Application of Flipped Classrooms to Military Science Courses

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Abstract

Despite the United States Military Academy pushing the Thayer method, Military Science instructors rarely use it. Cadets cite; competition for time, lack of interest, and difficulty of material, inhibit them from investing time to learn material before a lesson. Flipped classrooms, which are a form of the Thayer method, has the ability to reach USMA’s target audience, millennials. Through video and other online, interactive content, course material might be easier to digest outside of the classroom, fulfilling lower levels of Bloom’s Taxonomy. This allows instructors to utilize interactive and experiential activities to assist the cadets in achieving higher levels of learning in the classroom.

Introduction

The United States Military Academy (USMA) prides itself for developing the Thayer Method of education, and continuing its practice to date. Sylvanus Thayer, while serving as USMA’s Superintendent, adopted this method, which relies on students coming to class prepared on a topic and lesson material, and instructors reinforcing material through active learning exercises (Shell, 2002). While the Thayer method allows for students to take in material at their own pace, however, it places the predominance of learning on the student (Chetcuti, Thomas, & Pafford, 2014). However, some argue that the Thayer Method is not a viable option for all disciplines, depending on the complexity of the material and the background of the student.

Military Science is part of USMA’s core curriculum. The program consists of three sequential courses: MS100: Introduction to Warfighting; MS200: Fundamentals of Small Unit Tactics; and MS300: Platoon Operations. Each course is worth 1.5 academic credits. This allots instructors 40-each 55-minute in-class lessons and 35- minutes of out-of-classroom work. Though many instructors mention the desire to incorporate the Thayer method, some noted that West Point cadets “conduct little to no daily preparation when there are no graded requirements…” (Chetcuti, Pafford, & Thomas, 2015). This resonates with those teaching in Military Science as end-of- course feedback surveys show students put less work into Military Science, since the course is only worth 1.5-credits. This lack of preparation, along with gaps as large as 18-months between courses for some students, inefficiently forces the course director to invest a significant number of lessons to review material from previous courses. For example, in academic year 2017, MS200 spent 7-lessons of their 40-lessons reviewing material from MS100.

Realizing that cadets need to be held responsible for knowledge previously taught in other courses, the MS100 course director started making videos of lesson material she wanted to use as the foundation for in-class exercises. After sharing this idea with another faculty member in the Civil and Mechanical Engineering Department, she learned that this was a common method used in other departments called, flipping the classroom.

Defining Flipped Classrooms

The Khan Academy, credited as the catalyst for the flipped classroom, simplifies the definition by simply reversing the normal schedule to where students learn through online content, typically done at home, and then guided through exercises in class, led by a teacher
This provides the instructor with more time to interact with students and guide them through exercises and problems.

One of the leading proponents of flipped classroom practices is the Flipped Learning Network (FLN). According to the FLN, a flipped classroom only requires a teacher to have students prepare out of the classroom by reading and watching videos (FLN, 2016). The FLN stakeholders further differentiates and defines Flipped Learning as a “pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter” (FLN, 2016). FLN breaks down this definition by listing out four pillars by using the acronym FLIP: Flexible Environments, Learning Culture, Intentional Content, and Professional Educators.

Yunglung Chen, Yuping Wang, Kinshuk, and Nian-Shin Chen evaluated the FLIP pillars and recognized a significant gap when executing a flipped classroom. They believed that in a higher education setting, FLIP lacks the learner’s perspective and experience. Their research led to the development of FLIPPED, which adds PED: Progressive Networking Activities, Engaging and Effective Learning Experiences, and Diversified, and Seamless Learning Platforms (2014).

Finally, it should be noted that similar to the Thayer method, Flipped Classrooms place the onus on the student for material learned. With inverted classrooms, which are synonymous with flipped classrooms, Students are expected to view videos and complete all preparatory work prior to the class, so they can gain a deeper understanding of the material (Strayer, 2012). Flipped Classrooms allow for students to take in material at their own pace, so students can master the material at hand (O’Flaherty and Phillips, 2015).

**Examples of Flipped Classrooms in Practice and Evaluation**

In order to determine design principles to successfully incorporate flipping the classroom, it is necessary to review the literature to determine what was accomplished in the past, and what failed. While the focus on this paper is on Military Science, the discipline itself is hard to categorize in the typical fields used at West Point of Math, Science, and Engineering (MSE), and Humanities and Social Sciences (HSS). Therefore, for the purpose of being thorough, we will focus on our review of studies conducted on a survey population of students involved in higher education, at either the under-graduate level or higher, and also looking into as many disciplines as possible. Only then will we be able to derive the best examples of flipped classrooms in practice and apply it accordingly in the discipline of Military Science at the United States Military Academy.

Arguably, Anupama Prashar completed the most thorough literature review and study of flipped classroom, which he published in the Journal of Education for Business. Prashar focused his review on the discipline of Operations Management. First, Prashar began his premise of the flipped classroom in terms of Bloom’s revised taxonomy (See figure 1: Revised Bloom’s Taxonomy), and used the flipped learning to teach Operations Management modules to reinforce the lower order
skills. Anupama Prashar also developed a two-dimensional rubric to gauge the levels of flipped required for each session: either a full flip, partial flip, or no flip (which represented a normal, traditional class). The rubric considered the nature of the material being discussed in each module and assessed the requirement to flip it in terms of the need to flip it and balanced it with the need for direct instruction (2015).

Following the rigorous statistical analysis conducted based on qualitative and quantitative data collection, Anupama Prashar concluded that the students in the flipped classroom have more issues with the unstructured classroom activities and unpredictable homework when compared to other students in the non-flipped, traditional class. Subsequently, the author then deduced that the flipped pedagogical approach may not be the most suitable teaching approach for introductory level classes, since the students at that level may need more structure to develop their interest at the beginning of their intellectual pursuit. The author also noted that the students in the flipped classroom were more open and agreeable to finding innovative solutions and were more involved in the classroom (2015). This implied that the students in the flipped classroom were making the required connections with the content of this course and prerequisite courses.

Two different Mechanical Engineering Programs flipped courses, and also wrote respective articles. Gregory Masin, Teodora Shuman, and Kathleen Cook, from Seattle University, wrote about how their control systems course was flipped. While most studies compared a traditional and flipped courses taught in the same semester, and therefore had additional variables, their study focused on research conducted over two successive years, with the first year being a traditional course, and second year being a flipped course. This standardized many of the variables, including time of year, comparison with classmates, and professor. Additionally, they produced a total of 45-videos, varying in length between 5- and 15-minutes, for students to watch outside of the class. While the typical quantitative assessments of content coverage, quiz, and exam performance were conducted, they were buttressed with the typical qualitative assessments of student perception of teaching, learning, and the course format. Additionally, the authors took the time to verify any a priori differences between the two sample groups by comparing performances in two past courses, which were taught two quarters prior, with the same instructors, with the same book, and in the same format, to ensure that was no additional bias in the sampling. This statistical rigor verified there was no statistical differences between the two sample groups, suggesting that both groups had similar backgrounds and ability prior to taking the Controls Course (Mason, Shuman, & Cook, 2013).

Based on the new course, Gregory Masin, Teodora Shuman, and Kathleen Cook were surprised by some of the feedback from their students. One aspect that they noted was that their students recognized that the new flipped course format required more self-discipline than previous courses, and required changes to their study habits. The students felt, after the fourth week, that the flipped class was a better use of class time, and that they also believed that the new format better prepared them to actually practice engineering. Additionally, while the students were fairly equally split about when a flipped class should be offered (either senior year, junior/senior years, or sophomore/junior/senior years), all students agreed unanimously that it should not be offered successfully in a first-year setting. The authors were also surprised that they were able to cover more material in the flipped course than in a previous traditional setting. They were not surprised, that the students in the flipped classroom performed as well or better on all problems. However, as a cautionary note, they did state that the production time required for the videos were generally twice the actual video length, which added up quickly (2013).
Another study on a Mechanical Engineering program was conducted by Steven Chetcuti, Hans Thomas, and Brent Pafford of the United States Military Academy for their Introduction to Thermal Fluid Systems course. Similar to other programs, they developed an instructional method of posting lecture videos on the Blackboard Learning Management Software utilized by their university. Instead of making videos based not on concepts, the authors created videos on the objectives required for each lesson. While subtle, this difference facilitates future updates of the videos as the course decides to update specific lesson objectives, and also facilitates course restructuring by only having to update the specific videos that they need by lesson. Additionally, these authors maintained that the students watched no more than 40-minutes of video footage prior to each class, and also checked on their individual learning by offering a conceptual quiz at the start of each class to check on comprehension. Like other courses, they provided cadets the opportunities to witness live demonstrations and have access to training aids that were used in the videos. This was all in an effort to increase understanding, while the instructor moved throughout the classroom to help students as needed. They also gathered a rather unique list of important lessons learned, most of which were corroborated in other studies, but also uniquely noted that group work was not as effective as individual work. They came to this conclusion based on feedback received from nearly all students in their feedback surveys, where the students noted that they wanted to see videos of the lectures and of problems being solved. Based on their research, they found that the best ratio of students to instructor occurred at about 20:1 (2014).

Similarly to Mechanical Engineering, I. Ngambeki, S.E. Thomspon, P.A. Troch, M. Sivapalan, and D. Evangelou focused on flipping the Civil Engineering discipline of hydrology. Instead of the thermal-fluid systems of Mechanical Engineering, where fluids and heat were transferred in closed systems, hydrology focuses on the atmospheric and surface flows on the earth, which, due to the nature of the analysis, is often viewed as open systems. The authors felt a driving need to instill in their students a solid fundamental understanding of the theories, tools, methods, and approaches utilized in a field that demands critical thinking and interdisciplinary communication completed in an uncertain environment. In order to achieve this goal, the authors first categorized and utilized their theories by identifying the four essential elements in education: the learner; the curriculum, comprising the skills and knowledge required of the learner; the pedagogy; and the assessment use to measure learning outcomes (2015). With this understanding in mind, they focused the flipping of their course of study on the intersection between the learner, the content, and the pedagogy, deciding to focus on the assessment in a different study. The pedagogy was further linked with the specific subject matter at hand through the idiosyncratic theory of Pedagogical Content Knowledge (PCK), which is the understanding that this is where the intersection where instructors understand what is appropriate to teach, when to teach it, and how to teach it (2015). PCKs, at their most basic definition, were “powerful analogies, illustrations, examples, explanations, and demonstrations – in a word, the ways of representing and formulating the subject that makes it comprehensible for others (Berry et al., 2008).”

Additionally, the authors further characterized their efforts by the constructivist theories of learning, which states the student processes information from through their senses and then stores them into short-term memory and that the learners will then connect new information with previously stored information and memories as they construct a new understanding of these concepts in their long-term memory (2015). This theory is significant in the understanding of flipping a classroom, as stated by the authors for the following reasons:
1) These theories suggest that how students build upon their knowledge is context dependent.
2) Learning requires that the learner is actively engaged, and the instructor is responsible for creating the necessary means for two-way communication to occur to further assist the students.
3) Due to high student to teacher ratio, students will gain more benefit by learning from each other and engaging in collaborative exercises.

The third point as listed above seems to contradict the conclusion from Chetcuti, Thomas and Pafford’s deductions, which had more to do with the student’s desire to see problems worked in conjunction with their flipped class, not as a point against how classroom activities should be structured to build the student’s knowledge further along Bloom’s Revised Taxonomy (2014).

From Catholic Kwandong University in Korea, Jeong Ah Kim, Hae Ja Heo, and HeeHyun Lee focused on providing a flipped classroom for third-year undergraduate students in a project management class. While developing their courses and preparing the flipped material, they realized the need to measure student comprehension. Instead of utilizing the typical short quiz or some other form of examination, the authors utilized Trello to have the students write down questions, comments, and concerns prior to class. While in class, the authors would respond to the Trello cards written by the students, and the students, during the group phase of the class, would make additional Trello cards summarizing the discussion on the video and then posting questions on Trello (2015). While Trello serves as a great way to manage group projects in a modern, digital environment, the amount of feedback required to make this work, and the real-time that it would have to be produced by the individual instructors, makes it a source of concern for any instructor looking at doing this on a mass scale. While a great initiative, this method clearly worked for the class size of 15-students encountered by the authors, but multiples courses and classes taught by a single instructor would be very difficult to accomplish in this method. Of concern, the authors also noted that their students spent an average of approximately 3.5 hours of preparation for each class, which was an increase compared to the traditional teaching method (2015). If this model were to be extrapolated out to a full-time higher-level undergraduate student, the student would run out of hours in a day. One of the authors of this literature review, who teaches a construction management course, is unsure as to whether the high number of hours listed in this study is based due to cultural concerns, exaggeration, or any other factors of concern.

Lucretia Fraga and Janis Harmon from the University of Texas at San Antonio focus on teaching future elementary and middle school educators, and wrote their study on flipping a Reading Comprehension class. The authors investigated the students’ perspectives of the model of learning involved with the flipped classroom, and also attempted to quantify the impact that the flipped class may have had on student achievement, by focusing on one specific topic covered in the course. Using the typical qualitative and quantitative methods, the authors created a control group of 26-students, and an intervention group in the flipped classroom of 25-students. The students were not made aware of the use of the difference in teaching models utilized in this single topic of study. From the exam scores, the instructors noted that there were no statistically significant differences between the exam scores on this topic between the two groups, and concluded that the flipped model of teaching may not be suitable, when compared to a traditional teaching model, when teaching the specific module on word study (2015). This brings up the very relevant point that there may be some topics that are better taught through a traditional classroom setting, and not a flipped setting.
Finally, from the University of Southern California and the University of Georgia, Min Kyu Kim, So Mi Kim, Otto Khera, and Joan Getman authored the ambitious article exploring design principles for flipped classes. Their multi-disciplinary study determined nine design principles based on the feedback of their studies conducted in an undergraduate Biomedical Engineering course, Sociology course, and a Humanities course (2014). Their design principles were as follows:

1) Provide an opportunity for students to gain first exposure prior to class
2) Provide an incentive for students to prepare for class
3) Provide a mechanism to assess student understanding
4) Provide clear connections between in-class and out-of-class activities
5) Provide clearly defined and well-structured guidance
6) Provide enough time for students to carry out the assignments
7) Provide facilitation for building a learning community
8) Provide prompt/adaptive feedback on individual or group works
9) Provide technologies familiar and easy to access

This design methodology was very thorough, but it fails to address some of the points discussed in other studies, such as the need to first assess the students and where they stand with regards to Bloom’s Taxonomy and the course subject matter, and the requirement to provide clear, succinct, and modular videos, that allow the students to manage their time in a way that is sustainable to balance with the rest of the classes they are taking at that time.

Design of Flipped Classrooms

Based on the studies in flipped classrooms listed above, the authors of this paper proposed the following methodology in the design of a flipped classroom.

1) Assess the course
   As per Prashar’s study, an instructor interested in flipping a course should first determine whether or not they want to flip the entire course, flip portions of the course, or keep teaching a traditional course. This is especially critical when changing a course from a traditional teaching model to a flipped model. The instructor may want to consider a rubric, or some other decision making tool, to determine how to assess the course and decide how many, if any, lessons, would need to be flipped (2015).

2) Assess the students
   Flipped course technique is not suitable for introductory level courses, or for courses that are predominantly filled with first-year students. The students that participate in a flipped course should be understand the subject matter well enough that they are ready to engage in the higher levels of Bloom’s Revised Taxonomy in the subject matter (Fraga & Harmon, 2015).

3) Start small
   Instructors need to understand the initial time commitment required to flip the classroom. Chetcuti, Thomas, and Pafford noted the large production time associated with flipping a classroom. Based on their recommendations, it is recommended that the new instructor start small with deliberate videos that are synchronized with the technology used by the institution for ease of use (2014).

4) Stay Organized
While some studies offered unstructured learning videos for their students, this appeared to significantly increase the amount of time that the students spent outside class. This was typically done due to a belief that this would foster life-long learning. However, due practical time constraints that are imposed on cadets at USMA, or any full-time student at another university, this is not a practical method of instruction. One study advised that instructors should structure videos following lesson objectives done in a modular style that will facilitate updating the course as easily as possible (Chetcuti et al. 2014). Additionally, the length of the videos are recommended to not exceed 20-minutes, as that time-frame fits well with current studies indicating attention spans for the millennial generation (Phillips & Trainor, 2014).

5) Provide a Check on Learning

Checks-on-learning should focus on lower levels of Bloom’s Revised Taxonomy, simply checking on comprehension of lower skills and ensuring that the videos were watched and understood. If assessments are considered, the course director should take the time to determine the correct number of points to make the assessment in such a way that a failure to comprehend the material will not result in a significant cut to the student’s grade (Chetcuti, Thomas, & Pafford, 2013).

6) Deliberately plan Experiential In-Class Exercises

As per Prashar’s study, the quality of experiential learning that the instructor can facilitate once the students are grouped together will help individuals achieve further understanding of lesson material (2015).

7) Measure and Evaluate Course Metrics

Quantitative Assessments can continue, as per the studies previously noted, comparing assessments of both the traditional and flipped classes. Qualitative assessments can be determined based on survey responses from the students involved in the classes.

Gaps in Research

1) Flipped Classrooms for introductory level courses. What is the definition of an introductory course? As noted in research, flipped classrooms might not be the preferred instruction model for an introductory course (Strayer, 2012). The level of enthusiasm and interest in material for core courses was questioned, therefore students might be frustrated with ill-defined learning objectives.

2) Are there some topics that are taught more effectively in a traditional classroom setting, as opposed to a flipped classroom? Military Science has not been researched to date.

3) How can the instructor utilize in-class exercises and activities that build on out-of-class flipping, to maximize student learning with regards to Bloom’s Revised Taxonomy. Key thoughts to consider include the integration of project based learning, as well as in-class exercises based on themes.

4) For high-enrollment courses with many sections, such as Military Science, should flipped material be prepared by each individual instructor for their own respective sections, or should the flipped material be standardized throughout the course?
Conclusion

Flipping the classroom has the potential to truly enhance the Military Science Program. Due to a varied background of staff, not all instructors have the same level of expertise with the course material. Flipping the classroom would allow for students to receive instruction from a video platform from a subject matter expert with a great deal of real world experience. In class, the students could then be given a tactical decision exercise or an in-class exercise to work with another instructor or student to provide feedback. During exercises, instructors would validate the student’s ability to follow the troop leading procedures, and ability to think critically. Out-of-class, the students would be able to learn and understand doctrinal concepts that are the foundation for these exercises. If the military program wants to provide cadets more feedback on their ability to make sound decisions and think critically, then, at the very least, the program needs to reduce redundancy. Redundancy can be removed by creating a video library with lessons to review, allowing students to re-learn material at their own pace. This also fits with the millennial student’s preference for interactive and experiential-learning experiences (Phillips & Trainor, 2014).

In MS100, Introduction to Warfighting, one lesson was flipped. Though this is the first military science class most cadets have received, it should not be classified as introductory due to shared military training experience the cadets received the summer prior to the course. The flipped lesson was on map reading and route planning, where cadets were given instruction to watch two videos on advanced land navigation techniques, which were then reviewed in a practical exercise in class. During the in-class exercise the instructor was able to cover “best practices” allowing the cadets to tackle similar problems more efficiently in the future. Still, there were some cadets who failed to watch the videos and thus were lost during the practical exercises. The competition for cadet interest and time is difficult in a 1.5-credit course. To mitigate higher understanding with these cadets, the instructor partnered these cadets with cadets who had a better understanding of the material.

Flipped Classrooms might not work for every military science lesson. Without question it takes a lot of investment from instructors to go outside of the normal slideshow presentation. Which lessons to flip will largely depend on the type of material taught, and a decision making tool, similar to the rubric utilized by Prashar (2015) may need to be developed if the Department of Military Instruction wants to pursue further implementation.
Bibliography


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