

A STUDY OF THE EFFECT THE FLIPPED CLASSROOM MODEL ON STUDENT SELF-  
EFFICACY

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**Title**

A Study of the Effect the Flipped Classroom Model on Student Self-  
Efficacy

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North Dakota State University's regulations and meets the accepted  
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**MASTER OF SCIENCE**

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## ABSTRACT

The learning model known as the flipped classroom is one of the developing ideas of educating students. Bergmann and Sams (2012) using a flipped classroom in 2007 when they recorded lecture for students to view at home and allowing students to work on “homework” in the classroom. This research was conducted to identify the effect of the flipped classroom on student self-efficacy and the difference in self-efficacy between genders using this model. This study was conducted with 22 physics students in two classes, a traditional and a flipped classroom. The student’s self-efficacy was scored with the Self-Efficacy Survey. The results showed an increase in their average self-efficacy score with the flipped classroom while the traditional classroom decreased their average score. When analyzed separately, the males showed a decrease in self-efficacy while the females showed an increase while using the flipped classroom.

## ACKNOWLEDGEMENTS

I would like to firstly show my gratitude to my advisor, Dr. Anita Welch, without whom, this thesis would not have been possible. Thank you for all of your help and guidance throughout these years. It is a pleasure to thank my colleagues and administration for their support. This thesis would not have been possible without the advice and guidance of my advisory committee. Thank you for opening the door for new ideas and guiding the direction of this thesis. Without all of you this would not have been accomplished.

## DEDICATION

I would like to dedicate this work to my children, Harlee Julianna and Kaelen Michael. You have been my biggest drive and my greatest distraction in completing my Master's work. I would also like to make a special dedication to my wife, Jennifer. You have been my rock and I know I could not have completed this work without your continued and endless support.

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## INTRODUCTION

### Significance

Teaching techniques have evolved through the past decades to change the way students learn new material. The learning model known as the flipped classroom is one of the developing thoughts in education. In the flipped classroom, students are given initial information outside of the classroom and use class time to build their knowledge base (Bergmann and Sams, 2012).

The widely accepted constructivist theorists Bruner (1966) and Piaget (1970) would say that in a flipped classroom, students construct their own learning by doing problems with minimal initial help from the teacher. The suggestion behind constructivism is that students build their knowledge base by learning in a similar way to that of inquiry where students acquire new information through experience and not from lecture (Lotter, Marshall, Sirbu, & Smart, 2011; Rusche & Jason, 2011). In this way, high school science classrooms such as physics or biology incorporate labs without a definitive outcome or specified results. Both of these are student-centered approaches to education, and they are different from the direct lecture that comes from teacher-centered instruction.

Whether an educator uses traditional lecture where the teacher is the authority figure or more modern, student-centered methods of teaching, they should have a desire to make their students lifelong learners with good critical thinking skills such as analyzing problems and using previously learned material to problem solve. A teacher might have great success with reaching students using traditional means of education. There is a possibility that a place exists for direct instruction or lecture in some classes or activities such as in mathematics or safety procedures in labs. Students enjoy some of the aspects of the flipped classroom but have shown frustration without the direct instruction from the teacher (Levy, Dickerson, & Teague, 2011). By giving

the students freedom to learn at their own pace and allowing lectures to be viewed by the single student and not the entire class, the flipped classroom uses direct lecture instruction to encompass both the teacher-centered and student-centered electronic approaches to education at the same time.

Although traditional classrooms are still dominant, the National Science Foundation urges teachers to begin using a “mix of diverse content via the combined technological capabilities of the Internet, high performance computing, advanced networking, in-home electronics, and mobile communications” (Flumerfelt & Green, 2013, p. 356). These technology initiatives suggested by the NSF are needed due to the lack of students choosing career fields in science, technology, engineering , and mathematics (STEM) with women under-represented in these fields (Louis & Mistele, 2012).

#### Statement of Problem

The modern classroom is beginning to see a change in how students learn. With the advancement of online technology, teachers have begun using more novel approaches to reach students. Instructors use many different ways of introducing new material that include didactic lecture, inquiry-based learning, and problem-based constructivism. The use of the flipped classroom model is one of the ways teachers begin bringing more technology into the students’ learning environment and support a self-directed learner. The idea of using the flipped classroom model is that it changes the environment for initial introduction of new material. There are many different theories in implementing the flipped classroom that have arisen in the past few years, and one of these identified by Bergmann and Sams (2012), known as the flipped mastery model, will be evaluated to identify if it can increase student self-efficacy.

## Research Questions

- What is the effect of a flipped classroom model on student self-efficacy as measured by the Self-Efficacy Scale?
- What is the difference in self-efficacy between genders when using the flipped classroom model?

## NEED OF RESEARCH

Although research has shown the flipped classroom model is a promising tool in the field of education, there is little research providing statistical evidence as to the effect a flipped classrooms has on self-efficacy in the high school setting (Bergmann & Sams, 2012; Brame, 2012; Fulton, 2012; Lage, Platt, & Treglia, 2000; Nolan & Washington, 2013). Milman (2012), however, documented many anecdotal cases of teacher approval in using a flipped classroom model. Others have shown that there is little to no impact on student self-efficacy while using the flipped classroom model. While student achievement might increase anecdotally, students have also identified having a positive attitude towards their learning with a flipped classroom model and make them lifelong learners (Bergmann & Sams, 2012). More research needs to be done to identify if there is a link between student self-efficacy and learning in the flipped classroom.

## REVIEW OF LITERATURE

### Overview

Teachers have taught students for generations by the use of traditional lecture in the classroom and having students take work problems home. The thought behind this type of teaching is that the teacher give the student their first exposure to material in the classroom and then students work on a piece of homework to solidify their new information onto paper (Brame, 2012). If students had questions about the homework, they would bring the work to the teacher the following day and have a break in their acquisition of new material without completing the homework. A teacher would then review the lecture from the previous day and cover any questions over the homework during this review. Teachers have taught in this manner with great student success if the teachers can really reach the students. However, there are many drawbacks to this style of teaching (Kirschner, Sweller, & Clark, 2006).

Teachers have moved away from traditional methods of educating because students have changed from the passive students of previous generations. Modern students are busy and can be found missing a large portion of classroom seat time due to activities. Didactic styles of teaching lecture have been shown to be outdated (Ash, 2012). Revealing information about modern student learning styles has been brought to the frontline of education (Brame, 2012). Direct instruction versions of the classroom have relied on passive students as opposed to students that construct their own learning by trial and error (Brame, 2012). Learning of material does not show that students have retained the material or gained critical thinking skills needed in the collegiate environment or workforce. Students have been forced to just listen to lecture and absorb the information through notes and it has been shown that this style of teaching is ineffective, inefficient, and irrelevant to the students of present times (Brunsell & Horejsi,

2013b). Teachers that lecture show only that they are the expert on subject matter and not a facilitator of learning (Gilmartin & Moore, 2010). Techniques have come to the forefront grounded in traditional educational theories that have shown promise in increasing student learning.

### Overview of Flipped Classroom

Students use technology every day in many different ways, and teachers have been using this to their advantage for many years in many classes. The flipped classroom, or the inverted classroom as it was called in the late 1990s and early 2000s, moved what was traditionally done in the classroom to being done at home and the work done at home moved into the classroom (Lage et al., 2000). Technology is not required, however, as teachers have assigned introductory textbook reading for many years before modern technological advances.

The use of technology in the flipped classroom approach has been “used for years in some disciplines, notably within the humanities” (Brame, 2012, p. 1). College level courses at Harvard, MIT and Stanford have used this teaching model frequently over the years with documented success (Bull, Ferster, & Kjellstrom, 2012). The idea is that students have first contact of new material outside of the classroom and then incorporate that material into classroom activities the following day. In 2007, Bergmann and Sams (2012) began recording their lectures for students to use when absent which prompted great success implementing and expanding the idea of flipping the classroom. This approach was not a new concept as teachers have assigned reading homework to be completed before covering the material during the follow day’s lecture (Springen, 2013). The acquisition of new knowledge can be through an online video of the teacher’s lecture over the material, researching of a topic through classroom

approved websites, or simply as reading the material in advance (Brame, 2012). The flipped or inverted part of that model is when students used classroom time to enhance what they had initially learned at home by completing worksheets, doing lab activities, participating in debates, or engaging in other projects that involve higher level thinking. There have been no single correct ways of flipping the classroom (Bull et al., 2012). The process could have been differentiated to engage all students at different levels of mastery learning with some students being given more free time to work if needed (Ash, 2012). Students would watch the videos on their own and advance through a series of activities to show that they understood the material at their own pace. The flipped classroom model has been anecdotally shown to increase both goal setting and time management (Bergmann & Sams, 2012). This educational model had also been shown to meet the needs of many different learning styles (Marlowe, 2012).

The use of flipped classroom moved the didactic, direct instruction lecture away from the classroom and into a more student-friendly environment of electronic technology. The main pedagogical concept did not change with the use of the flipped classroom but instead changed passive listening and learning to active participation of students in the classroom (Nolan & Washington, 2013). The use of videos made by the classroom teacher was not even necessary due to videos easily found on internet sites such as Khan Academy, YouTube, or Ted (Tucker, 2012). Students could have possessed a technology device that they use to access the internet. Some schools have been experimenting with BYOD (bring your own device) structure with students (Schachter, 2012). Students that have their own laptop, tablet, smartphone, or other device would be allowed to bring those devices to class to enhance their learning in a BYOD school. With the increase in technology options for the classroom, the flipped classroom is one way of incorporating new ideas in schools and classrooms. Educators can form their own

technology experience and meld it with the students' to possibly increase learning and achievement. The flipped classroom changes how teachers and students view education.

A teacher debating to flip or not does not need to make the decision of all or nothing. There are many ways of completely or partially flipping the classroom with no single way being better than another that is yet proven (Nolan & Washington, 2013). If the teacher desires to increase technology usage in the classroom, the use of videos is the important part of flipping the classroom. Flipping the classroom has been at the intersection of novel approach to teaching and learning and emergent technology (Bull et al., 2012).

### Support for Flipped Classroom

Educators that have implemented the use of the flipped classroom have reported positive results in their classrooms. Students are more engaged in their own learning by collaborative problem solving with the teacher and the other students (Electronic Education Report [EER], 2011). Students began taking ownership of their own learning and teachers began to talk with students and not to the students (EER, 2011). Students received immediate feedback on material from their teacher instead of attempting the work at home and failing to complete the work due to missed information. The reduction of face-to-face didactic learning forces students to research and learn by other means such as collaborative work or peer instruction in the classroom (Gilmartin & Moore, 2010). At home, students are able to pause and rewind the lecture to go back, find unknown answers, and review confusing information (Bergmann & Sams, 2012). Bergmann and Sams discussed multiple reasons that outlined the benefits of using the flipped classroom model (2012). Some of their reasons to this benefit were flexibility, individual attention, and changes in classroom management (Nolan & Washington, 2013). The educational



method also allowed for transparency in the education of students (Bergmann & Sams, 2012). Parents and administrators could also view the material to follow the path of the students' education. Despite all of the documented benefits to using the flipped classroom model, some teachers noted some drawbacks to using this style of teaching.

### Disadvantages of Flipped Classroom

Educators found some problems with using the flipped classroom. The flipped model cannot inclusively use video for home viewing (Milman, 2012). Using traditional lecture online rather than in the classroom did nothing to shift the type of learning for students (Ash, 2011). Brunsell and Horejsi, (2013a) emphasized an increase in active and engaging learning experiences along with the online videos was a more complete classroom flip than just showing online videos. A student that showed apathy in the classroom before flipping would continue to be apathetic after the flip even when given them more freedom in the educational model (Springen, 2013). If students did not have access to internet for viewing videos online, then teachers had to identify new ways of connecting those students to the presented information. Spingen (2013) identified this as the digital divide. Students that could not afford a computer at home or did not have internet access, or a device given to them to watch videos would be left behind. Schools that wanted flipped classrooms needed to address this issue by allowing better access at school. Depending on the budget of the school district, the cost of flipping a classroom can be significant or reasonable with proper choices of technology (Lage et al., 2000). Good teachers using poor technology could still have been successful in the classroom; although, the use of technology could not make a poor teacher better (Levy et al., 2011).

## Flipped Classroom Resources

The teacher and administration possess many options in technology that can be both good and bad for their use in the flipped classroom. Schools have access to numerous platforms and online sources for flipping the classroom. One of the simplest resources that a teacher can use is YouTube to find videos that other educators have produced within specific subjects. A simple internet search showed an accumulation of materials including the Khan Academy for video presentations (Tucker, 2012). The Khan Academy is an online video library for educational use and is designed for educators. As more teachers become comfortable with the use of digital technology, the increase in educational videos will continue.

Teachers can also produce their own videos to provide a more familiar voice to the students they teach. The uses of online communities such as Blackboard, Camtasia, Coursera, Schoology, Haiku, and Moodle have also found their way into the flipped classroom with great success (Addy & Stevenson, 2012; Brame, 2012; Bull et al., 2012; Caverly & McDaniel, 2010; Dickerson et al., 2011; Fulton, 2012). These choices can help teachers of all technology levels. The choice of technology helped good teachers become better even if the technology was of poor quality. While some of the programs are overwhelming to some teachers, professional development can help a teacher that is technology deficient.

## Self-Efficacy

Teachers have known for years that when students use their own experiences in the classroom, they take ownership of their own learning and their desire to learn more about a subject because it becomes personal (Ajzen, 2005). Positive personal experiences in learning can elicit an increase in classroom performance (Ajzen, 2005). Bandura (1997) also identified this as

the student's self-view to complete the task at hand. While working on their own at their own pace, it could be argued that an increase in self-view could also increase self-efficacy.

People with higher self-efficacy set higher personal goals and have been shown to have a better commitment to accomplishing those goals (Bandura, 1989). The idea is that when a student believes they can accomplish a task, they are more academically motivated to complete the task (Clayton, Blumber, & Auld, 2010). Technology use such as calculators or computers have been shown to increase self-efficacy and showed a positive correlation to assessments and grades, as well as a negative correlation to time needed to solve problems (Joo, Bong, & Choi, 2000; Zheng, McAlack, Wilmes, Kohler-Evens, & Williamson, 2009). Hommes and Van der Molen (2012) identified that students with strong self-efficacy were not only driven to learn material but also used that newly acquired knowledge. Performance in web-based learning could be related to self-efficacy in that the more self-efficacy a student possesses, the better they do in these types of classes (Wang & Wu, 2008).

### Self-Efficacy and Learning

Students who believe in their abilities in the classroom (i.e. high self-efficacy) are able to rely on their own learning abilities when educational challenges are presented to them (Bandura, 1997). There have been numerous papers and research done on student self-efficacy and its place in the classroom (Arslan, 2013; Bandura, 1997; Louis & Mistele, 2012; Peters, 2013; Velayutham, Aldridge, & Fraser, 2012). Arslan (2013) identifies a reciprocal effect between self-efficacy and academic achievement with self-efficacy predicting achievement and achievement as a source of self-efficacy. Students that possess higher self-efficacy have also shown to perform better in math and science classes and pursue STEM fields (Peters, 2013).

## Self-Efficacy and Gender Differences

Differences in self-efficacy have been noted between genders. Attitudes towards education and specifically science were varied between the sexes (Fischer, Schult, & Hell, 2012). In 2012, Lerdpornkulrat, Koul, and Sujivorakul identified that, on average, female students in 10th, 11th, and 12th level classes showed lower self-efficacy compared to the male student in mathematics and sciences due to gender stereotype endorsements. According to Steele (1997), a stereotype threat is “a situational threat...that, in general form, can affect the members of any group about whom a negative stereotype exists” (p. 614). Even though females showed higher overall effort and class attendance, Fisher et al. (2012) showed differences in self-efficacy and beliefs about ability in math and science classes with females underestimating their own abilities. Conversely, Kiran and Sungur (2012) identified no difference in self-efficacy between genders at the middle school level. This suggests a need for a wider look at gender differences and self-efficacy.

Although there were differing results reported with self-efficacy, females reported more anxiety when it came to science classes (Desy, Peterson, & Brockman, 2011; Kiran & Sungur, 2012). Furthermore, Desy et al. (2011) reported females were less motivated in class and showed lower enjoyment in the sciences. Overall, science classes and careers were disproportionately underrepresented by females with a majority of the physical sciences dominated by males (Quinn & Lyons, 2011). Students that show higher levels of self-efficacy were more likely to pursue studies in mathematics and science related fields (Peters, 2013). If female students believe they can have greater achievement in mathematics and sciences, then the physical science fields could see an increase in female demographics. The flipped classroom could show differences in

genders due to differences in study habits between males and females with females devoting more time to academic work and showing greater academic motivation (Fischer et al., 2012). It could be possible to expect that females have greater self-efficacy in an online classroom or flipped classroom.

### Self-Efficacy and the Flipped Classroom

Teachers that implemented the flipped classroom model showed that students performed better on exams, they were better motivated, teachers were impressed by the content of work produced by students, and teachers identified a reduction in student stress levels (Marlowe, 2012). Nolan and Washington (2013) noted a “66% improvement in student behavior due to the increased time of one-on-one instruction and improved relations between the teacher and student” (p. 1). Students that displayed a positive effect from class also displayed an increase in self-efficacy (Ajzen, 2012). Many students in a flipped classroom showed an improvement in behavior and retention of material (Nolan & Washington, 2013). The flipped classroom’s use of technology and web-based learning is also showing promise with students that already show strong self-efficacy.

## METHODOLOGY

### Research Design

This was a quasi-experimental design because the sampling was not randomized and used non-equivalent groups. Students were placed into classes by the school and not randomized as a means of convenience sampling. Students wishing to be in a specific class at a specific time could be granted permission to change into their desired class. Students at this school have the opportunity to select classes based on availability, activity schedule, and other personal decisions. The classes were at two different times of the day with one being in the morning and the other at the end of the day. The difference in time would not allow the researcher to control factors for making the groups equal for sampling.

### Participants and Setting

The participants were 22 high school student enrolled in a private school in the upper Midwest. The sample was made up of 21 twelfth grade students with one eleventh grade student enrolled in physics. Students were split between two classes taught by the same teacher who is also the researcher. The sample included 13 male (59%) and 9 female (41%) students which was similar to that of the school with a total of 306 students with 51.6 % of the student body as male and 48.4% female.

The high school in which this study was conducted exhibits low ethnic diversity with less than 7% of students indicating minority status on a demographic survey. Likewise, less than 5% of students in the study indicated ethnicity. High homogeneity of students in both the school and the study could help eliminate statistical noise from outliers. Students that have similar background would have similar results.

Before signing up for physics, students needed to complete and pass specific prerequisite courses. As this class is algebra-based physics, students had to complete Algebra I, Geometry, and Algebra II. In addition to three math courses, students also had to complete one year of physical science and one year of biology. Most students had also taken chemistry and calculus.

Student electing to be in this physics class also showed high achievement levels before entering the study. Students in the comparison group had an average cumulative GPA of 3.71; the intervention group had an average cumulative GPA of 3.79.

Prior to data collection, I submitted the survey instrument, protocol form, parent/guardian permission form, and youth assent form to the North Dakota State University Institutional Review Board (IRB) for study approval (See Appendix A). Once granted, I invited the students to participate in the study and asked them to sign the assent form and have a parent/guardian sign the consent form and return both forms to me. Twenty-two students returned the forms agreeing to participate in the study while two declined to participate.

## Instrument

The Self-Efficacy Scale (Greene, Miller, Crowson, Duke, & Akey, 2004) was used for this study (See Appendix B). The Self-Efficacy Scale survey is designed to identify students' beliefs about their perceived self-efficacy of their learning and to assess their views about a traditional classroom teaching model compared to the flipped classroom. The Self-Efficacy Scale has a Cronbach  $\alpha$  reliability of .91 and had been validated with 220 high school student from a suburban high school in the Midwest (Greene et al., 2004). The survey was also validated in two other studies done by Miller, Greene, Montalvo, Ravindran, & Nicholls (1996) and Greene, & Miller (1996). Reliability was also established using factor analysis, path analysis,

and regression (Price, 2006). Price (2006) adapted the Self-Efficacy Scale survey and reworded question two and question six to reverse their value ordering. All questions contained the phrase “in this class” to focus student answers on the physics class in which they were enrolled. The answers contained a value range from 1-strongly disagree to 4-strongly agree. Total summation of score was used to determine an individual participant final score.

## Procedures

All of the vodcasts used in the intervention group’s flipped class were instructor generated. A vodcast is a video podcast that students can access for notes. The vodcasts were produced by making screenshots of the traditional PowerPoint lecture used in the traditional classroom. I produced the vodcasts to cover each section within each of the three units and included an activity for each vodcast. These vodcasts were produced and saved at Screencast-O-Matic.com with a link to each of the vodcasts posted on an online classroom called Schoology.com. The vodcasts were consistently between 10-12 minutes in length to ensure reasonable viewing time for students as suggested by Bergmann and Sams (2012). Students in the intervention group had access to this online classroom that connected the students to the unit objectives, vodcast links, and assignments. All activities and assignments were linked to North Dakota state science standards. Students studied rotational dynamics, rotational kinematics, and fluids with each subject being a unit (See Table 1). The researcher used a coin flip to determine which class to use as the intervention, and as a result, the morning class became the comparison group and the afternoon class became the intervention group. Students in the afternoon Physics class began working through each of three units using the flipped classroom model of teaching. Students in the morning class continued their education through traditional means.



**Table 1.** Timeline of Study, Data Collected and Units Taught

August 22, 2013	School began – all students in traditional classroom	Math concepts, kinematics of motion, Newton’s laws and forces, dynamics of circular motion, work and energy theorem, impulse and momentum
December 13, 2013	Pre-intervention Self-Efficacy Survey administered	
January 2, 2014	Afternoon physics class began Flipped Classroom	Rotational kinematics, rotational dynamics, and fluids
March 7, 2014	Post-intervention Self-Efficacy Survey administered	

The comparison group ( $N = 11$ , 64% male; 36% female) was in the morning and was taught as a traditional classroom with lecture and demonstrations that have been shown to students over many years of teaching. Their homework was assigned after lecture, at the end of class time and completed at home on their own time. The timeframe for this study was ten weeks. The students had formative assessments during their lecture to complete and direct their learning pace and, in addition, they had a summative assessment at the end of each unit over the 10 weeks with each subject being a unit.

The intervention group ( $N = 11$ , 55% male; 45% female) was in the afternoon and received a list of lessons, homework and activities at the beginning of each unit that needed to be completed in the given time frame for each lesson. The lessons were vodcasts of each section lecture and were accessed at Schoology.com which is an online classroom management system. The activities, labs, and homework were done in class at their own pace. This model of the flipped classroom was described as the flipped mastery model by Bergmann and Sams (2012).

Their assignments were completed during class time and their only homework was to view lecture and review the section before each activity. Students needed to view the lessons and complete a specific notes worksheet (See Appendix C) to show that they had watched the lesson on their own time. Once they returned the vodcast notes worksheet, the students received the activity or assignment that corresponded to the vodcast. These were to be completed in the classroom during the period. Students that had questions discussed them with the teacher as an individual, in small groups, or through peer work. Their activities were identical to the activities of the comparison group but were done in smaller group settings. The same summative assessments were given to the experimental group to conclude each of their three units of learning. These units were the same as the comparison group. After the ten weeks of units concluded, both groups were given the post-intervention survey to identify the students' view on their perceived self-efficacy while learning in their respective teaching models.

## DATA COLLECTION AND ANALYSIS

Students were given the Self-Efficacy Survey after 18 weeks of traditional classroom work. This pre-intervention survey was administered to both classes before flipping one of them, and determined initial information about how well students perceived their ability in the classroom.

After ten weeks of intervention, all students were given the post-intervention Self-Efficacy Survey. The surveys were compared to the pre-intervention surveys to identify if there was a change in self-efficacy and, if so, the extent of change.

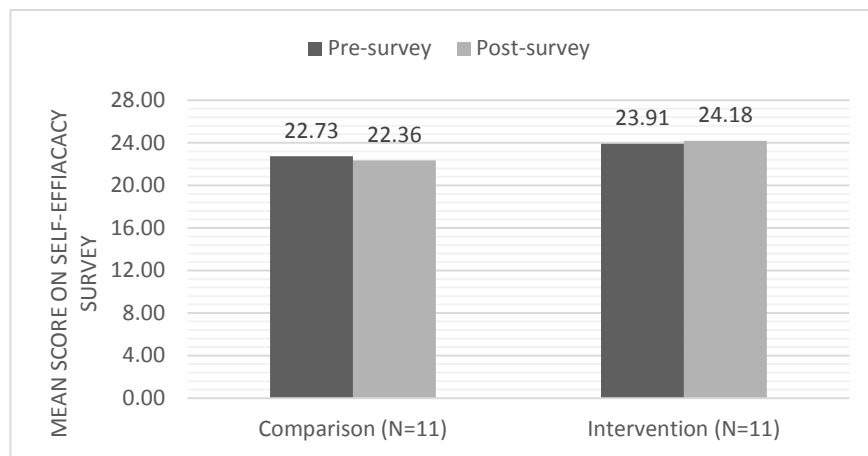
### Analysis

Analysis of data had been completed using IBM® SPSS® Statistics version 21, as this was the latest version that is readily available at the university. Question two and question six were reverse coded to align in the positive direction due to Price rewording these from original survey. Data was analyzed using descriptive statistics by comparing the differences of means.

The researcher calculated the effect size (Cohen's  $d$ ) to identify the magnitude of the difference between self-efficacy of the intervention group and the comparison group without identifying significance. Statistical significance is dependent on larger sample sizes in order to show small effects being significant. Conversely, small sample sizes with no significance would have shown some effect. Due to the small sample size of this study, statistical significance may not have shown accurate statistical effects. Cohen's  $d$  was calculated by dividing the mean difference of the two groups by the standard deviation of the control group.

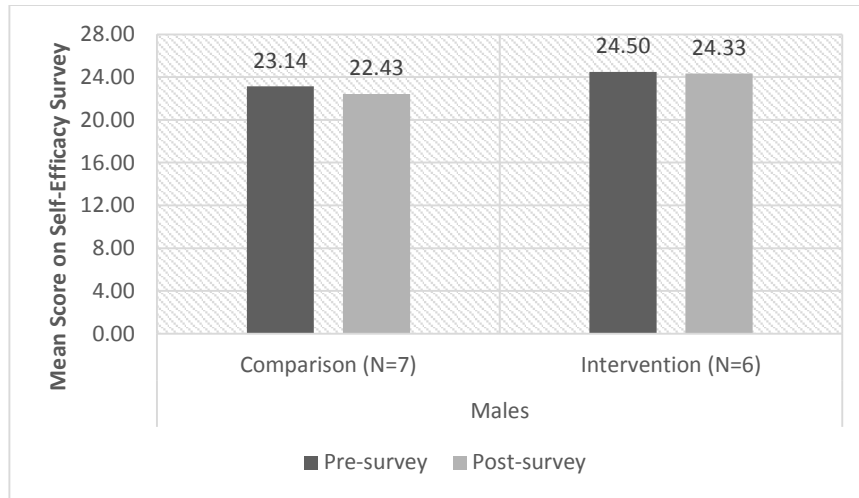
## Results

The mean score on the pre-intervention survey were compared to the post-intervention surveys. All students took the pre-intervention survey before the new semester started. The comparison group had a pre-intervention mean score of 22.73 and a post-intervention mean score of 22.36 with a mean difference of -0.37 (see Figure 1). The intervention group had a pre-intervention mean score of 23.91 and a post-intervention score of 24.18 with a mean difference of 0.27(see Figure1). The standardized effect size,  $d$ , was .54 indicating a medium effect.



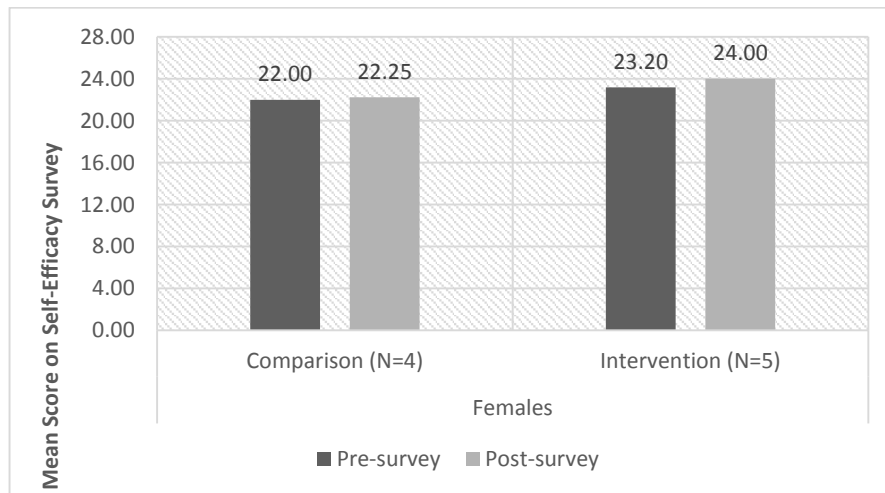
**Figure 1.** Comparison of Mean Scores on Self-Efficacy Survey

When isolating gender of each group, the mean score of the males in the comparison group had a pre-intervention score of 23.14 and a post-intervention mean score of 22.43 with a mean difference of -0.71 (see Figure 2). The mean score of the males in the intervention group had a pre-intervention score of 24.50 and a post-intervention mean score of 24.33 with a mean difference of -0.17 (see Figure 2). The standardized effect size index,  $d$ , was .61 indicating a medium effect.



**Figure 2.** Comparison of Male Mean Scores on Self-Efficacy Survey

The mean score of females in the comparison group had a pre-intervention score of 22.00 and a post-intervention score of 22.25 with a mean difference of 0.25 (see Figure 3). The mean score of females in the intervention group had a pre-intervention score of 23.20 and a post-intervention score of 24.00 with a mean difference of 0.80 (see Figure 3). The standardized effect size index,  $d$ , was .41 indicating a small effect.



**Figure 3.** Comparison of Female Mean Scores on Self-Efficacy Survey

## SUMMARY AND CONCLUSIONS

When looking at the difference in self-efficacy before and after the intervention, students in the intervention group indicated an increase in self-efficacy while the students in the comparison group identified a decrease in self-efficacy. The effect size of the flipped classroom on student self-efficacy when comparing the post-intervention scores showed to have been a medium effect. The flipped classroom focused on initial learning through online vodcasts. The academic lecture was directed towards individual student learning and not the whole class lecture to which these students were accustomed. The use of the flipped classroom decreased class question and answer time in such a way that students who would regularly engage in asking questions would no longer inquire in front of the whole class. These students would write down their questions while viewing the vodcast and I would answer them on the note sheet or talk with them individually.

Males identified a decrease in both the comparison group and the intervention group. The self-efficacy of the comparison group decreased greater than the intervention group. Students that have been taught by traditional means for a majority of their school years may have shown some reluctance to the flipped classroom. The effect size of the flipped classroom when comparing the post-intervention mean scores showed to have been a medium effect. Students may have also found this to be a novelty of a new educational tool and may not have taken it seriously. As these students were given more freedom in their class structure, it may have been harder to stay on task with the class.

Both the intervention group and comparison group of females indicated an increase in self-efficacy. The difference in mean scores before and after the study showed a greater mean difference in the intervention group. The effect size of the flipped classroom when comparing

the post-intervention mean scores show to have been a small effect. This could be due to the small number of female students in these classes. With only five females reporting, any decrease in self-efficacy would yield a large statistical decrease in effect size. Though both the intervention and comparison groups increased their self-efficacy, the female intervention group raised their value more than the male intervention group. It should also be noted that all of the female mean scores are lower than the males (see Figure 2 & Figure 3). This could be due to the previously mentioned stereotype threat identified by Steele (1997).

## LIMITATIONS

Physics students in this study have shown high academic drive by simply electing to take a high level science class. As previously mentioned, the cumulative GPA for students entering the study was relatively high at 3.75. Students discussed their desire to take physics with the teacher at the end of the previous year and were informed of the academic rigor of this class before they signed up for it and all expressed confidence to do well in the course. Students that chose to take this class opted to be challenged.

All students had equal access to technology at the school with multiple computers in the resource room and access to laptops for individual checkout. Student access at home may have been different depending on household income and individual technology uses. Differences in technology access and usage could have led to varying outcomes. Students at this high school have had very little exposure to a flipped classroom with integrated web-based technology. This physics class is the first class at the school to participate in a flipped classroom in that all lecture and notes came from internet vodcasts.

All students were taught by the same teacher and there is only one physics teacher at the school. The teacher is a male and this can lead to gender bias in the classroom. Potvin, Hazari, Tai, & Sadler (2009) identified a bias of all students towards better performance in science classes with male teachers. The teacher had taught the physics class for nine years previous to the study. This is the first class the teacher had flipped.

The sample size was small with only 22 participants divided as 9 female and 13 male students. With a small sample size of 22, statistical significance would have been difficult to achieve as the effect size was medium as shown by Cohen's  $d$  of .54. This medium effect size



showed that an effect is present for a portion of the class; although, small increases or decreases in results would show large changes in effect size.

## SCOPE FOR FURTHER RESEARCH

It is suggested that further research on the use of the flipped classroom should be conducted on a larger sample with sample sizes of 30 or more showing more statistical confidence. The effect size and statistical significance can change distinctly with an increase in sample size. A continued suggestion would be an extension of time during the intervention and implementation of the flipped classroom. The classes showed a decrease in self-efficacy during the short time and this may have been from the novelty of the education method. An increase in time from 10 weeks to 18 or 36 weeks would possibly show some benefit. The flipped classroom intervention could also begin at the start of the year to decrease student bias towards the traditional classroom model.

Studies should also be extended beyond the high school setting to incorporate middle school and college level classes. The flipped classroom has been used at the university level for many years (Bull et al., 2012). Comparing the flipped classroom at a specific level could identify the proper grade for the introduction of technology in the classroom for optimal benefit of self-efficacy. As this study indicates, a high school senior physics student may not show an increase in self-efficacy, although the flipped classroom might increase the self-efficacy at a different level and subject. Furthermore, studies on the flipped classroom should also extend beyond the science classroom. Researchers should continue to evaluate this educational model in classes such as the humanities and civics, language arts, or history. Finally, research needs to be conducted on the specific aspects of the flipped-classroom. Identification of factors used in the flipped classroom should be reviewed for student achievement.

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## APPENDIX A. IRB APPROVAL



December 3, 2013

FederalWide Assurance FWA00002439

Dr. Anita Welch  
School of Education  
210K FLC

IRB Approval of Protocol #HE14090, "A Study of the Effect the Flipped Classroom Model has on Student Self-Efficacy"

Co-investigator(s) and research team: **Donald Kenna**

**Approval period: 12/3/13 to 12/2/14**

**Continuing Review Report Due: 11/1/14**

Research site(s): **Shanley High School**

Funding agency: **n/a**

Review Type: Expedited category # 7

IRB approval is based on original submission, with revised: protocol, recruitment script and consent (received 12/2/2013).

**Additional approval is required:**

- o prior to implementation of any proposed changes to the protocol (*Protocol Amendment Request Form*).
- o for continuation of the project beyond the approval period (*Continuing Review/Completion Report Form*). A reminder is typically sent two months prior to the expiration date; timely submission of the report is your responsibility. To avoid a lapse in approval, suspension of recruitment, and/or data collection, a report must be received, and the protocol reviewed and approved prior to the expiration date.

**A report is required for:**

- o any research-related injuries, adverse events, or other unanticipated problems involving risks to participants or others within 72 hours of known occurrence (*Report of Unanticipated Problem or Serious Adverse Event Form*).
- o any significant new findings that may affect risks to participants.
- o closure of the project (*Continuing Review/Completion Report Form*).

**Research records are subject to random or directed audits at any time to verify compliance with IRB regulations and NDSU policies.**

Thank you for cooperating with NDSU IRB procedures, and best wishes for a successful study.

Sincerely,

Kristy Shirley, CIP

Research Compliance Administrator

INSTITUTIONAL REVIEW BOARD

NDSU Dept 4000 | PO Box 6050 | Fargo ND 58108-6050 | 701.231.8995 | Fax 701.231.8098 | ndsu.edu/irb

Shipping address: Research 1, 1735 NDSU Research Park Drive, Fargo, ND 58102

NDSU is an EO/AA university.

taught using the traditional classroom model (the comparison group).

Participating students in both the experimental and control classes will be asked to complete a seven-item survey about self-efficacy at the beginning of the third quarter (before the afternoon class switches to the Flipped Classroom model) and at the end of the third quarter so that we can compare if student self-efficacy increased more in the flipped classroom as compared to the traditional classroom.

Both the comparison and intervention groups will have the same classroom grading scale. They will both receive the same types of assignments, and will work through the same material at roughly the same time. The comparison is focused not on student achievement, but on how well the students perceive their ability to learn in each type of classroom.

#### **Potential Risks and Discomforts**

The potential risks and discomforts are very low for this investigation. There is a possibility that your student may receive different grades as a result of the implementation of the flipped classroom. This cannot be identified as an increase or decrease of GPA due to your student's ability in the classroom.

#### **Potential Benefits**

Your student's GPA and self-efficacy may increase from the flipped classroom. As technology use increases in the high school setting, your student may become more focused on their intrinsic motivation for learning. The use of the flipped classroom model could increase if there is positive data to support its use at the high school level.

#### **Alternatives to Participation**

If your student is in class that has the flipped classroom implemented and chooses not to participate, they will be given the lecture during class time and homework on an individual basis. They will not receive access to the online lecture or the problems found in the online classroom. They will continue their classwork in the same manner as they have all year. If your student is in the comparison classroom (i.e. traditional), then they will continue with their education as normal.

#### **Assurance of Confidentiality**

Students will use their student ID number on their survey for identification purposes. These will be used for the comparison between students that are in the flipped classroom and the students in the traditional classroom. As the surveys are collected, the raw data sheets will be kept confidential by keeping the sheets in a locked closet. As data collection is processed, the information will be placed in a spreadsheet document and saved with authorization password encrypted. The sheets will then be destroyed with a paper shredder. Real names of students or their identification number will not be used in the final paper. Their numbers will also be used to determine their gender and identify a possible connection between gender and self-efficacy. Access to the numbers in connection to the survey and study will be kept confidential and only the primary researchers will use them. Data and records created by this project are owned by the University and the investigator. You may view information collected from your child/legal ward by making a written request to the principal investigator. You may view only information collected from your child/legal ward, and not information collected about others participating in the project.

#### **Voluntary Participation and Withdrawal From the Study**

Your child/legal ward's participation is voluntary and he/she can quit at any time. Your decision whether or not to allow your child/legal ward to participate will not affect you or your child/legal ward's grade or any other benefits to which they are otherwise entitled. If you decide to allow your child/legal ward to participate, you are free to withdraw your permission and to discontinue their participation at any time.

**Offer to Answer Questions**

You and your child/legal ward should feel free to ask questions now or at any time during the study. If you or your child/legal ward has questions about this study, you can contact Don Kenna, 701.212.2857, [don.kenna@jp2schools.org](mailto:don.kenna@jp2schools.org); or Anita Welch, 701.231.5498; [Anita.Welch@ndsu.edu](mailto:Anita.Welch@ndsu.edu) If you have questions about the rights of human research participants, or wish to report a research-related problem or injury, contact the NDSU IRB Office at (701) 231-8908 or [ndsu.irb@ndsu.edu](mailto:ndsu.irb@ndsu.edu).

**Consent Statement**

By signing this form, you are stating that you have read and understand this form and the research project, and are freely agreeing to allow your child/legal ward to be a part of this study. If there are things you do not understand about the study, please ask the researchers before you sign the form. You will be given a copy of this form to keep.

Parent/Guardian Signature	Printed Name	Date
Parent/Guardian Signature	Printed Name	Date
Relation to Participant		Name of Child/Legal Ward
Researcher obtaining permission:		
Signature	Printed Name	Date

**Institutional Review Board**  
**North Dakota State University**

**PROTOCOL #:** HE14090

**APPROVED:** 12/3/13

**EXPIRES:** 12/2/14

NDSU North Dakota State University  
School of Education  
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### YOUTH ASSENT FORM

#### **A Study of the Effect the Flipped Classroom Model has on Student Self-Efficacy**

##### **Invitation:**

- You are invited to take part in a research study to identify if the use of the flipped classroom model is beneficial to student self-efficacy.
- The study is being done by Donald Kenna and Dr. Anita Welch.

**What will the research involve?** If you agree to participate, you will be asked to take a survey on your self-efficacy in regards to the traditional classroom. At the beginning of the third quarter of this school year, one of the two physics classes will be changing from a traditional classroom to a flipped classroom. This will be the period 7 class at the end of the day. The period 2 morning class will continue with a traditional classroom. At the end of the third quarter, all participating students will take the self-efficacy survey again and the results will be analyzed and compared to the first survey.

Students in the flipped classroom, you will access classroom content online and outside of class time. Your lecture will be presented in an online video and you will be expected to complete the notes and bring them to class when you are finished viewing the videos. During the class time, you will be engaged in working out problems, labs, activities, and assessments. In a traditional classroom, these problems and activities would be done as homework and class time would be devoted to lecture and note taking.

Students participating in the traditional class, you will be asked to take the Self-Efficacy Survey before third quarter and at the end of third quarter. No other action will be required of you.

**What are any risks or benefits for me?** This research may involve some risks; it's possible you might change your GPA by either increasing or decreasing. There is no risk of physical harm or discomfort in doing this study. Some of you might not like the educational videos or you are not inclined to independently learn from online tutorials. Some of you may see your GPA decrease while working in the flipped classroom. Some of you might also feel that you are not being treated fairly when compared to the traditional classroom style of teaching. Conversely, it may be good for you to take part in this research because this may help your GPA or suit your style of learning better than the traditional classroom. Your grades may shift depending on your response to the intervention. You may be able to help others by helping the researchers identify the benefits for other schools in their use of the flipped classroom. You can feel good about helping to advance the use of technology in local, regional, and national classrooms.

##### **Do I have to take part in the research?**

- Your parent(s) or legal guardian(s) have given their permission for you to be in the research, but it is still your choice whether or not to take part.

- o Even if you say yes now, you can change your mind later, and stop participating.
- o Your decision not to participate will have no effect (bad or good) on your grade in physics.
- o There are some situations where we may decide that you should leave the study; like when you are not following instructions, or if you are being harmed.
- o If you decide not to join the research, you could choose to learn by traditional means instead.

**Who will see my answers and information?**

- o We will make every effort to keep your information private; only the people helping us with the research will know your answers or see your information.
- o Your information will be combined with information from other people in the study. When we write about the study, we will write only about this combined information, and no one will be able to know what your information is.
- o If you want to look at the information we collect from you, just let us know, and we will provide it to you. But, you cannot look at information from others in the research.

**What if I have questions?**

- o You should ask any questions you have right now, before deciding whether or not to be a part of the research.
- o If you or your parent(s) or guardian(s) have questions later, contact us at: Don Kenna, 701.893.3265, [Don.Kenna@jp2schools.org](mailto:Don.Kenna@jp2schools.org); or Anita Welch, Ph.D., 701.231.5498, [Anita.Welch@ndsu.edu](mailto:Anita.Welch@ndsu.edu)
- o Your parent(s) or legal guardian will receive a copy of this form to keep.

**What are my rights?**

- o You have rights as a research participant.
- o For questions about your rights, or to tell someone else about a problem with this research, you can contact the NDSU Human Research Protection Program (HRPP) at:
  - 701-231-8908
  - Toll-free at 1-855-800-6717
  - [ndsu.irb@ndsu.edu](mailto:ndsu.irb@ndsu.edu) .
- o The HRPP is responsible to make sure that your rights and safety are protected in this research. More information is available at: [www.ndsu.edu/research/irb](http://www.ndsu.edu/research/irb).

**Institutional Review Board**  
 North Dakota State University  
 PROTOCOL #: HE14090  
 APPROVED: 12/3/13  
 EXPIRES: 12/2/14

**Sign this form only if you:**

- have understood what the research is about and why it's being done,
- have had all your questions answered,
- have talked to your parent(s)/legal guardian about this project, and
- agree to take part in this research

---

Your Signature                                  Printed Name                                  Date

---

Name of Parent(s) or Legal Guardian(s)

---

Signature                                  Printed Name                                  Date  
Researcher explaining study

**PARENT/GUARDIAN PERMISSION TO PARTICIPATE IN RESEARCH**

**A Study of the Effect the Flipped Classroom Model has on Student Self-Efficacy**

**Research Study**

Your child/legal ward is invited to participate in a research study of the effect the flipped classroom model has on student self-efficacy being conducted by Dr. Anita Welch, professor at NDSU and Donald Kenna, Graduate student at NDSU.

**Basis for Participant Selection**

Your child/legal ward has been selected because they are in a high school physics classroom. Their teacher, Donald Kenna, is working on receiving his Master's in Education. Your child/legal ward is one of 24 students being asked to participate in the study.

**Purpose of Study**

The study is being conducted to identify if there is a connection between the use of the flipped classroom model of teaching and student self-efficacy. Self-efficacy is the student's view of their ability to learn a subject. A student with high self-efficacy has been shown to do better in school.

Traditional classrooms provide lecture on new content to students during class time and sends the student out of the classroom to do homework on their own time. The flipped classroom model asks students to view lecture or acquire new content through online means on their own time before the class so that they will then have time in the classroom with the teacher present to work on other activities such as: problems, work on labs/activities, ask questions, or take assessments. This method allows students to work at their own pace. This model of teaching has been implemented in many schools around the region and nation but has not been studied to its effect on student self-efficacy not yet been studied.

A secondary research point will be based on gender, self-efficacy, and the use of the flipped classroom. It will be determined if there is a difference in male and female students when using the flipped classroom.

**Explanation of Procedures**

If your child/legal ward is in the afternoon physics class (period 7), they will be asked to participate in the flipped classroom (intervention group) for the entire third quarter. These students will be asked to view teacher produced videos in an "online classroom" in advance of class time. The videos are the classroom lecture except the student can pause, stop, and rewind as they need to complete the work. While viewing the videos, your student will need to take his/her notes and turn them in as evidence of watching the video. The teacher will look through and hand back the notes for the student to keep. Each set of lectures will be accompanied with items to work on during class time. These items could include: worksheets, problems from the book, further reading assignments, labs or activities, or possible quizzes.

If your child/legal ward is in the morning physics class (period 2), they will continue to be

**SCHOOL OF EDUCATION**

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Education Doctorate  
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Teacher Education  
135BPE Hall 3



## APPENDIX B. SELF-EFFICACY SURVEY

### What I Honestly Feel About Study Skills

Directions: These questions reflect opinions about study skills. Please indicate how much confidence you have in doing the specific behavior in this class. There are no right or wrong answers, we just want your honest opinions.

1. I am sure about my ability to do the assignments in this class.  
1. Strongly disagree      2. Somewhat disagree      3. Somewhat agree      4. Strongly agree
2. Compared to others in this class, I think I am poor at learning this material.  
1. Strongly disagree      2. Somewhat disagree      3. Somewhat agree      4. Strongly agree
3. I am certain I can understand the material presented in this class  
1. Strongly disagree      2. Somewhat disagree      3. Somewhat agree      4. Strongly agree
4. I am sure I can do as well as, or better than, other students in this class on exams.  
1. Strongly disagree      2. Somewhat disagree      3. Somewhat agree      4. Strongly agree
5. I am sure I have the ability to understand the ideas and skills taught in this course.  
1. Strongly disagree      2. Somewhat disagree      3. Somewhat agree      4. Strongly agree
6. Compared to other students in this class, my learning and study skills are weak.  
1. Strongly disagree      2. Somewhat disagree      3. Somewhat agree      4. Strongly agree
7. I am certain I can learn the ideas and skills taught in this class.  
1. Strongly disagree      2. Somewhat disagree      3. Somewhat agree      4. Strongly agree

(Price, 2006)



<b>2. Key Topics</b>	<b>1. Take your Notes</b>
	<b>3. What questions do you have about the video lecture?</b>
<b>4. Reflect + Restate</b> <i>In your own words and in complete sentences, write a 3-4 sentence summary paragraph. Your summary should cover the main concepts of the notes, be accurate, and use specific details. Use your key topics to form your summary.</i>	