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Andrew Urbaczewski

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Andrew Urbaczewski
Department of Business Information and Analytics
Daniels College of Business
University of Denver
Andrew.Urbaczewski@du.edu

Abstract:

The "flipped classroom", one where the lectures take place outside of the classroom and the homework is done in the classroom, is one of the trendier topics in contemporary education. The idea behind the model is that students can work on problems when both their instructor and peers are present, while having the lectures on video that can be watched at home allows the students to rewind, fast-forward, and otherwise tailor the lecture experience to meet each individual learner's needs.

This paper reports the results of the author's experiences in flipping the classroom in an advanced spreadsheet modeling class. It also offers recommendations for those wishing to participate in further flipped classroom experiences. While the amount of material able to be covered was greater, students who were used to doing less work reported anxieties. Care should be taken to be certain that students are prepared for the amount of work and for the benefits of the flipped classroom.

Keywords: flipped classroom, IS education, spreadsheet modeling

I. INTRODUCTION

Educators striving for continuous improvement are constantly searching for new methods of delivering quality education. The advent of affordable technology, both as it is fixed in the classroom and office as well as in the homes of the teachers and students, make possible a wide range of not only synchronous but also asynchronous educational methods. When combined with increasingly mobile technology, there are now more educational methodologies available than ever before.

While distance learning has existed for hundreds of years, new technologies made the learning and interaction process more and more feasible. Starting with the printing press, moving through radio and television, and finally into the Internet, distance learning could be seen not only as an alternate method of learning but also a supplement to traditional classroom learning.

One of the latest trends in education is the "Flipped Classroom". This methodology is becoming popular in skills-based and scientific-based courses, where practice of a particular skill is essential to mastering that skill. In the flipped classroom, students watch or listen to lectures at their leisure outside of the classroom, while actual class time is spent practicing the skills to be mastered. In the classroom, slower learners can get more individual attention from the instructor, while advanced learners can be given greater challenges to alleviate boredom and work towards achieving even higher levels of mastery. Broadband Internet and faster multimedia computers, tablets, and even phones make it possible to watch videos of lectures and screencasts of demonstrations with a minimum of burden and difficulty for media distribution.

While the flipped classroom has evolved through many different generations of media distribution, it is Bergman and Sams [2012] who may be the first to get credit for developing a flipped class. Their version of the flipped classroom involved delivering simple podcasts of their slides and lectures to students who missed class. Post-hoc video delivery of classroom sessions however goes much further back, made quantum leaps easier through the development of cheap recording and videotape with players starting to be available in homes [Gibbons et al., 1977].

The flipped class often refers to implementations in high schools, but it is equally applicable and prevalent in collegiate settings. Bergman and Sams [2012] and Stacy Roshan [Houston and Lin, 2012] used the flipped class in high school, while Andrew Martin [Berrett, 2012] and Strayer [2007] give examples of its use in college. Eric Mazur [Lambert 2012] has experimented with this in physics instruction for many years. Furthermore, Frydenberg [2012] shows how the flipped class can be used in IT classes, specifically with a mandatory spreadsheet skills class for first year student.

This paper describes the use of the flipped classroom in a senior-level IT class, one that teaches advanced spreadsheet modeling. Students enrolled in the course were required to have completed the basic spreadsheet skills class as either a sophomore or a junior. While many papers [e.g., Frydenberg, 2012] describe the successes of the flipped classroom and acceptance of the model by the students, the methodology in this class was met with a lot of resistance and in some cases outward hostility.

II. DESCRIPTION OF THE COURSE

This course took place in a medium-sized public Midwestern US university in the summer of 2013. The course met for 3 hours on Monday and Wednesday evenings over a 7-weeks, plus an exam week.

The students in the advanced course, as well as the instructor for the basic course, described the basic course experience as being like a cookbook, where students may have followed a recipe that was laid out for them in a book without really knowing what was really happening behind the scenes. One student described a person completing the basic course to be like Jesse Pinkman in the TV series Breaking Bad [Gould et al., 2011], as he can cook high-grade methamphetamine without really knowing the chemistry that makes it happen.

Students on the first day were informed of the nature of the course and of flipped classroom theory. Moreover, students were also informed that the project would be intentionally vague in order for them develop their problem solving skills. They were also informed that the course would be a lot of work, as learning requires doing which requires working, and that if they did not want to work, then they should likely drop the course.[1]

About one week before the class began, the instructor emailed all the students in the course to get some information about them that was used then in forming student teams. As the course was full, there were ten teams of four students formed. Through attrition in the course, it wound up being nine groups with either three or four members. The instructor attempted to make the teams heterogeneous by mixing up student majors, genders, work status, class standing, grades earned in the basic spreadsheet class, and personal interests. The difference between the student groups in this class as opposed to others is that the group work was all done in class, and work done outside of class was individual. This was to address the issue of students often not being able to coordinate schedules outside of class, as students in this class worked an (self-reported) average of 34.8 hours/week, in addition to taking classes.

Before each class, students were expected to read the chapters in the textbooks and also watch video demonstrations of the subject for that day. The videos to be watched ranged between 20-75 minutes, depending on the topic being discussed for that day. Videos were scouted from YouTube, and the instructor chose not to make his own videos as there were many sources already available. At the same time, the instructor never used the same source twice, relying on variety to give the students more possible ways to learn.

Class periods were structured as follows:

[1] On day 1 there were 40 students enrolled with 3 on the waitlist. One week later the final course enrollment was 31.

a) **Daily quiz**: At the beginning of class each day, the students took a 10-question fill-in-the-blank quiz. This quiz was largely designed to see if the students had actually watched the videos or read the chapters. They were not designed to be picky or test deep understanding, but just to be an incentive to ensure students were actually watching the videos.

b) **Discussion of the day's topic**: This was a 10-15 minute time period to discuss the matter for that day (e.g., Monte Carlo Simulation), answer questions about the techniques, and introduce the problem that was going to be solved. See Appendix A for an example of a day's problem

c) **Problem solving strategy:** Students then met in their teams to discuss how they might go about solving the problem. As mentioned, the problems were often vague, with no "back of the book" answer that required students to be creative and think about how they might obtain the data needed to solve the problem, what calculations might be necessary, and how they might format the solution. After five minutes or so of group discussion, the class reconvened for a few minutes to discuss strategies and what might be the benefits or pitfalls of certain methods.

d) **Actual problem solving:** The groups when then set about to try to solve the problem at hand. Students would take turns being the coder, the idea generator, and the researcher. Some groups would actually have two different coders when they wanted to try multiple solutions or if they thought they could complete the problem more efficiently by dividing it into multiple tasks that could be completed concurrently. This would then take the remaining 2.5 hours of class time. The instructor would walk around the classroom and assist the students with their problems as they had both spreadsheet-related and model-related questions. About halfway through this time, the instructor would randomly select one group, and it would be their job to present their solution to class during the last 15 minutes. Each group had to present once during the course.

e) **Student presentation and commentary:** The last 15 minutes of class was a presentation by one group to the rest of the class about their solution. The idea behind having this component was to give the students a chance to communicate their solution to their peers. The instructor believed that the students would work harder if public scrutiny was required (Topping 1998) and it would also give the other groups a chance to see a potentially different solution to the problem.

Table 1 shows the various assessments used in the course:

Table 1. Advanced Spreadsheet Modeling course assessments

Assessment	Weight	Notes
Daily Quizzes	30%	Twelve quizzes were given, and students could drop the lowest two scores. The others were counted as 3% each.
Final Exam	20%	This was a two-part exam which was first done closed-book and the second part was practical, solving problems in Excel.
Group Presentation	10%	Each group was graded on the 15-minute presentation that was done at the end of class.
Individual Project	30%	Each student had to complete an individual practical project using Excel and large data sets to create or modify some existing metric. Samples included valuing sports players on a team and the effects of economic boom and bust on recreational drug markets.
Class Participation	10%	Students were awarded points based on attendance and overall helpfulness/contribution to class learning

III. STUDENT REACTION

Overall, students were not pleased with this course format. Several students complained bitterly about the amount of work in the course, the frequency and difficulty of the quizzes, and some of the course policies. While many complained about not "learning" anything in the basic spreadsheet course, they then also complained about having to "learn on their own" or being behind because they did not really learn anything in the basic class.

Much of the student reaction occurred in the discussion forums for the course that were in the university's learning management system. While there were discussion forums for individual topics of the course, there was also an "Anonymous Course Comments" section, where students could write a posting without having his/her name attached. Though always offered, the instructor had only rarely had this section ever actually used by students, and when it was, it was to ask a question that a student would be concerned about ridicule, such as "how do I check my grades". In this class, this section was used frequently starting around the third week. It was a place where students would complain about a quiz grade, or the amount of videos, or the accent of a possible presenter, or even about each other. In many cases it was the mob mentality that occurs in a nameless, faceless Internet.

Some students seemed to enjoy the opportunity to actually practice the skills, while they were fewer and further between.

(Due to Learning Management System upgrading and archiving, actual student quotes are not available at this time but will be by the time of the conference)

IV. LESSONS LEARNED AND DISCUSSION

In this class, there were many factors that worked against the use of the flipped classroom, and as a result there were many things the instructor might do differently in the future:

a) Summer Semester: This course was compressed into half of the normal calendar days that might be expected to absorb the material. Trying this approach might have worked better in a normal-length semester. While the course learning goals and objectives are supposed to be the same no matter what semester or format that the course is offered, there was obvious expectation on the students' part that summer classes are supposed to be lighter.

b) Student body composition: As mentioned earlier, student in this course were working a self-reported average of almost 35 hours/week. It may have simply not been possible for many of them to finish class at 9:00 pm on a Monday night and do all the required work by 6:00pm on a Wednesday night in addition to the hours worked and other obligations. While the expected workload was roughly in line with the "one hour in, three hours out" guideline for expected work outside of the classroom, and the students knew work schedules when signing up for the course as well as the university guidelines on effort expectations, it is likely they had been desensitized to those rules. It is possible this effort would work better in a residential campus or in a day class where work hours are not likely to be as much of an interference with the learning process.

c) Total immersion into the flipped classroom: In Frydenberg [2012], Garrow et al. [2013], and others, the flipped classroom was done in a hybrid, where one day per week was done as a flipped class and the other day was done as a traditional class. The instructor considered this approach but felt it would be too confusing for the students. In retrospect in may have been the best way to introduce novices to the flipped classroom as to the processes.

d) **Cutoff anonymous commenting:** While the instructor attempted to insert himself (non-anonymously) into the anonymous discussions, it did not seem to be effective in curtailing negative discussion. When the discussion did not turn away from whining or name-calling, the instructor should have simply closed the forum for a day or two to have a "cooling off" period.

V. SUMMARY

Flipping the classroom is one of the latest trends in education. However, it is not an end-all be-all unto itself. There are certain situations where it could work better than others.

Ideally for future learning and research, the instructor would have two sections of the same course, where one was conducted with a flipped classroom and the other on a traditional manner, and compare several attitudinal, outcome, and learning assurance variables.

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APPENDIX A: SAMPLE DAILY PROBLEM

How much money will I have at retirement?

Will I have enough to live on?

One of the issues facing individuals today is wondering how much money does he/she need to save for an adequate retirement. Certainly the more you save and the longer you save, the more likely you are to have enough money that when you retire you will not outlive your savings. The investments that you make with your retirement savings will also affect your ability for your money work for you and grow to outpace inflation. Investments, however, come along with risk, and the timing and variance of returns will affect your ability to retire. Consider the following options for investment:

1. S&P 500 Stock Index Funds: mean of 12.26%, standard deviation of 19.97% (from 1926-2008)
2. High Quality Bond Funds: mean of 5.17%, standard deviation of 2.49%
3. Certificates of Deposit: mean 1.5%, standard deviation 0.5%

These are all common investments in individuals' retirement portfolios. While the stock investing gives the highest returns, it also has the most volatility. So simply assuming a mean when calculating projected retirement fund account balances would be tricky. It also means the range of possible returns is quite wide – there is a 1 in 4 chance that the stock portfolio would go down in value in a given year! But yet since we are all a long way from retirement, it is presumed that time and variance could cancel each other out and it could make sense to invest in the stock market.

Imagine you have an initial investment of $5,000 to start a retirement account – money you got as a graduation gift. You are also starting a job, at which point you will invest money at the end of each month when you get paid, having an amount taken out of your paycheck so that you don't even see it nor are tempted to spend it (and it's also pre-tax until you withdraw it). Let's assume for now that you invest $600/month, and you want to see if you will have enough to retire after 30 years. Use 100 trials of Monte Carlo simulation to calculate these possibilities.

- What is your portfolio's maximum, minimum, mean, and median wealth?
- Assume that you are going to live for 25 years after you stop working, and you are going to withdraw the mean monthly return (1%) of the value of your portfolio when you retire (i.e., 360 months from now) and withdraw that same amount every month for the next 25 years. Will you have enough savings? How many times will you run out of money?
- What is your recommendation to young people who are saving for retirement?

ABOUT THE AUTHOR

Andrew Urbaczewski is Chair and Associate Professor of Business Information and Analytics in the Daniels College of Business at the University of Denver. He is the author of 25 journal articles and over 40 conference presentations. As a past-president of AIS:SIGED, he has done much work on improving the process of IS Education. Andrew is the Editor-In-Chief of the *Journal of Information Technology Case and Application Research*.