# MAXIMIZING ENGAGEMENT AND UNDERSTANDING DURING THE FLIPPED PORTION OF AN HONORS PHYSICS COURSE

by

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# DEDICATION

Dedicated to my teachers who have modeled for me, my colleagues who have collaborated with me, and my students who have embraced the value of productive struggle.

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# GLOSSARY

*Edpuzzle* - a web-based eLearning application allowing users to select and customize a video by editing, cropping, recording their own audio, and adding quiz questions directly to the video stream. Edpuzzle also allows instructors to track, monitor, and grade students' engagement with the videos created.

*Flip* – A shortened version of Flipped Classroom Experience

*Flipped Classroom Experience* – A learning strategy in which students view videos for homework outside of class time. This content should be introductory, and students should be able to comprehend it with little additional guidance. This preparation allows class time to be used for more in-depth nuanced problem-solving and laboratory experiences.

*Institutional Review Board (IRB)* - The primary mission of the Institutional Review Board is the protection of the rights, welfare, and well-being of human subjects who participate in research at Montana State University.

*Percentage Viewed (%viewed)* – The portion of the flipped content video viewed by each student.

# ABSTRACT

Over the last two decades, teachers have been experimenting with Flipped Learning Methodology. With regard to this study, a flipped classroom experience is a learning strategy in which students view videos for homework outside of class time. This preparation allows class time to be used for more in-depth, nuanced problem-solving and laboratory experiences. A High School Honors Physics course moves through a great deal of material, necessitating working outside the classroom. While many studies have investigated the benefits of the flipped classroom during class time, fewer studies have looked at variables connected with the time spent viewing the flipped video content. This study investigated students' content mastery and engagement of students when two types of integrated prompts were used while watching the flipped content videos. In Phase One, students completed ten basic flips in which they practiced the procedures of viewing flipped content on Edpuzzle while taking Cornell notes. Each session was followed by a post-viewing quiz measuring content understanding at the beginning of class the following class period. Based on this data, students were grouped into two equal groups. In Phase Two, students received Edpuzzle delivery with either Specific Integrated Prompts or Generic Integrated Prompts. Specific prompts required students to respond to brief questions regarding the material that was immediately previously presented. Generic prompts were placed at the same points in the flipped content but merely reminded students to amend their notes with immediate previous material. Each group alternated integrated prompt types, providing each group equal opportunities to complete each prompt type. During the study, engagement was measured by recording the percentage of each video that students watched on the Edpuzzle Platform; Cornell notes were assessed and graded; and the number of completed flips was recorded. Content mastery was measured using a post-viewing quiz. Near the end of the treatment, students took a survey, and interviews were conducted. This study found no difference in engagement for different prompt types. Although students preferred Specific Prompts, their content mastery was marginally better on flipped videos using Generic Prompts. Generally, junior male students were less engaged with the flipped experience.

# CHAPTER ONE

# INTRODUCTION AND BACKGROUND

## Context of the Study

### Background

Over the last two decades, many teachers have moved to a Flipped Teaching Methodology. This methodology generally includes shifting activities typically completed during class to homework outside the class. For example, primary introductory material, usually given through lectures during class, is shifted to homework which is timed to occur before the next class time. Advanced problem-solving and lab analysis, which typically occur outside of class, is then completed during class time. Over the last many years, several studies (Bergman & Sams, 2008; Bergman, 2017; Talbert, 2017) have examined increased student engagement during the *in-class* portion of the flipped methodology or with post-secondary learners. In looking at engagement during the *flipped* part of courses, many recommendations for increasing engagement have been suggested. These recommendations generally stem from trial and improvement within instructors' own flipped classrooms. However, few studies formally analyze student engagement and content understanding during the flipped portion of class with high school students. This action research project aims to investigate methods that will maximize engagement and content understanding during the flipped part of an Honors Physics Course.

### Immediate Significance

As an instructor, my goal is to maximize learning both inside and outside of class. My flipped class allows me to give basic introductory information before class and then use class

time to engage with students in extended, advanced problem-solving and lab work during class. However, this model hinges on student engagement *during the flip* and content understanding gained *from the flip*. Ideally, successfully implementing flipped material before class begins will allow me to start the class period by highlighting learning objectives, answering clarification questions, and discussing any misconceptions about the content of the flipped lesson. However, I can only address these components if students fully engage with the content outside of class.

Therefore, student success during class is contingent upon completing and comprehending flipped content before class. If students are not completing the flipped portion of the class and lack understanding of the content presented, they may not be able to participate as effectively during in-class activities. This behavior could lead to gaps in their knowledge and understanding. This lack of preparation will require that students spend class time viewing the flipped material and lose out on time intended for guided work time with me or work with classmates on a lab activity. In a course in which each concept builds on previous lessons, students who do not complete the flip get so far behind that they may be unable to keep up or understand new material due to knowledge gaps or lack of understanding of previous material.

## Extended Significance

While this action research study is based on one Honors Physics Course, it could be used by other instructors in several ways. My initial goal is to contribute to our understanding and knowledge of the flipped teaching methodology. Only by studying this methodology in individual classrooms and then looking at it holistically can we educators best understand the overall effect of flipped teaching. Additionally, other instructors may be able to use this information as a starting point should they choose to flip their course. Every course functions

differently, but having this information as a reference point may smooth their transition to flipping or provide guidance in deciding whether to flip a course in the first place. Moreover, if my action research renders quantifiable results, I would welcome cross-curricular collaboration with colleagues within my building who might also implement flipped models and provide me additional feedback and insight.

## Purpose

Given the possible consequences of a student not completing the flip, I find it imperative to investigate methods for maximizing both the engagement during the flip and the content understanding of the flipped material. Therefore, in this study, I will evaluate the correlation between student engagement and content understanding and the type of integrated prompts used during the flipped video.

By fine-tuning the structure of the flipped experience, I can maximize student engagement and content understanding during the in-class portion of the course.

# Focus Question

## Observation

Students benefit from solving complex physics problems and participating in lab analysis during class time. However, due to high content requirements, these activities can only be incorporated in class time if students are engaged and master content during a flipped portion of instruction outside of class.

## Question

My focus question was, “How can I maximize engagement and content understanding during the flipped portion of a flipped Honors Physics Course?”

My sub-questions included the following:

1. To what degree is there a correlation between the type of integrated prompt and engagement?
2. What, if any, correlation exists between the type of integrated prompt and content understanding?
3. How will the results from this action research project affect my classroom instruction?

# CHAPTER TWO

# CONCEPTUAL FRAMEWORK

## Background

The flipped learning model has been known by many names, including reverse learning, the inverted classroom, and backward learning. Lage, Platt, and Treglia (2000) began experimenting with an inverted classroom design to mitigate the discrepancies in the different learning styles of their students. Talbert (2017) indicates that this study was "one of the clearest pictures we have of flipped learning in its infancy, and it was the first peer-reviewed journal article intended for a broad audience giving a formal framework for flipped learning" (p.33).

Bergmann and Sams (2008) initially began flipping their chemistry classrooms as an aide to absent students. However, they quickly saw the benefits of flipped learning for all students. They continued experimenting with the flipped teaching model and subsequently wrote a book outlining the reasons and processes for successfully flipping a classroom: *Flip your classroom: Reach every student in every class every day* (2012). Bergmann and Sams continued to research this area, and Bergmann founded the Flipped Learning Network. To better define the flipped classroom, the following definition of flipped learning has come to encompass the true meaning of the flipped method of teaching:

> Flipped Learning 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 (Flipped Learning Network, 2014, p.1).

Over the last two decades, many instructors have moved to some version of a flipped classroom. However, while many have published studies, it was still unclear whether there were actual benefits to the flipped learning model compared to the traditional learning model. Zheng et al. (2020) synthesized the findings of 95 studies in a meta-analysis published between 2013 and 2019. This analysis showed a medium effect size (0.663) for learning achievement and a medium effect size (0.661) for student motivation. The study also listed findings on the effect of variables on flipped classroom design. The study found that flipped classrooms implemented in junior and senior high schools had the highest effect size and that natural science had the largest effect size, although neither of these results was statistically significant. In addition, this study showed that while not statistically significant, watching videos had a higher effect size (.774) than completing readings (.698). The authors indicated that developing high-quality videos was essential in increasing learning outcomes. The largest effect size as far as the length of the intervention was five-eight weeks (1.112) and less than 50 students (.953).

McNally et al. (2017) indicated that for "flip resistors," students who do not prefer the flipped teaching method, there was a strong preference away from an assessment based on pre-class learning. However, it was suggested:

> that when a theoretical perspective is used to inform the flipped classroom design, when summative assessment is integrated into the design of the flipped classroom, and when an entire course is flipped, students felt they had participated more actively and attentively in class activities; they also achieved better grades in their specific course (p. 293).

Even though students do not *prefer* the summative assessment, this study implies that students perform better in class, perhaps because they are better prepared to complete in-class work. This finding supports the idea of investigating methods for increasing viewing engagement, meaningful homework, and learning accountability during the flipped portion of the class.

## Theory

Several educational theories are related to the flipped method of instruction. Three main theories supporting the flipped instruction method include self-determination theory, cognitive load theory, and constructivist theory.

### Self-Determination Theory

Abeysekera and Dawson (2015) proposed looking at the flipped teaching method through the lens of self-determination theory. Self-determination theory examines the motivations of an individual, which are generally on a spectrum ranging from extrinsically to intrinsically motivated. Competence, autonomy, and relatedness are three basic cognitive needs that support intrinsic motivation. Abeysekera and Dawson indicate that:

> The traditional lecture is caricatured as a passive, transmissive experience, effectively eliminating any sense of autonomy or competence in students. In fact, feelings of autonomy and competence are most likely to be experienced by the teacher within a learning environment created through this approach (p. 5).

In applying the flipped classroom model defined by the Flipped Learning Network above, students are in control of becoming competent in the content. Students are no longer passively taking notes at the speed of the teaching. Instead, students can autonomously adjust their learning by pausing and rewinding. Moreover, students who are quick to learn can watch the video at double speed, and students who struggle can watch the video several times to understand the content better. The goal in a well-designed flipped classroom is that students will immediately use the newly found knowledge in related activities in which social interaction with the teachers and peers occurs during class time.

Abeyserkera and Dawson proposed that the flipped classroom methodology would support intrinsic and autonomous extrinsic motivation but also called for additional studies showing actual support for increased motivation. Zainuddin and Perera (2019) defended flipped class learning in terms of competence and motivation. Two classes of English language learners participated in the study; one class using a traditional model and one class using a flipped model. To gauge competence, the researchers gave students three post-tests over three months. Post-test 1 revealed no statistically significant difference between the competence of the two groups. However,

> The second post-test reported significant differences between the scores of the two groups (flip class: $M$ = 82.19, SD = 2.80; non-flip class: $M$= 77.30, SD = 4.01), with $t$ = 5.54, $p$ = .007 ($p$ < .05). This implied that students' competence in the flipped class, for the second post-test, was better than that of the non-flipped class. As for the third post-test, it was reported that there were also significant differences found between the scores of the two groups (flip class: $M$ = 89.64, SD = 4.61; non-flip class: $M$ = 79.77, SD = 2.67), with $t$ = 10.17, $p$ = .001 ($p$ < .05). These results implied that students' competence in the flipped class for the third post-test was much better than that of the non-flip class (p. 119).

This portion of the study implies a higher competency for students in flipped courses. Additionally, "Most students perceived that their ELL flip class had trained them to study independently, at their own pace. They were also aware that, as university students, they needed to explore their own knowledge independently and not always depend on their instructors" (Zainuddin & Perera, 2019, p.123). This finding implies that student autonomy was also further developed in the flipped classroom approach. This study also suggested that students in the flipped class approach had a higher intrinsic motivation to watch the videos and attend class than those in the non-flipped class.

Zheng et al. (2020) showed a medium effect size (0.663) for learning achievement and a medium effect size (0.661) for student motivation. If learning achievement is substituted for competency, it would seem that flipped classrooms have a moderately positive effect on competency and student motivation. These positive effects would support the requirements of the self-determination theory.

## Cognitive Load Theory

The Cognitive Load Theory indicates that learners can only hold a certain amount of content in their working memory. Abeyserkera and Dawson (2015) proposed that this cognitive load can be reduced by allowing students to process the information at their own rate. Students who struggle can pause, rewind, and re-watch the videos, allowing an extended time of absorption of the content. Abeyserkera and Dawson (2015) additionally mention the benefits of in-class activities, enabling students to proceed at their own pace with the help of peers and the teacher to lighten the cognitive load. The class time that follows flipped lessons provides opportunities for further clarification, questioning, and social learning. No longer is a student stuck at home, failing to understand a problem or prompt. Now, the student has step-by-step help from peers and teachers and can take each step as they are comfortable moving forward.

## Constructivism

Bergmann and Sams (2012) mentioned that some feel a flipped classroom is incompatible with the constructivist theory of education in general and science education in particular. Presumably, some perceive this incompatibility because a flipped classroom structure does require some explanation before the exploration stage. However, Bergmann and Sams argued

that the in-class activities embody the true nature of constructivism in which students work on their own paradigms with a "guide on the side."

Xu and Shi (2018) argued that:

> Under the Constructivist Learning Theory, in a flipped classroom self-directed learning mode, students learn how to learn, how to use knowledge, and how to use the knowledge they have learned to solve complex problems, while the teacher systematically arranges courses for the purpose of integrating, exercising and refining complex ideas and learning techniques. It conforms to constructivist learning mode (p. 885).

This study showed that in a well-planned flipped learning course, the student is at the center, learning to assemble and construct a paradigm of critical content and knowledge. The flipped learning model might not initially be seen to support constructivism, particularly for those who do not fully understand the functions of the flip and in-class activities. However, there is strong support for a constructivist viewpoint in well-planned flipped classrooms because the learning method is still student-centered.

## Criticism of Flipped Learning Model

An essential aspect of giving context to the Flipped Learning Model includes references to views that question the effectiveness of the flipped model and the conclusions drawn from the favorable research. For example, over many years, different researchers have noted many drawbacks, including lower student performance and satisfaction levels (Taylor, 2015), teachers' considerable workload of creating flipped learning materials, students' disengagement in out-of-class learning (Lo & Hew, 2017), and lack of access to technology (Lo & Hew, 2017).

A recent criticism came from Setren et al. (2021), who, in a working paper in 2019 that was published in 2021, detailed the results of a large randomly controlled study of flipped

calculus and economics classes at West Point. This study was unique because it was one of the first to have randomized control of a study with a large group of students. Setren et al. found that the effects of a flipped classroom had a small initial positive effect in math classrooms which faded out by the end of the course. The effect on economics students was null. In addition, they found that the flipped method of instruction widened the achievement gap between male and female students, white students and black and Hispanic students, and high-achieving and low-achieving (measured by ACT scores), with white, male, high-achieving students receiving the largest gains of a flipped classroom. This study also "suggests that instructor preferences play a role in the impact of the flipped classroom" (Setren et al., 2021, p. 381). This study's initial findings indicated that instructors who preferred the flipped teaching method had students with higher quiz scores when compared to instructors who preferred standard lectures.

Talbert, a strong proponent of flipped method instruction, specifically in relation to closing the achievement gap, wrote a balanced response to this study. He specifically took issue with the definition of a flipped classroom in this study because it only defined flipping as using technology to view videos before class and did not discuss what occurred during the flipped videos. Talbert states, "If all you are doing is dropping videos on students and not providing any kind of structure or guidance for *how* to learn from the videos, then you are not doing flipped learning – or any other kind of learning" (2020a). Specifically, Talbert argued that asking students to watch a video without structure for evaluating learning is akin to asking students to read a chapter before class.

> …it puts some light on the result from this study that white men benefited from "flipped learning" while women and non-white students had little to no benefit. Why should we expect them to benefit, when the approach to "flipped learning" is

> nothing but the same that has been used to educate only the privileged 1% for hundreds of years (Talbert, 2020a, ¶ 27)?

Talbert also took issue with the study's literature review, the internal validity of the treatment (lack of time for the flipped treatment and poor description of the flipped activities), and external validity. Talbert pointed out that "studies done at West Point on West Point students have built-in significant limitations on external validity. What works for my highly diverse collection of students may not work in a military academy and vice versa" (Talbert, 2020b,¶26). Talbert argued that while studies like this are essential regarding standardization, ensuring they are conducted within the context of a more wholly defined flipped method is critical. Additionally, the meta-analysis completed by Zheng et al. (2020) showed moderate positive gains in student achievement and motivation, particularly benefitting older females and non-English speakers.

Ensuring equitable access to technology and the Internet is a valid concern. One beneficial change from the Covid-19 Pandemic is that now most students can access devices and the internet. In a survey of past Honors Physics students, many listed access as a possible drawback; however, they all had access to a device and the internet. Most access issues can now be managed with some intentional planning. The focus of this action research project was the engagement of students during the flip, and I was particularly encouraged by Talbert's responses (2020a; 2020b) as he indicates that much of the success of the flip is in teaching students how to use the pre-class videos to support and evaluate their learning. I aim to find a potential structure for helping students learn how to learn.

# CHAPTER THREE

# METHODOLOGY

This study evaluated effective instructional methods for maximizing engagement and content understanding during the flipped portion of an Honors Physics Course. In particular, this study investigates the structure of the individual learning activity by varying the type of integrated prompts inserted in the viewed video content. I gathered and analyzed data to answer the following sub-questions:

1. To what degree is there a correlation between the type of integrated prompt and engagement?
2. What, if any, correlation exists between the type of integrated prompt and content understanding?
3. How will the results from this action research project affect my classroom instruction?

## Demographics

This study was conducted with my Honors Physics class (N=18) which consisted of juniors and seniors in high school. This cohort included five females and thirteen males. Two students identified as Native American, three students identified as Asian, and thirteen students identified as White. Forty-two percent of our student body qualify for free and reduced lunch. This data was likely underreported as our feeder elementary and middle schools have an average of 57% qualifying for free and reduced lunch. Of the students in this sample, 39% (7 out of 18 students) qualify for free and reduced lunch. These statistics mandated that I ensure students participating in this study had access to a device and the internet. All students had full access.

This Honors Course followed the AP Physics 1 curriculum, which requires at least 25% of the material to be hands-on, inquiry-based activities. Students took a content and review quiz daily at the beginning of class unless they participated in an extended laboratory experience. A small amount of class time was spent on guided notes. Still, the goal of class time was to work on lots of problems representing nuanced scenarios and complete laboratory experiences and analysis. While each week differed in exact agenda, students generally spent about 50% of their time in hands-on activities, 20% in guided lectures, and 30% working on problems individually and in groups. Students have homework about 50% of the time; however, when the homework was a Flipped experience, the simultaneous viewing and notes were the only homework assigned for that evening (Bergmann, 2017, p. 39).

## Treatment

At the beginning of the year, students were informed that this Honors Physics Course would be conducted using a flipped teaching method. Students were given the rationale for the Flipped Teaching Method, and I explained that students were responsible for four pieces related to the flipped portion of the class. The four pieces are as follows:

1. Use Edpuzzle to watch required flipped video lessons in their entirety before class the next day.
    i. Students had the opportunity to ask clarifying questions at the beginning of class before the quiz. I also evaluated their notes.
    ii. Students could make up the flipped portion if they did not complete it for some credit, but I did not include that as a “completed on time” flip in my engagement data.

2. While viewing in Edpuzzle, students answered integrated prompts and responded in note-taking to integrated prompts, which occurred during the video.
3. Students took notes using the Cornell note-taking style.
4. Using Quizziz, students completed a post-viewing quiz measuring content understanding at the beginning of class the following class period.

Types of Integrated Prompts

The video-modifying platform, Edpuzzle, allows teachers to upload videos and add integrated prompts within the video. These prompts can be multiple-choice questions, open-ended questions, or a written or audio note created by the teacher. For the instructor, Edpuzzle displays data on the percentage of videos watched by each student and the responses to the integrated prompts. This data was used to measure engagement for the following three prompts in Table 1.

Table 1. Three integrated prompt treatments.

| | | |
|---|---|---|
| Basic | Beginning: | Please watch the whole video, take notes on *insert topic here*, and complete all integrated prompts. |
| | End: | Please summarize the topic, ask any questions you may have, or write an invented problem to demonstrate the concept. |
| Generic | Beginning: | Please watch the whole video, take notes on *insert topic here*, and complete all integrated prompts. |
| | Middle: | Prompts are placed at strategic points with the following wording: Please review the section and add notes about *insert subtopics here*. |
| | End: | Please summarize the topic, ask any questions you may have, or write an invented problem to demonstrate the concept. |
| Specific | Beginning: | Please watch the whole video, take notes on *insert topic here*, and complete all integrated prompts. |
| | Middle: | Multiple-choice or short-answer prompts are placed strategically. |
| | End: | Please summarize the topic, ask any questions you may have, or write an invented problem to demonstrate the concept. |

The Basic Prompt was simply a reminder to complete the requirements for the flipped video. The Generic Prompt used the basic prompt and included prompts placed at strategic points in the video to highlight each subtopic. However, these prompts were generic and not specific to the topic. In comparison, the Specific Prompt used the basic prompt and included multiple choice or short answer integrated prompts placed in the same positions as the Generic integrated prompts but focused on a particular aspect of the subtopic.

## Phase One

In Phase One, all students were given a flipped video with the basic prompt. The engagement was measured by evaluating the percentage of videos watched per student. Students took Cornell notes and the corresponding post-viewing content understanding quiz. Data was

collected measuring engagement during Edpuzzle viewing, Cornell notes score, and post-viewing quiz scores. This data, gathered from ten flipped experiences, was used to break students into Group X and Group Y for Phase Two.

Phase Two

Phase Two commenced after obtaining the International Review Board (IRB) exemption (Appendix A).

Students were broken into two groups, Group X and Group Y. Each group consisted of students with mixed watching percentages; for example, each group included approximately the same number of students who finished the video and students that partially completed the video. Another science teacher used these scores to assign students to groups based on percentage watched, quiz scores, and note completion.

Each group continued to be assigned a flipped video and completed the four steps described in Phase 1. However, students completed the alternating treatments of Generic and Specific Prompts. A partial schedule of the flipped experiences can be found in Appendix B.

Group X and Group Y were assigned alternating prompts. Students noticed the difference in prompts. However, each student was required to log into their account on Edpuzzle, ensuring that each student should have completed the prompt assigned to their particular group. Some possible variables throughout the study period included the length of the video, the difficulty of the material presented in the video, gained proficiency in the flipped model, and the instructor presenting the video. I controlled those factors by holding the video content constant and alternating the prompt type.

Phase Two was maintained for ten flip experiences, ensuring that Group X and Group Y had the same number of experiences for each prompt type.

Students were given a survey after Flip 15 and were chosen to complete student interviews based on their answers.

## Data Collection and Analysis Strategies

### Study Design – Mixed Methods

This study was a correlational design in which specific treatments were measured against specific outcomes. Additionally, qualitative data were collected by measuring the students' and teacher's perspectives and experiences. The instruments that were used for data collection are organized in Table 2.

Table 2. Data collection methodologies and qualitative/quantitative key.

| Data Collection Methodologies | Edpuzzle Viewing Platform | Notes Completion Rubric | Quizziz Platform | Student Surveys | Student Interviews | Overall Student Grade in Course | Teacher Log Journal |
|---|---|---|---|---|---|---|---|
| Research Questions | | | | | | | |
| Action Research Question<br>❖ How can engagement and content understanding be maximized during the flipped portion of a flipped Honors Physics Course? | D | C | E | B | B | E | A |
| Sub-question #1<br>❖ Is there a correlation between the type of integrated question and engagement? | D | C | | B | B | | |
| Sub-question #2<br>❖ What, if any, correlation exists between the type of integrated prompt and content understanding? | | | E | B | B | E | |
| Sub-question #3<br>❖ How will the results from this action research project affect my classroom instruction? | | | | | | | A |

A. Qualitative – measures teacher thoughts, perceptions, and process
B. Qualitative/Quantitative – measures student beliefs, perceptions, and experiences in a flipped classroom
C. Qualitative – measures completion of note-taking
D. Quantitative – measures student completion of a flipped video
E. Quantitative – measures student content understanding

Edpuzzle Viewing Platform. The Edpuzzle Viewing Platform has been shown to increase engagement (Hidayat & Praseno, 2020; Carney, 2017) and achievement (Hidayat & Praseno, 2020) when used with the flipped learning method and provided an excellent platform to monitor

the engagement of students as they interacted with the flipped video. The data was used to measure engagement for the Focus Research Question, Sub-question #1, and Sub-question #3.

The Edpuzzle Viewing Platform provided data on the percentage of videos each student watched and the responses to the integrated prompts. This instrument required that each student log in to their account. This platform does not allow students to skip portions of the video. Additionally, the video stopped playing if the student moved to another website tab on the computer when the video was playing. Students watched the Basic, Generic, or Specific videos, and their engagement was recorded.

While I did observe students' responses to the Specific integrated prompts, that information was primarily used to inform my lesson the next day. To minimize variables, I only collected data on the percentage of the video viewed by the student. Students were not graded on their responses to the integrated prompts but on the percentage of video viewed (%viewed), including answering any of the prompts during their viewing.

Most of my flipped videos were sourced from the Flipping Physics website (*AP Physics 1 Physics Videos*, n.d.) as they matched well with the AP Physics 1 curriculum and expertly pointed out common errors students can make. Many physics instructors and students use this site, and the site's author continually improves and updates these videos to meet the best practices of physics instructors. While my action research study was already in progress, the author of this website began uploading his videos to the Edpuzzle platform. While I still created my own integrated prompts, this move validated my choice to use Edpuzzle to complete the flipped portion of the course.

Notes Completion Rubric. Bergmann (2017) recommends both an advanced organizer (p. 51) and accountability through notetaking (p. 53). Students completed Cornell notes using the same template for every flipped experience (Appendix C). At the beginning of the year, students received the rubric and training on taking Cornell notes and the expectations for note-taking during the flipped experiences. The last section of the Cornell notes requires students to summarize, ask a question, or write a novel problem. This inclusion was an attempt to heed the recommendation of Bergmann (2017) for an open-ended question that moves beyond the knowledge or understanding level of Bloom's taxonomy. Students' note-taking completion was evaluated using the rubric displayed in Table 3.

Table 3. Notes completion rubric used for evaluation of engagement.

| Description | Points |
|---|---|
| • Notes contain partial content.<br>• Some subtopics covered | 3 |
| • Notes include all content<br>• All subtopics covered.<br>• Examples are provided. | 4 |
| • Notes include all content<br>• All subtopics covered.<br>• Examples are provided.<br>• Extension summary, novel question, or invented problem is present. | 5 |

This rubric evaluated the knowledge and skills students were expected to learn from a flipped experience. Students were scored on their note-taking throughout the study, which allowed feedback for improvement in quality and consistency.

An original rubric initially tried to measure the notes' quality and completion using a 1-5 scale. However, those two components were so closely interwoven that separating them was unrealistic. Therefore, that original rubric was amended, resulting in this final completion rubric. The quality of student notes (Appendix D) was used to provide data for the Focus Research Question, Sub-question #1, and Sub-question #3. These notes, in combination with the percentage of videos viewed (%viewed) and student surveys, allowed me to triangulate results for engagement.

Quizziz Platform. The Quizziz Platform allowed students to take a post-viewing content understanding quiz at the beginning of each class following a flipped content experience. Each quiz was carefully crafted using the flipped video and Specific integrated prompts as a guide. This platform allowed for quick formative assessment to inform my instruction. Additionally, I could project the class's anonymous answers to the questions and reteach any frequently missed concepts. Finally, during this instruction, students could quality check my data to see if I had accidentally mismarked a correct answer or given them inaccurate information. I could then amend their scores, allowing accurate data to be collected. After each flip, these scores were tabulated to determine the content understanding for the Focus Research Question and Sub-question #2.

Student Survey. The student survey (Appendix E) was developed and then amended based on comments and suggestions from advisors and colleagues. Students completed this survey on paper and via Google Forms at the end of Semester 1. Before students took the survey, I gave instruction on the difference between engagement and content understanding. Students were also directed to think critically about any neutral answers and answer as best as possible

based on their perceptions. Appendix F links each survey item to a corresponding aspect of the study. Results were analyzed by finding the response percentage for each item and are represented with bar charts and stacked bar charts in the Data Analysis Section.

Student Interviews. Interviewees were chosen in equal numbers from Group X and Group Y. Students were selected using stratified random sampling based on students' quiz scores. Additionally, there was a focus on students that showed a greater tendency for flip resistance. Interview questions (Appendix G) were asked of each student during a time when other students were otherwise occupied with independent or lab work. Responses were recorded using the Otter voice recording app.

Overall Student Grade in the Course. Students' grades in the course were evaluated by averaging their Semester 1 and Quarter 3 grades. These grades used a traditional percentage grading scale and were based on the entire breadth of assignments for the course, not just those corresponding to the flipped experiences. Additionally, I had access to students' other course grades and checked for validity by noting aspects such as cumulative course grades, homework completion, and test scores. These other course grades helped to guide my understanding of student motivation, particularly when students were resistant to flipped assignments.

Teacher Log Journal. While I initially had a log journal to complete with every flip, the information was nearly always the same and very intuitive. So, I shifted to a much broader record of perceptions (Appendix H) which centered on benefits, drawbacks, and insights that were novel or seemed non-intuitive.

# CHAPTER FOUR

# DATA ANALYSIS

The following data was collected starting in September 2022 and running through February 2023. Twenty flipped experiences were completed in this Honors Physics Course during this time. The following results will address the relationships related to engagement and content understanding observed when Integrated Prompts were varied during Phase Two. Data collected from Edpuzzle, Notes Completion, and Quizziz includes those from all 18 students taking the Honors Physics Course. However, only 17 students completed the Student Survey. Results are presented in the same order as the listed sub-questions starting with results focusing on engagement, then focusing on content understanding, and finally, those results which impacted me as an instructor.

## Results

### Engagement

Claim #1 – Engagement is not affected by Integrated Prompt Type. The Integrated Prompt Type did not affect student engagement (t-test, $p < 0.05$). A t-test ($p < 0.05$) was also used to compare scores for Cornell note completion when using Specific and Generic Integrated Prompts. Scores were only compared for students who watched the content *and* turned in notes. The t-test ($p < 0.05$) was performed for Phase Two, Flip Experiences #11 - #20, in which integrated prompts were employed. In all cases, there was no statistical difference (t-test, $p < 0.05$) between the engagement of students and the varied integrated prompt types when looking

at engagement based on %viewed or note completion. Students that started the flipped experience nearly always finished it. There were only two cases in which the %viewed was partial. Notes were nearly always scored either as a “4/5” or a “5/5,” and there was no statistical difference (t-test, $p<0.05$) in note completion based on the type of integrated prompt.

Students felt engaged when completing the flipped experience (Figure 1).

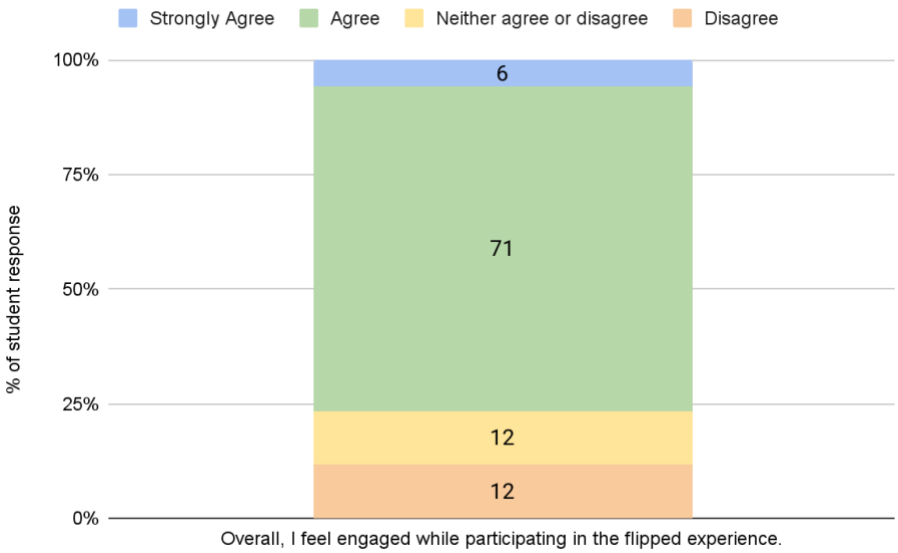


Figure 1. Student responses to engagement during the flip based on inclusion of integrated prompts, (*n*=17).

When responding to the statement about overall engagement, 77% (14 students) either agreed or strongly agreed that they felt engaged, while 12% (2 students) disagreed that they felt engaged. However, students have varied responses based on whether they felt the *integrated prompts* contributed to their engagement (Figure 2).

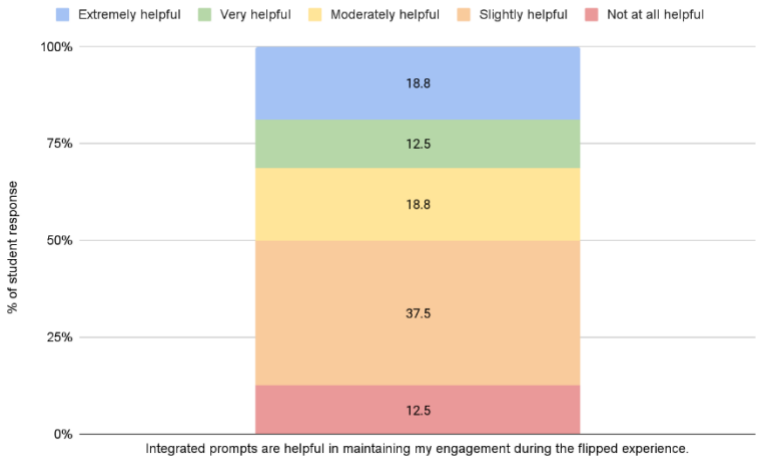


Figure 2. Student responses regarding integrated prompts and engagement, (*n*=17).

Most students felt that the integrated prompts were in some way helpful in maintaining their engagement, while only 12.5% felt that they were not at all helpful. Students who felt the integrated prompts were extremely or very helpful generally linked the helpfulness to keeping them on track. As one student said, “It’s easy to zone out during a video and with this feature it helps keep myself on track,” while another student mentioned, “I will rewatch or pay extra attention when I have to answer a question.” Students who perceived the prompts as moderately helpful or slightly helpful generally felt that they could stay on track without the prompts and that prompts were an annoyance. As one student summed it up, “The prompts can help sometimes, but other times it feels like it gets in the way of the video,” while another student remarked, “occasionally, the prompts, which are placed at the end of the concept, come up quickly before I can get the notes and then I have to navigate to get back to the notes.” Students who felt that the integrated prompts were not at all helpful did not expound on their reasoning for responding in this way.

When asked for their engagement prompt preference, most students (68.8%) said it makes no difference, while 31.3% preferred the Specific prompt type (Figure 3). No students preferred the Generic prompts. One student indicated, “I would get rid of the Integrated Prompts, especially the Generic ones,” while another student said, “No more pop up prompts and let us take our own notes.” This distaste for the integrated prompts seemed to affect their perception of engagement. In interviewing the students, most generally felt that the Generic prompts reminded them to “do what they were already doing,” It was annoying to “continually dismiss the prompt.” As an instructor, I had strategically placed the prompts at critical learning points to cause students to pause and think about their learned content; however, students did not initially grasp my purpose. To them, it felt like nagging. In the future, it will be essential for me to clarify my strategy for choosing the placement of the prompts.

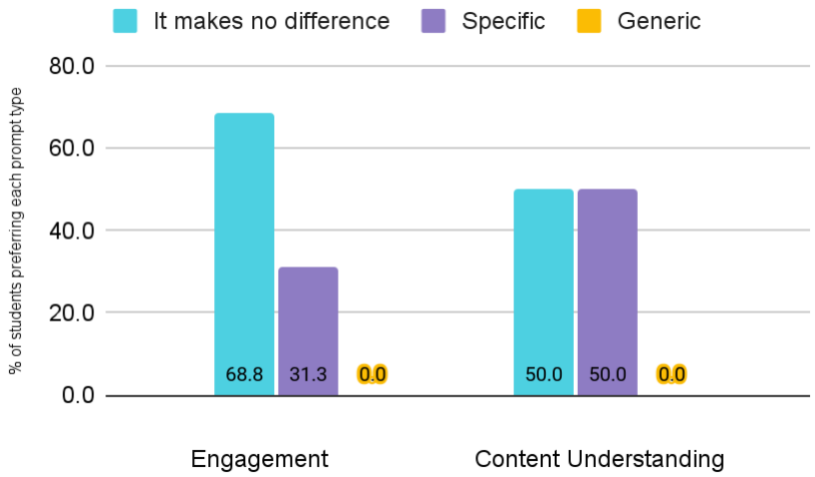


Figure 3. Student preference for integrated prompt type, (*n*=17).

Claim #2 – Junior males were less likely to complete the flipped experience. While this claim is not explicitly related to the integrated prompt type, I did find it to be a significant trend which has also been noted in other studies (McNally et al., 2017, p. 289).

Figure 4 represents the percentage of students, who are juniors and seniors, completing each flipped experience and post-viewing quiz on time. In many cases, students later completed the viewing and quiz for a grade, but those scores were not included for this purpose, so a trend in flip resistance could be observed.

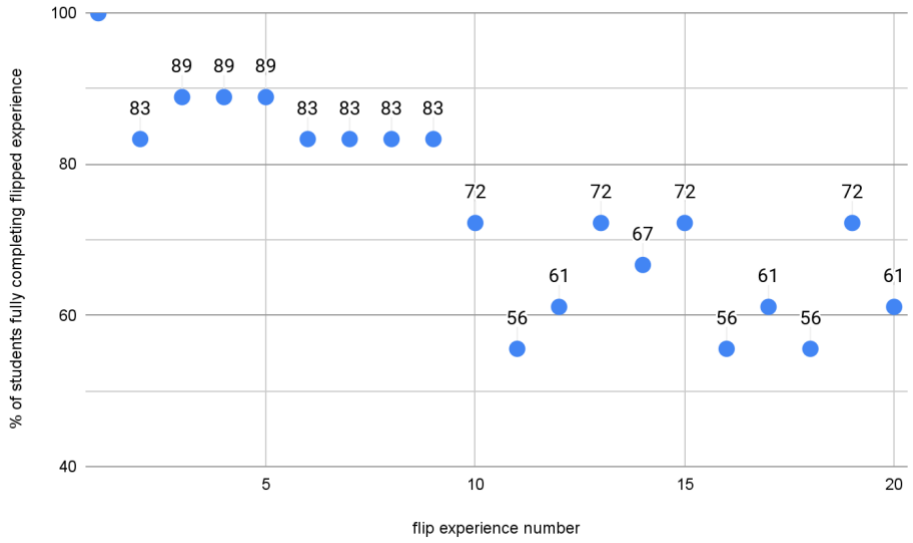


Figure 4. Percentage of students fully completing the flip vs. flip experience number, (*N*=18).

While students did start well for the first nine flipped experiences, there was a sharp drop in completed flipped experiences starting with Flip #10 and continuing to Flip #20. Flip #11 was the point at which the flipped experiences required more work and accountability due to the integrated prompts. There are many reasons for this change (absence, school activities, illness, etc.); however, there seemed to be a predominant trend in which several of these students did not complete the flipped experience.

In all but one case (Figure 5), female students completed all of the flipped experiences. Even if these students were absent for a day, they would proactively complete the work the night before and take the quiz the following day. Females comprised a smaller percentage (28%) of the

class, so there were fewer chances for something to affect their work completion. With that said, the female students in this class were very diligent about staying caught up with their work.

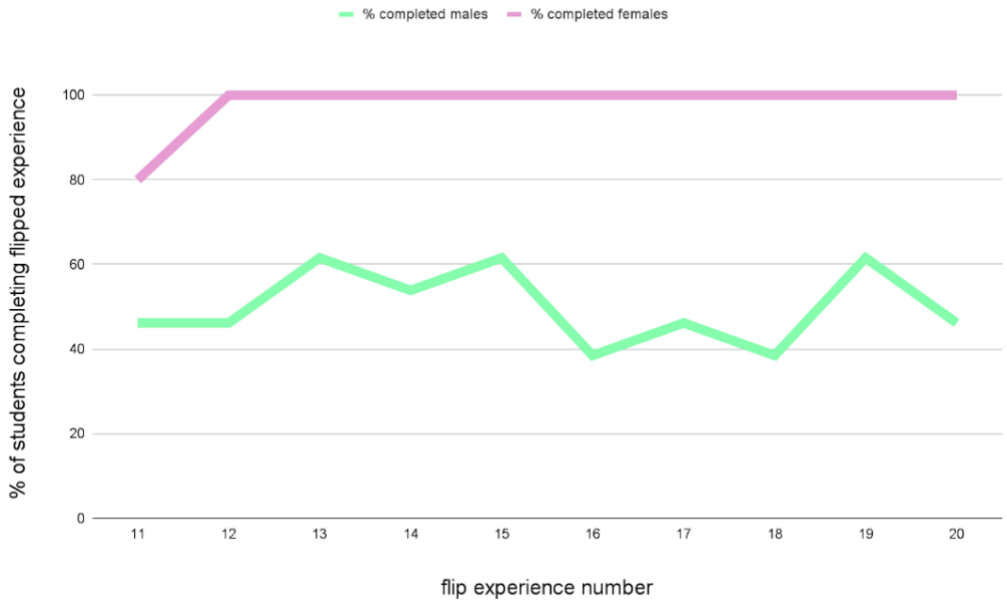


Figure 5. Percentage of completed flip experiences for males (*n*=13) and females (*n*=5) vs. flip experience number during phase 2, (*N*=18).

When evaluating male students' engagement, I created a scatterplot comparing the percentage of flipped experiences missed by each student with the student's age in months. A regression line was added, and a weak negative correlation ($R^2$ value =0.161) was found (Appendix I). Age alone was a weak predictor of whether students would resist completing the flip.

When students' percentage missed flipped experiences were analyzed based on a male student's class, junior or senior, most of the incomplete flipped experiences were attributed to junior males (Figure 6).

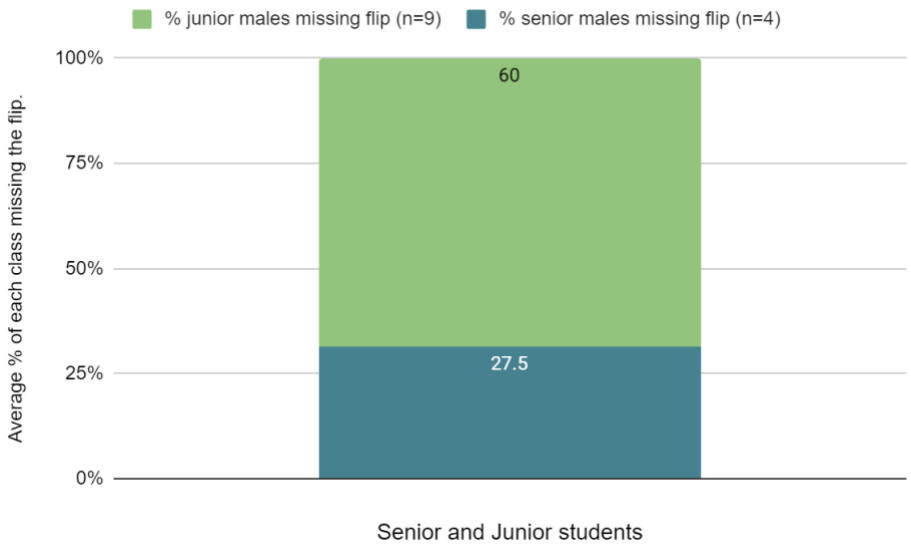


Figure 6. Percentage of male junior students (*n*=9) and male senior students (*n*=4) missing flipped experiences, (*n*=13).

One senior male repeatedly missed the initial deadline and would make up the flipped viewing after his grade was posted and affected by the zero. Another senior male occasionally missed when participating in school-related activities. However, junior males (*n*=9) had an average miss rate of 68% during Flips #11 through #20, with the lowest missed percentage of 44% and the highest missed percentage of 78%.

Most flipped experiences included videos with a run time of fewer than ten minutes. If students were to pause and take notes, their assignment should take at most 20 minutes in total. All of these male and female students have obligations outside their course requirements. Commonly stated barriers to completing the flip were work, family obligations, homework in other courses, and extracurricular activities. Many indicated that they got the work done somehow: One student indicated that “Both extracurricular activities and homework from other courses would take up a majority of the time, but I always manage to get the flipped experience

completed," and another said, "It is usually quick and not strenuous, so I don't have barriers often." However, junior male students who frequently did not complete the flip felt the requirements were too much. One student responded, "Stress from a 13-hour working day, then having to go home at 9 PM to complete a due next day homework assignment" was not reasonable. Other students cite a "lack of motivation" or "personal beliefs – I don't think school should take up more time outside of school." Many of these students exhibit similar behavior in other courses. When interviewed, they generally felt school was "ramrodding" them through a system, and they should be allowed to determine their path. Based on these initial results, it is clear that, at least with this group of junior males, care must be taken in designing the course instruction during class time to help support the incomplete flipped experiences outside of class.

Content Understanding

Claim #3 – Completing the Flipped Experience has a moderate correlation with higher content understanding for Honors Physics Students.

Figure 7 was created by plotting students' average quiz scores against the number of flipped experiences they fully completed. Linear regression was performed by setting a trend line and finding the $r^2$ value. Given the $r^2$ value of 0.495, a medium correlation exists between completed flipped experiences and average quiz scores. The number of completed flips explains about half of the average quiz score variance. Looking at Figure 7, it is clear that students who regularly complete flipped content score well on the quiz. However, a few students struggle with the material and complete most flipped content but have lower quiz scores. Additionally, some students with high math ability frequently do not complete the flipped content but score higher than average. Because flipped content is introductory, students can frequently use some previous knowledge to earn a high score on the post-viewing quizzes.

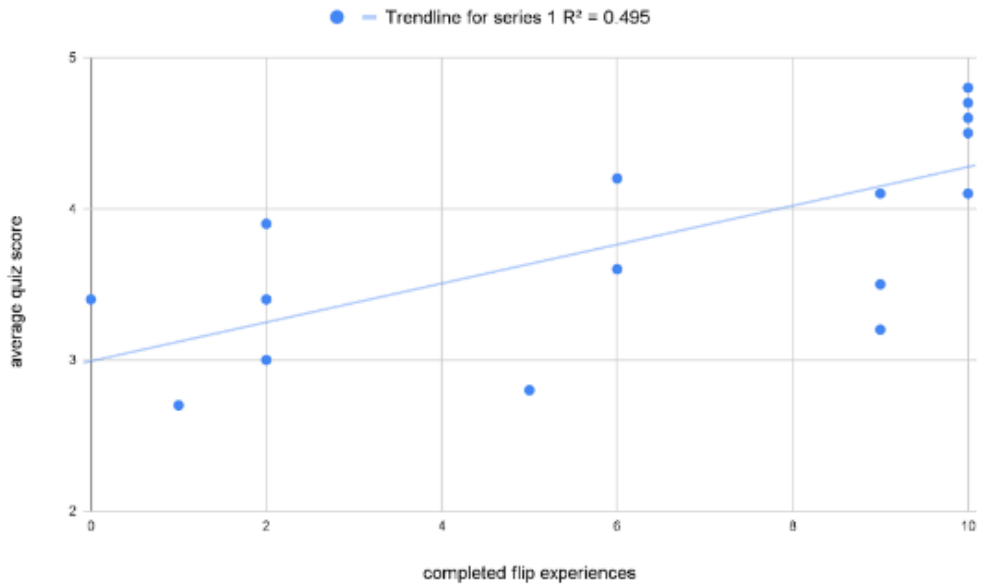


Figure 7. Average quiz score vs. completed flip experience, (*N*=18).

Comparing the number of completed flipped experiences to students' average course grades, we find a stronger correlation of $r^2 = 0.634$ (Figure 8).

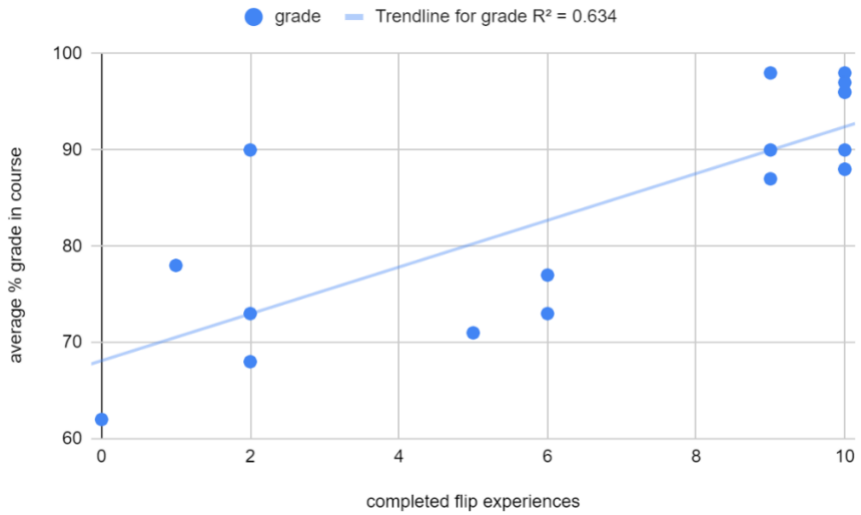


Figure 8. Average course grade vs. completed flip experiences, (*N*=18).

The data collected in this study encompassed the entire Fall Semester and much of the Third Quarter in the Spring Semester. Because many students had Third Quarter grades that differed from their First Semester grades, average student grades in the course were calculated by averaging First Semester and Third Quarter grades. Figure 8 was created by plotting students' average course grades against the number of flipped experiences they fully completed. Linear regression was performed by setting a trend line and finding the $r^2$ value of 0.634. Because individual grades were given for completion of the viewing, the Cornell notes, and the quiz, it is not surprising that a higher level of completion of flipped experiences would result in higher grades. However, the overall average course grades reflect a broader set of course activities, including hands-on lab work, advanced problem-solving, and assessments. This data would suggest that completing the flipped experiences is at least partially correlated to higher course grades.

It is also possible that the process used to complete the flipped experiences is a good filter in that those students who complete the experiences are more capable students who generally complete the requirements for any course they are in. While I did not specifically interview other teachers of these students, I could view the other teachers' grade books. Anecdotally, students that struggle to complete the flip frequently do not complete homework in other courses, and students completing the flip typically complete their homework in other courses. These students who can intentionally structure and complete their learning opportunities, such as a flipped experience, would generally be stronger academically. These students would then excel at the flipped experience as they would excel at other academic experiences.

In addition to the quiz and course grades, students generally felt that the flipped experience was useful in their understanding of the content (Figure 9).

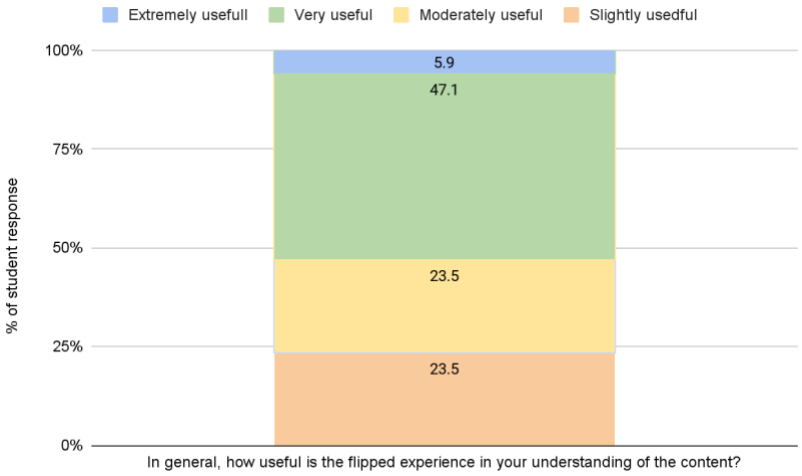


Figure 9. Student response regarding usefulness of the flipped experience for content understanding, (*n*=17).

While 53% of students felt that the flipped experience was extremely or very useful, and 47% felt it was moderately or slightly useful, no students felt it was not useful.

Additionally, Figure 10 shows that students had high confidence in content understanding after fully completing the flipped process. Of the students that took the survey, 68% indicated that they were extremely or very confident in their content understanding, 25% were moderately confident, and 6.3% were slightly confident. Overall, honors students seemed to buy into the flipped experience to gain content understanding and felt confident after completing the flipped experience.

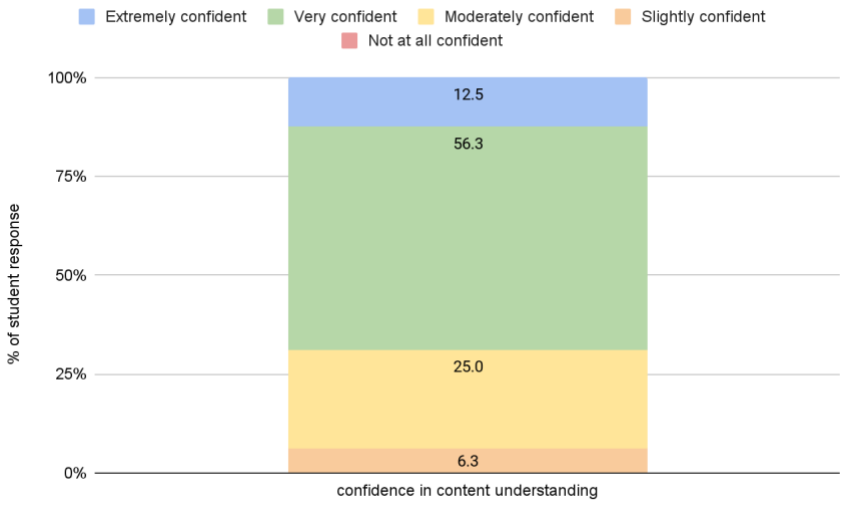


Figure 10. Student responses regarding their confidence in content understanding after fully completing the flipped experience, (*n*=17).

The flipped experiences were intentionally designed to introduce only basic material such as conventions, formulas, and intuitive examples. While these honors students perceived high confidence in their ability to understand content learned during the flipped experience, they are generally eager and adept learners who quickly grasp essential content and frequently independently extend thinking on their own. These same results may not be valid for benchmark learners who are less proficient in grasping knowledge at the understanding level and translating it to the application level of Bloom's taxonomy.

Claim #4 – Generic integrated prompts yielded the highest quiz scores. After observing the results for claim #3, it would have been easy to assume that an instructor could assign a video, have the students view it, and the content would be adequately covered. However, using integrated prompts provided an opportunity to vary the experience during the flipped content. Talbert (2020a) discussed the importance of creating structure within the flipped environment

rather than just “dropping videos on students” like assigned pre-reading. To guide students and create structure, two different integrated prompts were used.

Students had mixed reviews regarding the usefulness of integrated prompts and their effect on content understanding (Figure 11). Of the students surveyed, 12.5 % indicated that they thought the integrated prompts were very helpful, 62.6% viewed the integrated prompts as moderately or slightly helpful, and 25% indicated that the integrated prompts were not at all helpful. No students felt the prompts were extremely helpful in supporting their content understanding.


Figure 11. Student response regarding usefulness of integrated prompts, (*n*=17).

When asked to pick which type of integrated prompt best supported the content understanding, 50% of students said it made no difference, 50% of students indicated that the Specific Prompts best supported their content understanding, and no students felt the Generic

Prompt best supported their content understanding. One student said, “it is really annoying to get a prompt telling us to do what we are already doing.”

When analyzing the scores on quizzes regarding different prompts, unpaired sample t-tests ($p < 0.05$) were run on the quiz scores from each flip. In no cases was there a significant difference in quiz scores. However, comparing means of the quiz scores gives a deeper understanding of the effect of prompt type and content understanding (Figure 12).

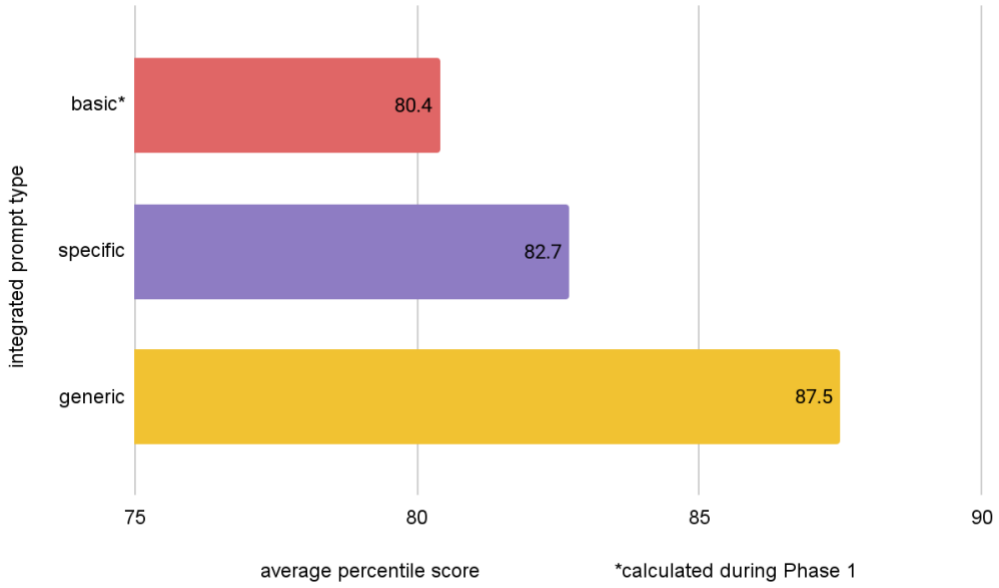


Figure 12. Integrated prompt type vs. average percentile score on quiz, (*N*=18).

Students’ quiz scores for all types of prompts over the whole study were averaged and compared. Overall, it was found that the Generic prompts produced the highest quiz scores. All students participated in the Basic Prompt Flips for the first ten flipped experiences; the average score was 80.4%. Because the Basic Prompt was not given during Flips #11 through #20, they cannot be directly compared with the Specific and Generic Scores. However, the average score does set a baseline for general quiz scores using the Basic Prompt. When comparing the

integrated prompt types used during Phase 2, quiz scores stemming from Generic prompts earned an average score of about five percentage points higher than those stemming from Specific Prompts.

I completed some member checking and presented this portion of the information to students to gauge their response to the validity of this data. Most of my students were just as surprised as I was to find that Generic prompts yielded better quiz scores. I asked students to interact with additional flipped experiences containing only Generic prompts and reflect on this result. Students responded that the Specific Prompts got in the way of their broad comprehension of the material. “I'm still surprised Generic resulted with better quiz grades, but perhaps, with the Specific prompts, we were too busy listening for that answer and missed the other information,” said one student. Another student indicated, “I think for me it is that when there isn’t Specific prompts, I can focus on learning the material without having to memorize a specific part for a question during the video. It is also easier to take notes when I don’t have to answer questions.” It seems that students had a “broad idea of what to answer or do, rather than a specific question” when completing Generic prompts, which potentially indicates that “with Generic prompts, it might be easier to understand the overall idea.” I think students are circling the idea that their thinking was disrupted in a few different ways by Specific prompts and that the Generic prompts allowed them to attend to comprehension of the main idea.

Quiz scores were further broken down by students who were high-performers, middle-performers, and low-performers in the Honors Physics course (Figure 13.) These categories were determined by looking at the average course grades from Semester 1 and Quarter 3. Students fell

into three fairly distinct groups: high-performing students earning 96%-98% in the course, middle-performing students earning 87%-90%, and low-performing students earning 62%-78%. For high-performing students, Generic prompts yielded a 4% gain in average quiz scores, middle-performing students saw a 4% gain, and low-performing students saw a 3% gain in average quiz scores. Because this method of gathering data included absences and completed flips, this information was limited only to students who both watched the video content and took the quiz. While a three to four percent gain in average quiz scores can seem small, it represents the difference in letter grades for high-performing and low-performing students. For Honors students who are frequently internally motivated and eager to learn, the Generic prompt is the best tool to elicit the highest level of content understanding.

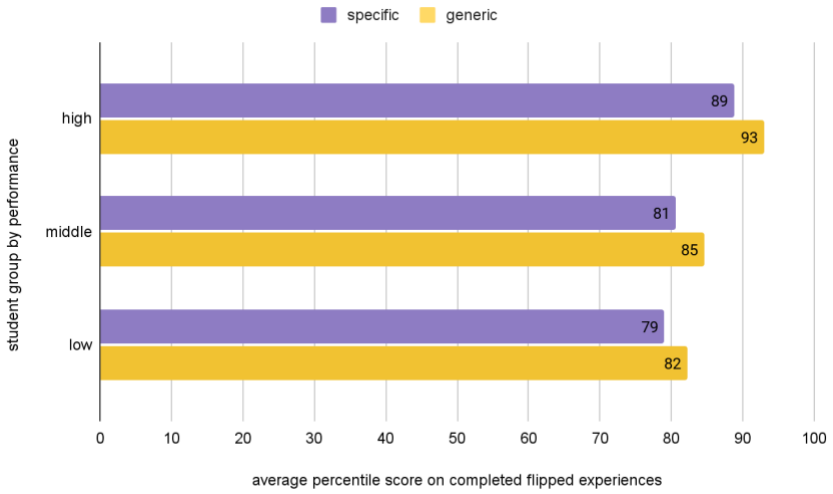


Figure 13. Post-viewing mean quiz scores for high (*n*=5), middle (*n*=6), and low performing (*n*=7) students, (*N*=18).

Flipping as an Instructor

Claim #5 – Flipping is beneficial for my teaching method. When looking at the effects of flipping my classroom as an instructor, I rank them as positive. My class is currently “five weeks

ahead of where they were last year." While some of this increase in curriculum coverage can probably be attributed to my increase in efficiency as a teacher, most can be attributed to moving to a flipped course method. When flipping the introductory content to the front, I can better use my time guiding students through a lab or problem-solving rather than acting as a lecturer giving basic information. I find that overall morale is better in my classroom because I am there to assist students in solving those complex problems rather than spending additional time reworking those confusing questions the next day. This method better allows me to place students in that zone of proximal development when they are in the classroom; to help them through a productive struggle rather than sending them out to what is often a fruitless struggle at home.

I also added 14 new hands-on lab experiences to this Honors Physics Course compared to last year. As an instructor, I know that hands-on inquiry is essential, but it is particularly validating when students say, "It is so nice to complete a lab in person rather than reading about it." Another student remarked that he could solve problems on paper but said, "I was still not understanding the full concept until I measured the value and played with it myself." In my journal, I noted, "I am more careful in planning a sequence of lessons when I have to think about exactly which flipped content will support a lab during the following class period." These additional hands-on pieces have made a difference in my students' comprehension of the material and may be the most significant benefit of moving to the flipped model.

Creating the flipped content required much time, particularly since I was creating two sets of each video, one with Specific and one with Generic prompts. For each Flipped Experience, approximately 45 minutes were spent developing the content and creating the structure that allowed the students to access the content. However, that process has now been

completed for several flips, and I will not need to take the time for that in the coming year. I will continue to amend those current experiences and add some additional experiences as required. While the upfront cost in time is high, it will benefit me for years to come.

An unexpected area of time-saving was attributed to supporting students who were absent and catching up. In the past, a student and I would sit together after school, and I would cover the basics of the lesson. The student would then work with support. While I prioritize working with these students over preparation and grading, this process often resulted in a massive commitment of time dedicated to one student over many days. One particular student was out 20 times during Semester 1. It was daunting for him to consider what it might take to get caught up and daunting for me to consider the amount of time I would spend catching him up. With the available flipped content, we fell into a routine where he would complete the flipped work while I attended to other obligations immediately after school. Then, when he had reached a point of confusion, we would sit and chat. This process allowed him to have self-direction in getting caught up and also allowed me to be freed from the burden of reteaching weeks of material. Students who are absent still come into my classroom and work. However, they now begin by viewing the flipped material independently and begin to work. While I am still able to support each student, I can work on other tasks during this time.

With the flipped method, students are more frequently willing to look to other sources for answers before coming to me. This year, I have found that high-performing and middle-performing students frequently look to other resources, including each other, before coming to me with questions. For example, one student indicated that “the flipped experience gives a good opportunity to have another perspective on how certain laws of physics work.”

Claim #6 – Results from this study allowed me to assess student needs. Moving to a flipped instruction model has also allowed me to assess student needs and address areas of concern. Throughout the study, students gave several suggestions to make the flipped experience more effective. Some suggestions could be easily accomplished, while others require more reflection. For example, one student mentioned that "making the note sheet have a place for drawing our setups" would be helpful, and another mentioned that "the video should be posted immediately after class." Both of these changes are easy to make. While I did not change the note template during the study, I will change it in the future.

Regarding posting the video, I had initially waited until the end of the day so that my students would not be completing the flipped homework while their other courses were in session. However, many of these students have open periods scheduled near the end of their day with the specific intent of working on homework. Therefore, whenever it was possible, the flipped video content was posted immediately after class.

One particular area of concern came when evaluating the students' perceptions regarding their note-taking requirements and format (Figure 14).

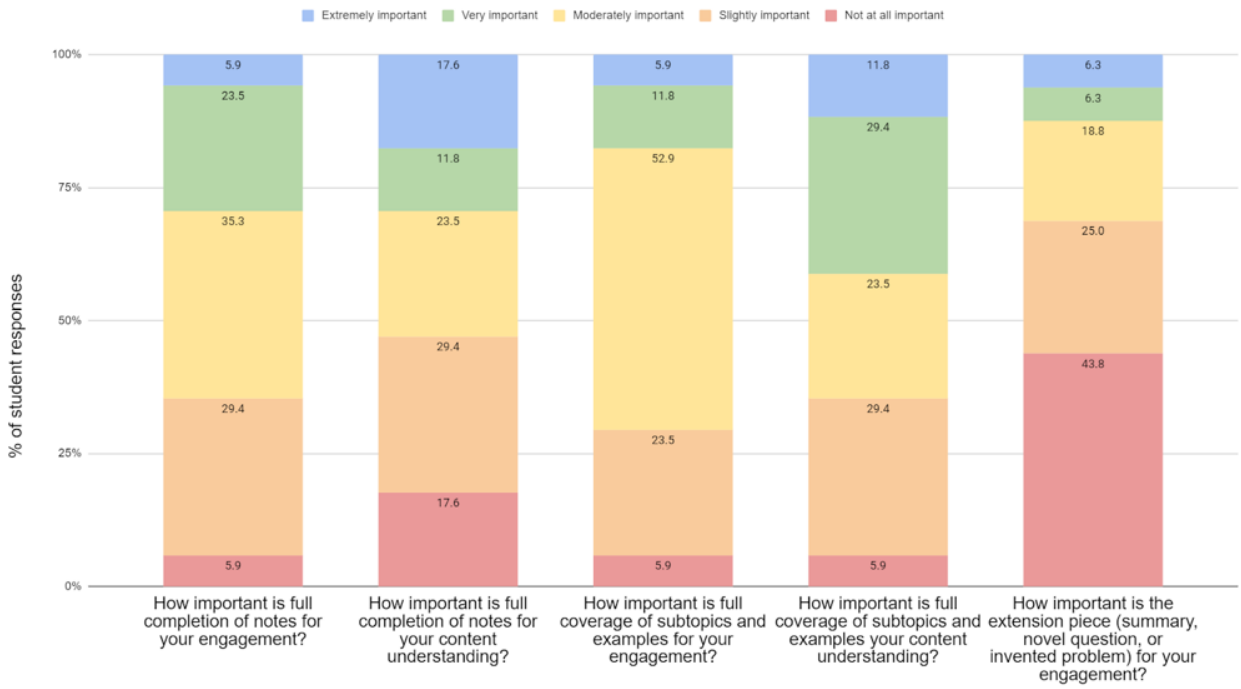


Figure 14. Student responses regarding note-taking during the flipped experience, (*n*=17).

While most (94%) of students felt note-taking was important to engagement during the flip, only 82% felt it was important for their content understanding. One student indicated, “I enjoy the videos and taking notes keeps me engaged.” Most students felt full coverage of subtopics and examples was important for engagement and content understanding. However, students were less enthusiastic about the extension piece at the end of the notes. One student indicated that he was “not sure what the novel question and invented problem parts are.” Another student indicated they “usually can’t think of a good invented problem. So I mostly just do a summary.” Another student said I should “just get rid of the summary as it adds nothing.” While evaluating students’ notes throughout the study, their notes seemed to be generally complete and thoughtful. While some students struggled with the summary, it seemed to be a standard struggle for high schoolers in summarizing. I am unsure if the struggle stems from the note requirements

as part of the accountability for the flip or if this struggle would be the same with a different summarizing activity, like pre-reading. Regardless of the cause of the struggle, I need to better instruct students in completing the extension piece in a way that supports their learning.

While uncovering the need to better instruct students in summarization was particularly discussed above, moving to the flipped model gives me the tools to better address each learner's immediate need because I can interact personally with them more frequently. It allows for basic instruction and regular formative assessment, which can occur both formally as a group and informally with each individual. I am better able to "spot each student's strengths and weaknesses, which allows me to plan a specific intervention for that student." This personal interaction helps me to put students on a path toward more independent idea construction, reflection, and learning.

# CHAPTER FIVE

## CLAIMS EVIDENCE AND REASONING

Three years ago, I took over the instruction of the Honors Physics Courses at my school. During the first and second years of teaching this course, it became apparent that the breadth of the curriculum covered and tested by the AP exam was far too much to fit into a single school year without assigning homework. In my first year of teaching this course, I was beginning to learn that assigning advanced problems and data analysis from labs as homework was a poor use of time in terms of learning, and also diminished the morale of the students taking the course. Students struggled with nuanced problems at home, generally failed to solve them, and then we would tackle the challenge the next day of sorting through all the wrong turns and misconceptions. Often, this process would take the better part of a class period. So, in my second year instructing the course, I began to experiment and pilot possible solutions for flipping the course so that basic introductory information would occur first as a flipped video experience which would allow us to solve problems and complete lab data analysis within the classroom setting. This instructional change not only anecdotally improved morale and concept understanding but also allowed the pace of the course to progress much more quickly. Seeing that this method could potentially work for this group of students, my goal turned to maximizing the flipped experience so that students could gain as much information as possible during that short time.

For this action research project, my focus research question was, “How can I maximize engagement and content understanding during the flipped portion of a flipped Honors Physics Course?”

My sub-questions were as follows:

- Sub-question #1 – To what degree is there a correlation between the type of integrated prompt and engagement?
- Sub-question #2 – What, if any, correlation exists between the type of integrated prompt and content understanding?
- Sub-question #3 - How will the results from this action research project affect my classroom instruction?

I will address and expound on some of the findings presented above regarding each sub-question, the value of this study and considerations for future research, and the impact of this action research on my classroom instruction.

## Claims from Study

### Engagement

Claim #1 – Integrated prompt type did not affect the engagement during the flipped experience. Students who had the motivation to start the flipped experience almost universally finished the process. Students report reasonable levels of engagement with the process. With regard to the integrated prompt, 68% indicated that prompt type did not matter. While 32% preferred the Specific Prompt type, no students preferred the Generic Prompt type.

These results are encouraging in that they support the idea proposed by Talbert (2017) that the successful individual space activity should have a structure that is "minimal, simple, engaging, productive and failure tolerant" (p. 135). In either case, both integrated prompts provided enough structure to engage nearly all students that began the activity. This finding allows the instructor the freedom to craft the integrated prompts as needed for each particular

activity as long as the structure remains in place. This finding provides a solid instructional requirement for each flipped experience and solidifies the current model, which was in place during Phase Two.

Claim #2 – Junior males are less likely to complete the flipped experience. While most students are engaged regardless of the integrated prompt type, some students are less likely to engage with the flipped experience in the first place. During this study, the most flip-resistant students were junior males. This trend was also noted in McNally et al. (2017), in which students, younger males, were more flip-resistant because they did not like the accountability of a post-viewing quiz but were shown to have increased test scores when participating in the flipped experience.

In surveys and interviews conducted during this action research project, these flip-resistant students were able to offer little helpful comments regarding motivators for completing the flip. These students did not want to complete the assigned flip experience either because they lacked the time or did not feel they should have to complete the flipped experience. Talbert addresses this issue and indicates that the reasons for flip-resistance are generally one of a few possibilities, such as,

> the individual space activity might need more structure, the student might be engaging in unproductive study habits, the student might be engaging in perfectionist practices on individual space work, or the student might be spending a normal, expected amount of time on individual space work, but it's more time than she or he is used to spending outside of class (Talbert, 2017, p.180).

When evaluating these students' in-class behavior and comments, their behavior aligns with two possible reasons for flip-resistance: the flip requires more time than the student is willing to spend, and the student is engaging in unproductive study habits.

While we cannot blame everything on the disruption caused by the Covid 19 Pandemic, the uneven practice of schooling during the spring of 2020 and the academic year of 2020-2021 was significant. Like much of the country, our school district moved to full remote learning during the spring of 2020. During the academic year, we did our best to maintain face-to-face learning, but were frequently shifted to remote learning due to restrictions from ill staff and students. That academic year also saw a temporary one-year shift to a block schedule, a schedule with which students and staff were unfamiliar, which caused a struggle with the continuity of instructional practices and students' exposure to content. For these junior males, these disruptions in education would have occurred during a fairly formative time, the end of their eighth-grade year and the entire year of their ninth-grade year. It would be expected for eighth-grade instructors to help students move toward the more rigorous academic classwork and homework requirements of high school during that final spring middle school quarter.

Additionally, ninth-grade students learn to monitor themselves and complete classwork and homework. For students that struggled with the paradigm shift of remote learning, the whole process was embittering. I suspect that the effect of all those changes during a formative point in their life may be driving some of these junior males' habits, behaviors, and attitudes.

The first group, those who believe the flipped experience requires more time than the student is willing to spend, consists of two highly accelerated individuals in math. While most juniors take Algebra II/Trigonometry concurrently with this course, these students take Calculus or Analysis. Generally, these students enjoy learning and are a pleasure to interact with in class. However, they have found that their understanding of mathematical principles and previous exposure to physics concepts in math class allow them to skate by without participating in the

flips. Frequently, another student would "call them out" when they did not correctly understand a concept. Being "called out" occasionally resulted in completing the next flip with one student. The other student resolutely refused to participate in this portion of the course. In addressing the engagement of these students, a possible option for motivation may be to include much harder content; however, that method is generally not recommended for flipped material, and it might have the alternate effect of requiring even more time dedicated to an activity that students are not readily willing to complete in the first place.

While the first group presents a conundrum, they generally perform well in the class because they can ask questions quickly and get caught up to speed by speaking with their peers or me. The second group, those who engage in unproductive study habits, presents a more considerable concern. This group consists of four students who need help to direct their focus and time management. Frequently, they need help constructing or demonstrating their knowledge by showing work and are convinced that their work is correct even when their peers or I reasonably invalidate it. This group tends to have frequent absences and missing homework in other classes – their academic abilities are sufficient, but their habits are a detriment, and their grades suffer. They struggle to extend their thinking and connect related concepts when more than a basic connection is required. Many of them have been "pretty good" at math. At this point, they need to use their knowledge and apply problem-solving skills to each varied scenario, which is a struggle for these students.

In the future, I can see two options for this group of students; neither is ideal. The first option would be to force the flipped experience. During the study, I reminded and asked these students to complete their flipped homework, and they were penalized in the grade book when they chose not to complete it. However, I did not put any protocol in place that would force the flip. One possible option would be to force

the students to complete the introductory flipped material before participating in the in-class work for the day. While this would probably ensure that the flipped material would be completed, I do not believe these students would successfully complete the advanced problem-solving or lab analysis independently as homework outside of class.

The second option would be to continue operating as I have been, perhaps with more outreach to parents. These students are still getting opportunities to solve nuanced problems and participate in lab experiences in class. While the students will suffer in not having the basic conventions and "vocabulary" learned during the flip, I suspect they will benefit more from continuing to construct knowledge with their peers and me during class activities. While the flipped experience can exist as one tool in my teaching practice, it may not work for these students who will benefit from other tools and practices.

Content Understanding

Claim #3 and #4 - Completing the Flipped Experience has a moderate correlation with higher content understanding, and Generic integrated prompts yielded the highest quiz scores. Overall, students score five percent higher on post-viewing quizzes after completing the Generic prompts than when completing the Specific prompts. When completing the flipped experience with Generic prompts, high-performing and middle-performing students benefitted the most, with a four percent gain in average quiz scores, while low-performing students still experienced an average increase of three in their quiz scores. While it was not surprising that completing the flipped experience would have at least a moderate correlation with a student's content understanding, it was surprising to find that the Generic Integrated Prompt resulted in higher average quiz scores. I had initially set the Generic prompt up as a null hypothesis and expected, if anything, that the Specific Prompt would result in higher content understanding. I can initially

surmise three possible reasons this effect is present: 1. Specific Prompts are one more additional hurdle that students must complete, and they are not willing to go to that extra step; 2: Specific Prompts may break up the continuity of flow too much for the student to attend to the material throughout the flip, or 3: Generic Prompts require students to actively process what they have learned and to synthesize before continuing with the video, while Specific Prompts allow a student to zone out a bit while waiting for the prompt and then to answer a quick question.

Given that engagement is not dependent on Integrated Prompt Type, I suspect the Specific Prompts are not too big of a hurdle. While some students mentioned that "prompts ruin the flow of the video," they generally spoke of all prompts, not the Specific or Generic Prompt. When questioned about the benefit of completing flipped experiences with Generic prompts, students pointed to a disruption in the flow of the content. Additionally, students indicated that Generic prompts allowed them to focus on the broad overall concept. In contrast, the Specific Prompts often required them to "focus on hitting a button for one specific answer" rather than allowing "each student to think about the subject in their own way."

My observations lead me to conclude that the Generic Prompt forces students to consider the content they learned during each small chunk of instruction and synthesize that learning in their notes. Students who cannot demonstrate their learning may re-watch that chunk more carefully. This "thinking about thinking" and content review would benefit most students.

Students did not like the integrated prompts, and even my most patient, compliant students wished for the Generic prompts to be gone. Students saw these prompts as a waste of time because they were "reminding them to do what they were already doing." However, the average difference in quiz scores showed a three or four percent advantage to those who

participated with the Generic Prompt. Those results were enough to make a difference in the letter grade received on the quiz for high-performing and low-performing students. While most of these students are motivated to learn, they are also motivated by points and grades. I believe most of the students would be willing to tolerate the Generic prompts if it meant that their learning and grades would be higher by participating and that it is wise to capitalize on the motivation for points in this case. This study's results will help me frame these Generic prompts positively for students participating in my courses in future years. It will be critical for me to show students why those prompts exist and help them to think about their constructive learning and sense-making while viewing the flipped content.

Additionally, this result is a benefit for me, the instructor. While it has required much time to create flipped video content with integrated prompts, Generic prompts require far less time and energy than Specific prompts. This result also means that I can spend time on something other than pouring over the responses to the Specific prompts and can turn my attention toward individual student questions posed at the end of each video. The Specific prompts are more likely to be used as post-viewing quiz questions.

## Value of the Study and Consideration for Future Research

This study forced me to consider and implement a structure for teaching a flipped course in which student engagement and learning were maximized. While I do not understand all the components for reaching full maximization, I learned many beneficial procedures and discovered some interesting themes while specifically researching the flipped portion of the course. This research supported the efficacy of a flipped course as a valid instructional method while providing a prompt structure that best supports students. I found that the students completing the

flipped experience had a better content understanding than those who did not complete the flip, and that Generic intermediate prompts were associated with greater content understanding for all groups. Moreover, I learned as much about what does not work. Based on student Likert information, I learned that students dislike and struggle with summarizing learned content. Tracking completion of flipped experience with males, I found that junior males in this course are less likely to engage with the flipped experience than their peers.

This project also provides a starting point for colleagues to consider the feasibility and benefit of setting up flipped courses. One benefit of teaching is enjoying the feedback and collaboration from colleagues who have different skill sets and talents and are also generous and honest about the successes and missteps they have made in curriculum and instruction. While I do not plan to tell my colleagues how they should or could do their jobs, I am energized and looking forward to conversations and collaborations with my peers concerning ways to further amend and improve our courses based on some of the findings from this research. Reflection, refinement, and improvement are always a need in every classroom.

Moreover, additional research can be guided by these current needs. For example, I still want to determine if providing students with better training to extend their thinking increases content understanding. As teachers, we know that one of the hallmarks of understanding a subject is the ability of a student to explain that content in their own words. Further studies focusing on the benefits of each kind of extension piece with regard to content understanding would be beneficial for designing the structure of the flipped experience.

These results may be unique to the Honors students because these students are naturally adept at picking up on specific subpoints and exceptions. However, the results may differ with

benchmark learners who may need more guidance. Striking a balance between time spent directly teaching the curriculum and providing opportunities for benchmark learners to practice summary and synthesis would be an important goal. Doing so could prove valuable in many ways, but additional trials and experimentation will be necessary to craft this balance for benchmark students.

Finally, content understanding, both in and out of class, is best maximized when students engage with the flip. Therefore, I aim to continue to fine-tune processes and ask questions of students that are flip-resistant. In addition, assessing students with Likert-like surveys regularly may provide a more in-depth understanding of the tendency toward flip-resistance and point toward additional possible solutions.

## Impact of Action Research on the Author

Participating in this action research project has given me the evidence that using a flipped classroom instruction is a valid method of instruction for this Honors Physics Course. Shifting to this method of instruction has allowed me to give students the independence to construct their knowledge both in and out of class while maintaining the instructional pace required to adequately address all of the curricular content. While creating flipped experiences does require an inordinate amount of time at the outset, I have benefitted from several sources of well-made videos which address Honors Physics content. Those flipped experiences are now created and will require a more manageable amount of time to reconstruct in subsequent years. An additional benefit was the increased ability of students to independently make up missed work when absent. I saw increased independent and peer learning for most students, allowing me to focus on guiding students and correcting misconceptions rather than full direct instruction. Students were

able to independently make meaning of advanced content using the introductory content presented in the flipped videos, found the flipped experience to be generally useful, and most were confident in their content understanding after completing the flipped experience. This change in instruction and presentation allowed me to interact more individually, making the course much more enjoyable. I learned that I still have work to do in fine-tuning the structure of the flipped experience in small ways, like changing the timing of the event, and in more significant ways, like teaching students the skill of summarizing their learning. I can better identify flip-resistant students and be proactive with those students from the start.

Aside from the instructional benefits in the Honors Physics course, this action research project helped me to develop and recognize skills that support strong instruction overall. These skills include everything from focusing on a reasonable, investigable problem, to creating surveys and formative assessments by listening to students, to deeply considering my own instructional beliefs and practices. Overall, this research allowed me to stretch my growth as an instructor while helping students stretch their comfort levels with new methods and productive struggles. Finally, by sharing this journey with my students, and soliciting honest and frequent feedback, I have helped them improve their learning and have improved my skills.

In extending this study, I intend to continue using the flipped learning method in this course next academic year. During April and May, I am currently piloting a study investigating possible relationships between the type of notes students use during the flipped experience and their content understanding. For the remainder of this year, students are completing flipped experiences with only the Generic prompts. Students are still required to take and submit their notes. However, they may choose to continue to use the Cornell Note Template or create a note-

taking structure of their choosing. With the understanding that notes should be used as a reference, notes are graded on completion, legibility, and use of hierarchy. This year, I intend to look at any preliminary varied note-taking results and then fine-tune my requirements for next year. As mentioned above, I have some current students firmly entrenched in the flip-resistant group. I will obtain more authentic whole-group results from my students enrolled next academic year. This pilot study has the additional benefit of forcing me to continue creating the flipped content for the rest of this school year.

Next year, I also intend to focus on summarizing content with students. Students will be carefully instructed in different methods of summarization. Students would then complete flipped experiences using each method of summarization. Finally, data will be collected and analyzed to determine whether any relationship exists between content understanding and the summarization method.

Flip resistance is the major drawback of the flipped method of instruction. While flip-resistant students might still gain a great deal from in-class activities, these students would benefit most by also completing the flipped experiences. The whole class would benefit as these students would not present the drag to peers and content pacing. My goal would be to investigate whether the flip-resistant trend exhibited by junior males continues to hold in the coming years. Additionally, I aim to interview those students more frequently and better understand their viewpoints, hoping to move them to the flip-completion group.

I teach several sections of the ninth-grade Earth and Space Science Honors course. I am interested in investigating whether these findings translate to a lower grade level of Honors students. This research is more daunting because I have many more students to move through the

process. While these increased numbers may give me additional validity, it also requires that I keep track of a much larger set of data points (%viewed, notes completed, and quizzes) for many students. I am unsure if I could complete this work while returning the assignments to students on time. However, if I could work out the logistics (perhaps students would grade their notes after some training), flipping this course would allow these students to do much more in-depth projects and relevant research that they are ready to complete as young high schoolers. It would be research worth pursuing at some point.

As with any instructional practice, my goal is to improve every year until I have a well-functioning process that is efficient but also delivers high engagement and content understanding to all students. If students can increase their learning and access additional learning experiences, this research would be worthwhile.

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# APPENDICES

# APPENDIX A

## INSTITUTIONAL REVIEW BOARD EXEMPTION

Hello Wiles, Elizabeth,

Your protocol was reviewed by the IRB and has been approved.

PI: Wiles, Elizabeth
Approval Date: 11/14/2022
Title: Maximizing Engagement and Understanding during the Flipped Portion of an Honors Physics Course

Protocol #: 2022-387-EXEMPT
Review Type: Exempt Review
Expiration Date: 11/14/2027

Work described under this protocol may now commence. The PI is responsible for ensuring that the protocol accurately describes research practices being conducted.

> Review Category designation determined by the IRB can be found in the final section of your protocol.
> IRB-stamped active Consent Forms are attached within your protocol where applicable.
> Any changes must be submitted via Amendment prior to implementation.
> Per the Common Rule, research only requires Interim (annual) Review by the IRB if 1) it was reviewed via Full Committee or 2) is sponsored by the FDA.
> All research is subject to post approval monitoring.
> All protocol types must be renewed 5 years after approval.
> Inform the IRB once your research is complete so that the protocol may be inactivated.

Please contact your IRB Program Manager with any questions or if you are in need of assistance. Thank you for your diligence in the care of human subjects research participants.

Institutional Review Board for the Protection of Human Subjects | Office of Research Compliance | Montana State University

Access your protocol anytime at https://us-east-2.protection.sophos.com?d=topazti.net&u=aHR0cHM6Ly9tb250YW5hcHJvZC50b3BhenRpLm5ldC8vRWxlbWVudHM_ZW1haWxMaW5rPTExJTJjMTAyJTJjODQ0NQ==&p=m&i=NWY4NzM1MzVhYjMyNzkwZGZmMWU4MWMw&t=c2pvRUM2TWNFbDBJMmVGbGRJOHlrakllzbTRsSXVvdG16ZDNudzRyMXdRTT0=&h=ae6274b6c8a144eea48d8bbe63cfb66e&s=AVNPUEhUT0NFTkNSWVBUSVYph3phLlpJIgzSVJ_Zh96SCVX46ftmkKzb81xfxMZXwg.

# APPENDIX B

## SCHEDULE OF INTEGRATED PROMPT TYPE ASSIGNED TO EACH GROUP

Table B1. Schedule of integrated prompt type assigned to each group

| Flip Experience # | Group X Prompt | Group Y Prompt |
|---|---|---|
| Flip 11 | Generic | Specific |
| Flip 12 | Specific | Generic |
| Flip 13 | Generic | Specific |
| Flip 14 | Specific | Generic |
| Flip 15 | Generic | Specific |
| Flip 16-20 | Continue pattern | Continue pattern |

# APPENDIX C

## NOTE TAKING TEMPLATE

Source:

| Keywords or New Words | Notes |
| --- | --- |
| | |

Summary

# APPENDIX D

## EXAMPLES OF STUDENT NOTES

## Source:

Intro to Circular Motion and Arc Length

### Keywords or New Words

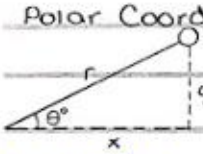
circular motion
arc length

5/5

### Notes

**Polar Coordinates:** $(r, \theta)$

- you can relate Cartesian Coordinates and Polar Coordinates with trig functions

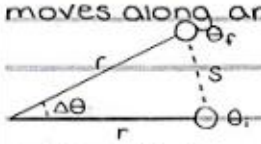



$\sin\theta = \frac{o}{h} = \frac{y}{r} \dashrightarrow y = r \cdot \sin\theta$

$\cos\theta = \frac{a}{h} = \frac{x}{r} \dashrightarrow x = r \cdot \cos\theta$

$\Delta\theta = \theta_f - \theta_i$

**arc length** - the linear distance an object moves along an arc




$S = r\Delta\theta$ (use radians)

$C = 2\pi r = r(2\pi)$

$S = r\Delta\theta$

## Summary

circular motion calculations can be easily related to those of trig functions ✓

calculations using θ must be done in radians, not degrees ✓

**Source:** Introduction to circular motion

**Keywords or New Words**

Circular

Sphere

radius

Angular displacement

$\Delta\theta$

arc length = $s$

sketches?

4/5

## Notes

Use location using radius and angular position. (polar coordinates) $(r, \theta)$

Initial angular position to Final angular pos

$s = r \cdot \Delta\theta$ ← Use Radians

## Summary

We use what we already know to branch into a new topic

Good

**Source:** 3|5

| Keywords or New Words | Notes |
| --- | --- |
| Cartesian vs Polar | $y = r\sin\theta$<br>$x = r\cos\theta$ |
| arc length | The linear distance on a circle traveling on, on arc is called arc length |
| Circumference | $s = r\Delta\theta$<br>-1 use radians |
| sketches? -1 | $C = 2\pi r$ |

## Summary

-1

# APPENDIX E

## STUDENT SURVEY

# Student Survey

**Name:**

*This survey will help me to better understand the importance of each portion of the flipped experience. Please reflect on your flipped experiences as you respond to the following items. Please circle your answer as well as submit them in Google Classroom.*

Participation is voluntary and you can choose to not answer any questions you do not want to answer and/or you can stop at any time. Proceeding with the survey indicates your consent to participate.

**Please review a few terms which will be referred to during this survey.**

*Flipped experience – students using video content and notes to learn introductory material outside of class time*
*Integrated prompts – Prompts that pop up throughout the video posted in Edpuzzle.*

## General Questions

| | Almost never | Occasionally | About half the time | Most of the time | Almost always |
|---|---|---|---|---|---|
| **1. I frequently complete my homework in all my courses.** | 1 | 2 | 3 | 4 | 5 |

| | *Strongly disagree* | *Disagree* | *Neither agree or disagree* | *Agree* | *Strongly Agree* |
|---|---|---|---|---|---|
| ***2. It is important for me to do well in physics class*** | *1* | *2* | *3* | *4* | *5* |

| | Less than 50% | 60% | 70% | 80% | 90% or greater |
|---|---|---|---|---|---|
| **3. Roughly how much of the flipped content do you regularly complete?** | 1 | 2 | 3 | 4 | 5 |

| | *7-10 minutes* | *11-14 minutes* | *15-18 minutes* | *19-21 minutes* | *22 minutes or greater* |
|---|---|---|---|---|---|
| ***4. What is the maximum length of a flipped video for which you remain engaged in the content?*** | *1* | *2* | *3* | *4* | *5* |

| Work | Extracurricular activity | Family obligations | Homework in other courses | Access to internet/data | Other: |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| **5. What is your greatest barrier for completing the flipped experience?** | 1 | 2 | 3 | 4 | 5 |

***6. Please list other barriers to completing the flipped experience:***

| |
|---|
| |

| | Phone | Home device | School device | Public Library device | Other: |
|---|---|---|---|---|---|
| **7. How do you typically access flipped video content?** | 1 | 2 | 3 | 4 | 5 |

***8. Please list any other device you typically use to access flipped video content:***

| |
|---|
| |

| | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly Agree |
|---|---|---|---|---|---|
| **9. Overall, I feel engaged while participating in the flipped experience.** | 1 | 2 | 3 | 4 | 5 |

***10. Please explain and give an example as to why you answered the way you did in the above question:***

| |
|---|
| |

| | By Myself | With Peers | A little of both |
|---|---|---|---|
| **11. Generally, do you complete the flipped portion by yourself or with a group of peers?** | 1 | 2 | 3 |

| | *Very easy* | *Somewhat Easy* | *Neither Easy or Hard* | *Moderately Hard* | *Very Hard* |
|---|---|---|---|---|---|
| ***12. In general, how would you rank the difficulty of the material presented during a flipped experience?*** | *1* | *2* | *3* | *4* | *5* |

| | Totally unclear | Somewhat unclear | Moderately clear | Mostly clear | Very clear |
|---|---|---|---|---|---|
| **13. Please rate the general clarity of the flipped material.** | 1 | 2 | 3 | 4 | 5 |

| | *Not at all useful* | *Slightly useful* | *Moderately useful* | *Very useful* | *Extremely useful* |
|---|---|---|---|---|---|
| ***14. In general, how useful is the flipped experience in your understanding of the content?*** | *1* | *2* | *3* | *4* | *5* |

**15. Anything else about our flipped experience that you'd like me to know?**

## Cornell Notes

*As part of the accountability in the flipped experience, you are required to take Cornell notes. Please reflect on your experience in taking these notes as you respond to the following items.*

| | *Not at all well* | *Slightly well* | *Moderately well* | *Very well* | *Extremely well* |
|---|---|---|---|---|---|
| ***16. Cornell notes help me to stay engaged during the flipped experience.*** | *1* | *2* | *3* | *4* | *5* |

| | Not at all helpful | Slightly helpful | Moderately helpful | Very helpful | Extremely helpful |
|---|---|---|---|---|---|
| **17. The Cornell notes I take during the flipped experience are helpful in my learning of the content.** | 1 | 2 | 3 | 4 | 5 |

| | *Not at all important* | *Slightly important* | *Moderately important* | *Very important* | *Extremely Important* |
|---|---|---|---|---|---|
| ***18. When taking Cornell notes, how important is full completion of notes for your engagement?*** | *1* | *2* | *3* | *4* | *5* |
| ***19. When taking Cornell notes, how important is full completion of notes for your content understanding?*** | *1* | *2* | *3* | *4* | *5* |
| ***20. When taking Cornell notes, how important is full coverage of subtopics and examples for your engagement?*** | *1* | *2* | *3* | *4* | *5* |

| | | | | | |
|---|---|---|---|---|---|
| ***21. When taking Cornell notes, how important is full coverage of subtopics and examples to your content understanding?*** | *1* | *2* | *3* | *4* | *5* |
| ***22. When taking Cornell notes, how important is the extension piece (summary, novel question, or invented problem) for your engagement?*** | *1* | *2* | *3* | *4* | *5* |
| ***23. When taking Cornell notes, how important is the extension piece (summary, novel question, or invented problem) for your content understanding?*** | *1* | *2* | *3* | *4* | *5* |

| | Summary | Novel question | Invented problem |
|---|---|---|---|
| **24. Which extension piece do you feel best solidifies your understanding of the content?** | 1 | 2 | 3 |
| **25. Which extension piece do you most frequently choose?** | 1 | 2 | 3 |

***26. Anything else about Cornell notes that might be helpful for me to know?***

## Integrated Prompts

*You receive different types of integrated prompts, sometimes they are Generic and sometimes Specific. Please review the different types of prompts below and reflect on your experience as you respond to the following items.*

*Generic Integrated Prompt: Please review this section and add notes about the topic*
*Specific Integrated Prompt: These take the form of multiple choice, True or False, or short answers prompts that you much complete before moving forward.*

| | Not at all helpful | Slightly helpful | Moderately helpful | Very helpful | Extremely helpful |
|---|---|---|---|---|---|
| **27. Integrated prompts are helpful in maintaining my <u>engagement</u> during the flipped experience.** | 1 | 2 | 3 | 4 | 5 |

***28. Why did you answer the way you did in the above question?***

| |
|---|
| |

| | Not at all helpful | Slightly helpful | Moderately helpful | Very helpful | Extremely helpful |
|---|---|---|---|---|---|
| **29. Integrated prompts are helpful in my <u>content understanding</u> during the flipped experience.** | 1 | 2 | 3 | 4 | 5 |

| | *Generic* | *Specific* | *It makes no difference* |
|---|---|---|---|
| ***30. Which type of integrated prompt best keeps you engaged in completing the flip experience?*** | *1* | *2* | *3* |
| ***31. Which type of integrated prompt best helps you to <u>understand</u> the content?*** | *1* | *2* | *3* |

## Post-Viewing Quiz

*You take a post-viewing quiz to demonstrate your learning from the previous flipped experience. Please reflect on your experience with the post-viewing quiz as you respond to the following items.*

| | Not at all comfortable | Slightly comfortable | Moderately comfortable | Very comfortable | Extremely comfortable |
|---|---|---|---|---|---|
| **32. In general, how comfortable do you feel asking questions before the post-viewing quiz?** | 1 | 2 | 3 | 4 | 5 |
| **33. In general, after viewing the flipped material and taking Cornell notes, how confident are you in your <u>understanding</u> of the content?** | 1 | 2 | 3 | 4 | 5 |

| | *No match* | *Poor match* | *Adequate match* | *Very well matched* | *Extremely well matched* |
|---|---|---|---|---|---|
| ***34. How well do you feel the post-viewing quiz matches the content covered during the flipped experience?*** | *1* | *2* | *3* | *4* | *5* |

| | Not important | Somewhat important | Moderately important | Very important | Extremely Important |
|---|---|---|---|---|---|
| **35. The accountability of the post-viewing quiz is important for me to maintain <u>engagement</u> during the flipped experience.** | 1 | 2 | 3 | 4 | 5 |
| **36. The accountability of the post-viewing quiz is important for my <u>content understanding</u> during the flipped experience.** | 1 | 2 | 3 | 4 | 5 |

## Overall Conclusion Item

***37. If you could add or change any particular aspect of the flipped experience protocol, while still maintaining learning and accountability, what would you change and why?***

# APPENDIX F

## ACTION RESEARCH SUB-COMPONENT VS. STUDENT SURVEY ITEM

Table F1. Action research sub-component vs. student survey item

| | Survey Item Number |
|---|---|
| General Information | 1-15, 37 |
| Sub-question #1<br>Integrated prompt and engagement | 27,28 30 |
| Sub-question #2<br>Integrated prompt and content understanding | 29,31 |
| Sub-question #3<br>Flip resistance | 1-15 |
| Cornell notes – engagement | 16,18,20,22,25,26 |
| Cornell notes – content understanding | 17,19,21,23,24,26 |
| Post- viewing quiz - engagement | 35 |
| Post-viewing quiz – content understanding | 32,33,34,36 |

# APPENDIX G

## STUDENT INTERVIEW QUESTIONS

Student Interview Questions

Participation is voluntary and you can choose to not answer any questions you do not want to answer and/or you can stop at any time.

Proceeding with the interview indicates your consent to participate.

1. What is the reason for using a flipped model of learning?

2. How do you generally feel about participating in the flipped model of learning?

3. Would you rather complete a flip as homework or problem sets?
    a. Why?

4. What, if any, are some benefits of using the flipped model of learning?
    a. Probing – Why do you think that is a benefit?
    b. Probing – Based on these benefits, can you see this model working in another course?

5. What, if any, are some drawbacks to using the flipped model of learning?
    a. Probing – Is there a way you could make a change within the flipped model to mitigate the drawback?

6. Aside from the drawbacks, are there any additional barriers you see to completing the flip?

7. Do you view yourself as a self-directed learner?
    a. Probing - Can you give an example of why you feel that way?

8. When you are completing the flip, do you generally feel engaged?
    a. What makes you feel engaged?
    b. If not, is there something that could increase your engagement?

9. How effectively did the flip introduce the content or help you to comprehend the material?
    a. What changes could be made that would help your comprehension?

10. How well do you feel the flip prepared you for the post viewing quiz?
    a. Could any changes be made to better align this information?

11. Which type of integrated prompt, Generic or Specific, do you prefer?
    a. Why?

12. Why are you motivated or not motivated to complete the flip?
    a. Is there anything I could do to change your motivation?

13. How does note-taking affect your:
    a. Engagement?
    b. Content understanding?

14. Are there any portions of the process that you feel are redundant and could be removed without affecting your engagement or content understanding?

15. If you could add or change any particular aspect of the flipped experience protocol, while still maintaining learning and accountability, what would you change and why?

# APPENDIX H

## TEACHER LOG JOURNAL

Teacher Log Journal

Benefits to Students

Benefits to Teachers

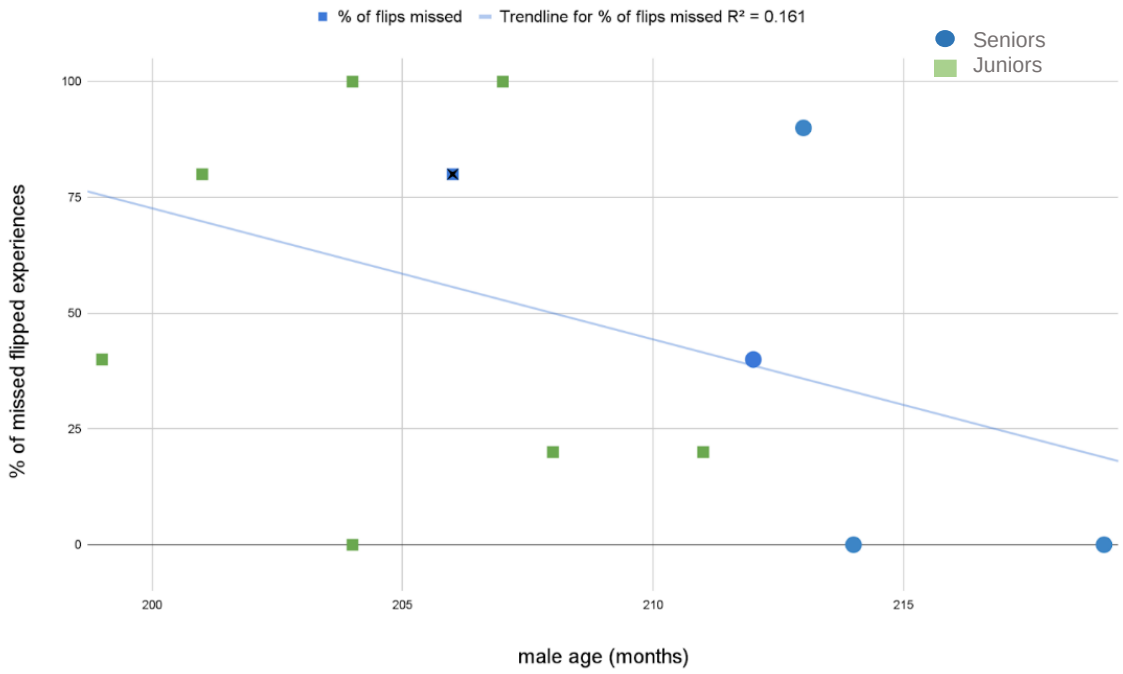
Detriments to Students

Detriments to Teachers

Thoughts/Observations/Insights

# APPENDIX I

MISSED FLIPPED EXPERIENCES WHEN COMPARED TO MALE AGE


% of flips missed
Trendline for % of flips missed R² = 0.161
Seniors
Juniors
100
75
50
25
0
% of missed flipped experiences
200
205
210
215
male age (months)