The Effect of the Flipped Classroom

on

Homework Completion and Mastery of the Content

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Submitted in Partial Fulfillment of the Requirements for the

Degree of Master of Education

June 2015

Graduate Programs in Education

Goucher College

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Abstract

The purpose of this research was to study the effect of the flipped classroom environment on homework completion and mastery of the content in a high school Honors Biology class. In the second semester of the year, students were given content material such as video lectures, reading assignments or other direct instructional delivery methods to complete outside the classroom. Most of the classroom activities were centered on working with peers and the teacher on inquiry based activities and project based learning. The data revealed students were significantly successful with completion of homework and mastery of the material. Students found the self-paced environment to be beneficial and effective with regards to their grades. For the teacher, there was more time to work with students individually and get to know their learning styles.

Thank you to my mentors for their guidance and patience.

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CHAPTER I

INTRODUCTION

Overview

The purpose of this study was to explore flipped classrooms and the effect on high school student learning and proficiency of students' knowledge. It is often difficult to maintain students' attention in class, and keep them engaged. Students are often observed with that glazed, far-away look when a teacher is delivering information. Not only are students unable to maintain attention, but also in many cases, they are unable to retain the information. Most students in class copy notes word-for-word that are provided to them, and rarely does the material encourage interaction. If students were provided exposure to the content before class, this would ensure enhancement of the processing part of synthesizing the information in class. Preview of the material with general mastery of the content outside the classroom helps to engage students to then apply, analyze and evaluate.

This study was prompted by lack of student engagement in the classroom, low performance on assessments, and the need for students to receive more individualized attention with regard to understanding Biology content. There is a feeling among teachers of "pushing" students through the content in order to meet state standardized testing, rather than giving the students an opportunity to learn valuable material at a comfortable pace. Students are frequently lulled to sleep when lectures are given. They are unable to rewind the classroom lecture if they are unclear or later have questions. Class time should be dedicated to providing more engaging learning, such as project-based learning, or inquiry-based learning activities. In addition, students who struggle with difficult concepts require more individualized attention and clarification of the

material. Overall, it is important to the future of education to provide an environment of independent, self-sufficient learners.

Why do we have students' complete homework and what is the quality of the homework assignment? Typically, homework is assigned to reinforce what is learned in the classroom and to see whether students understand the content. In some cases, if students have not gained the knowledge or confidence in the material or understand directions, they are unable to complete the assignment at home. As a result, students will copy homework from one another, or make their parents feel responsible for doing the assignment for them.

Statement of Problem

There is an increasing focus in high schools and colleges on the research of the effectiveness of flipped classrooms. It is important to understand how this movement from traditional learning changes pedagogy. The purpose of this research is to explore flipped classrooms and its effect on student learning as seen through homework completion and mastery of the material.

Hypothesis

Learning in a flipped classroom environment would have no effect on homework completion or mastery of the material.

Operational Definition

The independent variable is the flipped learning environment presenting content material to the students outside the classroom. The study using the flipped learning classroom environment consisted of sixty Honors Biology students completing assignments outside the classroom. Students completed Cornell Notes, summaries or explanatory writing assignments on the content varying from video lectures, reading assignments, or some other direct instructional

delivery methods. Cornell Notes is a systematic way for students to review material to promote active learning. The students are then measured on whether they could master the basics. Mastery was evaluated through students taking online assessments. Students were able to retake assessments multiple times to better demonstrate whether they understood the content, thus increasing confidence with the learning process. The dependent variable is homework completion and mastery of the material measured with multiple choice and short constructed responses.

CHAPTER II

REVIEW OF THE LITERATURE

There are many misconceptions around flipped classroom learning. It is not about unstructured isolated time with videos replacing teachers or classes becoming online courses. Teachers are able to give individual attention to students forming better relationships around content learning. This is seen as a significant learning process and as a result, more effective student engagement and efficient use of class time (Tucker, 2012).

Traditional homework completion for some students can be a struggle, especially if they are unclear about the assignment or expected outcomes. In some cases they may be unable to complete homework, and rely on parental help or fellow classmates when seeking the answers, and are still not clear on the topic. Completion of the "homework" in a flipped classroom is student's interaction with their individual learning space at home retrieving information on their topic through videos, podcasts, textbook or article reading, or other media. On the "flip-side", students can then return to the classroom with some knowledge of the topic and explore with more in-depth activities.

Teachers are changing the classroom environment format from teacher-led to student-centered learning. With the fusion and formalization of technology, classrooms are transformed into digital learning environments. Students can have access to different ways of acquiring the content aside from typical lectures by a teacher in a formal classroom setting. The current focus on instructional strategy is to guide students to becoming more independent learners. With the flipped classroom and flipped learning, the environment of exploring the content is moved outside the classroom. Flipped classroom is a "pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group

space is transformed into a dynamic, interactive learning environment where the educator guides students' as they apply concepts and engage creatively in the subject matter" (FLN, 2014). The task of completing note-taking or content gathering outside the classroom helps to facilitate students' progress beyond the remembering and understanding level, and toward to a higher level of thinking in the classroom. Homework completion becomes easier for the student with more efficient use of class time for students, such as asking questions for clarification, project-based learning activities, and Socratic seminars. Developing real-world connections is a goal for students. Students often ask, "Why do we have to learn this?" The 21st Century classroom is focused on what students know and can do, and not memorizing facts. Activities and lessons are created around Bloom's Taxonomy upper levels of analyzing and evaluating with active classroom learners. Shaw (2013) describes the classroom as "research-driven" with "active learning" utilizing higher levels of student engagement and ownership of their learning. Unfortunately, this transition of a shift in the presentation of content material and classroom activities is tedious to the traditional teacher. It requires additional work in order to prepare the outside delivery of instruction. The traditional student also needs to shift their instant gratification and focus on exploring their learning independence.

What Defines Inverted or Flipped Classrooms?

There are two formats for flipped classroom programs: traditional and mastery. Traditional programs involve students viewing an instructional video at home. When the students come to class, the content of the video is discussed with the teacher, and then there is collaboration with practice problems, labs or activities, or extensions of the content. In the mastery model, students work independently at their own pace, while completing the content videos, and practicing and assessing problems, as they are ready. This type of format is geared

toward the accelerated student so they can advance through the material at an individualized rate. Students having difficulty with the mastery format can receive more one-on-one assistance from the teacher (Ash, 2012).

Cook-Sather (2010) examined the roles of students as learners and teachers, and their ability to take responsibility, transform education and redefine accountability. Traditionally, in education, students are accustomed to doing what the teachers ask with regard to their learning process. Teachers primarily are in the role of disseminating information to students. Identification of student and teacher responsibility and accountability was the focus of this comparative descriptive analysis. The study explored high school and college student's collaboration with teachers and their desire to be responsible and accountable for their learning. They elaborated on ways in which educators need to rethink their approach to learning, and ways that students should be included in teachers' planning of material. The findings suggested that students felt encouraged and set higher achievable goals when included in the process of their learning. When students are able to collaboratively work through their learning process, they gain confidence and are able to make applications of learning material.

Bergmann and Sams (2012), founders of the concept of the "flipped classroom", view collaborative ways to use technology outside the classroom for one-to-one time for student learning. This allows for more personalized education tailored to their individual student needs. Teachers can have time in the classroom to focus on difficult concepts. The key to the learning process of flipped classroom is not the videos, but what the videos allow you to do in class. Preparation for class content is not new to education. Historically, teachers have asked students to read a chapter in a textbook so they are prepared for class activities. A flipped classroom

follows the same approach, but with the advent of audiovisual technology, allows the use of digital material to augment traditional textbook reading.

Flipped classroom learning allows for students to return to the classroom able to engage in higher levels of learning, having achieved the lower levels of Bloom's Taxonomy of gaining knowledge and general understanding outside the classroom. When they return to the classroom, they engage in higher levels such as application, analysis, synthesis and evaluation. Students are able to pace themselves through the content and determine mastery with self-assessments. Sweet (2014) noted differentiation of material is seen through the student's ability to pause the teacher, or replay the lecture as needed, "providing a personalized rate of consumption" (p. 53). Having a variety of resources outside the classroom allow somewhat of a personalized selection of materials to best fit the student. Bergmann and Sams (2013) stated "Education is for everyone, but the way in which we deliver education – and the way in which students receive it – is not the same for everyone" (p. 20).

Technologies and Flipped Classroom Presentations

There are several applications to provide materials to outside the classroom learning. Sweet (2014) has consolidated some of the resources for creating "Microlectures" which are short, concise presentations on a topic. These presentations are usually created by the teacher or taken from other sources such as Khan Academy or Ted-Ed. Uses and applications of the microlectures are a way for students to be provided new information about a topic, review a topic from a class discussion, learn or review a new skill, or review for an exam. There are many online opportunities for resources for teachers who do not feel comfortable with creating their own videos. Along with Cook-Sather (2010), Sweet feels using microlectures helps promote student independence and responsibility for their learning process. Something that must be

considered with the applications of flipped classrooms is that students must be able to have access to the material outside the classroom. Bergmann and Sams (2012) suggested students utilize portable drives or DVD's created by the teachers with the material.

Opening the door to student's ability to achieve higher level skills and further expand their learning of advanced material can be achieved by flipped classroom. As observed by Siegle (2014), Gifted and Talented students were given other opportunities, outside video viewing, to explore further through provided websites. Students were given access to materials from many top universities such as Yale, Stanford, MIT, Berkeley and Harvard to advance and maximize their learning environment.

The use of Learning Management Systems (LMS) to create a learning environment can be incorporated to facilitate the process of tailoring homework and streamlining the tools needed into one system for flipped classrooms. Psycharis, Chaltzoglidis and Kalogiannakis (2013) investigated the role of "e-learning" in high school students using Moodle. They found students had a higher level of understanding of the content and found better organization of material using an LMS platform. Other LMS platforms include Canvas, Edmodo, Wikispaces and Blackboard which are currently utilized in public high schools in Maryland. Through LMS platforms, students can engage in group discussions with peers and teachers, exchange learning materials, complete online assessments or reflections of their outside information gathering.

Assessing the Results of Flipped Classroom Learning

By utilizing learning technologies in the classroom, flipped classrooms can use types of engagement to check for understanding. Such technologies are available through clickers, "Kahoot," " Poll-Everywhere," and "Socrative" (Garver & Roberts, 2013). Most of these technologies give a clear and concise picture to assess students' knowledge. These online digital

assessments are less obtrusive than a paper and pencil quiz. Other ways of checking for understanding is through inquiry and project-based-learning with student-centered learning of content mastery that can be applied to solving real-world problems. More class time is available for formative assessment driving the curriculum and individualized lessons. Herreid and Schiller (2013) "Case Studies and the Flipped Classroom" found students could engage more in case studies in the classroom as a way of extending their basic knowledge of a topic utilizing real-world situations. Students are then able to examine multiple aspects of a topic in one case study.

While most studies proposed positive results from flipped classroom, one study involving college students particularly detailed the reactions or conversations of several students and their take on inverted learning and math. In this study, the inverted classroom entailed working with an intelligent tutoring system whereby students learned introductory material working at their own pace with mastery benchmarks. The other group worked through a traditional lecture in school with homework outside school. One student in the inverted classroom study reflected on how they were able to take detailed notes at home over a traditional classroom lecture. They felt uncomfortable with the new classroom structure but over time-felt cooperative learning with peers were most effective. An assumption made from this study was that students might have been feeling uneasy about leaving behind traditional lecture-homework. It was interesting to note that this study included utilizing College and University Classroom Environment Inventory (CUCEI) to identify perceptions of the learning environment of the students. Understanding student perceptions of what and how they are performing is an integral part of how they assume a new learning format. Students' becoming more aware of their learning process is important. This time for reflection helps to make better connections to the course material (Strayer, 2012).

CHAPTER III

METHODS

Design

The type of design used in this study was quasi-experimental, which included a pre-post test design. The independent variable was the flipped classroom model. Students were pre-tested before the introduction of the flipped classroom model, and then post-tested to determine if this model was effective. The dependent variable was homework completion and mastery of the content. The flipped classroom model instruction was implemented midway through the second semester of the school year.

Participants

The participants were in Biology Honors classes at a Howard County Public High School. The school is one of the highest performing high schools in the county with an enrollment of 1,161 and a graduation rate of 97.9%.

Two of the three Honors Biology classes that were part of this study consisted of 60 sophomore students. There were 27 males and 33 females with the average age of 15 years old. The race of the students included 4 Asian, 4 Black/African American, 2 Hispanic and 50 White students. The student average grade in Biology was 85% with no students receiving special education services.

Instrument

The teacher generated all questionnaires and tests. The study began with a Survey Monkey questionnaire to better understand student's perception of homework (Appendix A). During the study, as students utilized the flipped classroom model of taking notes or obtaining content information outside of school, several other questionnaires were given to determine whether the students were comfortable with the model. The questionnaire was used to help

modify or streamline the flipped model. Assessment questions to determine mastery of the content were written by the instructor or taken from prior Maryland State of Department of Education Biology Curriculum and Biology High School Assessment questions.

Procedure

The flipped classroom model was introduced to Biology classes in the beginning of the second semester of the school year. There were several considerations before executing this model, such as student accessibility of resources outside of school, student and parent perception of something new, and efficient use of classroom time for teacher and student. Initially a survey was conducted of the students to identify accessibility of a home computer and Internet. All but one student had access to a computer outside of school and a mobile device. One student had access to a home computer but no Internet services and was provided materials on an external drive and CD.

The general plan for the research was to analyze whether the flipped classroom model was an effective way to determine an increase in homework completion, and general mastery of the content, thus increasing student engagement in the classroom. Students were given various formats to obtain content material outside the classroom. The instructor used Camtasia for creating and recording lectures, and either Vimeo or YouTube as a platform for presenting the videos. Lectures contained a power point presentation with a voice over, and in some cases an electronic white board and stylus. Other online videos and lectures were used, such as Bozeman Science, Khan Academy and Discovery Education. Presentations were kept to fifteen minutes or less. Additional outside resources used consisted of articles, textbook material, and online library resources. All presentations and materials were coordinated for student access through Canvas Learning Management System.

A typical assignment consisted of students being exposed to new material outside the classroom through online video lecture, article, or textbook reading. Students completed Cornell-note taking and upon returning to class revisited the material through their notes by writing questions and a summary. The instructor reviewed the material through higher levels of questioning in-group discussions. In-class, students then completed a short constructed responses or online assessment created by through Quia, QuizStar, Socrative or Testmoz to determine mastery of the content. With the information reviewed, students participated in active learning activities, inquiry based laboratory exercises and project based learning.

CHAPTER IV

RESULTS

This quasi-experimental study included a pre/post test design. The data was collected for one semester. This chapter summarizes the data collection and statistical treatment of content mastery in the flipped classroom environment.

The 10 pre/post test concepts were created by the instructor based on the assessment format of the Biology High School Assessment (HSA) Program, a test required of students by Maryland for graduation. The tests were short and focused on specific content areas such as Chemistry of Life; Cells and Homeostasis and Energy Transfer and Use; Nucleic Acids and Protein Synthesis; Genetics; Evolution, Diversity and Classification; and Ecology. The assessments were structured with multiple choice and short constructed responses. Assessments 2, 3, 7, 8, and 10 were out of 5 points; 1, 4, 5, 6 and 9 were out of 10 points. Final testing as seen in assessment 9 and 10 consisted of application of general Skills and Processes such as recognizing real problems have more than one solution; applying scientific questioning and proposing investigative approaches; understanding data analysis and general mathematical processes.

Table 1: *Mean Pre & Post Test Scores on 10 Concepts*

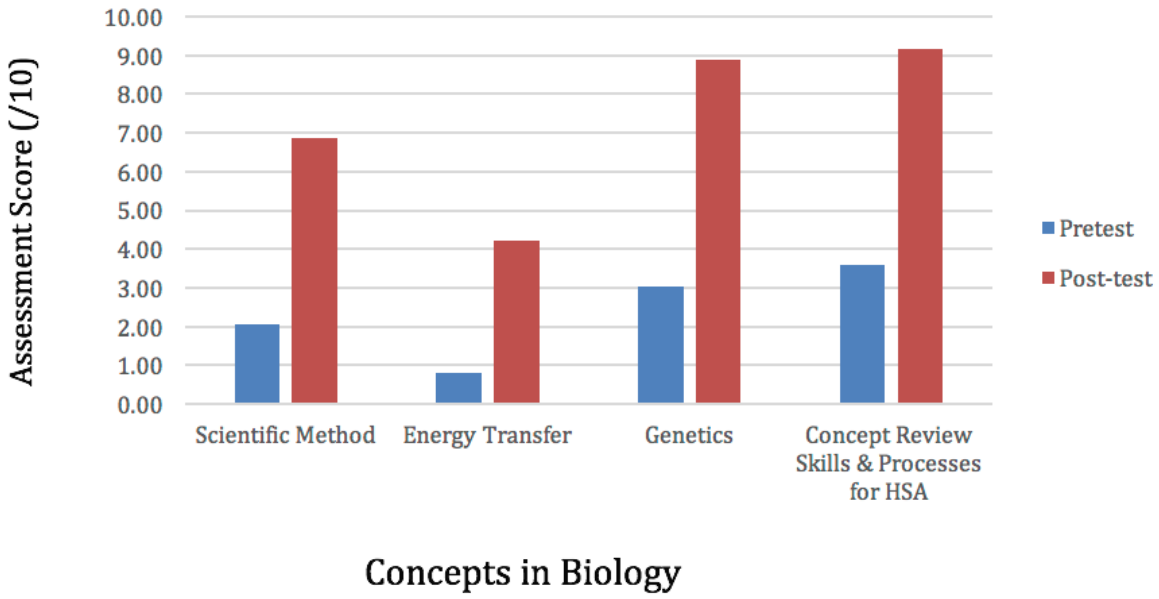
Assessment/Concepts	Mean (Pre-Test)	Mean (Post-Test)
1 Scientific Method	2.05	6.68
2 Chemistry of Life	0.82	4.21
3 Cells and Homeostasis	0.90	4.22
4 Energy Transfer and Use	2.62	8.80
5 Nucleic Acids and Protein Synthesis	2.65	8.65
6 Genetics	3.02	8.88
7 Evolution, Diversity, and Classification	1.57	4.40
8 Ecology	1.72	4.57
9 Concept Review Skills and Processes for HSA	3.60	9.18
10 Concept Review Skills and Processes for HSA	2.32	4.55

The analysis revealed a significant difference between pre and post test scores on the scientific method concept t(59)= -22.67, p<.05. These concepts were later revisited in the semester (Pair 9), and again. These concepts were later revisited in the semester (Pair 9), and again showed a significant increase in the pretest (M=3.60) to the post test (M=9.18), t(59)= -18.67, p<.05. Also, concepts of the Scientific Method with Skills and Processes were again tested (Pair 10) with a significant difference between pretest (M=2.32) and post test (M=4.55), t(59) = -17.64, p<.05.

There was a significant difference in all other scores for mastery learning in a flipped classroom. Assessment of chemistry of life revealed a pretest mean score of 0.82, which significantly increased to 4.21, t(59)=-.26.93, p<05. Assessment of homeostatic regulation of cells showed a score of 0.90 which significantly increased to (M=0.90) and posttest (M=4.22), t(59) = -27.11, p<.05. Pair 4 pretest (M=2.62) and posttest (M=8.80), which assessed the transfer and use of matter and energy in photosynthetic and non-photosynthetic organisms, also showed a significant increase t(59) = -22.52, p<.05. For Pair 5, one of the more difficult concepts for students to understand, results were pretest (M=2.65) and posttest (M=8.65); t(59) = -27.71, p<.05 indicating a significant difference. Scores for pair 6 pretest (M=3.02) and posttest (M=8.88), which tested students on basic concepts in genetics and the way traits are inherited and passed on from one generation to another resulted in a significant increase in mean scores, t(59)=-24.15, p<.05. Pair 7 pretest (M=1.57) and posttest (M=4.40) tested mechanisms for evolutionary change and classification of organisms also showed a significant increase t(59) = -19.30, p<.05. Ecology and environmental interdependence were tested with significant differences between pre-test (M=1.72) and post-test (M=4.57), t(59) = -18.54, p<.05.

Figure 1 shows selected pre and post test scores on four concepts. There was a progression from the pre and post test scores, with students becoming more comfortable with the new learning environment.

Figure 1: *Mean Pre & Post Test Scores on 4 Concepts*



CHAPTER V

DISCUSSION

Implications of the Results

The statistical analysis showed a significant difference between pre and post tests therefore the null hypothesis, learning in a flipped classroom environment would have no effect on homework completion or mastery of the material is rejected.

Theoretical Consequences

All of the students exhibited an increase in test scores from pretesting to post testing. The data demonstrated that the students benefitted from an independent environment of delivery in their instruction. Over time, students became more responsible in the process of controlling their learning. They were more engaged in the classroom where they were given more opportunity to work with their peers and receive quality time with the instructor. It also gave a better opportunity for the instructor to get to know individual students.

Threats to the Validity

There were some basic threats to the internal validity. In this study maturation was a validity threat. In the normal passage of time in any classroom environment, student's progress as the semester goes on. Therefore, the question remains did the students' performance increase with the pre and post testing because it was something new and different from their other classes? Was their success due to their standing in an Honors Biology class?

Another threat to validity was differential selection. In this study participants were not randomly selected but were students in the honors classes. Two Honors Biology classes were selected for the flipped classroom study. In addition, one student did not consistently have access to the Internet outside of school but still was able to be part of the study because they were given

access to the material.

It can be concluded that the change in this particular Honors Biology classroom environment had an effect on the completion of homework and mastery of the material. The study only looked at "honors" students. Typically, those students complete homework and are usually focused on schoolwork regardless of the task assigned.

Connections to Previous Studies/Existing Literature

There were several studies that were aligned with converting the classroom to a flipped learning environment. Tucker (2012) found the instructor and student relationship to benefit by becoming more productive and successful in the efficient use of class time. Active learning of an engaged student is critical in present day education. Instant gratification and immediate need for the answer does not help the high school student prepare for college or workplace. Shaw (2013) helped to also inspire the decision to make the classroom an "active-learning" space whereby students have ownership of their learning process. The students' ability to work collaboratively through inquiry based lessons and project based learning helped to increase self-esteem and confidence. The material was differentiated and at a pace tailored to the individual student (Bergmann & Sams, 2012).

Implications for Future Research

The students in this study completed several surveys during the semester. Most of the students came to be very comfortable with the environment. All of the students expressed the benefit of having more class time to work difficult problems, get more "teacher-time" and collaborate with peers. Several students noted that their stress level was significantly reduced at home with completion of homework, and at school with more engaging, quality classroom time.

It would be helpful to have more qualitative and quantitative research, not only at the

high school but college level. There were significant insights based on this research not only for the students involved but also for other teachers. Preparing high school students to work more as independent learners by gathering the content material outside the classroom could possibly in turn see students more prepared for secondary education.

Conclusion/Summary

There are many considerations around the flipped classroom model. This format is seen as being extremely valuable not only to the students but also to the teacher. Classroom time involves the ability for teachers to really get to know each and every student. The end-of-the-year student survey results were only positive and most students felt relieved of the stress of complicated and timely homework. They are truly more confident with the material. Recent results from the state testing revealed their success where every student not only passed the exam but also exceeded compared to seven years of prior test scores with a similar population. Most students wished other classes were in the same format, especially math classes.

In conclusion, simply stated by "Flipped Learning Network" (FLN, 2014), the four pillars, "FLIP" can help to provide a well-guided format for the classroom. The classroom should be "flexible" for the learner where students can identify their learning style independently. The "learning culture" is moved away from the teacher, who now facilitates and differentiates learning, to the student, who accepts the responsibility of gathering the material. With "intentional content", teachers can prioritize and guide students through required material without creating an environment of feeding the information without allowing the students time to process. This process is not intended to replace the "professional educator". It is, however, a significant transformation for any teacher to let go of "their" classroom-learning environment and allow students to explore, inquire, and open new doors to their education.

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Appendix A

Student Homework Survey
(Created in Survey Monkey™)

1. What subjects do you usually have for homework? (List all that apply).
2. What time do you usually start your homework?
3. How long does it take you to complete your homework each night?
4. Do family members help you with your homework?
5. Have you ever copied another students' homework?
6. How challenging is your homework?
7. Do you usually understand your homework?
8. What are some pros and cons of homework?