

THE BENEFITS AND CHALLENGES OF A FLIPPED CLASSROOM
IN HIGH SCHOOL BIOLOGY

by

Michele Lee Fields

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DEDICATION

I wish to dedicate this paper to my mom, Ann L. Snyder, and my dad, Russell R. Snyder. While working on this project, they both encouraged me to work to my fullest potential. In addition, they stood by my side as they were both undergoing many challenges with their health. I know that as I present this paper that they will be together and looking down on me from heaven smiling on a daughter who worked to complete a dream that both had for her.

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ABSTRACT

Before the pandemic, using a computer in the classroom was becoming more common. The idea of flipping a classroom, where the student takes the notes as homework, and interacts with the teacher to solve problems during class was an idea that was tested in some classrooms not only in the United States but across the world. This study looked at the benefits and flaws of using a flipped classroom. The qualitative data examined the attitudes that learners, parents, and teachers had about this concept in the form of a survey. The quantitative data included was to be in the form of state scores on tests, number of homework assignments, in the form of notes, turned in on time, and lastly the grades that each student received in the class. The survey suggested that students were wary of the flipped classroom at first, but some liked it better than the traditional classroom. Teachers agreed that once the classroom was flipped, it was a sustainable model for teaching. The time commitment to flip a classroom totally was great and many suggest doing a unit a year. Parents felt that if the notes were accompanied by lecture, the flipped classroom model was easier on them because they could use the videos to aid their student when it came to questions about the material or aiding in studying. Grades and scores on the standardized test did not increase or decrease from previous years where the classroom was not flipped. In conclusion, after reviewing all the data, it appeared that the flipped classroom is a tool that a teacher can use the same as any other tool at the teacher's disposal. The benefits and flaws seemed to cancel each other out.

CHAPTER ONE

INTRODUCTION AND BACKGROUND

Context of the Study

I teach at James Monroe High school in the city of Fredericksburg, Virginia. The school has approximately 1,100 students who attend from various backgrounds and income levels. We have students who live in multi-million-dollar houses and homeless immigrants from other countries all in the same classrooms. There is an extensive English Language Learner (ELL) population in our school. At this present time, there are thirty-four different languages spoken in our school. In addition to the ELL base that we had, there was also chronic absenteeism in the school. The absenteeism makes such an impact on the school that we have Wednesday and Saturday school once a month so that students can meet the attendance requirements. Based on all these obstacles, I needed to find a way to allow students to work at their own pace in learning.

Having just come from a one-to-one school and seeing them transition from a traditional classroom to a one-to-one format and the grades for standard testing raise, I decided I needed to try and do something with technology to see if it would help the students raise their test scores. Because Fredericksburg is not one-to-one and some students do not have access to computers and wifi, I needed to find something that would work for them all. I had previously had students write notes on their own time during class in a notebook at my one-to-one school and then they just took ten to fifteen minutes once a week to discuss the notes with the class. So, I could not go full one on one but what about a flipped classroom? This would allow my students to take ownership of their learning by putting the burden of responsibility for their notes on them. Many

of my students have phones so they could use the TEAMS app that was available to them through the school to obtain the notes and videos. In addition, students could stay after school to use the computers in my classroom. If that was not feasible, there was a public library that was available to them with computers.

There was no one in the school district who had tried the flipped classroom. I proposed the idea to my assistant principal who thought it might work. The proposal was that I would flip the classroom but also have paper copies of my PowerPoint presentations available for my students who did not have access to computers and wifi. This seemed to meet the needs of all students. The students who had paper copies still had to write the notes; however, they did miss out on the lecture. This was because the PowerPoint was accompanied by my lecture explaining the slides. I also agreed to give them some lead time from the time that I assigned the notes until they were due so that the students could stay after school or go to the public library to do the notes without the paper copies. The notes would be assigned on Mondays for the following week. Variation in the amount or number of days of notes would vary based on the topic that was to be taught. In other words, on Monday, September 9th, there would be 3 days' worth of notes due for the next week. These due dates would be September 16th, September 17th, and September 19th. Monday, September 16th, there would be 1 set of notes being given as there was only one day of notes for the week of September 23rd. The notes were due on the date that the topic was being discussed, thus giving the students a week or more to get the notes into a notebook and work around their schedule.

Focus Question

My focus question was, What are the pros to a flipped classroom for all the stakeholders involved in the classroom experience?

My sub questions include the following:

1. What will a flipped classroom look like for the types of students that I teach (i.e.: Advanced Biology, General Biology, Special Education students and ELL students)?
2. What type of correlation is there between the number of notes taken at home, when they are due in class, and the SOL scores on the Virginia tests?
3. Is the flipped classroom a sustainable way to teach in my classroom, and why or why not?

CHAPTER TWO

CONCEPTUAL FRAMEWORK

Flipped Classroom Philosophy

A flipped classroom is a type of blended learning that reverses traditional pedagogical practice by requiring students to preview instructional content (often online) at home and moving experiential or hands-on activities that are usually done outside of classroom (e.g., lab experiments, peer reviews, and presentations, and PBL) into the classroom (Bishop and Verleger, 2013; Jhong, Song, & Jiao, 2013). Although instruction that takes place outside of the classroom may take different forms, learning is not restricted to time and space constraints in class. Because “content delivery” is mostly done outside of the classroom, more time can be spent in class on higher-order thinking, usually guided by a teacher; and importantly, throughout various collaborative activities, students are invited to co-construct knowledge with their teacher and peers. This allows them to learn actively, increases motivation and facilitates deeper levels of understanding (Yang, Liu, Y.-T., & Todd, A. G., 2019).

Flipped classrooms became popular after two high school teachers in Colorado, Jonathan Bergmann and Aaron Sams started a classroom that followed this model. There were 8 tenets that followed in the definition of the flipped classroom and included:

- 1) Interactions between students and teachers should be maximized;
- 2) Students should take charge of their own learning environment;
- 3) The role of teachers as guides should be enhanced;
- 4) Activities in class should integrate both narrative and constructivist-associated learning;
- 5) Classes should be designed to allow absent students to access materials and make up their learning;
- 6) Students should be provided with sustainable learning materials or resources (e.g., recorded content) for students to revisit/review;
- 7) The design of the curriculum should encourage

students to take part in the proposed learning activities; 8: All students should benefit from personalized education (Bergman & Sams, 2012, p. 42).

To understand the Philosophy of the Flipped Classroom, one must understand that there are different terms for this model throughout the world. The most frequent name is the inverted classroom model (ICM). Throughout this paper, these terms will be used interchangeably because of the different sources from which the research was pulled.

Lecturing to passive students who are distracted by *Facebook* (cf. Junco, 2012) and *WhatsApp* or whatever is popular at the moment appears to be an absurdity. However, the idea of the lecture is deeply ingrained in both the students' and the teachers' minds (cf. {INT12}). In addition, a huge amount of expository teaching seems to be unavoidable," (Handke, Kiesler, N., & Wiemeyer, L., 2013, p.3).

It has been proven in many cases that listening to lectures and handwriting the notes can enhance a student's ability to retain the information. An article published in *Scientific America* dated June 13, 2014, and written by Cindy May explored this concept. To summarize the article, studies were conducted on students who used their laptops to take notes and those who used handwritten notes. The study emphasized recall in various ways to include the immediate recall, given a week to study recall and then long term at the end of the class. All the studies concluded that the majority of students who wrote notes recalled the materials better than those who had typed the notes. The authors of the study felt that typing on the computer could be considered a non-engaging memory tool for the student. Students could type almost verbatim what the teacher was saying but were not actually "processing" the material. The students who handwrote the notes were paying more attention and had to summarize to understand the notes down the road. This made the brain engage in processing and retaining information. Thus, it gives way to

the adage that the flipped classroom and taking notes will be effective in retaining and obtaining knowledge.

“Implementing the inverted classroom model (ICM) also entails modifying it to suit the students’ and lecturers’ needs” (Handke, Kiesler, N., & Wiemeyer, L., 2013, p. 1). The pre-class portion of the flipped course can include what type of videos or prior knowledge acquisition the teacher feels are best for the students as well as descriptions of how the student will be assessed, and what type of activities will be done in the class. Eventually the teacher may find that the class can become a student paced class where there is class discussion and teacher intervention is minimal in the pre-class portion of the flipped classroom.

What do you then do with the in-class portion of the flipped classroom? “The face-to-face time of the class, however, is available for open-ended discussion, discovery learning, and other constructivist methods that require proficient, swift and highly personalized scaffolding from a teacher, which is something that is far beyond the capability of currently available software” (Handke, Kiesler, N., & Wiemeyer, L., 2013, p.4). Many different designs of this face-to-face portion of the classroom have popped up. It can be labs, conversations, think-pair-share activities, presentations or building an item that can be used from the concept that was addressed in the pre-class information. Kahoot, augmented reality, and some virtual tours can also be brought into the picture during the in-class portion of the flipped classroom.

Flipped Classroom Design

To develop or design any type of classroom, one must first look at the pedagogy that is good for all classrooms. This includes the following:

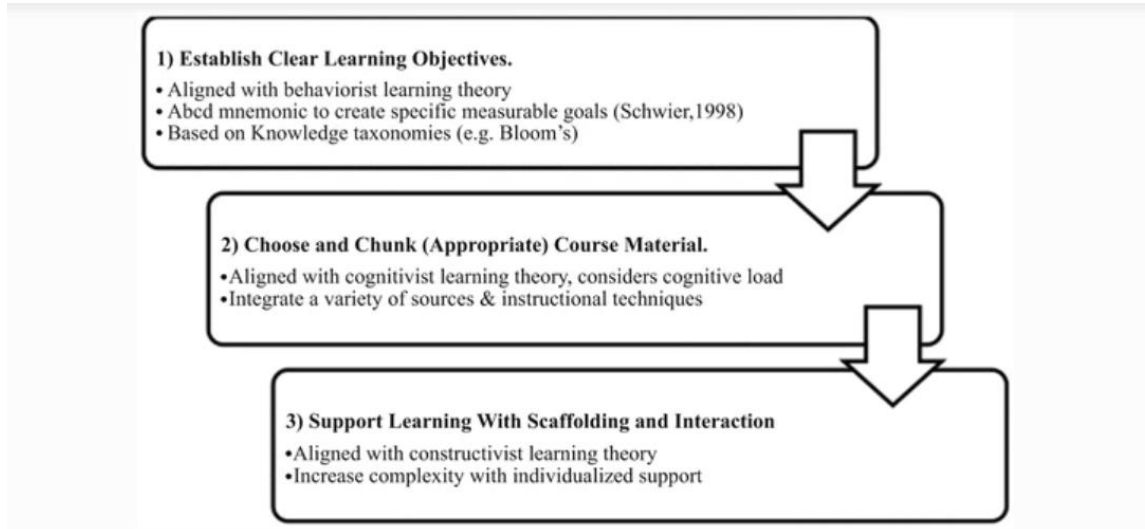


Figure 1: Three key instructional design pieces (Santos Green, Banas, J. R., & Perkins, R. A., 2017, p.12).

All lessons, regardless of whether they are flipped or not, should include the components addressed above. The learning objectives should be clear and, in most cases, start with an I can statement followed by different levels of Bloom’s taxonomy. Choose and chunk is what we are taught as teachers, start with something big and break it down into various subtopics and then break it down even further. Lastly, hang these chunks on ideas that are already there, prior knowledge. It is easier to remember and interact with material when we have something to reference that has previously been taught.

In the flipped classroom method, Bloom’s taxonomy is also flipped. Homework in the past was generally the higher levels where application was expected. In this model, the application is done in the classroom while the knowledge acquisition is done at home on the student’s own time. This allows for a constant in-class discourse between teacher and students for the student to become more of an active learner in the classroom. It also allows the teacher to become a facilitator rather than a one man play.

The activities completed in the flipped classroom design can be many. Most commonly it is the notes or lectures given online while the hands-on portion of the class is spent doing what would have been considered homework in the past. The videos can consist of teachers giving the lecture or videos such as Khan academy or Amoeba Sisters. They can also contain such things as embedded quizzes and peer discussions, and just-in-time teaching. The videos should not be longer than 10 - 15 minutes so as to chunk the material. This does not mean that only one 10 - 15-minute video is all the pre-classwork that a student should receive but each video or activity should be no longer than 10 - 15 minutes. In a study conducted after Covid and published in 2022, it was found that “short videos can significantly improve students’ engagement by 24.7 % (median value) and their final exam scores by 7.4%, compared to the long-video group, which can be attributed to the reduced cognitive load” (Zhu, Zang, et al., 2022, p.6). The short videos were about 8 -10 minutes long, and the long videos were a full lecture time of 55 minutes. The variation of not just doing long videos allows the student time to balance their activities.

One of the methods of getting the students to actively participate in the pre-class study is peer instruction.

A method that is particularly effective but simple to implement has already been widely researched into as an enrichment of standard lectures: *Peer Instruction* (Porter et al., 2013). Here challenging questions are posed to the students. Initially, every student has to answer on his or her own. After small-group discussions, students are asked again. One may conclude each question with a whole-class discussion (Handke, Kiesler, N., & Wiemeyer, L., 2013 p. 9).

The peer discussion method is good for getting the students involved and showing their understanding of the concept. But for the teacher, just-in-time teaching is a method to better assess the students understanding with a more difficult concept that is being introduced in the pre-class portion of the flipped classroom. Just in time teaching is assigning an activity to

students to complete before class and then adapting the face-to-face lecture to address the outcomes that were expected versus the outcomes that happened. If all students understood the concept, one could move on with the entire class to an activity to further enhance the concept. If there were varying degrees of understanding, one could break the classroom into groups by understanding the concept. These groups might include a group who works directly with the teacher – students who are having difficulty with the concept. A group who does some further reading and hands on manipulation - the students who understand the basics but need more time to assimilate the concept. And lastly, a group that expands the concept by doing a project and applying the knowledge they acquired.

Flipped Classroom Advantages

Students, parents, and teachers alike see the advantages of the flipped classroom in acquiring knowledge. The main one being that “Putting lecture videos online and consequently relieving lectures from restrictions concerning time and place is an obvious way to go. Web-based lectures improve access for part-time students and enable slow learners to work at their own pace” (Handke, Kiesler, N., & Wiemeyer, L., 2013, p.1). In addition to loosening the restrictions of lecturing, the student can go back and relearn, revisit, and review the material basics to better grasp a concept.

Also, if the lecture has embedded quizzes or formative assessments throughout the lecture, the teacher can glance at these to see the understanding of the students from the recorded lectures. The students understand that the pre-class lecture will help to clear up the misconceptions of the ideas formed while taking the notes. These formative assessments in the notes can also allow further differentiation. Teachers can form as many groups as needed in the

classroom to make sure that each student is being remediated or enhanced depending on the score of the formative assessment. This will allow both teachers and students to use the in-class time to assimilate the material that is needed for success. Students will not be finishing assignments about material that they have already learned but working on items that are still needed to be learned.

One of the advantages of a flipped classroom that is discussed repeatedly is the fact that students can actually start to take responsibility for their learning. The structure of the classroom allows the students the freedom to learn at their own pace. The pre-class material should be given with plenty of time for the students to review it. If a student is a slower learner, they can pause the video, repeat the video, and copy down notes as fast or as slow as necessary. This allows students who write and assimilate the material faster to move on quickly, not being held back as they wait for the slower learners.

Lastly, developing competencies rather than grades as a motivating force is another major plus in the flipped classroom model. The flipped classroom lends itself to embedding in student's minds the concepts, skills, and steps that they will need to succeed in a particular subject. This gives them the ability to learn for learning's sake and not be asking what I need to get an "A". Because of the pre-assessment quizzes and answers, a different path can be given based on the depth of knowledge that a student shows. A student who is in a classroom may show a strength in learning one concept but needs help in a different lesson. In the first example, the student would be assigned an enrichment activity to use the newfound knowledge. In the second example, the student would receive remediation activities so that all students would know what is expected.

Flipped Classroom Disadvantages

While one can see the advantages of the flipped classroom, there are some disadvantages. The most significant one is that “Web-based lectures do not lead for a fundamental difference” (Handke, Kiesler, N., & Wiemeyer, L., 2013, p. 3) in teaching and learning if there is not something else going on in the classroom. Lecture is lecture. Students only retain about 10 - 20 minutes of lecture and then tune the lecturer out. There will need to be a more cooperative or hands-on type of ideology going on in the in-class portion of the flipped classroom.

The second disadvantage is that students will get left behind in the lecture phase thus making it difficult for student and teacher to “catch the student up”. If a student does not keep up with the out of class work, the in-class work will be difficult for them. This will then lead to frustration on the teacher and student’s part. Because the learning and acquisition of the original material is in the students’ hands, it is sometimes hard for the teacher to move on with the in-class part of the material if the student has not assumed the responsibility for acquiring that knowledge. It then becomes an issue when the student is a habitual offender and how the two will work together to resolve this challenge.

Findings of Studies of Flipped Classroom

In a field study conducted in the Netherlands in (year) a flipped classroom approach was being used in a mandatory introductory to statistics class. The study looked at the study habits of students in a flipped classroom. Two hundred and five students were in the data group. The study was conducted using an online survey sent out bi-weekly because of the size of the class and because of the data to be collected. This data looked not only at the classroom level but also

at the student's home studying habits. In the end, there was a low response rate to these surveys. But what could be gleaned from the data is the overwhelming majority of students did not like the flipped classroom approach. The main reason given was that the teacher only covered the harder parts of the course in the lecture rather than all the content. This study had some positive and negative effects. In the end, the summation of the study read as follows:

The advantage of using course evaluation forms that did not include questions about the flipped classroom was that students only provided comments on flipped classroom aspects when they felt the need to share their thoughts with the teacher. This means that our data were not cluttered with potentially far-fetched responses from students with no clear opinion about the flipped classroom. The disadvantage, however, is that it was impossible to link student responses on the course evaluation to their study behavior data and performance on the final exam. It would have been interesting to examine whether students who were positive about the flipped classroom indeed distributed their activities over the weeks of the course and whether they performed better on the final exam than students who commented negatively about the course. Furthermore, the use of the course evaluation forms did not allow us to ask follow-up questions about positive or negative experiences. As a consequence, our understanding of student perceptions remains rather superficial (Vugteveen, Boevé, A., & Hoekstra, R., 2018, p. 7).

Another study done by Adrienne Williams from the University of California Irvine studied introductory Biology students. There were around 300 freshmen in her class. During pre-class time, students were asked to watch videos in which she lectured on a new concept. The students were to take notes. Early in the class, each freshman was to bring the notes to either the professor or the TA. This allowed for the identification of students who were not taking notes properly. The videos remained up and able to be seen for the entirety of the semester for students to review. In class, students were given articles regarding the topics and were asked to review them in groups. While the groups were evaluating these, the professor walked around and interjected as she saw fit. Some of the problems that the instructor found was that while in the groups, the participants did not want to answer the questions on the article for fear of being

incorrect. Professor Williams overcame this obstacle by agreeing to give the answers to the questions in class if the pupils would try to answer the questions. The second issue was when it came to exams and tests. The exams/tests had a great deal of theory in them. Participants expected the tests/exams to include only questions that were introduced in class by the article and notes. They were not prepared to expand on other themes addressed in the tests/exams. As the quarter went on, the students began to understand the author was trying to get them think as a biologist and not just regurgitate facts back to the teacher.

A study by Njal Foldnes showed that it may not be the flipped classroom but the cooperative learning that increased test scores. There were 235 participants in the study. The classroom was flipped for both study groups. Study group 1 received flipped classroom materials to complete on their own. This included all the activities that were done in both pre-class and during class. The author found that there was some cooperative learning going on when the students would be assigned a task. These groups would dissolve once the task was completed. In the second study group, the students would do individual pre-class work and then come to class and would work cooperatively in a predesigned group for the entire run of the class. The results in the study were interesting. Students who worked on the individual flipped classroom and the students in the traditional lecture classroom scored about the same in the tests. But the students who did pre-class individual work and then worked cooperatively saw an increase in the score achieved. “‘Study 2’ was conducted as a randomised controlled trial in order to detect a potential causal effect of the cooperative flipped classroom relative to the lecture format. A highly significant increase in performance was found, 12 percentage points, in

the flipped group relative to the lecture group. This effect was the same for both weak and strong students” (Foldnes, 2016, p. 11).

CHAPTER THREE

METHODOLOGY

Demographics

Based on the Virginia Department of Education Report Card, James Monroe is a school that has approximately 1,011 students in grades nine through twelve. The teacher-to-student ratio is fourteen to one. The minority enrollment is 68%. Overall, the school is ranked in the bottom 50% of the high schools in Virginia. The general ratio of males to females is 50.8% male and 49.2% female. The breakdown of the different ethnicity are as follows:

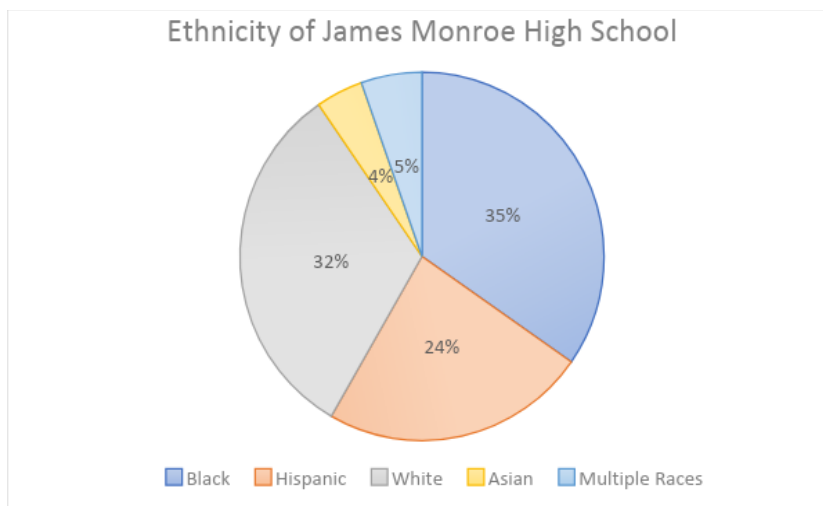


Figure 2: Ethnicity of James Monroe High School, (N=1011).

In 2018-2019, I taught three classes of Advanced Biology, with a total of seventy-seven students. There was one special education student in the classroom. In the year 2019-2020 I taught two classes of Advanced Biology with a total of fifty students. There were no special education students in the classroom. The breakdown according to ethnicity by year for my Advanced Biology is as follows:

Table 1: Breakdown of Ethnicity for the Advanced Students 2018-2019(*N*=77)

| Race of Students | Total number of students | Percentage in classroom |
|------------------|--------------------------|-------------------------|
| Asian | 1 | 1.3 |
| Black | 18 | 23.4 |
| Hispanic | 15 | 19.4 |
| Other | 4 | 5.1 |
| White | 39 | 50.6 |

Table 2: Breakdown of Ethnicity for the Advanced Students 2019 – 2020 (*N*=50)

| Race of students | Total number of students | Percentage in classroom |
|------------------|--------------------------|-------------------------|
| Asian | 1 | 2.0 |
| Black | 15 | 30.0 |
| Hispanic | 8 | 16.0 |
| Other | 1 | 2.0 |
| White | 25 | 50.0 |

My biology classes for both years were smaller. These classes were generally composed of ELL students, the lower socioeconomic students, and students from whom you saw chronic absenteeism. James Monroe is a Title I school with a free and reduced lunch rate of 54%. In the year 2018-2019 I taught fifty-six students. Of these fifty-six students, two were special education. In 2019-2020 I taught forty-five students and there were four who were special education students. During this year, I had many more ELL learners in my classroom. This was because we moved to a four-by-four learning system. Students would take 4 classes daily during the first semester. After the first semester was over, the students would attend 4 new classes. Thus, they still received 8 classes in a block schedule but only had 4 each semester. In the first semester, we had a biology teacher leave because of an illness. She was teaching an ELL class with an ELL teacher. Most of the students did not pass the class nor the standardized testing. The students were placed into my classroom to see if having the science immediately after

failing the class and the SOL would spur the results that the school was looking for. There were a total of eleven ELL students in these classes.

Both my Advanced Biology and Biology classes are held to the same SOL (Standards of Learning) standard. The class differs due to the type of learners for each level. The Advanced Biology students are generally students that will be attending college and taking higher level classes. Based on this, the students received beyond the minimal requirements, a score of 400, to pass the standardized test. Generally, for this group, I am looking for the advanced scores, score of 475 or higher, and not just the “pass” score.

Biology students are students who more than likely will be attending a community college or going the vocational technical route after graduation. The goal of biology for these students is to; pass the class, pass the SOL, obtain verified credit, and graduate.

Treatment

To conduct my research, I used my Advanced Biology classes from 2018 – 2019 which had traditional note taking style in class and compared it to the results of my Advanced Biology classes from 2019-2020 which used a flipped classroom approach where students watched a video and took notes before coming to class. Since we looked at two different years and demographics, I compared the overall scores of the final tests, the general feeling of a flipped classroom from students, parents and teachers, and grades. Since students changed from year to year, this was a general review of a flipped classroom. The final data was skewed by not being able to track the exact same students for the final SOL test.

The General Biology classes were handled in the same way during the treatment. The only change was that the 2018 -2019 school year students used traditional lecture/notes delivered in class by a teacher. The 2019 – 2020 students received their notes watching a video via Microsoft Teams.

The notes for the 2019-2020 school year were recorded on Screencast-O-Matic with the same PowerPoint that was used in 2018-2019. My voice reviewed the notes as the PowerPoint went along. This recording from Screencast-O-Matic was placed on TEAMS as an assignment. Students were expected to watch the video and take freehand notes. The notes were checked on the day that they were due to identify if the student had completed the assignment. The students received the notes on the Monday before next week's notes were due. For example, notes were added to the Teams site on January 6, 2020. The notes were due on January 13, January 15, and January 16. This allowed the students to complete the notes in a manner that worked for them based on other obligations they may have. It also allowed students without computer access to plan to get to a library, coffee shop, or stay after school to obtain the notes. The Team's app was downloaded to the phone so that the students had access to the notes on their phones. Lastly, if a student was not able to use any of the above methods to obtain his notes, the student received a printed copy of the PowerPoint.

The students' notes were checked for completeness the day after the notes were due. This was tracked using a clipboard with the students' names on it. Each student received a homework grade for the notes that were completed. The only difference between the Advanced Biology and the General Biology classes was that the General Biology classes had Cloze notes.

The Advanced Biology took notes in their preferred method. This was Outline, Doodle notes, or Cornell style notes. This method of note taking was administered throughout the entire year.

Data Collection and Analysis Strategies

The biggest piece of data I collected for this research is the scores for the standardized test, the SOL (Standards of Learning). Notes that were received by the students both years directly correlated to the concepts that are tested on the SOL. These notes have been used by me for the past 6 years in my biology classes. My classes have scored anywhere from 75% - 95% on the standardized test. The notes given to each of the groups were exactly the same from year to year. The only thing that changed was the method of obtaining the notes. To compare the numbers, I not only looked at the pass, fail, and pass advanced scores but also the averages for the classes. The advanced students generally passed the SOL, but a more useful data set would be the average score that the students received.

In addition to the SOL scores, I tracked the number of notes that the students completed on time. Since I wished my students to succeed, I allowed them to turn in assignments late. If turned in late, there would be a penalty of 10% for one day late, 20% for 2 days late, and 50% if 3 or more days late. I considered it an on-time assignment if it was turned in before the quiz on that material and not the date that it was due. The final grade a student received in my class is something that I will look at to see if there was a correlation to the SOL pass score. A survey was handed out to 2 other teachers that are flipped classroom teachers so that I assessed their pros and cons along with mine. The parents and students also received a survey to see what their

pros and cons of a flipped classroom looks like. A summary of all my data collection can be seen in Table 3:

Table 3: Data Collection Matrix

| Research Question | Qualitative Data | Quantitative Data |
|--|---|--|
| What are the pros to a flipped classroom for all the stakeholders involved in a classroom experience? | 1.Survey of parents 2.Administration input 3.Student survey 4.Teacher survey | 1.SOL scores 2.Grades |
| What will a flipped classroom look like for every type of student that I teach (i.e.: Advanced Biology, General Biology, Special Education, ELL) | 1.Survey of how the students obtain their notes | 1.Data on type of device the student uses to obtain notes: computer at home, computer at library, staying after school, phone, or paper. |
| What type of correlation is there between the number of notes taken at home when they are due in class and the SOL scores on the Virginia tests? | 1.Student survey | 1 Each set of notes that is turned in on time. |
| Based on teacher experiences, is the flipped classroom a sustainable way to teach in my classroom, why or why not? | 1.Survey of teachers 2.Personal journal about flipped classroom | 1.SOL scores 2.Grades |

An IRB was granted for this study. It is found in Appendix A.

CHAPTER FOUR

DATA ANALYSIS

Results

Although I am presenting this paper in 2023, the data collected, and the study was conceived during the 2019-2020 school year. In the state of Virginia, we shut down our schools in March of 2020 and this capstone was not finished. There was no Standards of Learning Test given in 2020 because it was a logistic nightmare. All students who were passing the class passed the Standards of Learning this year. Because of this, I will answer each of the questions that are in my matrix by reviewing data and methods that already exist where I do not have data.

Pros to a Flipped Classroom from a Student Perspective

Edwin Musdi, Anggit Reviana Dewi Agustyani and Fridgo Tasman conducted a study on the student's perception toward flipped classroom learning. This study was published in 2019. The study was conducted with physics students. Students were to watch a video that the teacher had made regarding the content that was to be covered in class. At the end of the study, each student in class was given a questionnaire to answer regarding the attractiveness, process of use of the videos, ease of the use of the videos and time. Also, there were 3 students chosen to be interviewed in this study. One of these students was an excellent math student, another of average math and a third was a lower math student. Below please find the matrix that the researchers used for the questionnaires and the results:

Table 4: Data of Questionnaire Results of Students' Perceptions (IOP Conf. Series: Journal of Physics: Conf. Series 1317, 2019 p.4)

| Question Number | Dimensions | % of Students Agreement |
|-----------------|---|-------------------------|
| 1 | Attractiveness | 81% |
| | <i>Interesting learning videos to watch</i> | 79% |
| | <i>The videos provide learning material that well understood</i> | 81% |
| | <i>The material presented in the learning video are the material being studied in class</i> | 83% |
| 2 | Process of use | 76% |
| | <i>Learning videos help me understand the learning material</i> | 75% |
| | <i>The learning videos direct me to find the concept of learning material</i> | 79% |
| | <i>Learning videos help me explore ideas that will be discussed in class</i> | 76% |
| | <i>The exercises contained in the learning videos can help me to measure my mathematical ability to the learning material</i> | 76% |
| | <i>Understanding the material from the learning video is able to make me active while studying class</i> | 74% |
| 3 | Ease of Use | 81% |
| | <i>Easy learning videos to</i> | 79% |

| | | |
|---|--|-----|
| | <i>watch on my handphone, laptop or computer</i> | |
| | <i>Learning videos are easily played back so that helps me to understand the learning material</i> | 83% |
| 4 | Time | |
| | <i>The duration of the learning video does not make me bored to watch it</i> | 79% |

Based on the data, overall, the students felt the flipped classroom was a good use of their time. They liked the duration of the video and did not feel that it was boring to watch, unlike the times that they may have spent listening to a lecture. Because there were many videos broken down on the subject, the students liked that they could review the material on their own time and could rewatch the videos if needed. The category that showed the least amount of likability was the process of use. Students needed to work through the problems with the professor. This made it harder to use the videos alone without the trips to the class to further understand the concepts that were introduced in the videos.

Another study I found regarding student perceptions was conducted in Sweden in 2021 by Oscar Olmefor and Jan Scheffel. This study only included eight students in a high school math class. The data collection for this study were student interviews. This was easy to do as there were only 8 participants. This study looked at the following: “1. the change to a flipped classroom 2. student activity in terms of watching videos before class; 3: the shift in responsibility for the student” (Oscar, 2021 p. 12). After looking through and talking to all involved, the authors concluded that this practice of the flipped classroom was a benefit to most

students. Seven of the eight thought it was a good idea if they could remember to watch the video and all others in the class did the video. It gave them an idea of what they were going to be taught and what would be expected of them the following day in the classroom. The one student who had ADHD and dyslexia did not find this method helpful. He stated that the videos were boring, and he fell asleep. He was not alone in feeling that something was left out of the videos because many of the students felt that the teacher could not adjust for students in a video. As teachers are explaining a new concept in person, there is feedback in the students' faces and mannerisms. The teacher adjusts his/her explanation based on these indicators. When the lecture is pre-recorded, the students felt that the teacher had no indication of whether the lecture needed to be adjusted for the students. In other words, the face-to-face explanation of the concept is best taught when the teacher and students have a discourse together.

Based on these two studies, it appears that the students can adapt to the flipped classroom. The drawbacks would be remembering that there is an assignment and doing the pre-work. Students who have disabilities or are slower may have some struggles without the face-to-face interaction of student and teacher. It appears that the flipped classroom has a place in the classroom, but it may not be a great fit for the students who struggle with learning without a teacher present.

Pros of the Flipped Classroom for Parents

In 2020 M. Loizou conducted some research with primary schools to see the parents' perception of the flipped classroom method. Although this was not a secondary classroom, it was one of the only studies done with parent involvement. Most of the studies were completed

for students and teachers as these are the person's most directly related to the learning that goes on in schools. The study looked at 77 parents and their perceptions. Overall, the experience was positive. Parents felt that the videos could be re-watched by students until the skills were mastered. It aided the parents in seeing what was going on in the classroom. Lastly, since the parents were there watching with their children, they felt that they had a stake in the child's education.

Although I did not officially gather data on this, many of the parents whom I spoke with in the beginning of the school year 2019-2020 seemed receptive to the idea. They felt that this would aid them in helping students review the material. During some of the parent - teacher conferences that were held prior to the shutdown of school, the parents did mention that many days/nights they could hear my voice as I was giving the lecture to students. Many used these videos to help students prepare for assessments.

There were not many studies that included parent perception. Since Covid has brought the classroom into the home, more and more parents are now becoming adept at the computer and the type of learning that was considered during many lockdowns. I expect to see more of the parents' perspectives in the future.

Pros of a Flipped Classroom for a Teacher

In 2019 V. Rachmawati conducted a study in the perceptions of teachers' perspective of a flipped classroom in the subject of math. This was done with a small sampling of 5 teachers. The demographics of the people in the study are as follows:

Table 5: Demographics of Teachers in V. Rachmawati study (V. Rachmawati 2019 pp. 2-3)

| | | Participant | Percentage |
|------------------------|------------------------|-------------|------------|
| Gender | Male | 2 | 40% |
| | Female | 3 | 60% |
| Age | less than 30 y. o | 2 | 40% |
| | 30 y.o. to 50 y.o. | 2 | 40% |
| | greater than 50 y.o. | 1 | 20% |
| Teaching experience | less than 5 years | 2 | 40% |
| | 5 to 15 years | 1 | 20% |
| | More than 15 years | 2 | 40% |
| Educational Background | Undergraduate | 2 | 40% |
| | Postgraduate (ongoing) | 2 | 40% |
| | Postgraduate | 1 | 20% |

These teachers were not familiar with the methods or the terminology that was associated with a flipped classroom. Each teacher was asked for perceptions after using the flipped classroom through an interview. The results are below:

Table 6: Teacher perceptions from interviews (V. Rachmawati 2019, p. 3)

| Categories | Teacher Perception (positive) | Teacher Perception (negative) |
|---|-------------------------------|-------------------------------|
| Knowledge about flipped classroom | 20% | 80% |
| Experience using the flipped classroom | 80% | 20% |
| Flipped classroom can facilitate students to learn mathematics | 100% | 0% |
| The flipped classroom is suitable for all mathematics topic | 20% | 80% |
| Flipped classroom can train students' critical thinking | 100% | 0% |
| Flipped classroom can make students to actively learn mathematics | 100% | 0% |
| Flipped classroom can train students' problem solving | 80% | 20% |

Overall, teachers felt the flipped classroom would work for some of the topics taught in math. It would not work for all the concepts taught in math. The positives included the students taking control of their own learning at a time when that learning was conducive to them rather than during class which might not be the optimal time to learn a new topic. Teachers felt that the flipped classroom had a benefit in teaching critical thinking skills but learned that some students would not perform the task of reviewing the material unless there was some sort of assignment attached to the review such as a chat. The idea of attaching a discussion board or questions that needed to be answered during a review of notes was necessary to ensure that the students would

complete the review of the material. If there was no assignment, students did not see the value of the pre-class review.

In a study from 2021 by Unal, teachers' perceptions were studied using a survey. In this study, twenty-six teachers were no mathematics and science teachers. Thirty-one were teachers of mathematics and science. Both sets of teachers felt that the flipped model of teaching removes all the passive learning involved in teaching. It is a more active approach to the student taking control of their individual learning. In addition to the students becoming more active in their individual learning, there is more interaction and cooperation in the classroom among students. Teachers have also found that observing the students while they are doing the more difficult problems in class can help them to reevaluate whether they need to change the course of their curriculum.

Based on both studies, the teachers' perception is that the learning is now more active in the classroom. The students can both learn to think critically and will take responsibility for their own learning. In both studies, there was a concern that some students may not be able to do the pre-work. This was due to either lack of motivation or lack of technology. Without the pre-work (flipped classroom part done at home), the student may not be able to participate in the classroom side of the flipped classroom.

Types of Flipped Classrooms

In a paper written by Becki Brown in 2016. She explained three types of flipped classrooms based on how they are run. They are the traditional flipped classroom, the in-class flipped classroom and the mastery flipped classroom. Each of these used the model of the

teacher giving notes as a video. This can either be with the teacher made videos or it can be with videos that are pre-made. The differences are in when and how the videos are used. Traditional flipping is when the videos are given for homework. This means that the students will need to be responsible for doing the pre-work in class. In-class flipping is set up as a rotation type of model where the notetaking is done as part of the class but not where the teacher will lecture in front of the entire class. This will ensure that the students will obtain the information that they need from the teacher. While still being student driven, it allows for students who are less motivated and students who have technology issues to keep up academically with the other students in the class. Lastly is the mastery flipped classroom. The mastery flipped classroom lays out the objectives and activities for each unit. Students will set the pace for finishing the activities and learning the objectives. As the students finish these, there is a summative assessment given to each student. If the student has mastered the objectives, the student can move onto the next section. Not meeting the objectives in the summative assessment will allow the student to be remediated in the topic that was not mastered.

In addition to these types mentioned above, there are many different types based on how the in-class portion will happen. They can be classified as discussion type flipped classroom, the demonstration based flipped classroom, the faux flipped classroom, the group-based flipped classroom, the virtual flipped classroom and finally flipping the teacher. Each of the above flipped classrooms are based on the technique that one would use to set up their flipped classroom. It is not necessarily when the material is presented as in the first example but how the material is presented. There are however, the 7 basic principles for each of the flipped classroom models previously mentioned in the review of the literature.

Correlation of Test Scores and the Flipped Classroom

Flipped classroom scores were reviewed in many of the studies in college. One done in 2016 by Ryan and Reid compared a flipped classroom with the traditional lecture classroom. During this time, one class was taught the “traditional” way and one class was taught using the traditional flipped classroom method. On average 3 lectures were given per week to the flipped classroom. Assignments were also done online, like the traditional class. The flipped class met one time per week for 75 minutes for discussion and maybe a “micro-lecture”, which was 1 - 2 slides. Upon looking at the data, the scores for both classes were the same. But what was worthy of note was that the bottom one third of the flipped classroom benefitted from the active participation in class. There were less withdrawals from the class. In the flipped classroom the withdrawal was 1.6% and the traditional classroom was 6.3%. The average each semester historically is around 6%.

Another paper written by Torstein Lan and Rannveigh Grom Saele in 2019 which did a meta data analysis of papers written comparing the flipped classroom and the effect of test scores. While doing the deep dive analysis, the writers found that there was a skew in the data if you looked at data with small data points. Because of this, they threw that data out and concentrated on larger data pools. After scrubbing the data and deleting any biased data, it was found that the difference in the scores of a flipped classroom versus a traditional classroom were negligent. If there was any favor it was towards the flipped classroom. The writers felt that this was due to the students “liking” the flipped classroom model better than the traditional model.

In summary, these two studies show that overall, the flipped classroom model versus the traditional model are similar when it comes to student learning. Both studies show that the test scores remain relatively similar with a possible edge to the flipped classroom. The only possible advantage may be to the students who are in the bottom one third of the classes. Doing away with passive learning may increase the scores of the students as they will be actively engaged in learning.

Sustainability of the Flipped Classroom by a Teacher

As I searched for information regarding if a flipped classroom was sustainable, I could not find any information from a teacher's experience. At the time that I started this paper, which was 4 years ago, I knew of 4 teachers who had flipped his/her classroom. At this point, none of the teachers who had flipped their classroom is still flipping the classroom. Some are doing an in-class version of the flipped classroom so that they can continue to use their videos. When talking with them regarding the change, it has to do with the expectations of the students since Covid. Most of the schools in Virginia have not returned to complete normalcy since being out for 1.5 years due to the pandemic. The counties and cities in my area are gradually working towards the normal before Covid. Maybe at that time, the flipped classroom will return but for now, it does not appear to be sustainable.

CHAPTER FIVE

CLAIM, EVIDENCE AND REASONING

Claims from the Study

After reviewing all the material from this study, I have concluded the following: the flipped classroom is a more active type of learning, flipped learning is not going to increase students' overall grades/test scores except for the lower 33% of your student's test scored. The flipped classroom will allow a greater transparency of what you are teaching for the parents, in order for the flipped classroom to be successful you must know what you are doing, and lastly it is not known if the flipped classroom is a sustainable way to teach. The greatest eye opener was the fact that after all the research in literature and the data that others have collected, the flipped classroom is just another tool that a teacher will have in his/her arsenal of things to use. It can be used with one class with great success and another class may not find it successful at all. The methodology that one uses to set up the flipped classroom may also differ based on what you are trying to achieve. Classrooms can be the traditional flip, the in-class flip, or the mastery flip based on where/how the videos are watched. There can also be discussion flips, demonstration flips, and mirror inclusion flips based on what the classroom portion of your flip is to look like.

It appears that if one was to truly embrace the flipped classroom, there is no right or wrong way to set it up. The only thing to remember is to bring in the ideology of the flipped classroom mentioned in the review of literature. It would only require that the students become more active learners. This would engage them and increase scores of the bottom 33% of the classes.

Value of the Study and Consideration for Future Research

This study was conducted to ascertain whether the flipped classroom was a viable option for a non-technological school to increase scores on the statewide Standards of Learning Test given at the end of a biology class. While moving through the study, many things changed both in the district and with testing. The school became more technological in the fact that it became a one-to-one school with everyone having a laptop. All the teaching was done on computers, some synchronous and some asynchronous. Lastly, videos made by teachers became a norm rather than a rarity. However, now that we have come back to face-to-face teaching, the value of this study may be more relevant if we can get the students to forget the videos that they have often endured during the Covid years. Many of the videos during Covid were long and tedious. Students did not have the willpower to sustain those 60-minute videos that some teachers felt were a necessity. These are the things that the students remember, no teacher engagement and boring content with no interaction. The study should be helpful in determining the way that blended learning can work together. Making the student both accountable for the learning that he/she needs and bringing the face-to-face interaction that was missing in the pure videos of the old.

The research we need to look at now would be determining if a flipped classroom approach, blending the technology that most teachers learned, and the face-to-face interactions are really the best way to teach students. In further research, considering if the flipped classroom model is sustainable for teachers is something that should be studied. As a society and educators, we have looked at the positives for the students, but I could not find anything that discussed the sustainability of a flipped classroom for teachers. While more teachers are leaving

the profession and many are not entering, this study should be done. Is this blended method a sustainable and possibly better way for teachers in the future? Are flipped classrooms a way for the parents to see what is being taught in a school curriculum so that they might partner with the teachers rather than be adversarial as we have seen in the media? Are students ready to take on the responsibility of their own learning in a flipped classroom? And lastly, will a flipped classroom help us get beyond the adage that the grade is what matters and not that the student is actually gaining knowledge?

Impact of Action Research on the Author

As I finish this study and research for this class, I have learned a great deal. The most eye-opening thing about this trip is to realize that this is just another tool in my arsenal of tools. A flipped classroom might work for some of my classes/students, but it might not work for others. Just like problem-based learning, projects, cut and paste activities, and lectures will work for different classes; the way that I use this tool will determine if my test scores and my student learning increases.

The realization that there are different types of flipped classrooms was intriguing. Before the mention of the in-class flipped classroom, I had been using this in my one class. At the time there was no name for it, but it was the first time in the history of giving my Standards of Learning that an entire class of lower-level learners passed the test. With, the value of teaching to your students is always something that a teacher should consider. Each class and each student may need a different way of learning. However, the active part of this flipped classroom experiment makes it believable that it will work. In the future, both the in-class method with

mastery seems to be a way to try and get students to where they need to be in the testing scheme of things. The hope is that the difficult years of Covid have not colored my students' minds to learn from a video rather than listening to me talk.

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APPENDICES

APPENDIX A
IRB APPROVAL



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

2155 Analysis Drive
 c/o Microbiology & Immunology
 Montana State University
 Bozeman, MT 59718
 Telephone: 406-994-4706
 FAX: 406-994-4303
 E-mail: cherylj@montana.edu

Chair: Mark Quinn
 406-994-4707
 mquinn@montana.edu
Administrator:
 Cheryl Johnson
 406-994-4706
 cherylj@montana.edu

MEMORANDUM

TO: Michelle High and Walter Woolbaugh
FROM: Mark Quinn *Mark Quinn CH*
 Chair, Institutional Review Board for the Protection of Human Subjects
DATE: April 6, 2020
RE: "The Pros and Cons of a Flipped Classroom in High School Biology and its Effects on Standardized Testing"
 [MH040620-EX]

The above research, described in your submission of April 3, 2020, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation; and (iii) the information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by section 16.111(a)(7).
- (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B

ETHNIC BREAKDOWN OF MY CLASSES FOR BIOLOGY BY YEAR

Breakdown of Race for the Biology Students 2018-2019(N=56)

| Race of students | Number of students | Percentage of Students |
|------------------|--------------------|------------------------|
| Asian | 0 | 0.0 |
| Black | 27 | 48.2 |
| Hispanic | 10 | 17.9 |
| Other | 3 | 5.4 |
| White | 16 | 28.6 |

Breakdown of Race for Biology Students 2019-2020 (N=45)

| Race of Students | Number of Students | Percentage of Students |
|------------------|--------------------|------------------------|
| Asian | 0 | 0.0 |
| Black | 25 | 55.6 |
| Hispanic | 11 | 24.4 |
| Other | 1 | 2.2 |
| White | 8 | 17.8 |