**

In answering the research question of whether or not the preparation exercise increased class preparation and facilitated in-class discussion, there was no data to either support or refute either claim. Anecdotally instructors of EV450 did often find that the preparation exercises worked well as a spring board discussion for the beginning of class on the topics covered that day or in previous lessons.

An expected result was that student preparation did correlate to their grade in the course. A distinct trend is evident where those students who attempted the class preparation exercises and scored well on those exercises had better grades in the course (Figures 2 and 3).
Figure 2: Relationship between Class Preparation Grade and Final Course Grade Fall Term in 2013.

Figure 3: Relationship between Class Preparation Grade and Final Course Grade Fall Term in 2012.
Additionally, this study suggests that not only did the students need to score well on the class preparation, but if they made more attempts at all, this correlated to a higher grade in the course.

**Figure 4: Relationship between Preparation Attempts and Final Score**

Figure 4 displays the average final course grade of those individual students who attempted the class preparation exercises a given number of times (1-19), regardless of their score on those events. Using linear regression, a strong correlation is evident between those individual students who attempt the class preparation exercises and their final grade in the course.

**A Model for Motivation:**

A trend of student motivation over time is apparent when assuming motivation is linked to the number of class preparation exercises that a student attempted. Data for this study indicates that A students (A- to A+ in the course) attempted, on average, 17 of the class preparation exercises B students 14, C students 9.5, an D students 4.5. This decreasing number of attempts models the trend of student motivation as an aggregate and when viewed independently by student classification is indicative of how motivated each category of student is (see Figure 5)
Figure 5: Student motivation and class preparation grade segregated by overall course grade. *All student categorizations are from - to+, i.e., an A student completed the course with an A-, A, or A+ as their final grade.

Figure 5 displays the different groupings of students and the number of class preparation exercises they completed (their motivation) and a downward shift from the upper right quadrant (high class preparation grade and high number of attempts) to the lower quadrant (low class preparation grade and low number of attempts) is evident. Of note when viewing this data is that these two factors are dependent on each other. Fewer attempts will lead to a lower score, especially after less than 15 attempts are made as each non-attempt results in 0 out of 5 points for that exercise. While the correlation is direct, the course preparation grade is still significant, because the course preparation grade is only 7.5% of the overall course grade.

Student motivation was also analyzed over the course duration to identify and correlate factors that may affect student motivation to complete class preparation assignments. Figure 6 indicates that major graded assignments in the course had a large impact on student motivation to complete class preparation assignments. Additionally, the data shows a precipitous drop in motivation toward the end of the semester as competing requirements for all classes courses competed for student time. This assessment of student aggregate motivation on preparation exercises over time can be used as a tool to determine those factors that lead to increased and decreased preparation, and hence learning as well. For example, class preparation exercise six was due the same day as homework one was due (see Figure 6). This resulted in a large drop in
students completing the class preparation exercise, as most had not budgeted time for a 5 point exercise when a 140 point homework was due the same day. Conversely, for class preparation exercise number 12, faculty advertised that the class preparation exercise would be answering questions related to a YouTube video on a day where a major assignment was due. There was a spike in attempts to complete the preparation exercise.

**Figure 6: Graded Event Impact on Student Motivation for Class Preparation**

Another trend is evident when students are grouped by their course grade. A clear disparity of motivation is identified between students with grades of A, B, C, and D. Student motivation, as measured by the number of exercises attempted throughout the semester, mirrored the students overall course grade. Figure 7 depicts this categorization throughout the entirety of the course. Additionally, through the entire course, motivation by each student group was separated by approximately 20% in each group. Students earning an A in the class attempted 89% of the class preparation exercise (on average); B students attempted 73% of the exercises; C students averaged 50% attempt rate; and D students attempted 24% of the exercises on average. Instructors anticipated these averages to be higher had we not offered dropping the bottom five results from the course average.
Of interesting note in Figure 7, the only grouping of students to ever have 100% of the students attempt a class preparation exercise were the A students and the only group to ever have zero percent of the students attempt the class preparation exercises were the D students.

A final component to this study was to identify student perceptions of these in-class preparation exercises. Student opinion on the effectiveness of these class preparation exercises can drive motivation throughout the duration of a semester. To assess student opinions, all students were asked to complete a five question survey after completing their term end exam. Using a Likert scale, students were asked five questions to identify how much they value the exercises and the affect the exercises had on their level of preparation. Instructors hypothesized a direct correlation between academic major and student opinions on the use of class preparation exercises. To test this hypothesis, surveys were made anonymous except for academic major.

Survey questions and a summary of results are shown below in Figure 8.

Figure 7: Student Motivation over time stratified by course grade.
Figure 8: Results from end-of-term student survey on their opinion of class preparation exercises based on academic major categories: humanities and social sciences (HSS) and science, technology, and mathematics (STEM). Engineering is omitted since the course is taught to non-engineering students.

Based on conversations with students throughout the semester, instructors had anticipated negative feedback from the class preparation activities. The overall results of the survey showed that the class preparation activities resonated with over half of the students. Survey results were mixed, until we categorized our responses by their academic major. Students majoring in a STEM-related field (mathematics, chemistry, physics, life science, environmental science, geographic information science, kinesiology, and geography) gave more positive feedback than students with majors in the humanities and social sciences (politics, economics, psychology, English, history, international relations, law, management, foreign language, and defense and strategic studies). Statistical results were validated using a Chi squared, 1-tailed Mann-Whitney, and t-tests. Chi Squared Test and T-test show there is a statistical difference between STEM and non-STEM majors.

Assessment of the surveys showed us how much students liked multiple attempts to conduct the homework exercises. Since the intent of the exercises is to promote studying and class preparation, we decide to increase the number of attempts for next year. Most of the class exercises consisted of math calculations, which justifies the lower rates of concurrence amongst humanities and social science (HSS) majors compared to STEM majors. This feedback tells the instructors that we need to vary the types of exercises we do that will resonate more with various learning styles.

### Claims and Conclusions

This study has evolved over the course of two years. What started out as a sample of convenience has evolved into opportunities for further research into applicable techniques to motivate upper-level undergraduate students. Analysis of this data has confirmed what instructors know already: if students put in the effort, they will be rewarded with a higher grade.
and in turn, increased learning. Adding class preparation exercises outside of class improved the level of learning in the classroom. The exercises became a springboard for discussion and gave students instant feedback on their interpretation of the material. This also validated successful study habits or reading comprehension. Without class preparation by students, class meetings defaulted to a lecture.

Another learning point for instructors is assessment data can be used to alter the course. Instructors in EV450 learned that the exercises became a great predictor for learning in the classroom. Showing the students the assessment data showed an increase in attempts following the benchmark grades after 33% of the exercises were completed. This motivation lapsed over time, so another benchmark at 66% complete is warranted. The benchmark assessment allows instructors to identify students who are not showing effort and engage early. This also shows an early pattern of behavior for borderline students and assists instructors in evaluations. It is also wise to allow students to focus on major graded assignments and separate lesson assessments, since there will not be much preparation conducted on those lessons with major graded events.

Student surveys confirmed that the preparation exercises were beneficial and improved their metacognition. Students viewed these exercises as a forcing function and another graded assignment, rather than a tool to assist in their understanding of the material. It became an extrinsic motivational tool. A learning point for instructors is to mitigate the negative perceptions of the students to the exercises. Some of this was due to the technical problems associated with technology. This is anecdotal, provided the technological method functions correctly. Instructors should consider methods to mitigate the negative perceptions, such as increasing multiple attempts and describing the purpose and reasons for the specific exercises. Student perception was favorable overall, but results were different for STEM and HSS majors. Improvements to the class preparation exercises will be made to ensure we capture the learning styles typical to those who are HSS majors. Case studies and analysis of videos will be added to the class preparation work.

Once competing requirements increased, class preparation exercises decreased, as shown in the decrease of attempts over time. One way to combat this motivation problem is to increase the extrinsic motivation by increasing the points associated with preparation. This has a potential negative impact in that intrinsic motivation can decrease in higher performing students. This must be managed with great care. Further study for this course and future faculty members enrolled in master teacher program should focus on maintaining student motivation.

The institution we are all a part of is designed to push our students past their limits. Students will either embrace this challenge and grow beyond their limits, or students will identify the minimum requirements to survive and do only what is required. The classroom preparation exercises were successful in increasing student preparation on the whole, and Blackboard was a successful delivery method to decrease instructor workload. However, this alone was not enough to reach the higher levels of intrinsic motivation and preparation that the instructors
strived for. Brian Brost in his 2006 journal stated that “Faculty need to ensure that we create the appropriate learning conditions that actually foster and reward the behavior we seek.” The byproduct of the structure of the U.S. Military Academy overall is the level of extrinsic motivation in the distinct evaluation system of our students. I have learned throughout this study that teaching or instructing students isn’t about how well I teach the lesson material and the subject matter. Rather, how well I can motivate the students to learn on their own and set the conditions for them to grow their knowledge set and expand their skill set regardless of discipline is where I can contribute long-lasting growth in students. Student motivation, their inspiration to learn, develop and grow, and internalizing the purpose to their efforts will make the greatest impact to student growth because this is what lasts a lifetime.

References


