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The effects of flipped learning on students in secondary education

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As schools incorporate flipped instruction into the classroom, it is important to understand the effectiveness of flipped learning and its pedagogical shift. This literature review analyzed 24 peer-reviewed empirical studies out of 30 articles that explore the effectiveness of flipped learning versus a traditional learning style on student achievement and student engagement in general and the promotion of student-centered learning activities when using a flipped learning environment in particularly. Studies selected for the review were conducted in secondary classrooms after the year 2000 with sound research methodology.

The major findings reveal that flipped learning can lead to higher student achievement and student engagement as a result of implementing student-centered teaching approaches. Recommendations for implementation of flipped learning and future research are discussed.

The Effects of Flipped Learning on Students in Secondary Education

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SECONDARY STUDENTS AND FLIPPED LEARNING

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SECONDARY STUDENTS AND FLIPPED LEARNING

Abstract

As schools incorporate flipped instruction into the classroom, it is important to understand the effectiveness of flipped learning and its pedagogical shift. This literature review analyzed 24 peer-reviewed empirical studies out of 30 articles that explore the effectiveness of flipped learning versus a traditional learning style on student achievement and student engagement in general and the promotion of student-centered learning activities when using a flipped learning environment in particularly. Studies selected for the review were conducted in secondary classrooms after the year 2000 with sound research methodology. The major findings reveal that flipped learning can lead to higher student achievement and student engagement as a result of implementing student-centered teaching approaches. Recommendations for implementation of flipped learning and future research are discussed.

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The Effects of Flipped Learning on Students in Secondary Education

When Jon started coming home with no mathematics homework, his mother started to worry. After contact with the mathematics teacher, she found out Jon's teacher was flipping the classroom. Jon no longer had mathematics problems to bring home, but instead watching videos with instruction for the next day.

Flipped learning, also known as the "flipped classroom", is a growing trend in schools. Teachers or schools that implement flipped learning may benefit from recent research conducted on its effects on student achievement. Flipped learning provides the student with either videos, vodcasts, and/or podcasts which covers the content before the student enters class the next day. What is typically considered homework, such as working out problems for a mathematics assignment, is then conducted during classroom time with the teacher, a partner, groups, and/or whole classroom discussion. The working definition of flipped learning is 'an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom' (Bishop & Verleger, 2013, n.p).

Flipped learning has been a teaching strategy at the university level since the early 1990s originating with Erik Mazur, a physics professor at Harvard University (Gillett, Moore, & Steele, 2014, p. 421). The professor incorporated flipped learning when requiring students to research articles before class the next day. Since then technology has been evolving, such as the Internet, since the origination in the 1990s, therefore teachers are able to do more with flipped learning, such as video record, audio record or upload these items into learning management systems (Ng, 2014).

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At the K-12 educational setting, Bergman and Sams (2012) started to implement flipped instruction for teaching science in high school chemistry by recording their PowerPoint slides for students who were absent from class due to school activities or illness. Because of this, they saw an opportunity to use the flipped learning environment. They then founded the Flipped Learning Network, which provides support to those who are or who are thinking about flipping their classroom. While flipping the classroom, there are four pillars in order to be effective according to Bergmann and Sams. These four pillars are flexible environment, learning culture, intentional content, and professional educator (FLN, 2014).

Schools have looked into the flipped learning environment for a variety of reasons. Administration has used this strategy for budget purposes, such as getting rid of textbooks (Fulton, 2012a). Teachers are looking at strategies to engage students and develop higher order thinking skills. As more and more elementary and secondary schools are integrating one-to-one environments, in which students have access to technology at their fingertips at all times, teachers are looking for what is best for their kids. Students like the blended learning environment as it allows them to manage their own learning (Akbayin & Yapici, 2012a). Therefore, this review examines what research is available on the effects of student learning in a flipped learning environment in general, as well as in the secondary classroom in particular to generate the researched based evidence as a reference.

This review will address the following questions:

1. How does the flipped learning environment promote student-centered learning?
2. What are the effects of flipped learning on student achievement?
3. What are the effects of flipped learning on student engagement?

This review may be beneficial to educators and ultimately students. The results may help teachers determine what is best in their own classrooms. This review may also provide evidence of the effectiveness of flipped learning before implementing it in the classroom.

For the purpose of this review, flipped instruction is defined as a combination of interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom (Bishop & Verlege, 2013). Direct instruction is any instruction in which students learn new content led by a person in the form of, but not limited to, lecture, presentation, and discussion boards. The interactive group learning activities inside the classroom include classroom discussions, investigation/inquiry problems, group work, and real world problems. According to Webster's dictionary, engagement is defined as the act of sharing in the activities of a group ("Engagement", n.d.). For the purpose of this review, engagement is student participation and motivation. Student achievement is defined by Webster's dictionary as the act of achieving or successfully performing ("Achievement", n.d.). For the purpose of this review, this same definition will be used. Therefore, in analyzing flipped learning, this review of the literature will investigate student achievement and engagement as a result of learning in a flipped learning environment.

Methodology

Finding reliable research on flipped learning was initially challenging to the researcher. The researcher went through an iterative process for the searching. The first database used was Education Resources Information Center, ERIC, with the descriptor *flipped classrooms*. This database was used because the topic was educational. This resulted

with only one article for the first search. The ERIC thesaurus produced other terms that were beneficial to locating other articles related to the topic. The second search was conducted by using other descriptors, such as *inverted classrooms, blended learning environment, flipped instruction, student motivation, student achievement, and student engagement,* which generated hundreds of articles, however, these articles still had to meet additional criteria. Therefore three articles were selected.

After locating three articles from the ERIC database, the researcher used the University of Northern Iowa's OneSearch for the third search. This resource located articles from a number of databases, such as ERIC, Google Scholar, and EBSCO, which is why the researcher used this source. Once 15 articles were found to be useful, the researcher used the snowball method to locate other articles that were related to the topic. The snowball method of research involves using the reference list from one article, which leads to other articles. Another process in the snowball method is to search citations for the original article by using Google Scholar. These citations can lead to other articles that are related to the topic.

In order to expand the search results, besides looking for articles directly related to student achievement and/or engagement, the researcher looked for articles pertaining to student-centered classroom activities. The descriptors were *student-centered learning activities, real world activities,* and *problem based tasks.* While using the descriptors, the researcher used the Boolean Search method to also include flipped learning. This resulted with eight additional articles.

Another expansion occurred after researching student-centered classroom activities. Student-centered classrooms are classes that most teachers use when flipping their own

classroom, but why. This then led into the pedagogy behind the flipped learning environment and student-centered classroom activities. The descriptors were *flipped learning, pedagogy,* and *critical thinking.* After searching with these descriptors, two articles were found that related to critical thinking and higher order thinking skills.

While searching for articles, the researcher established the criteria. The articles needed to be peer-reviewed, relevant to the research topic, and written after the year 2000. This allowed for reliable and credible sources. The researcher also sought out the originators of flipped classrooms, Bergman and Sams, within the reference page of the articles. Another criteria by the researcher was to include a variety of research design methods, such as quantitative and qualitative designs. Originally, the researcher also sought out articles that were focused in a secondary classroom. However, limiting the literature to only secondary classroom did not produce as many articles. With this, the researcher expanded this to include undergraduate courses, as well as elementary as the references for the secondary education.

Twenty-four articles were considered of quality based on meeting the criteria. After the researcher read through the articles, these articles were sorted into three different themes: student-centered learning activities, student achievement, and student engagement/motivation. Once sorted into the appropriate theme, the articles were then coded again looking for emerging subcategories.

Analysis and Discussion

Among 24 peer reviewed articles, three major themes emerge: 1) Flipped learning and the use of classroom time in regards to student-centered learning activities 2) Student

achievement while in a flipped learning environment and 3) Student engagement in terms of in and out of the classroom.

Student-Centered Learning

The first recurring theme is related to the impact of flipped instruction on student-centered learning. Teachers have generally taught using the lecture style learning. However, as technology has evolved so have the students. Teachers are now shifting "from a teaching-centered paradigm toward a learner-centered paradigm" (Roehl, Reddy, & Shannon, 2013, p. 45). Within a student-centered learning environment, teachers are the facilitators of learning, while students are exploring the content on their own to develop understanding. But what exactly is the correlation between student-centered learning and the flipped learning environment for students' critical thinking skills and collaboration?

Critical thinking skills. In a student-centered learning environment, critical thinking skills are needed for students to learn on their own. Teachers do not provide students with the answer right away, but instead ask thought provoking questions and support. This in turn helps students become more independent and self-aware of their own learning (Eisenhut & Taylor, 2015; Kong, 2014; 2015).

Kong (2014) conducted a two-year study that focused on the development of critical thinking skills and information literacy of 107 secondary students in a flipped classroom in Hong Kong High School. With the dual focus, 107 students engaged in student-centered learning activities, such as researching information to determine reliability, as well as discussing information found online throughout the 13-week trial. Students worked in groups on activities, worksheets, discussions and reflections to gain a deeper understanding of the

material. Students also completed a pre-test, mid-test, and post-test to determine significant difference regarding their critical thinking skills. The activities conducted during classroom instruction time needed to be focused and designed to engage students, as well as facilitating students in the topic area (p. 172). The video lessons are an introduction to the content, but the in class activities play a critical role in the development of student understanding. One major finding was the design of the curriculum determined the development of critical thinking skills. The activities involved included a wide range of thinking skills, as well as cross-discipline topics. Another major finding was the amount of time needed to develop critical thinking skills using the variety of activities. However, a limitation is that the curriculum and activities were designed by the researcher and not the teacher. In regards to this, teachers need training on how to develop curriculum that would align to the development of critical thinking skills.

Kong (2015) extended his original study one more year in developing critical thinking skills through Integrated Humanities knowledge (p. 18). During this extension teachers increased the difficulty level of problem based tasks. For instance, during the first year there were less questions on the activity worksheets than the third year. Another component to develop students' critical thinking skills was the implementation of varying dimensions in critical thinking skills. According to Kong, (2015) "critical thinking skills can be categorized into five major dimensions: (i) hypothesis identification... (ii) induction... (iii) deduction... (iv) explanation... and (v) evaluation" (p.17). Students worked on tasks in pairs with Google Docs, they had group discussions, and created presentation of their findings when researching. After extending the study another year, a major finding that was different than

the previous two years was the appropriate use of technology. The use of Google Docs was a motivational tool for students, as well as a means for sharing different thinking perspectives. It was also found that the use of discussions played a major role in the development of critical thinking skills. According to Kong (2015), "secondary students are strong in identifying hypothesis and deductive thinking; but comparatively weak in explaining and evaluating conclusions" (p. 28). The discussions promoted the skill development on explanation and evaluating conclusions.

The above mentioned studies only focused on students' learning. Eisenhut and Taylor (2015) filled the research gap by investigating the teacher's perspectives of using student-centered learning activities within the flipped learning environment by adopting qualitative study approaches. Three teachers were interviewed within this holistic multiple-case study. All teachers wanted their students to practice mathematical skills on their own and develop their conceptual understanding. One teacher sought out the development of critical thinking through an investigation problem. From his perspective, "'letting them wrestle was going to help them build their reasoning and critical thinking skills'" (p. 23). Even though the study did not investigate student outcomes, the major finding is that teachers foster critical thinking skills by providing students with discussions to fully conceptualize mathematical content. The results of this study did not look at the student outcomes based on discussions used and may not be tailored to every classroom that uses the flipped learning environment.

Collaboration. While developing critical thinking skills, student-centered activities also promote the use of collaboration through discussion or presentations. In a qualitative study conducted by Brown, Jacobsen, and Mazur (2015), the primary focus was on

collaborative learning, group work, and accessibility to technology. During the study, three units were implemented to five ninth grade social studies classes. Throughout the three differing units, students used at least one of the focus points. Each unit had the same structure, which was based on Friesen's Teaching Effectiveness Framework. Students would enter the class via an entrance ticket that showed their learning from the video lesson. Once in the class, students worked in groups to further understand the content. Students were able to collaborate with in class discussions and online discussions. According to Brown, et al., (2015) "Each student was assigned an individual role to encourage participation. Learning became student-centered as students worked together to build upon existing knowledge and problem-solve to find answers to questions they struggled to explain" (p. 9). Deadlines were also set on when these discussion questions needed to be complete in order to keep the class moving forward and on task. The study presented was based on the structure of Friesen's Teaching Effectiveness Framework, while other frameworks may be beneficial to investigate, such as TPACK.

Despite the teaching framework difference, Grypp and Luebeck (2015) conducted an action research study about twenty-one students in an AP calculus course by using survey data and a teacher journal. It was noted that the students did prefer a recap of the video lesson prior to starting an activity to refocus on the mathematics process covered in the video. Students emphasized the use of group work as a strong foundation for developing their understanding. The researchers found that the use of student-centered learning activities was more relevant and meaningful than homework assignments from a textbook to students (p. 192). They also found that flipped learning has the benefits of differentiated instruction. For

example, "quieter students were more actively engaged in discussions than was typical in a lecture-based class. Participation was more equally distributed among stronger and weaker students, with no indication that one person was completing the work for the entire group" (p. 190). However, the number of participants was limited to the classroom size of twenty-one highly motivated students. Another limitation was the fact that the researcher was also the classroom teacher.

To overcome the researcher being the classroom teacher, Pearson (2013b) conducted a case study in Bryon High School. The classroom teacher piloted flipped learning during his mathematics courses to 525 students throughout a three year time frame. During this time, Mr. Faulker, the classroom teacher, allowed for peer instruction during classroom time. Students were able to answer questions individually and then work in groups to defend the individual answer was correct. Not only were the students doing the mathematics, but they were also learning how to critique and collaborate with others.

In summary, the student-centered activities were promoted during the flipped learning environment. Student-centered learning was more feasible due to the time increase because of the flipped learning environment. These student-centered activities may have also had a relation to student achievement and student engagement while in the flipped learning environment.

Student Achievement

In addition to adopting student-centered learning activities, the second theme throughout the articles is the effects of flipped instruction on student achievement. Student achievement can be measured in many different ways throughout the studies. For example,

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Pearson (2013a) measured student achievement by increased proficiency rates on a state exam. Several studies measured student achievement as an increase in percentage points from a pre-test to a post-test (Akbayin &Yapici, 2012b; Chang,Hus, Liang, Shu, & Tseng, 2014; Clark, 2015; Dermirkol & Kazua, 2014; Duffield, Rasmussen, Schultz, & Wageman, 2014; Kirvan, Rakes & Zamora, 2015; Kong, 2014; Lu, Shen, & Tsai, 2015). While other studies, Choi and Heo (2014), Flumerfelt and Green (2013), Fulton (2012b), Gillett, et al., (2014) measured student achievement as students' abilities to understand the content and homework completion.

Flipped instruction and achievement perceptions. While most studies measured student achievement by adopting quantitative research methods as mentioned above, some used qualitative methods to compare students', teachers', and parents' perceptions of achievement. For example, after Gillett, Moore and Steele (2014) read the literature on flipped learning, they decided it was time to flip the mathematics classroom as their action research. Gillett introduced flipped learning in an 8th grade honors geometry class, while Moore flipped a 7th grade pre-algebra course. Both implementations of the flipped instruction by Gillett and Moore reflected positive results regarding student achievement with students completing more mathematical problems on their own and the quality of their work improved. Additionally, both Gillett and Moore noticed there was more one-on-one time with each individual student. According to Gillett (2014), "They [the students] spent less time taking notes in class and more time doing problem solving, a big reason for me to continue with the flipped classroom" (p. 423). Moore also found an increase in homework completion by 13% while implementing the flipped classroom. Likewise, Gillett's homework

completion increased by 5.4%. This study is unique since it investigated the effects of flipped instruction in multiple sites, but it found the same results.

Fulton (2012b) conducted a mixed-methods, comprehensive study about the effect of flipped instruction on student mathematics learning from the perspectives of students and parents at Byron High School. Fulton reported the qualitative results about Mr. Troy Faulkner, a pioneer for implementing flipped instruction in a high school calculus class. For example, the researcher observed that Mr. Faulkner went around checking in on students whether that is answering questions, listening, or writing down who needs more help regarding the lesson. He also found that "the feedback [daily spot quizzes at the beginning of class with results] allows for group discussion and peer instruction on the problems that many students are struggling with and helps Faulkner and his colleagues target – and revise in real time – instruction on concepts that students find difficult" (p. 13). When students were interviewed about their perceptions, one student had said, "'I like that we watched the concept at home, but then mastered the concept in class'" (p. 14). One significant result is that flipped instruction increased the mathematics mastery level from 65.6% to 73.8% on the state standardized tests within one year of the flipped classroom. Even though Mr. Faulkner used the flipped learning strategy, he was forced to use this as a means to supplement textbook materials as the budget did not allow for new textbooks.

Fulton (2012b) also included the survey data from parents in the article. The results of voluntary survey indicated that 84% of parents was their preferred choice of instruction (p. 20). Some parents were concerned that students may not be able to receive the content at home with no Internet available. One parent has no longer needed to pay for a mathematics

tutor due to the child's increasing success. Using the flipped learning approach, parents also do not have to worry about trying to help their child with homework, as the homework is now completed in class. Due to the positive impact of the flipped classroom at Byron High School, other teachers planned to adopt flipped instruction. However, this study only focused on the effects of the flipped instruction for regular students. Can flipped instruction benefit at-risk students?

Pearson (2013a) investigated the effects of flipped instruction across all subject areas for at risk students: Clintondale High School in Clinton Township, Michigan. The flipped instruction started for a social studies course, because the course pass rate was unacceptably low in the school, but later expanded to all subject areas. School administration decided to implement flipped learning in the at-risk social studies course to see if student achievement could improve. During the first trial period, all of the at-risk students passed, which caused a chain reaction in the district. The following academic year, all classes were using flipped learning. The graduating class of 2012 increased the graduation rate from 80% to 90% within one year. That same year, the 11th graders increased all core subject areas at least 6% on the Michigan Merit Exam. According to Pearson (2013a), "The amount of one-on-one time teachers spend with students has increased by a factor of four, allowing them to get to know students better, personalize learning and assessment, and improve students' skills and understanding" (Implementation Section, *para* 5). Not only are the students watching the videos to learn, but parents are as well. The community has seen a positive impact in regards to education and even increasing enrollment into the district.

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A similar finding was found in another study conducted by Flumerfelt and Green (2013) at Clintondale High School in Michigan implemented lean—an approach to create value as determined by the consumer—in the flipped classroom for at risk students. Twenty-three at-risk students in the high school government increased online engagement and homework from 75% to 100% within the flipped learning environment. This experimental pilot study was over the course of one semester.

This improvement on success rate has also been investigated in the international context. For example, Choi and Heo (2014) conducted a qualitative study in Korea for investigating flipped learning in the middle school math classroom and the correlation to voluntary video learning. Voluntary video learning is the students' responsibility to watch the videos at home versus coming into class without any prior knowledge. The correlation between the two was $r = .68$. Students seemed to be positively motivated to watch the videos and learn. When observing the correlation between the classroom and achievement, the correlation was $r = .83$. According to Choi and Heo (2014), "Such achievement analysis shows not only the importance of just watching videos in flipped learning but also voluntary enthusiastic participation of the student itself" (p. 97). It was also noted that having self-checks after the videos had a positive impact in student self-awareness to their understanding. Despite the positive attitudes shown by the middle school mathematics class, this was only a two week time frame. The school was also an all-female school, which may alter the results as well.

In sum, the achievement perception was positive not only from the regular students but also at risk students, therefore flipped instruction can be an effectively way for

differential instruction to reach all learner. Although, how is student perception related to student performance?

Flipped instruction and student performance. The effects of flipped learning and student achievement can be viewed in Table 1. Most studies about student performance were quantitative ones. Each quantitative study measured achievement in different ways. Most studies conducted a pre-test and post-test to determine significant difference in achievement. All of the studies mentioned limitations to the studies.

Table 1

Student Achievement and Flipped Learning in the Secondary Classroom

Author/year	**Sample Size**	**P value ($p < .05$)**
	Significant Difference	
Akbayin and Yapici (2012b)	107	.001
Duffield, et al., (2014)	32 Control Group 29 Treatment Group	.0049
Demirkol and Kazu (2014)	27 Control Group 27 Treatment Group	.000
Kong (2014)	107	-22.21
Lu, et al.,(2015)	50 Flipped Problem Based Learning Group 48 Problem Based Learning Group	.004
Kirvan, et al., (2015)	29 Control Group 25 Treatment Group	.011
	No Significant Difference	
Chang, et al., (2014)	65	.825
Clark, (2015)	42	.44

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The results of the table show that six studies (Akbayin & Yapici, 2012b; Dermirkol & Kazu, 2014; Duffield, et al., 2014; Kong, 2014; Lu, et al., 2015; and Kirvan, et al., 2015) had a significance difference. Of the six significant studies, only Kong (2014) did not use a treatment group versus a control group. The table also shows that Chang, et al., (2014) and Clark, (2015) did not show a significance difference. Both of these studies also did not use a treatment group versus a control group, but rather used the results from one group of students.

One study that had a significant difference was the study conducted by Akbayin and Yapici (2012b). This study was conducted as a six-week experimental design study at Diyarbakir Anatolian High School. Students in the control and treatment groups used flipped instruction, however, students in the treatment group were provided a blog, in which additional resources were provided. Students could furthermore discuss the content and ask questions among their peers on the blog page. Pre-test and post-test were given during the unit of instruction to both control and treatment groups. The results showed a significant difference on student achievement (p=.001) in a flipped learning environment versus the traditional learning environment. According to Akbayin and Yapici,, "An effective teaching can be achieved by blending the advantages of the web environment with face to face interaction in the courses which have more visual elements such as biology course" (p. 236). Although the results of this paper were very convening because of the large sample size -- 109 participants, it only presented the novelty findings in a relative short period--six weeks to a semester.

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Rather than measuring the short-term effects of the flipped instruction, Duffield, et al., (2014) conducted a two-year experimental design study at a Midwest high school where flipped learning was sought out to potentially meet the needs of all learners based on student achievement. In the first year, the control group primarily used traditional learning style. In the following year it consisted of the treatment group, flipped learning style. Participants in both groups were selected because they were a part of the Advanced Placement Chemistry class. The researchers further analyzed the data into two subcategories, gender and grade level, to see if there was a significant difference between the control group and the treatment group. On all eight chapter test throughout the course, the treatment group outperformed the control group with a significant difference p=.0049. However, the sample size is small (32/29) for the generalization. It is also noted that because the study was conducted in an Advanced Placement Chemistry class, students are highly motivated to be successful and chose to be a part of this course rather than a required course.

Similarly to Akbayin and Yapici (2012b), Demirkol and Kazu (2014) conducted another experimental design study at Diyarbakir Anatolian High School in 2010-2011 academic year, first semester biology courses for six weeks. Although the purpose of the study was the same as what in Duffield, et al., (2014), Diyarbakir high school considered flipped learning because of the technological advances. With this being said, the treatment group had a blog outside of the classroom in which students could interact via discussions. Students who did not have access to the Internet at home were allowed to use the computer lab at the school any time the school was open. After the six weeks, Demirkol and Kazu found that students within both the control and treatment groups had no significant difference

in achievement on the pre-test exam. The control group averaged 28.88% on the pre-test and 72.22% on the post-test. While the treatment group averaged 29.25% on the pre-test and 78.70% on the post-test. Both groups showed growth, but the students in the treatment group outperformed the ones in the control group. Even though both groups demonstrated success, one limitation to the study is that the tests were designed by the researchers rather than the teachers. If this were to be implemented in a classroom, teachers would need support in order to create quality tests.

In a study conducted by Kirvan, et al., (2015), Kirvan was the teacher and researcher, which was supported by the other researchers, to design quality summative assessments. During the treatment, the emphasis was on the visualization of the mathematical content. Specifically, the visualization of solving systems of linear equations was beneficial for students using a flipped learning environment. Algebra students were split into a treatment and control group based on randomization. Both groups were exposed to collaborative learning, and investigation/inquiry based problems, but the major difference was the amount of time each group spent on these variety of activities. The treatment group had approximately the whole 45 minutes class period versus the control group use of 20 minutes (p. 208). Even though both groups showed improvement using the enrichment activities, it was significant ($p = .001$) that the treatment group showed more improvement in their abilities. However, the significant improvement of the treatment group may be the result of the longer period of the student learning rather than the sole impact of the flipped instruction. The results may be different if the flipped learning environment was also conducted during multiple units rather than the one unit given to a small sample size of 25/29.

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Although Kong (2014) had focused on the critical thinking skills of students presented in the earlier section, the results of the study also revealed that the flipped learning environment had a significant difference (p = -22.21) on student achievement. Students showed an increase on their abilities to make decisions and apply critical thinking skills to applications on the pre-test (8.62 mean) to post-test (20.15 mean). Some students had generalized that the variety of activities and additional information from resources on the Internet helped to improve their understanding (p.166).

Another experimental design study that focused on the activities taught during classroom time was conducted with 98 6th grade students by Lu, et al., (2014) in Taiwan. Students in the flipped problem based learning group watched lessons at home through the use of Moodle, while the problem based learning group received guidance and instruction while at school. Both groups had to create an eBook during a 20 week unit. At the end of the unit, Lu, Shen and Tsai compared the overall scores of the unit to result in a significant difference between the two groups (p = .004). One major difference between the groups seemed that the students' ability to receive feedback immediately in class from the teacher (p. 38). However, both groups were highly motivated to create the eBook because of the novelty effects of using technology.

Despite a positive impact mentioned in the seven articles above, two articles in a list of nine research projects indicated no significant difference between the traditional approaches and flipped instruction. For example, Chang, et al., (2014) investigated the topic at the vocational school in Taiwan. Sixty-five participants were randomly placed into each type of classroom. The course being taught, electrical machinery, was a part of the electrical

engineering program, in which all of the participants were majoring. Students in the blended learning environment received face-to-face instruction two hours a week and a webpage containing additional material. Both classes were administered the same pre-test and post-test. After the unit was finished, the control group post-test mean was 34.061 and the treatment group mean was 35.092. There was no significant difference ($p = .825$) between a traditional learning and flipped learning. According to Chang, et al., (2014), "The course implemented in the study only lasted five weeks which was not enough time for students to get used to blended learning, so there was no significant difference in achievement test scores between both groups" (p. 225). At the same time, the study collected student perceptions regarding the blended learning environment and students liked the blended classroom as compared to the traditional classroom.

Similarly to Chang, et al., (2014), Clark (2015) found no significant difference ($p = .44$) as well. Within Clark's study, 42 ninth grade algebra students participated in the seven-week study. Students within the flipped learning environment not only had the instruction via the video, but also had hands-on learning activities while in class. Students were then measured on achievement based on a unit test that the teacher had created. Based on the results, students in the flipped learning environment and the non-flipped environment both had a wide range of abilities on the unit test (p. 102). However, while conducting interviews of the students, students had stated that results may have been different if they were not exposed to challenging content and a new method of learning.

Overall the flipped learning environment had a positive impact on student achievement. Not only was this type of learning style able to increase student achievement,

but also helped those at-risk students to succeed. Student achievement can also be related to the level of student engagement and motivation, but how did the flipped learning environment affect student engagement?

Student Engagement

The third recurring theme is about the impact of flipped instruction on student engagement to address the common concerns among teachers. Such questions arise such as do students actually watch the videos at home, how long should the videos be, what happens if a student does not watch the video, or how can the teacher keep the students motivated with this style of classroom. These factors play a role into the student achievement, as well as the pedagogy behind the flipped learning environment. Some comments by students about their motivation while in the flipped learning environment can be found in Table 2.

Table 2

Student Engagement Perceptions from Students

Author/Year	Subject Area	Student Perceptions
Fulton, 2012b	Mathematics	"I liked how I could rewind and pause the lectures in case I didn't understand something" (p. 14)
Akbayin & Yapici, 2012a	Science	"Face-to-face environment is necessary because coming together and talking to each other allows telling the mistakes and sharing the new ideas" (p. 134) "The high number of visual elements made it easy to keep the subject in my mind. I could ask questions when I had difficulty understanding the subject" (p. 133)
Chao, Chen, & Chaung, 2015	Engineering	"I think the sharing time at the end of the discussion was the most important part, since each group could understand the other groups' opinions. However, I think the sharing part should be longer" (p. 523)

Geiger & Muir, 2016	Mathematics	"I really prefer the videos - I think they're definitely more engaging and you actually pay attention to it. They're just more appealing to you and using today's technology - they're just really good" (p. 162) "...it is easier to understand as the teacher is working through the question with you on the video and you can follow on" (p. 164)

As shown in Table 2, students had positive comments in regards to their learning and engagement. From these comments, there were three sub-themes that emerged, group work, availability and video content.

Group work. In terms of the pedagogy behind the flipped learning environment, collaboration has played major role. When comparing five different studies (Akbayin & Yapici, 2012a; Chao, et al., 2015; Clark, 2015; Fulton, 2012a; Gillett, et al., 2014) that explored student perceptions regarding the flipped instruction, the same theme kept repeating: students felt more engaged in class during collaboration. For instance, as mentioned previously, Clark (2015) interviewed 22 students in an Algebra 1 class, and found that flipped learning increased use of group work and how it functioned to improve their participation and involvement in the classroom (p.106). Furthermore, students felt with the collaboration, they (the students) had to take on a more active role in the group work. Similarly in an anecdotal report conducted by Kettle (2013), the researcher found that students in a high school Physics class found working through problems together was more enjoyable than helping a friend out on the homework (p. 594). In a study conducted by Grypp and Luebeck (2015), the teacher also noticed more collaboration among students.

Students within this study also mentioned that the collaboration helped to maintain understanding for everyone.

Availability. Another common theme to increase engagement was the availability to students. For instance, in a qualitative study conducted by Akbayin & Yapici (2012a) in Nevzat Ayaz Anatolian High School, the researchers found students expressed their liking of being able to watch the videos on their own schedule and if necessary repeatedly. The researchers surveyed 47 students during the second semester of a biology course. As quoted from a student in the study, "'I can study for my lesson whenever I want. Thanks to the opportunity to study along and in a quiet environment, I can understand the subject better' " (p. 133). With positive views in regards to the availability and freedom of the video lessons, it was not mentioned how long the students had been exposed to the flipped learning environment.

Unlike Akbayin and Yapici (2012a), Kong (2015) conducted the study over a three-year period as mentioned in an earlier section. Students did have a positive attitude towards the videos, but also valued the availability to access the Internet to search for additional help while watching the video. The researcher stated that "The students considered these technology-supported learning activities fostered them to develop and apply domain knowledge as well as critical thinking skills according to their own needs inside and outside of the classroom" (p.28).

Similarly, Clark (2015) also found that students enjoyed the ability to watch the videos on their own time. Students within Clark's mixed methods study had access to the video content 24 hours before the next class. "...Focus group session demonstrated the

students' satisfaction of having more one-one-one time with teacher during the flipped model of instruction intervention" (p.106). The teacher was available to help students solidify the content that was covered within the video. This allowed for the teacher to speak to every student within the classroom. However, students did mention during interviews that the time frame of the study needed to be more than one unit as the content was also challenging to learn in a new environment.

Geiger and Muir (2016) also conducted interviews of students who experienced a flipped learning environment in a high school mathematics class and had a similar finding. These interviews however, were conducted in groups of three students. Along with the interviews, 27 sophomores completed surveys, while 6 of these students completed an in-depth interview. Just like Clark (2015), the researchers found that students enjoyed learning the content via video lessons. Only 13% of the students found the videos boring as a mode of instruction. However, 100% of the students stated that they thought they understood the work better in class because they watched the tutorial before class (p. 159). In terms of availability, students' comments were positive. According to one student, "'Sometimes the teacher is busy with other students so you can watch it while you are waiting and it might help you understand better'" (p. 165). Having this self-paced course and availability of the teacher when needed, helped to develop student autonomy as well. Even though students like the ability to watch the videos at their own pace, how can teachers make sure the students will watch the videos?

Video content. The video content plays an important role for student engagement. According to Bergmann and Sams (2012), it is best to keep the videos to 15 minutes or

shorter. This means only one topic per video, because "We are teaching the YouTube generation, and they want things in bite-sized pieces" (p. 43). It was also found that the more personalization of the instructor within the video will also help engage students with the video lesson. According to Geiger and Muir (2016), the teacher within the study tried to engage students by singing a song at the start of the video to keep students engaged, which will be discussed further on (p. 164).

Having engaging videos is an imperative aspect of making sure students are fully watching the videos. This has been shown in a quasi-experimental mixed-methods research study conducted in Taiwan with high school engineering students by Chao,et al., (2015). During this study, 91 students participated in the study, in which 45 students were a part of the experimental group. Throughout the eight week study, the experimental group was exposed to discussions and group work while the control group had a traditional lecture style with activities to be completed at home on their own. The researchers used a student's comment to show the effect of the flipped instruction found,

> Watching the video before the class could arouse our interest which is learning motivation. We could better understand the lecture or the supplementary material in class. Moreover, we knew what we were learning, and knew how to discuss when encountering some problems. (Chao, et al., 2015 p. 522).

However, this study was conducted in an eight-week time frame. Students' motivation and attitudes may have changed during a longer period of time.

Although, Grypp and Luebeck (2015) conducted a three week study and found students were not always engaged. Even though the discussions in class helped students

understand the content better, does not mean that every student watched the video before class. For instance, Grypp and Luebeck found that out of 20 students only twelve had watched all of the videos within the three week unit. All of the twenty students had watched at least three videos out of the five videos. Even though the majority of students had watched the videos, students had commented that the teacher should still provide a recap of the video (p. 191 - 192). Simply using videos cannot automatically enhance student engagement as found out by Grypp and Luebeck. As stated previously, the in class activities promote student thinking, such as discussions or real world problems (Brown, et al., 2015; Eisenhut & Taylor, 2015; Grypp & Luebeck, 2015; Kong, 2014:2015).

Comparatively, students in a qualitative study conducted by Cargile and Harkness (2015) engaged in flipped learning, but the in class time was spent on textbook problems. Students also were assigned video lectures, which were all from Khan Academy versus teacher made videos. The five participants attended different schools, but all had the requirement to watch Khan Academy. All participants had a similar experience in that the teacher did not create the videos and did not use class time for student-centered learning activities. Instead the students watched the videos at home, then in class worked on problems individually out of a textbook. One participant had stated that her engagement was not increased because of this style of learning, but she still enjoyed learning mathematics (p.25).

However, not all studies conducted showed that students enjoyed the video content. While interviewing students in a high school physics class, Kettle (2013) found that most students did not enjoy the videos and thought this was an ineffective way to learn. Despite the small sample size, these same twelve students stated that note taking was enjoyable and

an effective way to learn (p. 594). Before students watch the videos, teachers should guide students on the effective note taking strategies at home and prepare discussion questions to bring in class the following day.

In summary, students in these studies found the group work and collaboration allowed them to not only better understand the content, but also found the content to be more intriguing to their own tastes. Therefore, the sound pedagogy rather than technology has the direct, and positive impacts on student learning.

Conclusions and Recommendations

Students in the 21st century have more available resources at their fingertips in order to learn content than ever before. Educators are at a pivotal point in which to change the learning environment to meet the needs of students. One change is flipped learning, in which the direct instruction is outside of the classroom and more rigorous activities can be led inside the classroom. Therefore teachers need to adopt new teaching strategies to engage students for active learning.

Flipped Learning: Key Findings

The flipped learning environment does provide teachers with the opportunity to promote student-centered learning (Brown, et al., 2015; Eisenhut & Taylor, 2015; Grypp & Luebeck, 2015; Kong, 2014; 2015). Students are able to learn the basics through the video lessons and then able to dive deeper into the content with the student-centered learning activities (Eisenhut & Taylor, 2015; Kong, 2014; 2015). Simply using videos cannot automatically enhance student engagement as found out by Grypp and Luebeck. As stated previously, the in class student-centered learning activities promote student thinking, such as

discussions or real world problems (Brown, et al., 2015; Eisenhut & Taylor, 2015; Grypp & Luebeck, 2015; Kong, 2014:2015). Within the student-centered learning activities, teachers are able to differentiation and individualize the instruction better for each student (Ng, 2014). Using the student-centered learning activities also promotes critical thinking skills, which helps learners become self-aware of their learning (Eisenhut & Taylor, 2015; Kong, 2015; Roehl, et al., 2013).

While students are working within a student-centered learning environment, the results did show that the flipped learning environment had a positive impact on student achievement (Akbayin & Yapici, 2012b; Demirkol & Kazu, 2015; Duffield, et al., 2014; Kirvan, et al., 2015; Kong, 2014; Lu, et al.,2015). Homework completion increased, which in turn would allow for students to stay on track (Gillett, et al., 2014). Teachers were also able to provide more one-on-one time with each student to get a better idea of misconceptions (Fulton 2012b; Gillett, et al., 2014). As teachers worked individually with each student, students in turn asked more questions regarding the content (Duffield et al., 2014; Fulton, 2012b; Gillett, et al., 2014). As a result of flipped learning, more class time was available for students to fully understand the content, whether that was through questioning or activities provided.

Even though the evidence shows flipped learning increases student achievement, educators need to be prepared (Cargile & Harkness, 2015). If educators are using videos for the direct instruction, the videos need to be short, 15 minutes maximum, in order to engage students (Bergmann & Sams, 2012; Duffield, et al., 2014). Teachers also need to explore

different websites or learning management systems, which contain the content to be accessed, and determine which best suits the needs of their learners.

Once in the classroom, students need to be engaged with the new content, whether that is through hands on activities, or higher order thinking. The flipped learning environment does provide positive student engagement. According to several articles (Akbayin & Yapici, 2012a; Cargile & Harkness, 2015; Chao, et al., 2015; Clark, 2015; Geiger & Muir, 2016; Grypp & Luebeck, 2015; Kong, 2015), students enjoyed this type of learning style because of a variety of reasons. For instance, students enjoyed the differing learning activities during class time, valued the individualization of the content, and enjoyed the collaboration among peers (Chao, et al., 2015; Clark 2015; Kettle 2013).

Despite mostly positive feedback in regards to student engagement, there were some downfalls as well. Some students had struggled viewing all of the video lessons (Grypp & Luebeck, 2015; Kettle, 2013). Another downfall was the length of the video lesson, in which students had stated there was too much content to learn within the video (Bergmann & Sams, 2012; Kettle 2013). These negative experiences are the blocks to effective student achievement and student engagement, therefore the following recommendations are suggested.

Recommendations

After reviewing these articles there are many recommendations. However, these recommendations can be categorized into researchers, administration and teachers. All three of these categories play an intricate role for the research conducted on the flipped instruction.

SECONDARY STUDENTS AND FLIPPED LEARNING

Researchers. Although the studies reviewed were mostly conducted in the secondary classrooms, there is still room for more research to be conducted across the grade levels in K-12 settings. Most of the studies were conducted in the science and mathematics classrooms. The science and mathematics classrooms do provide ample opportunities to use student-centered learning activities during classroom time, but other subject areas have those same opportunities. I recommend researching for all the subject areas.

Another recommendation for future research is to conduct a study with the same students at least over one year. Teach students using the traditional style for the first half of the year and then using the flipped learning environment for the second half of the year. Not only does this use the same set of students for the full study, but also allows for multiple units to be used when conducting the quantitative analysis on student achievement. Students would also have a better perception of which method they prefer after multiple units, instead of basing their perceptions from one unit. By adopting mixed research methods, more longitudinal studies are needed to explore the long term effect of flipping instruction on student learning.

Administration. It is also my recommendation that the administration take an active role on training teachers. Some teachers may need technological help. If teachers are not trained on how to create videos, they may always use someone else's video versus making the content more meaningful to their own students. Administration also needs to make sure that teachers have the proper training on how to implement student-centered learning. Teachers need more time to prepare flipped instruction. It is important to provide teachers more learning opportunities for Professional Learning Community. As shown in the articles

reviewed, the student-centered learning environment not only engaged the students, but also engage teachers for reinforcing higher order thinking skills.

Teachers. It is also my recommendation that teachers, administrators, parents, and students discuss and train on the flipped learning environment. Students need to be trained on the expectations from them in terms of receiving the content and what is expected during classroom time. Students also need to be guided on how to effectively watch the video content and be prepared with questions before coming to class the next day. Teachers may struggle with students taking on a more active role in the learning through the student-centered learning activities, so these expectations need to be addressed ahead of time. Having students view the content at home and then working on problems in class does not show to be effective (Cargile & Harkness, 2015). Having the parents informed will also help to monitor students and make the parents aware of why the teacher is flipping the classroom.

Furthermore, teachers also need to be conscience of the video content. While making the videos, teachers need to think about how much content should go into one video and the time length of the video. Students are learning this content at home by themselves, so it may take students several times to go watch the video to truly understand the material. It has also shown that adding the teacher personality within the video has helped to engage students (Geiger & Muir, 2016).

In sum, after reviewing quantitative and qualitative data, I believe that the flipped learning environment has a positive impact on students, in regards to their independent learning abilities, achievement, and engagement. The flipped learning environment has been

shown to be favored by parents, students, and teachers. Using this method of teaching benefits the students, which is the ultimate goal of any educator.

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