STEM Teacher Efficacy in Flipped Classrooms

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Introduction

Since the evolution and subsequent large-scale use and adoption of the Internet, educators have looked for methods to integrate Internet-based resources into their curricula. One incarnation of this digital migration has been the flipped classroom instructional model. Also called the inverted classroom, flipped classrooms take information and instruction typically given didactically inside the classroom and deliver it outside the classroom environment (Lage, Platt, & Treglia, 2000). Much of the current movement towards flipping the classroom can be traced back to Alison King's (1993) paper that advocated a change from the teacher as the "sage on the stage" to being the "guide on the side (p. 30)". In this model, the teacher facilitates instruction rather than delivering content in a more direct, instructor-led manner.

Digital and Internet-based multimedia technologies have allowed educators the ability to efficiently distribute pre-recorded lectures and presentations to the students in lieu of dubbing video cassette tapes or providing video lab access to students outside of class time as documented in early studies and examples of flipped courses (Lage et al., 2000). Other Internet-based technologies such as Khan Academy, Discovery Education, and YouTube provide resources to teachers and schools who desire to use the flipped classroom instructional model or supplement teacher-made presentations for students to view asynchronously outside of class. Subsequently, teachers who have embraced – whether by choice or policy – the flipped classroom instructional model, spend a greater amount of time and resources preparing each lesson due to the need to pre-record and distribute the lecture component of the course while still saddled with the responsibility of developing materials for the in-class element (Bergmann & Sams, 2014). The addition of video lectures for asynchronous viewing may add time to the course by exceeding the instructional time that teachers and students in traditional instructional models have. This reality may be a bit disconcerting for many teachers. In a study that compared the concerns of beginning teachers to more experienced ones, teachers viewed time management and time constraints as the second highest rated concern only behind dealing with aberrant behavior from students (Melminck & Meister, 2008). This greater amount of instructional time means more content must be planned for and potentially adds greater workloads to those teachers engaged in flipped classroom learning environments.

Research has provided evidence that teacher efficacy levels are positively associated with student achievement and academic outcomes (Cantrell, Young, & Moore, 2003). Grounded in the social cognitive theoretical framework, teacher efficacy is defined as a teachers' belief in their ability to impact student outcomes (Berman et al., 1977). Within the extant literature, it is clear that along with student outcomes, teacher efficacy has strong and positive association with teachers' persistence, commitment to the profession, morale, and teaching practices (Tschannen-Moran & Hoy, 2001). Job satisfaction and persistence are significant contributing factors of STEM teacher retention – an issue of national concern with 30% leaving the profession and increasing calls for more STEM literate students (Author). Educators with higher levels of teacher efficacy are more persistent and resilient, less critical of student errors, and are better equipped to address student learning and behavioral deficits within their classrooms (Protheroe, 2008). Understanding underlying factors affecting teacher satisfaction and retention are critical areas of concern for the profession warranting the need for further research.

Teacher efficacy has broad-reaching impacts on students and the educational setting itself. Teachers who exhibit high teacher efficacy levels demonstrate greater levels of planning and organization, are more open to new ideas, and are more willing to experiment with new methods to better meet the needs of their students (Protheroe, 2008). In this study, we seek to extend prior research by investigating the impact of flipped classrooms on teacher efficacy, adding to the discourse surrounding the flipped classroom instructional model. To accomplish this task, we examined the effect that a flipped classroom instructional model had on teacher efficacy for educators in science, technology, engineering, and mathematics (STEM) subjects.

Review of the Literature

Teacher Efficacy

Teacher efficacy is defined as "the extent to which the teacher believe[s] he or she [has] the capacity to affect student performance" (Berman et al., 1977, p.137). Modern iterations of teacher efficacy are situated in social cognitive theory (SCT), and the construct has been demonstrated to be both context and subject dependent (Dellinger, Bobbett, Olivier, & Ellett, 2008; Tschannen-Moran & Hoy, 2001). Ostensibly similar to Bandura's (1977) theory of self-efficacy, where the focus lies on the outcomes for oneself, teacher efficacy differs in that it measures the belief in the ability to influence the outcomes of others (Hoy, 2000). Common to contemporary discussions of both teacher efficacy and self-efficacy are three factors affecting both constructs: experience, vicarious experience, and social persuasion (Bandura, 1977; Protheroe, 2008). Teacher efficacy is highly context dependent and subject specific (Tschannen-Moran & Hoy, 2001). Teachers may experience high levels of efficacy in a particular topic or with one group of students, but low efficacy levels with different groups or subject matter.

Although there has been recent discussion on the original basis of the theory and measurement of teacher efficacy – whether it is situated in Bandura's (1977) theory of self-efficacy or Rotter's (1966) locus of control – modern (post-1977) research and instrument development are firmly grounded in Bandura's theory of self-efficacy (Dellinger et al., 2008; Klassen, Tze, Betts, & Gordon, 2011).

Researchers have concluded that the construct of teacher efficacy is multi-dimensional and that several dimensions correspond to Bandura's self-efficacy as it relates to outcome expectancy affected by internal and external factors (Gibson & Dembo, 1984; Tschannen-Moran & Hoy, 2001). Although there is general agreement on the underlying factors of teacher efficacy, Tschannen-Moran and Hoy (2001) characterized it as "an elusive construct." In this study, we seek to qualitatively examine teacher efficacy as it relates to these factors; mastery experience (how the teachers directly experienced the flipped classroom instructional model), vicarious experience (how the teachers understood the students' perception of the model), and social persuasion (how the teachers viewed

supports within the school and other teachers' perception of the flipped classroom). Physiological factors are a component of self-efficacy (Bandura, 1997), but are not examined in this study, as they are not discussed in the extant literature related to teacher efficacy.

Flipped Classrooms

The first mention of the flipped classroom instructional model appeared in the literature in a paper titled "Inverting the classroom: A gateway to creating an inclusive learning environment" (Lage et al., 2000). This was the first research into flipping the classroom and focused on student and faculty perceptions in an introductory economics course at Miami University. Simultaneously, Wesley Baker (2000) was presenting a theoretical model, "The 'classroom flip': Using web course management tools to become the guide by the side," referencing Alison King's (1993) work. Baker's work is the start of the colloquial term "flipped classroom". Both define the flipped classroom instructional model similarly as "events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa" (Lage et al., 2000, p. 32). Both papers stress that the advent of modern communication technologies and the Internet provide a platform for educators to present lecture material to students outside of the classroom, leaving greater time for discussion facilitation and active learning.

Although scholarly research at the K-12 level is still sparse, there is a growing body of academic and empirical research into the impact of the flipped classroom instructional model on student academic performance indicators (Bishop & Verleger, 2013). The bulk of these studies have been at the university level and have been represented by convenience samples comprised of courses taught by professors studying the effect of using a flipped classroom instructional model.

To date, the effect of using the flipped classroom instructional model on teacher efficacy has not been examined. The flipped classroom instructional model does not boast a prescribed method for the teacher to follow. Variations in technology availability and understanding of the best practices for their use in the classroom have yet to be empirically studied. Similarly, teacher understanding of and comfort with this teaching method have not been featured in the extant literature. The limited body of K-12 research in these areas presents a demonstrable need for the study of a burgeoning instructional model that is growing in popularity among educators and administrators.

Methodology

Research has provided evidence that teacher efficacy acts as a mediating factor for student academic and serves as a predictor of teaching success and student achievement (Cantrell et al., 2003; Gibson & Dembo, 1984). To better understand the effect of the flipped classroom instructional model on teacher efficacy levels, we utilized qualitative methodology to gain valuable insights. Since literature provides proof that student achievement is influenced by this construct, it is important to understand the underlying motivations and perceptions of teachers utilizing the flipped classroom instructional model. We do this by applying transcendental phenomenology as an analytical method to help understand the flipped classroom instructional model within the bounds of this case study (Creswell, 2007; Creswell, 2013; Moustakas, 1994).

Participants

Participants for this case study were volunteers from a purposefully selected group of STEM educators at a local charter high school. The group was selected both for their respective school's STEM focus and a committed emphasis on flipped classrooms. The school's website states their mission "is to increase access to globally competitive Science, Technology, Engineering, and Math (STEM) education for students and teachers across North Carolina...." The school's homepage states: "Our school is built around the 'flipped' model of education, in which teachers deliver content knowledge outside of class so that students can practice, apply, and build on what they have begun to learn." It is required that all teachers employ the flipped classroom instructional model and interviewing teachers must demonstrate a flipped classroom as part of the interview process.

The school's staff directory was used to identify teachers in STEM content areas and obtain contact information. These six teachers were contacted via email. A voluntary sample of three teachers responded and agreed to participate in the study. This sample size falls within the acceptable range of three to ten participants for an exploratory case study as discussed by Creswell (2007). These teachers represented chemistry, environmental science, calculus, and engineering (technology education is not explicitly taught). Engineering is included in this study as a subject taught; however, the participating teacher who teaches both calculus and engineering does not use the flipped classroom instructional model in the engineering class, as there is no work assigned outside of class. Participating teacher demographics are displayed in Table 1 below.

Setting

A suburban North Carolina public charter high school was chosen for this study because of its focus on both STEM and flipped instructional practices. The school has been in operation for three years and had an enrollment level of 341 students serving grades 9-11 at the time of this study. The average classroom had 24 students with the following ethnic demographic breakdown: 8% Asian, 6% Hispanic, 6% other/multiracial, 26% Black, 54% White. Twenty-two percent of students qualified for the federal free or reduced lunch program.

The school places emphasis on ensuring teachers have all the needed resources available for satisfactory implementation of the flipped classrooms. This includes technological resources (hardware and software), professional development, and in-house technical staff. The school follows a bring-your-own-device (BYOD) model for student computer technology use. Students without their own devices may use loaner computers provided by the school. Students with no or limited Internet access are also provided time before, during, and after school to access online class resources.

Research Questions

The purpose of this research was to determine the effect flipped classroom instructional methods have on teacher efficacy. Flipping was a key component of the courses they taught. The research questions for the study are as follows:

1. What are STEM teachers' perceptions of flipped class rooms?
2. How do STEM teachers' perceptions and/or use of flipped classrooms affect their teacher efficacy to teach in a flipped classroom environment?

Methods

Figure 1 presents the process used for this study. This process is based on the procedures set forth by Creswell (2007; 2013) and Moustakas (1994).

Semi-structured interviews were used as the method of data collection for this study. Semi-structured interviews were deemed appropriate for this study due to their suitability for perception exploration, the ability to probe

Teacher	Gender	Education Level	Subject(s) taught	Teaching experience	Flipped classroom experience
A	Female	Master's	Chemistry	< 20 years	Two years
B	Male	Master's	Calculus and Engineering	6 years	Three years
C	Female	Master's	Environmental Science	4 years	Two years

Table 1. Participating Teacher Demographics

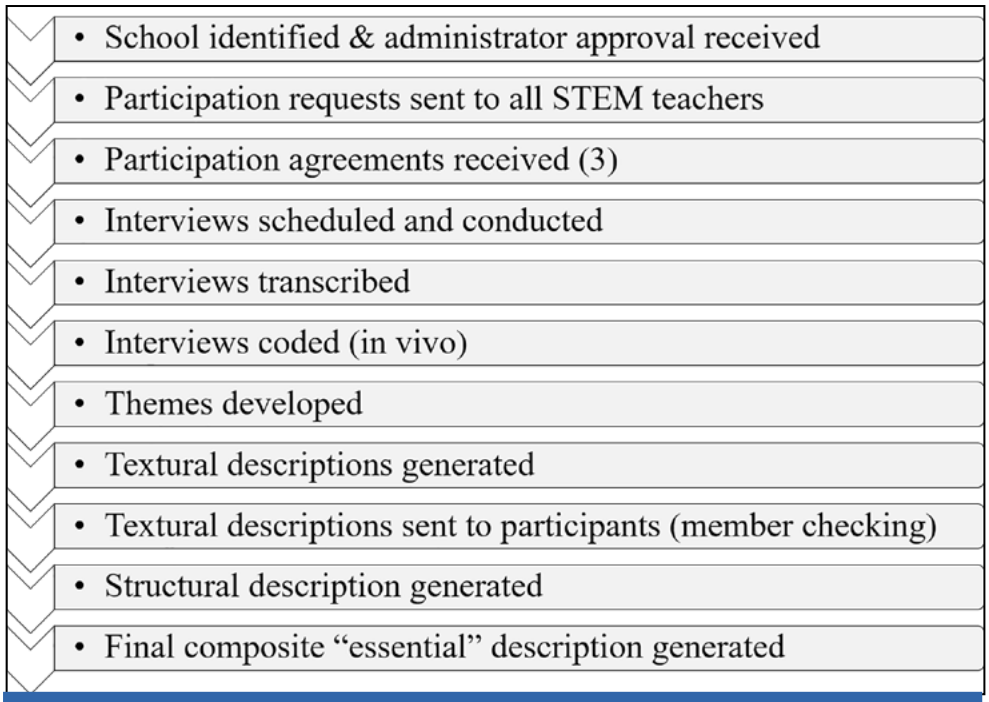

Figure 1. Data collection and analysis process used in this study.

for deeper understanding, and the varied professional experience of the participants disallowed a standardized question set (Barriball & While, 1994).

Data Gathering

Data collection for this study consisted of audio-recorded semi-structured interviews, which were then transcribed by the researcher. Semi-structured interviews were appropriate for this research study due to their ability to help gain in-depth knowledge into the perceptions of the teacher participants (de Marrais & Laplan, 2004).

Interview questions. Qualitative interview questions developed for this study were guided by the research questions framing this study. These questions are informed by the three constructs of teacher efficacy examined in this study (mastery experience, vicarious experience, and social persuasion). These questions were designed to elicit responses from the participants as to how they personally experienced the flipped classroom instructional model, how they saw other teachers use the model, and what they had been told or trained concerning flipping their classrooms. These questions were designed to be open-ended, for the participants own words were an essential component of this study (Fink, 2003). Figure 2 displays the questions developed and used as a starting point for the semi-structured interviews.

Procedure

This exploratory case study was bounded by the use of a single high school and the use of only STEM teachers using the flipped classroom instructional model. Transcendental phenomenological reduction was chosen as a method of analyzing the data collected for several reasons. The approach in this research involved studying a small number of participants, and it was deemed appropriate to study the flipped classroom instructional model as it was experienced by the participants as their perceptions were being analyzed (Creswell, 2013). Furthermore, Transcendental phenomenology considers the experience of each participant as a unique occurrence (Moustakas, 1994). Those experiences were combined and reduced to derive the "essence" of the phenomenon as experienced by the participants (Creswell, 2007; Moustakas, 1994).

Data Analysis

We coded literal words and phrases from the transcriptions of each participant that appeared to hold significance as to how the participants experienced the flipped classroom instructional model (Creswell, 2007; Moustakas, 1994; Saldaña, 2012). This step is also referred to as horizontalization (Creswell, 2007; Moustakas, 1994). These codes were then developed into three themes based on Bandura's (1995) factors affecting self-efficacy. Exemplars of participant statements and the themes into which they were coded are presented in Table 2.

Once all participant interviews were coded and themes developed, textural descriptions of how each participant experienced the flipped classroom instructional model were developed as it related to each theme. These textural descriptions were condensed into a composite textural description of how the instructional model was experienced by each participant. We then wrote a structural description of the environment in which the participants teach (Creswell, 2007; Moustakas, 1994). This included school demographic information, mission, STEM focus, and required use of the flipped classroom methods of instruction. From these composite descriptions a final composite description, or "essential description," was generated (Creswell, 2007; Moustakas, 1994). This description captures the essence of the flipped classroom instructional model as commonly experienced by the participants.

Theme Generation

Themes were determined based on the three factors affecting teacher efficacy: experience, vicarious experience, and social persuasion (Bandura, 1977; Protheroe, 2008). Codes generated from participant interview transcripts were sorted into one of these categorical themes.

Experience. Codes that related directly to the experience of the participants were categorized as experience. These included codes related to flipping the classroom,

1. How would you define a flipped classroom?
2. Does using a flipped classroom affect your teaching various subjects? How so?
3. Is additional planning required to successfully implement a flipped classroom? If so, what is that planning time used for?
4. Have you completed any professional development regarding flipped classrooms?
5. What professional development, if any, have you completed?
6. What professional development did you find the most helpful?
7. What professional development would you recommend for those implementing flipped classrooms?
8. Does the use of online lectures in a flipped classroom increase the level of student understanding of and/or engagement with the content?
9. What is your opinion of the educational value of flipped classrooms? Was your opinion different prior to teaching in a flipped environment?
10. What are the benefits of using a flipped classroom setting?
11. What are the drawbacks of using a flipped classroom?
12. Do you have all the resources needed to properly teach a flipped

Figure 2. Initial interview questions for the semi-structured interviews.

technology use, success and/or failure with the flipped format, time gained in class, and reports of student experiences.

Vicarious experience. Codes that related to the experience of the students or other educators were categorized as vicarious experience. These included codes related to student observation, perceived student understanding of material and use of flipped format, success and/or failure of other teachers with the flipped format and technology use, and perceptions of student experiences. Students were not interviewed; rather, their experiences through the lens of the teacher were considered vicarious experiences for the purposes of this study.

Social persuasion. Codes that related to professional development (both formal and informal), support and resources provided by the school and its administrators, and the atmosphere/climate of the school regarding flipped classrooms were categorized as social persuasion.

Trustworthiness

Multiple procedures – including clarifying researcher bias, bracketing, member checking, and external auditing – were used to evaluate the trustworthiness and validity of the coding and analysis of the data (Creswell, 2007). The primary researcher and author's understanding and opinion of the flipped classroom instructional model were written down and archived at the outset of the study as part of a validation strategy iterated by Creswell (2007). This clarification and articulation of the researcher's biases were written to both acknowledge their existence and to serve as a reminder during data analysis for the researcher so that prior experience and bias may not color the analysis. This understanding was used to bracket (set aside the researcher's opinions) during the data analysis component of the study.

The primary author also sent the textual descriptions for each participant's interview to them electronically and asked them to both verify that they accurately described the participants' experience of the flipped classroom and they were asked to clarify and correct any portions they felt did not represent their experiences accurately (Creswell, 2007). The participants all confirmed that the textural descriptions were an accurate representation of their experiences and no participants offered or suggested any changes.

A peer review process was used to ensure the findings of the study were supported by the data and process used for the collection and analysis of data (Creswell, 2007). The two reviewers were experienced researchers not directly connected to the study and were provided complete access to all study materials and reports. Regular meetings were conducted with the reviewers during the data collection and analysis phase. This review along with member checking and researcher bias clarification are three procedures detailed by Creswell (2007) as part of an eight-item validation strategy list where he recommends the use of at least two.

Findings

The STEM teachers interviewed for this study had high levels of observed teacher efficacy. It is important to note that teacher participants' attitudes towards flipped

Theme	Definition	Representative Quotation from the Participants
Mastery Experience	Experiences or feelings the teacher personally has or has personally observed as they relate to the teacher's activity.	"It frees up that really valuable class time to do things that I think makes them understand the material better." (Participant A) "I am spending more time walking around the room and sitting with students and working problems and going towards a deeper understanding." (Participant B) "It also allows time as teachers to be there while students are working on problems to clear up misconceptions immediately instead of them having to struggle through the bulk of a work set not knowing what to do." (Participant C)
Vicarious Experience	Experiences or feelings the teacher has been informed of directly from their students or personally observed student behaviors.	"They'll go back and rewatch it and it makes so much more sense." (Participant A) "They should have a greater opportunity to get the skills communicated, and then, when they're in class they get to practice, and if they have the blank sheet of paper effect in class then guess what, they have the whole class, their classmates are there and the teacher there to get the task done." (Participant B) "It increases student engagement while they're in the classroom because they are not having to sit still and listen, they're getting to talk with each other." (Participant C)
Social Persuasion	Experiences or feelings the teacher has been made aware of but did not directly observe and support received or not received from the school.	"Watching other people talk about flipping, what worked for them, what didn't work for them." (Participant A) "I have not [completed professional development], nothing formal. I mean, we'll have chats and talks at school during PD time but no formal training." (Participant B) "I would ask for it and it would happen our school." (Participant C)

Table 2. Developed Themes and Representative Quotations

classroom methods changed as a result of teaching in flipped classrooms. The consensus among the three participants is that flipping the classroom positively impacts their teaching and student learning.

Two fundamental questions drove this research: (a) What are STEM teachers' perceptions of flipped classrooms? and (b) How do STEM teachers' perceptions and/or use of flipped classrooms affect their teacher efficacy to teach in a flipped classroom environment? In order to address these questions, the experiences reported by the participating teachers were combined and reduced into themes based on the three factors affecting teacher efficacy: experience, vicarious experience, and social persuasion (Bandura, 1977; Protheroe, 2008).

Theme 1: Experience

Teachers in the school chosen for this study are required to flip instruction and came to the school with varying levels of experience. Although teachers may begin with some skepticism or prior failure with respect to flipping the classroom, these feelings were transformed to positive ones after successfully implementing the flipped classroom instructional model.

> "I mean, you're talking to a teacher, I was very skeptical, very skeptical. But I was so tired of not finishing content, also students are out they miss the content, now they don't miss the content. So, it's incredible." (Participant A)

Even though the teachers in this study were positive about the flipped classroom model, there were some caveats regarding how best to implement the model.

> "When I first heard about it I didn't quite get it, then when I saw okay there could be some value in it I started it with my calculus class. The reason I did it was I thinking they were mature and would actually cooperate and do the stuff and it kind of has worked that way. The change in my opinion is that at the lower levels it wouldn't be as effective because students just wouldn't watch the videos. . ." (Participant B)

There were some lessons learned that informed the participants' views and opinions on the use of the flipped classroom instructional model. These experiences, both positive and negative, contributed to the teachers' refinement of how they personally employed the flipped instructional model in their classrooms. The teacher's comfort level with the content also played a significant role in their decision-making related to the implementation of the model.

> "I tried to do my own version of flipped classroom with the cart of laptops that we had and self-directed learning. It fell flat on its face, but that was because it was math and math teaching was not my game." (Participant C)

> "[I don't flip my engineering course] mainly because most of the content in the course is collaborative, group work. Construction type projects where they're applying engineering skills to solve some problem, so it's very hands-on and I didn't feel that it made any sense at all to flip it." (Participant B)

When flipping the classroom, more class time is available for the students to work through projects and tasks and the teacher is more available for direct student interaction and assistance. This allows teachers to create a deeper understanding of the topics and concepts in the students.

> "As a science teacher it frees up class time that can be used for more hands on investigative learning. Engage in the actually scientific process." (Participant B)

Although, greater time outside of class must be devoted to video creation and editing, teachers reap the rewards from that time spent in the first year of teaching a course in having a ready-made library for subsequent years. Students are able to watch the videos, pause, and take notes at their own pace. Students are also able to review the lectures prior to taking a test and those absent from class are able to watch the lectures at home. More time is available for teachers to delve deeper into material and as a result, they can cover more topics with time to review prior to final exams.

> "They'll re-watch videos to relearn the content. It frees up that really valuable class time to do things that I think makes them understand the material better." (Participant A)

The first year of implementation presented the greatest challenge for teachers participating in this study. The time needed to prepare videos, the development of incentives for student participation, and ensuring the appropriateness of the use of the flipped model for both the course material and students was a significant obstacle that had to be overcome by the participating teachers. The establishment of a video library for use in subsequent years, was seen by the participating teachers as an important aspect to success when flipping a classroom.

> "The first year is a huge, huge tax on your time. I would say that's a major drawback especially for new teachers but I'm teaching a new subject and creating a flipped curriculum, but even teachers who have been teaching the same subject and went to the flipped curriculum, it just takes so much time to get your video library established." (Participant C)

> "My first year, so I have taught chemistry for about 20 years, and last year there were days when I was getting up at four o'clock to make the video, because I didn't have a library of videos to go to. So even though I knew the content, knew what I was going to be covering, even had some sheets that I was going to use in the class or the labs were prepared. Just making the videos were time consuming. So, the first year there is a lot, its very time consuming, but now I am reaping those benefits this year, and so I am able to make other videos this year that I wanted to make but couldn't make. But it's a lot. That first year was tough though. It was tough." (Participant A)

> "I'm spending a lot of time recording videos. This year has been a rough year, I started at a new school where everything is flipped, so I'm recording the entire pre-calculus course which I have never taught, the calculus stuff I had largely done so that was good, but its time consuming. I'm actually sitting here on my spring break, I have my pre-calc book in front of me and I'm planning recording a bunch of videos today." (Participant B)

Less class time is wasted giving the lecture, managing behavior, and repeating content for students struggling with concepts. Teachers also have a better understanding of the misconceptions held by students that may have gone unnoticed in a traditional class format. Teachers are able to sit with the students as they incorrectly answer questions and address student conceptual issues in real-time, rather than trying to determine the cause of the misconceptions post-hoc.

> "It also allows time as teachers to be there while students are working on problems to clear up misconceptions immediately instead of them having to struggle through the bulk of a work set not knowing what to do." (Participant C)

According to the participants, teachers using flipped classrooms should design their course with that inversion in mind. Additionally, they suggest that students watch the video lectures at home for the flipping the classroom model to be successful. It is incumbent on the teachers to develop consistent accountability methods to ensure the students interact with the online materials outside of class.

> "They are going to come in and it is pretty much standard routine, they do a warm up based on the night's video, and they have their notes out so they can use them to help, and then I can see. I'll say, 'Oh you know you didn't watch you video? Well, you need to watch your video, you know, go watch it now.' So it's kind of a way to keep them accountable." (Participant A)

The teachers in this study held the flipped classroom instructional model in high esteem regardless of how they felt prior to using the method. As detailed by the experience of the teachers in this study, the classroom was "revolutionized" (Participant A) by the switch from traditional lecture-based teaching to a flipped environment. Participants B and C referred to the flipped classroom as "great," while participant A reported that having that the flipped classroom instructional model was "priceless."

Theme 2: Vicarious Experience

Students who are active participants in flipped classrooms have greater opportunities to work with and talk to other students rather than sitting and listening as a passive listener. One teacher described what they called "the blank sheet of paper effect" as a regular occurrence prior to flipping the classroom. This was described as the moment when students would leave class and attempt the homework only to sit and stare at a blank piece of paper. Having the flipped lessons, if students are "in class they get to practice, and if they have the blank sheet of paper effect in class, they have the whole class, their classmates, and the teacher there to get the task done" (participant B).

Students are also able to re-watch videos if needed. In class, students can get assistance from teachers and students when faced with a task that presents a challenge or a struggle.

> "Students tell me that they re-watch videos before tests so it's almost like hearing the lecture twice or going to class twice. So, they'll re-watch videos to relearn the content." (Participant A)

As outlined by the participants, it is important that expectations for watching the videos be established as part of the course. If the teacher re-teaches a lesson because students did not watch the video at home, students are not motivated to watch the videos. Incentivizing the students to watch the videos is an important aspect as it is not repeating the video content in class because some students did not watch them at home. Student buy-in and participation are key factors for success in a flipped classroom environment.

> "I think that is what makes students that watch the videos more vigilant to watch the videos because they are going to just come in and get the lesson anyways because it didn't give them any gain. Once it got past that, I think that I'm more effective in using the tool." (Participant C)

> "The kids that do not watch videos fall behind and stay behind unless they take initiative to catch back up." (Participant C)

Some teachers perceive deficiencies in their own technological skills when creating videos. Videos created by younger, more technologically savvy teachers have higher levels of editing and effects. Yet, videos created by less experienced teachers with respect to video editing are still effective.

> "I had to learn, this did not come naturally to me. And our younger teachers, their videos are amazing, the video editing. The biology teacher, her videos are just. . . they're awesome." (Participant A)

The students buying in, being an active participant, and watching the online videos with fidelity were common themes as it relates to the experience of others. There was some concern about not being able to create "flashy" videos, but the effect on students appeared negligible as participant A described, "the students perform very well on their end of grade test," and "completed all the content and with time to review which [they] had never done before."

Theme 3: Social Persuasion

Professional development is a key component of successfully flipping the classroom. This is provided by the school through regular professional development meetings and as needed/requested by teachers. Formal training is limited with teachers relying on peer-to-peer guidance and informal discussions of experience with flipping the classroom. This was consistent among all the teachers participating in this study.

> "Watching other people talk about flipping, what worked for them, what didn't work for them, and it is kind of content specific as well." (Participant A)

Teachers are able to learn from each other, and while they may desire additional training into pedagogy and technical skills, teachers feel comfortable discussing their methods with each other. School administrators in the school chosen for this study are supportive and ensure resources are available for successfully flipping the classroom. This includes equipment, training, and software. There is an atmosphere of support among teachers and administrators surrounding flipped classrooms.

> "If I wanted anything else, I would ask for it and it would happen our school, especially if it was for video making." (Participant C)

Support from the school and discussions of the successes and frustrations of the implementation of the flipped classroom with other teachers appears to be a strong and consistent factor in the feelings and perception of teacher efficacy related to the flipped classroom. Feeling supported by school administration is not a novel concept in education and teaching, but seems to be of greater importance when a flipped model involving technology is involved. The success of the model in this school was attributed to the support received by teachers and exemplified by one teacher (Participant C) commenting that if any resources were needed, "I would ask for it and it would happen our school."

Discussion

Participants in this study perceived the use of the method to be largely positive, which was not indicative of their perceptions prior to engagement in flipped classrooms. This was in light of increased time during class to cover material and address student misconceptions in real time. Student misconceptions also became clearer to the teachers when flipping the classroom. Teacher perceptions of flipped classrooms ranged from positive to "priceless", revolutionizing their teaching.

The teachers perceived student use as a positive factor because students were able to stop and re-watch the video or sections of it. Students who were absent were able to stay abreast on content delivery, and those wishing to review lectures before exams could revisit the online videos. A concern raised centered on students neglecting to watch the videos outside of class which led to them being more likely to get, and stay, behind. Participants addressed this as a demonstrable need to incentivize students to participate actively in out-of-class activities and to provide these mechanisms from the outset of class to ensure this participation.

A common theme among all participants was time. While positive gains in classroom time spent with students and on curricula were reported, the extra time spent planning and creating online lectures was remarkable. Teachers reported that preparing for a course took more time especially in the first year of teaching the curriculum as a flipped class. Participants also reported that the time spent in the first year of a course was rewarded in subsequent years as a library of content was built. While videos covering course content is readily available online, it was the opinion of the participants that teacher-made videos are superior. It should be noted that time management and time constraints continue to be a major concern for all teachers and this is exacerbated when considering a flipped classroom environment. However, it was clear that participants for this study viewed the extra time committed as a trade-off for increased student understanding.

Implications

During the analysis of data, a recurring theme emerged that may have further implications for research in the area of teacher efficacy particularly as it pertains to flipped classrooms. Time proved to be a consistent factor in courses with flipped instruction both in time spent preparing and instructional time gained. The amount of time spent planning and creating videos for use in the flipped classroom was regularly brought up. Teachers gain more time in class by having the lecture component completed at home. However, video creation and editing are an additional tax on the teacher's time outside of class. The first year requires the greatest additional time outside of normal classroom planning, as the teacher must create the videos used for class.

Bandura (1997) categorized physiological factors as being a contributor to self-efficacy. This factor was included in the original design and analysis of this research, but we found it difficult to assess the physiological factors within the scope of the study and data collected. This being said, time seemed to play a significant role and the additional time requirement is a stressor on flipped classroom teachers, especially in their first year(s) of teaching in a flipped classroom format.

"There is additional outside of class time involved. . . a lot of time recording videos." The first year "is a huge, huge tax on your time." Much of this time is used plan-

ning and finding "time to actually make the videos." One teacher was "recording the entire pre-calculus course" they had never taught and "it's time consuming." Another teacher reflecting on their first year said that "just making the videos were time consuming" and they had difficulty finding time for all of the requirements needed for a successful classroom flip. They went on to say, "There were days when I was getting up at 4am to make the video" for the day. Being the first year, they "didn't have a library of videos to go to" in order to spend more time improving instruction. When it came to discussing the creation of the videos, another teacher stated, "the time to record the videos is significant and additional." Teachers reported saving "class time, but you're losing planning time." This presented a "major drawback, especially for new teachers," who may need that planning time. "It just takes so much time to get your video library established."

Although these issues appeared to be largely overcome by the teachers in this study, they may represent an aspect of teacher efficacy not present in other areas. The flipped model is a departure from traditional teaching methods, as it generally required the creation of digital media that students consume at home. This quasi-unique feature may have implications not addressed in the more customary teacher efficacy model. Future studies should focus on the impact of the additional time that teachers must devote to digital media creation and if teachers' technological literacy and/or ability are a factor in a flipped classroom setting. Ideally, this study should be longitudinal in nature to help determine if this time commitment lessens in subsequent years after teachers have taught the course in subsequent years.

Recommendations for Future Study

This study was limited in that it was conducted using only three teachers who were volunteers from one purposefully selected high school. The school in this study also places a high value on flipping the classroom and necessary resources for teachers and students are provided. We did not quantify teacher efficacy levels and served only to identify the factors within successfully flipped classrooms affecting teacher efficacy. Further research in schools without such a focus may give greater insight into how much school culture impacts successful implementation. Triangulation of qualitative and quantitative data may also lead to greater insight into the effect of the flipped classroom instructional model on teacher efficacy.

Student perceptions were not considered except where teacher perceptions of student engagement and participation were concerned. Studies of K-12 student perceptions on flipped classrooms represent a dearth in the current body of scholarly literature. Future studies should also look to investigate the impact of time exclusively as a mediator of teacher efficacy. Variations in instructional practices between different subjects and school environments may also play a role in the effect of the flipped classroom instructional model on teacher efficacy and ultimately, its use. Studies examining these different environments and subjects would help stakeholders gain a broader picture of the flipped classroom and the most appropriate ways to incorporate the model into instruction.

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