Flipping your Classroom in Economics Instruction: It's not all or nothing

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The best way to learn is to do; the worst way to teach is to talk.

Paul Halmos, 1975

…Evidence is mounting that readjusting the focus of education from information transfer to helping students assimilate material is paying off. My only regret is that I love to lecture.

Eric Mazur, 2009

Introduction

There is more and more evidence that the traditional lecture style of teaching is not the most effective form of instruction. In particular, instructional methods which engage students in active learning exercises have been shown to increase student outcomes. For example, a recent study by Freeman et al. (2014) meta-analyzed 225 studies which compared student outcomes in traditional lecture based courses with those that used active learning. They found that, "…average examination scores improved by about 6% in active learning sections, and that students in classes with traditional lecturing were 1.5 times more likely to fail than were students in classes with active learning." These results are in stark contrast to the findings that the median dominate form of teaching in economics has remained "chalk and talk" for some time (see Watts and Schaur, 2011). Also, Becker and Watts (1998, p.4) note that, compared with economics, "there is recent evidence that in other subject areas class discussion and other forms of active learning – not extensive lecturing – are the most prominent forms of instruction in U.S. higher education." These findings imply considering using innovative teaching methods like active learning might be especially important for economics instructors.

Goffe and Kauper (2014) discuss why economics instructors tend to stick with so-called "chalk and talk" teaching styles. They find that of the instructors in their survey, "one-third [say] that students learn best from lecture; another third [report] that students do not learn best from lecture, but it is cost-effective; and the rest [answer] that students do not learn best from lecture, so alternatives are preferred. Lecture advocates often cite the inputs and costs of teaching while advocates of alternatives often cite student outcomes." Of course professors must weigh the relative importance of research, university service, and teaching in their current positions. Especially given the research expectations in many economics departments, professors may be wary to invest time and effort to dramatically change their teaching style. To switch from a lecture method of teaching to one where active learning is used throughout a class can represent very large investment of time. This issue will be referred to as the "fixed cost problem."

In addition to the cost benefit analysis that instructors might engage in when considering whether to use active learning exercises during classroom time, certainly hysteresis and habit formation also matter. Many instructors may stay with their current style of teaching simply because that is what they are accustomed to. In addition, the uncertainty associated with trying a new approach may be a large enough obstacle to prevent a change in teaching style. Becker and Watts (1998, p.4) write, "the equilibrium might may be one established by convenience, custom, and inertia rather than efficiency or, especially, by what represents effective teaching practices in today's undergraduate curriculum." These issues are also compounded by the uncertainly of how the students and faculty peers would react to a dramatic change in teaching style. These collective concerns regarding using new teaching methods will be referred to as the "inertia problem."

The purpose of this paper is to address both the fixed cost and inertia problem by proposing a method by which an instructor can test the waters of student engagement and active learning by simply switching a single lecture from a chalk and talk style to one where these new approaches to teaching are used. This proposal will be motivated by showing that the fixed costs are much smaller that many instructors might realize. In addition, by only changing a single lecture, the issues associated with the inertia problem will be minimized.

The active learning framework that will be used in this paper is that of a "flipped" or "inverted" classroom. This method of using active learning in the classroom is one that has received a lot of attention and one that many instructors are already familiar with, at least on a superficial level. In the flipped classroom, the instructor provides instructional videos that students watch before coming to class. These videos, which are usually short and range from five to fifteen minutes, take the place of the conventional lecture where information is transmitted from instructor to student. During class time, the instructor provides active learning exercises that help the students apply the material that was covered in the videos.

Bishop and Verleger (2013) provide a useful definition of the flipped classroom: "the flipped classroom [is] an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom." The commonly mentioned advantages of the flipped classroom are that it engages students in the learning process and allows to professor to be present and assist the students in the application of the course content. These advantages are also easily scaled so that even in large classes, student engagement can be increased. Also, given that students view the videos before the class, the use of active learning activities does not

come at the cost of not being able to cover as much material during the course. When studying the flipped classroom technique, it might be tempting to focus on the production and use of the videos in a flipped classroom. Actually, when it comes to what the evidence from the literature on student outcomes reports, the most important part of a flipped classroom is not the videos but the active learning exercises.

Evidence of the Benefits of Active Learning in Flipped Classrooms

Perhaps the first research relating to flipped classrooms in undergraduate economics education is Lage et al. (2000). While this study did not focus on student outcomes, they did find evidence that students preferred the flipped classroom and also that the new format may even help attract female students to economics. Maxwell et al. (2005) find that when using problem-based learning, a form of active learning, in a large sample of High School economics students, performance can increase if teachers are properly trained in both the new teaching techniques and in economics. Yamarik (2007) compared two economics courses, one taught in traditional lecture format and one with cooperative learning, and found that student's performance on exams was higher. Roach (2014) found that students reacted positively to the use of a flipped classroom in principles microeconomics class. Calimeris and Sauer (2014) present empirical evidence that in a randomized experiment, "following a negative adjustment period, students who experienced the flipped teaching method scored significantly higher on midterm and final exams than did the control group." Thus the evidence in economics teaching research appears to suggest that students react positively to the use of a flipped classroom and it increases their performance.

The research relating to increased student performance and the use of flipped classrooms has also been found in non-economics courses. Deslauriers et al. (2011) compare the traditional lecture format with one that uses "clickers" in an introductory physics course in a controlled experiment. While this study only looked at the effect of changing one lecture, they did find that the experimental section that devoted time to student discussions and clicker questions performed 2.5 standard deviations above the control group. McLaughlin et al. (2013) compared traditional lecture to a flipped classroom in a basic pharmaceutics course. While they didn't not find evidence of increase student performance, they did find evidence that the flipped course "promoted student empowerment, development, and engagement." Lorenzo et al. (2006) find that in a non-major introductory physics class, "with certain interactive strategies not only yields significantly increased understanding for both males and females, but also reduces the gender gap." Moravec et al. (2010) found that a flipped classroom format used in

three introductory biology courses led to a 21% increase in correct answers on exams related to the content covered using the new method. Day and Foley (2006) found significant gains in student performance in computer interaction class using a flipped classroom. Love et al. (2014) found improved student outcomes in a flipped linear algebra course in addition to positive student perceptions. Touchton (2015) compares two undergraduate political science statistics courses and finds that student performance increases in "difficult, applied areas emphasized in class."

Although not a study that is directly related to flipped classrooms, Karpicke and Blunt (2011) contains useful findings that support the active learning teaching approach. In two separate randomized experiments they compared the performance on tests relating to comprehension and understanding of science related texts. They randomly assigned students to different forms of study to prepare them for the exam. It was shown that the students who prepared for the exam by simply tried to recall the information they had read performed better than those who studied using more elaborate methods like concept diagraming. Even though the retrieval method resulted in better outcomes, the students who used this method had the lowest predictions about how they were going to perform on the exam. In a New York Times article, Belluck (2011) reports the following after interviewing another researcher regarding this study:

> *It may also be that the struggle involved in recalling something helps reinforce it in our brains.*
>
> *Maybe that is also why students who took retrieval practice tests were less confident about how they would perform a week later.*
>
> *"The struggle helps you learn, but it makes you feel like you're not learning," said Nate Kornell, a psychologist at Williams College. "You feel like: 'I don't know it that well. This is hard and I'm having trouble coming up with this information.' "*
>
> *By contrast, he said, when rereading texts and possibly even drawing diagrams, "you say: 'Oh, this is easier. I read this already.' "*

In a flipped classroom, time is spend on working through practice problems students are forced to recall and use information they learned by watching videos before coming to class. While it may require more effort when compared with sitting in class and listening to lecture, requiring students to recall and use the information they learned in pre-class videos may be the reason that there appears to be increased student performance in flipped classrooms.

Anecdotal Evidence from Personal Experience

The courses taught by the authors include principles of macroeconomics, applied business statistics courses (both undergraduate and MBA), and an upper level time series econometrics course. The flipped classroom approach has been used for approximately three years across most of these classes that have taught during this period of time. Students watch two to five short videos before coming to class. Watching the videos is not required or graded but strongly encouraged. Class time is devoted, almost exclusively to working through practice problems and providing real world examples. For the active learning exercises, the students are given problems to work through. Most problems are past exam questions. They first attempt the problem by themselves, and then after a period of time they are asked to discuss their results with the group of students they are sitting with. After that, a group at random is picked to discuss their work. Any questions from the entire class are addressed at that point.

An anonymous poll was taken towards the end of a business stats course taught in a flipped classroom style. Students were asked how often they watched the videos before class. Of the 73 respondents 64 answered "Almost always" or "Most of the time" while only 9 answered "Sometimes" or "Almost Never." Student reception has been largely positive. In the same class, the students were asked in an anonymous pol, "True or False: Compared to traditional lectures, I prefer to watch videos before class and then do practice problems in class." Of the 71 responses, 60 or 84.5% responded "True." Based upon the author's experience, these responses are largely representative of most if not all of the courses taught using a flipped classroom approach. Although there is no empirical evidence to back this claim, the authors also believe that student performance has increased.

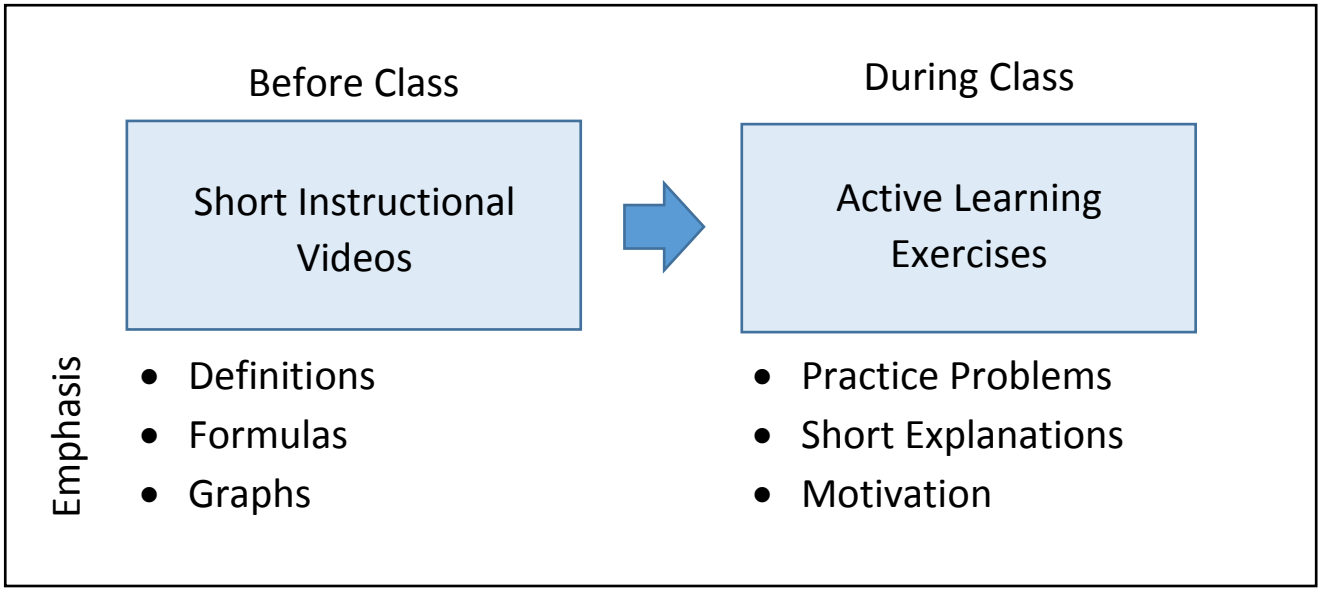
One concern of active learning is not being able to cover as much material. In our experience, the flipped format has allowed us to cover more material. For example, in the principles of macroeconomics class, using a flipped classroom there is now sufficient time to be able to add a unit dealing with international economics. This was also found by Bland (2006) who was also able to cover more material in a flipped classroom compared with a traditional lecture based system of teaching.

The authors have also found that students ask much more questions than in a traditional lecture based class. One reason students may not ask questions during class is that they don't understand what they don't know. When listening to a lecture, they may think they understand, when in fact they don't. When doing practice problems together during class, students realize what their deficiencies in understanding are. This overcomes the common occurrence when, after lecturing for a length of time,

the instructor asks, “Any questions?” and no students respond. In a flipped classroom, where time is spent engaging students in the learning process by having them work through practice problems, student are more able to identify what questions they need to ask when the instructor is present. In a traditional classroom that uses a lecture based style of teaching, students also realize what questions they might have when they work through problems. The main disadvantage is that usually happens when the professor is not present.

Flipped Classrooms

The following diagram describes the main components of a flipped classroom. Short instructional videos are given to student to watch before class. The videos focus on the information such as definitions, and formulas, and graphs. In class time, is spend on active learning exercises that use and apply the information presented in the videos.



Again, two of the problems that could stand in the way of an instructor not experimenting with the use of a flipped classroom are the fixed cost problem and the inertia problem. The fixed cost problem relates mainly to the work it takes to make the videos that students watch before class, while the inertia problem is connected to the active learning exercises that happen in class. While the phrase “active learning” encompasses a wide range of activities, the activities mentioned in this paper are chosen to minimize the awkwardness that is sometimes associated with trying a new teaching technique in class. This type of uneasiness can compound the issues associated with the inertia problem.

As Brame (2013) has noted, another way to understand how a flipped classroom works is in terms of Bloom's taxonomy. The lower order forms of learning such knowledge and comprehension take place outside of class, while the higher orders like application, analysis, synthesis, and evaluation take place in the classroom. Brame (2013) writes, "If the students gained basic knowledge outside of class, then they need to spend class time to promote deeper learning… The key is that students are using class time to deepen their understanding and increase their skills at using their new knowledge." This implies that the videos that students watch before class should focus on the parts of the course content that involves memorization or basis comprehension. The in class active learning exercises should then focus on applying the information from the videos and possibly using that information to analyze real world problems.

Before Class Instructional Videos

There are three parts to the construction of an instruction video that would be used in a flipped classroom: 1) Preparing the content of the video, 2) recording the video, and 3) providing a venue for the students to video the view the video. Given that the focus of this paper is to encourage those who may have never tried active learning exercises in classrooms to use such practices, the suggestions here regarding the production of the videos are designed to make this part of flipping the classroom as simple as possible. This is very important considering that the fixed-cost problem is a major impediment to change for many instructors. In brief, the suggestions here are to convert the lecture material already used into a PDF file. The PDF file along with narration by the instructor are then used to make a video that can be delivered to students to watch before class.

For those instructors that teach using a traditional lecture, the existing delivery method of information is most likely either some sort of computer presentation software (like PowerPoint) or the handwritten notes displayed on a whiteboard, chalkboard, or overhead projector. To prepare the content of the video the instructor can simply take a copy of either their presentation slides or lecture notes and make a PDF copy. In the case of presentation slides, the PDF copy can be produced by saving the file in a PDF format. To produce a PDF version of handwritten notes, there are many options. Many copy machines found in university departments will scan hard copies of lecture sides or notes to a PDF. Flatbed scanners are also ubiquitous, and can produce PDF files. For those instructors who own a smartphone, there are many free apps which will use the phones camera to produce PDFs. Again the emphasis here is one reducing the fixed costs of video production. Hence, the suggestion is to simply take the existing delivery method and convert it into a PDF.

Once the PDF is created, the instructor can now turn to recording the video. Screen recording software is used to make the video that students will watch before class. Perhaps the most well-known paid screen recording software is made by TechSmith Corporation. TechSmith offers more than one software option. The programs differ in the tradeoffs between price and features. The free option, "Jing," has few features and is limited to videos of five minutes or less. The middle of the road option is "SnagIt," which is has many more features, but costs $29.95 for a single user educational license with not annual fees. "Camtasia," has by far the most features and costs $179.00 for a single user license with no annual fees. Both of the paid software options offered by TechSmith have free 14 day trial options, which should make them attractive for those who are investigating the use of a flipped classroom. The other cost that comes with the more expensive version is that, with the increase in the number of features, the complexity of use also increases. For those instructors with an average level of proficiency with technology, "SnagIt" is probably the best option.

The actual video can be produced by simply recording a narration of the PDF version of the lecture slides or notes as if the instructor was explaining them to a student in office hours. One important note is that while most laptops have a built in microphone capable of recording voice narration, some desktop PCs do not have the hardware necessary to make sound recordings. A simple and inexpensive solution is to purchase a microphone with a 3.5 mm jack or USB connection. These can be purchased for around $10 to $20 from online retailers.

One important point is that the videos do not have to include a recording of the instructors face. The video is simply a video recording of the PDF slides or notes with only the voice of the instructor explaining the material. The mouse cursor can be used to point to or highlight important parts of the material. The key is to not view the video as a video of a lecture that might take place in a classroom, rather is a narration of the material being presented. Producing videos in this manner will serve to alleviate concerns of instructors who do not feel comfortable recording a visual depiction of themselves teaching. In addition, it serves to make the content of the video as accessible as possible by devoting the entire area to the content of the PDF file.

After the video is recorded, it needs to be accessible to students to watch before class. For those who use one of TechSmith's products, they can use their Screencast.com service. There is a free version of this cloud service with provides 2 GB of storage space. This is more than enough for an instructor who is only experimenting with using a flipped classroom. Instructors can then simply email the URL link to the student who then can view the video before class.

The TechSmith Products are by no means the only software options that could be used to record videos for a flipped classroom. For those instructors with access to an iPad, there are many options for apps that will create instructional videos. These include Vittle, Explain Everything, Educreations, and Screen Chomp. The website http://www.screencast-o-matic.com/ also has provides free screen recording software to use with desktop computers although screen recording is limited to 15 minutes or less.

One potentially attractive alternative to making one's own video for a flipped class room, would be to direct students to a video that has already been produced. Websites like Kahn Academy and others have videos on a wide variety of topics, including economics. Although this would serve to reduce the fixed cost problem, it also takes the instructor out of half of the process of flipping the classroom. There is also evidence that it may reduce the effectiveness of the flipped. In a randomized experiment, Joyce, et al. (2015) test the casual impact of class time on student performance. For those students assigned to the treatment group with less class time, extensive online material was given to compensate for reduced face to face time. In their experiment, two professors taught the courses, but the online material was only made my one of the professors. They report that, "…we find that students whose professor was in the videos watch 8.6 more videos than those whose professor was not in the videos. Students appear drawn to videos in which *their* professor appears. The finding argues for personalizing online material as much as possible." In other words, students are more likely to view, and thus benefit from, videos when they are made by the instructor who teaches the course. In addition when the instructor makes their own videos, they will be no confusion that might arise from different notation or terminology that might come from using another instructor's videos.

Active Learning Exercises

There are many different types of active learning exercises. Given the issues associated with the inertia and fixed costs problems, for those instructors who have never attempted to use different types of teaching techniques active learning exercises should be choses that don't require a great deal of upfront preparation and that would not cause the instructor to feel awkward or uncomfortable. In addition, the type of active learning exercise should be one that is suited the technical and quantitative nature of economics instruction.

The suggestion in this paper is to use a type of active learning known as problem-based learning (PBL). Barrows (1996) states that six characteristics of PBL are: 1) Learning is Student-Centered, 2) Learning Occurs in Small Student Group, 3) Teachers are Facilitators or Guides, 4) Problems Form the Organizing

Focus and Stimulus for Learning, 5) Problems are a vehicle for the development of clinical problem-solving skills, and 6) New information is acquired through self-directed learning. Given that economics is primarily a tools based discipline and learning economics is not primarily reliant on memorization, PBL seems particularly appropriate. In addition, going over practice problems is something that should be familiar to most if not all economics instructors.

In excellent source of practice problems for an instructor that wants convert a lecture to a flipped classroom format are previously given exams. This reduces the fixed cost problem by employing questions that have already be made. In addition, this can be used to motivate students to take the practice problems seriously. When the instructor tells the students that the practice problems are previously used exam questions, they are more likely to expend effort on answering them correctly. Given this, it is important that the types of problems covered in class are similar to those used on exams. The actual type of question shouldn't matter as much. Multiple choice, short answer, and numeric based problems can all be used during class time. End of chapter problems from the textbook are another source of practice problems.

The format of the PBL can take the following form. It is important to form the class into groups of between 3-6 students at the beginning of class. To make the process as simple as possible, the instructor can tell the students to form their own groups using the students sitting around them. The following process is the same for each question presented to the class. In addition it can be used in small classes as well for classes with a large number of students.

1. Present the problem to the class. Inform them that they should first work on the problem individually and that they shouldn't use their notes or textbook for help.
2. The instructor can walk around the class during this time. If they feel comfortable, they can engage individual students and provide assistance. Otherwise, they can observe how the students are answering the questions in general.
3. After a few minutes, tell the students that they should work together with their group and can feel free to use their notes and books.
4. Again the instructor can walk around the class, engage student groups, and provide individual assistance.
5. After another few minutes the instructor can pick a group at random and ask the students some of the following questions. It is important to focus on how they answered the question, rather than the actual answer they arrived at.

a. What tool/equation/graph did you use to answer the question?
b. What was the first step you took to answer this question?
c. What was the hardest part of working through this question?
d. How did you answer the question?
e. What mistakes do you think you made?

6. The instructor can then provide the correct solution and ask the class as a whole if they have any questions. The instructor can respond to the additional questions raised.
7. The instructor then presents the next question and proceeds using the same steps.

It is helpful to understand the motivation behind the above steps. Having the students work individually to begin with, and without the help of notes or the textbooks, serves to help them understand what they don't know. As is noted by Bressoud (2011), when speaking of mathematics students (although also applicable to students of economics), "…Uri Triesman famously observed and documented back in the 1970s, most mathematics students do not know what they do not know, nor how to begin to overcome this deficit. The most effective way for them to discover the gaps in their own knowledge is to discuss the mathematics with their peers who also are struggling to put the pieces together." This leads to the next step where the students discuss their individual efforts with the other students in their group. Throughout this process, the instructor can simply walk around the room and observe the efforts of the students. In practice, it has been shown that students are much more likely to ask the instructor questions when they are in close proximity to each other. Perhaps this is because the students feel less fearful of asking questions in front of the entire classroom.

Asking groups at random, incentivizes all students to put forth effort to answer the question. Even if a group was selected to answer the last question, they are still equally likely to be selected for the next question. The randomization can be employed by numbering the groups and using a random number generator in a spreadsheet program to select the group. After picking a group, the instructor asks the group questions. Emphasis should be placed on the fact that mistakes are expected to me made and that by learning from the mistakes made, the students will be better prepared for exams. The questions the instructor asks the students should also focus more on how the students answered the practice problem rather than the end answer. This can even be the case if multiple choice questions are used. Instead of asking, "What answer did you pick?" a better question could be "What was the first step that you took to answer the question." Question that focus on the process rather than the end result will better prepare students by helping them focus on the method of answering questions that can be

applied generally. After the instructor thinks that the group discussion should end, she or he can display the correct solution to the practice problem. Again time should be devoted to answering any questions that might arise from the class as a whole. Instructors will most likely note that students are more engaged in the learning process and ask more questions than they normally do.

Selecting a Lecture to Flip

As was stated earlier, the flipped classroom can be thought of in terms of Bloom's taxonomy where the out of class instructional videos focus on remembering and understanding, and the in class active learning exercises should focus on application, analysis, synthesis, and evaluation. This concept can be a guide for the instructor who wants to experiment with flipping their classroom and devote just one class period to this new teaching technique. For example, in a traditionally taught course, some lectures focus more on definitions, basic equations, or the introduction of core models. Lectures that cover these types of topics would especially be suited to being flipped, whereas a lecture that focuses more on the application or use of concepts would not be as appropriate for a flipped classroom.

Honeycutt (2013) suggest a set of guidelines to help instructors identify parts of their course that are particularly suited to using a flipped classroom setup. Two of the suggestions are "Look for the fundamentals," and "Look for boredom." These suggestions can be related to Bloom's Taxonomy. The core concepts in any topic that are covered in an economics course typically involves a greater proportion of lower order understanding. For example, when introducing the supply and demand model, the instructor needs to cover topics such as what variables are on each axis, the algebraic difference between movement along a curve and shifting a curve, and the variables which shift the supply and demand curves. These are all topics that involve lower order forms of learning. Thus the lecture when a model is introduced and developed can be a good time during the course to use a flipped classroom.

The second suggestion from Honeycutt (2013) is to look for boredom. This applies not only to boredom in the students but also boredom in the instructor. Again, this relates to Bloom's taxonomy. Lectures that focus a great deal on definitions and formulas are not engaging for the student nor the instructor. A good example of this is the introduction of price elasticity of demand in a principles of microeconomics course. In this case, the equation of price elasticity of demand must be covered in addition to the definitions of elastic, unit elastic, and inelastic. Also, typically the basic relationships to a linear demand curve is also covered. These topics, while essential to understanding a fundamental

principle of economics, most likely will not elicit a great deal of excitement from the students. In addition, it can be very tedious for instructors to cover such topics every time they teach the course. Thus, introducing such topics in a video that students watch before class will not only frees up time in class for the more interesting applications of such topics, but also results in the instructor not having to repeatedly cover banal material in class.

Thus for the instructor who is considering experimenting with using a flipped classroom and wants to focus on changing how she or he teaches a single lecture, a good place to start would be the introduction of a topic when definitions, formulas, and models are introduced. This has the added benefit of providing the students a convenient way in which they can review the fundamental material over and over again by re-watching the videos. This can be done at any time during the course. It is also particularly important for the core information in an economics course. Student can feel overwhelmed when a new concept is introduced. When that information is introduced in a video, students are able to assimilate the information at their own pace. The ability to rewind videos is one aspect of a flipped class that students perceive as being beneficial. For example, Roach (2014) reports that 82% of students either agree or strongly agree that being able to rewind video lectures as being as aspect of the flipped classroom that they said helped them learn.

Conclusion

The evidence of the use of active learning increasing students' performance is growing. One of the most popular applications of active learning, is the flipped classroom where topics are introduced to students in video format before class. In class time is then spent on active learning exercises that use the material from the videos. For many instructors, the foreignness of such teaching techniques and the cost of using such techniques for the first time incentivize then to stick with the traditional method of "chalk and talk." The purpose of this paper was to show that both the inertia problem and fixed cost problem are smaller than many instructors might think. Thus the suggestion in this paper is for economics instructors to experiment which using a flipped classroom by flipping a single lecture. It was shown that videos can be made at relatively low cost. In addition, the active learning exercises can focus on problem based learning which should be familiar to most instructors. In addition, the costs of preparing in class active learning exercises are modest given that they are based upon existing sets of questions used by instructors. Suggestions were given to identify the single lecture in a course that might be well suited to being turning into a flipped classroom. Following such suggestions will help those

who teach economics courses personally understand how these teaching methods can help their students become more proficient in using the tools of economics.

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