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CONVENTIONAL INSTRUCTION VERSUS FLIPPED CLASSROOM MODEL: PRE-SERVICE TEACHERS' SELF-EFFICACY IN ELEMENTARY MATHEMATICS INSTRUCTION

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ABSTRACT
One instructional style gaining attention is the flipped classroom model. Despite the many positive claims, this model has yet to be explored in a teacher education course.To contribute to this line of investigation, a mixed-methods study was conducted, which compared two hybrid mathematics method classes: one using conventional instruction and another using the flipped classroom model. The participants were 92 community college transfer students, who took a mathematics method course in a university educator preparation program. Measures of pre-service teachers' confidence towards teaching were compared through Mathematics Teaching Efficacy Belief Instrument (MTEBI). Results found no significant differences between the conventional instruction classroom and the flipped model, indicating that the pre-service teachers in both the classrooms held similar beliefs regarding their teaching. Seventy percent of the participants responded that the flipped model helped them to learn the mathematical concepts better. Implications for teacher education are discussed.

Key Words: Flipped classroom model, mixed-methods research design, MTEBI, pre-service teachers, elementary mathematics instruction, and teacher preparation program.

1. INTRODUCTION
The American Association of State Colleges and University (AASCU) (2017) stated that, sometimes, community colleges are an overlooked channel in the pipeline that feeds potential educators into teacher preparation programs, but they are a significant source of teacher candidates for American institutions. According to the AASCU survey of education deans in 2016, 70% of AASCU institutions have articulation agreements with community colleges to facilitate their students to transfer to the university teacher preparation programs (AASCU, 2017). These students constitute about 32% of the teacher preparation population. These candidates are more likely than other teacher education students to be from low-income families and underserved populations, who have grown up in the local community, positioning them well to serve as an important bridge to partner schools and to become culturally competent teachers(AASCU, 2017).

In teacher education, the integration of technology in the classroom generates opportunities to transform traditional teaching (Vaughan, 2014). Through the use of innovative teaching models,

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teacher educators can seize the opportunity to equip pre-service teachers with the pedagogical skills and strategies they will need to engage their future students. However, this is a challenge. Teacher educators must begin to adopt instructional models that capitalize the technological mindset of millennial learners. They also need to adjust education coursework to focus on new and innovative teaching models, such as the flipped classroom, to prepare pre-service teachers to teach their own students (Vaughan, 2014).

2. PURPOSE OF THE STUDY

The current study was a follow-up investigation of an action research conducted in Spring 2017 on pre-service teachers' self-efficacy in teaching elementary mathematics. In that semester, one of the researchers was the instructor. Even though she had taught the course for seven years, it was her first semester teaching the hybrid mathematics method course to the community college transfer students in a university satellite campus in south Texas. She used mainly direct instruction with some hands-on activities using manipulatives. The findings of the Spring 2017 study indicated that the participants wanted more hands-on activities during the classroom meetings to better prepare them for teaching. In response to the students' feedback and to improve student performance, the instructor adopted the flipped classroom model in Spring 2018.

The flipped classroom model has gained attention recently (Fraga & Harmon, 2015). In this model, lectures take place out of the classroom. This idea allows more efficient and effective use of the instructor's time during class to provide the necessary scaffolding students need. It is congruent with learning theory, easily lendsitself to differentiated instruction, and promotes teacher-student interactions. In addition, the model enables instructors and students to take advantage of current instructional technology practices, particularly mobile learning (Fraga & Harmon, 2015).

Nevertheless, despite the many positive claims, this modelneeds to be explored in a teacher education course (Dickenson, 2016; Yough, Merzdorf, Fedesco, & Cho, 2019). Also, in spite ofthe awareness of the importance of self-efficacy, this concept has been studied in a limited sense among community college students (Amelink, Artis, & Liu, 2015). Therefore, this current study contributes to the research base by providing evidence concerning the self-efficacy for mathematical instruction of pre-service teachers, who were community college transfer students, and their perspectives of the flipped classroom.

To contribute to this line of research on the flipped classroom model in hybrid teacher education courses, the purpose of this study was two-fold: (a) to compare the effects of the flipped classroom instructional model with conventional instructional practices on pre-service teachers' self-efficacy for mathematics instruction; and (b) to investigate the pre-service teachers' perspectives of the flipped classroom in improving learning outcomes.

3. REVIEW OF THE LITERATURE

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3.1 Flipped Classroom Model

The flipped classroom model embraces a socio-constructivist learning theory. It invites students to be active learners with the support of the instructor (Vygotsky, 1978). Another theoretical perspective is activity theory (Fraga & Harmon, 2015), which is based on the notion that learning occurs within some system of activity and that these systems can be analyzed from socio-cultural situations (Jonassen & Rohrer-Murphy, 1999).

In higher education, the flipped classroom model is referred to as the inverted classroom (Dickenson, 2016). Lage, Platt, and Tregalia (2000), who first introduced the inverted classroom to teach introductory economics, stated that this model "can appeal to all types of learners" (p. 32). In this model, multimedia is the cornerstone of instruction. The course material was divided into topics that corresponded to chapters in the textbook. Students were expected to read about a topic before their face-to-face classes. Videotaped lectures were available for viewing in labs. PowerPoint lectures, assignments, and old exams could be downloaded from the course homepage. Instructors started a class meeting by asking if the students had any questions. Student questions generally led to a 10-minute mini-lecture. If there were no questions, the instructors would not lecture and began hands-on activities (Lage et al., 2000).

Class time was typically devoted to worksheets and review questions (Lage et al., 2000). Students were expected to have completed these worksheets before attending the class meeting. Students were divided into groups, discussed their answers, and presented their work to their peers. To ensure that students were coming to class prepared, instructors would periodically collect the worksheets to check for completeness. The review questions were more challenging, which were focused on applying the concepts being discussed. Students would work in small groups and then present their results to the class. Instructors would collect the review questions periodically. The class meeting ended with the final questions (Lage et al., 2000).

3.2 Flipped Classroom in Teacher Education

Vaughan (2014) maintained that the flipped classroom model is a good match for teacher preparation coursework. It encourages student ownership of learning, while freeing up class time to expose pre-service teachers to various instructional strategies during class meetings. Vaughan conducted a study to investigate the use of a flipped classroom in an introductory education course. She found that in the flipped classroom, as more discussion and collaboration took up class time, the sophomore education majors responded with more higher-level questions and answers. The results indicated that students had engaged in reading the texts, displayed a higher level of reflections and inquiry in their coursework, and they could demonstrate more instructional strategies within the course (Vaughan, 2014).

Moreover, Dickenson (2016) asserted that the flipped classroom is an approach to lecturing where the passivity of listening takes place in the comfort of home. This allows students to process the information and think about questions that might support their understanding. In addition, students may review lectures several times and use the information to complete their

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assignments. This model provides instructor with a better understanding of what material is being learned and what might need to be retaught. In addition, the flipped model allows student-centered activities to take place. These activities provide pre-service teachers with some control in their learning process and require active participation, including peer collaboration, group discussion, and project-based learning (Dickenson, 2016).

Dickenson (2016) conducted a case study to compare two hybrid teacher education classes – one using traditional lecture during face-to-face meetings, and the other providing video lecture. The teacher candidates were randomly assigned to one of two identical courses at the university. Both experimental and control groups had access to the course material through an online learning management system. Instructors in both groups held monthly face-to-face classes with the participants during the semester. Measures of the participants' confidence towards teaching were compared through self-assessment. The results found that there were statistically significant differences in confidence gains among those who attended the flipped classroom.

Nevertheless, Yough and his colleagues (2019) stressed that currently, flipped classrooms have received limited attention in teacher education programs and results have been mixed.For example, in Fraga and Harmon's (2015) study, the researchers compared pre-service teachers' perspectives and achievement in two sections of a literacy course. One section was taught using a conventional teacher-directed instruction and the other section used the flipped classroom model. The findings indicated that the pre-service teachers in the flipped classroom reported being better prepared to utilize strategies from the course to their practicing classroomand a greater willingness to discuss ideas in class than the conventional group. However, there were no statistically significant differences in exam scores across groups (Fraga & Harmon, 2015).

3.3 Teaching Self-Efficacy

The current study was conducted to compare the effects of the flipped classroom model with conventional instructional practices on pre-service teachers' self-efficacy for mathematics instruction. Efficacy beliefs have been associated with Bandura (1977), who defined efficacy as intellectual activity by which beliefs are developed about one's ability to attain a certain level of accomplishment. Bandura (1997) defined self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). Those with high self-efficacy may accomplish tasks far beyond their capabilities (Bandura, 1982).

Teacher efficacy was derived from Bandura's (1977) conceptualization of self-efficacy. The value and power of teachers' sense of efficacy have been well-established in the literature. Giles, Byrd, and Bendolph (2016) summarized that teachers who have a greater sense of self-efficacy, provide a greater academic focus in the classroom, try new methods, persist with struggling students, engage more in professional development, and place more emphasis on building warm relationships with their students.

Teacher preparation programs are challenged with providing a space for candidates to interact with their instructors and peers to learn effective teaching practices and receive formative

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feedback from the instructors (Dickenson, 2016). It is the instructor's decisions to determine how much time is spent online and in face-to-face class meetings. Research suggests that education professors' instructional strategies influence pre-service teachers' self-efficacy (Nietfeld& Cao, 2003). Therefore, it is essential to examine pre-service teachers' self-efficacy and how it is shaped by an instructor's pedagogy (Dickenson, 2016).

4. METHODS

A mixed-methods research with an embedded design(Leedy& Ormrod, 2013) was utilized, where the qualitative approach served as a supplementary role. The researchers conducted the study in the Spring 2017 and 2018 semesters to contrast two specific instructional models – conventionalinstruction and flipped model –in a junior-level method hybrid course on elementary mathematics instruction. Both quantitative and qualitative data were collected at the same time.

4.1 Context

The course content and assignments were designed by a university professor, who was one of the researchers in this study. In Spring 2017 semester, she taught 70 Latino pre-service teachers using conventional lectureand hands-on activities (manipulatives and activity sheets). In Spring 2018 semester, she espoused the flipped classroom approach by utilizing the university online learning management system. There were seven modules established according to the textbook. Activity sheets and videos of teaching strategies were posted online for the students to preview and attempt. The students(n = 49) were assigned to read the chapters in the textbook, complete the notes sheets, and take the chapter quizzes prior to the class meetings. Occasional online meetings, which were recorded, were scheduled for questions and to review course materials for tests and examinations. During the face-to-face meetings, the instructor went over the notes sheets and answered any questions related to the chapters. She also engaged the students by using different manipulatives to demonstrate the teaching strategies. The pre-service teachers were assigned to present their teaching strategies in the face-to-face meetings.

4.2 Participants

The participants in this study included 119 Latino pre-service teachers at a satellite learning center of a medium-sized university in south Texas. The participants, who were community college transfer students, were pursuing a Texas teaching credential and were engaged in 80 hours of field-based experience in local elementary schools. Owing to the ethical guidelines ofconducting an action research, the university institution review board did not allow the researchers to gather any demographic data from the participants.

4.3 Instrument

The instrument used to measure the pre-service teachers' mathematics teaching efficacy was the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) (Enochs, Smith, &Huinker, 2000)

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(see Appendix A). The MTEBI consists of 21 items and is a Likert-scale instrument that has five response categories ranging from "Strongly Agree" to "Strongly Disagree". Higher scores on the MTEBI indicate a greater teaching efficacy with lower scores indicating a lower teaching efficacy. Thirteen of the MTEBI items are classified as the Personal Mathematics Teaching Efficacy (PMTE) subscale, and eight are classified as the Mathematics Teaching Outcome Expectancy (MTOE) subscale. The PMTE subscale addresses pre-service teachers' self-efficacy about their capabilities to become effective mathematics teachers. The MTOE subscale relates to pre-service teachers' beliefs that effective teaching can increase student learning regardless of external factors. These subscales have high reliability (Chronbach's alpha = .88 for PMTE and .81 for MTOE).

At the end of the instrument, the researchers added two open-ended questions asking the participants to give their opinion related to flipped learning: (a) Do you believe flipped learning helps you to learn better? Why? (b) Do you have any concerns regarding the flipped learning? If yes, what are your concerns?

5. DATA ANALYSIS

A posttest only research design was utilized for this study to avoid pretest sensitization (Gall, Gall, & Borg, 2003). Data collection was conducted on the last day of the class meeting. There were 92 participants (47 in Spring 2017 and 45 in Spring 2018) who completed the survey. The response rate was 77%.

Descriptive statistics, independent *t*-tests and one-way ANOVA were used to determine the level of participants' mathematics teaching efficacy in both conventional and flipped classrooms. SPSS version 25 was used to analyze the data. In MTEBI, there are eight reverse-score items, which contain negative wording (items 3, 6, 8, 15, 17, 18, 19, 21).Data recoding procedures were conducted. Qualitative data analysis was employed to search for themes of the participants' perspectives of the flipped classroom.

6. RESULTS

6.1 Quantitative Results

Mean scores, standard deviations, and ranks from administration of the MTEBI subscales are provided in Table 1 and Table 2. In the PMTE, there were 9 questions with a mean score greater than 4 (Q2, Q3, Q8, Q15, Q16, Q 18, Q19, Q20, and Q21 respectively). In the MTOE, there were 4 questions with a mean score greater than 4 (Q 1, Q4, Q9, and Q14). The results indicated that the respondents' answers ranged from agree to strongly agree of their beliefs of mathematics teaching efficacy.

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Table 1 .PMTE Subscale Results

	Conventional Instruction			Flipped Model		
Item	Mean	SD	Rank	Mean	SD	Rank
Q2	4.83	0.38	1	4.76	0.43	1
Q3	4.02	0.74	10	4.27	0.65	5
Q5	3.72	0.68	12	3.42	0.69	12
Q6	3.96	0.98	11	4.04	0.95	10
Q8	4.28	0.80	5.5	4.36	0.68	4
Q11	4.09	0.83	9	3.87	0.63	11
Q15	4.28	0.88	5.5	4.42	0.66	3
Q16	4.43	0.65	3	4.25	0.65	6
Q17	3.06	1.21	13	2.82	0.96	13
Q18	4.30	0.78	4	4.07	0.84	8.5
Q19	4.11	1.05	7.5	4.20	0.76	7
Q20	4.71	0.44	2	4.67	0.48	2
Q21	4.11	0.89	7.5	4.07	0.81	8.5
	4.15	2.34		4.09	3.15	

Table 2 .MTOE Subscale Results

	Conventional Instruction			Flipped Model		
Item	Mean	SD	Rank	Mean	SD	Rank
Q1	4.19	0.78	4	4.11	0.88	5
Q4	4.47	0.58	1	4.29	0.82	1
Q7	3.47	1.14	8	3.47	1.14	8
Q9	4.28	0.68	2	4.36	0.77	2
Q10	3.72	1.04	7	4.16	0.71	4
Q12	3.91	0.86	6	3.82	0.86	7
Q13	4.04	0.69	5	3.96	0.85	6
Q14	4.21	0.72	3	4.22	0.70	3
	4.04	0.74		4.05	0.60	

Independent *t*-tests were conducted to determine if significant differences existed in the pre-service teachers' self-efficacy between conventional instruction and the flipped model. As shown in Table 3, there was no statistically significant difference in the mean scores of PMTE (t = 0.28, p = .39) and MTOE (t = -0.08, p = .47). The result indicated that the pre-service teachers in both conventional and flipped classrooms held similar beliefs with regards to their elementary mathematics instruction.

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Table 3 .Independent t-test Efficacy Results

Subscale	Mean	SD	*t*-value
PMTE			
Conventional Instruction	4.15	2.34	
Flipped Model	4.09	3.15	0.28
MTOE			
Conventional Instruction	4.04	0.74	
Flipped Model	4.05	0.60	-0.08
N = 92	*df* = 91	One-tailed	*P* > 0.05

Results from ANOVA showed that there was a statistically significant difference in Item 5, *I know how to teach mathematics concepts effectively* [F(1, 90) = 4.43, *p* = .04] (see Table 4). The participants in the conventional instruction classroom scored themselves (*M* = 3.72, *SD* = 0.68) higher than those in the flipped classroom (*M* = 3.42, *SD* = 0.69).

Table 4 .One-Way Analysis of Variance of Personal Mathematics Teaching Efficacy subscale (PMTE) Item
 # 5. I know how to teach mathematics concepts effectively.

Source	*df*	*SS*	*MS*	*F*	*P*
Between Groups	1	2.085	2.085	4.428	.04
Within Groups	90	42.382	.471		
Total	91	44.467			

P< 0.05

In addition, there was a statistically significant difference in Item 10,*When a low achieving child progresses in mathematics, it is usually due to extra attention given by the teacher* [F(1, 90) = 5.42, *p* = .02] (see Table 5). The participants in the flipped classroom scored themselves (*M* = 4.16, *SD* = 0.71) higher than those in the conventional instruction classroom (M = 3.72, *SD* = 1.04).

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Table 5 .One-Way Analysis of Variance of Mathematics Teaching Outcomes Expectancy (MTOE) subscale

Item #10. When a low-achieving child progresses in mathematics, it is usually due to extra attention given by the teacher.

Source	*df*	*SS*	*MS*	*F*	*P*
Between Groups	1	4.293	4.293	5.418	.02
Within Groups	90	71.315	.792		
Total	91	75.609			

$P < 0.05$

6.2 Qualitative Results

The pre-service teachers were asked to answer two open-ended questions after they had completed the MTEBI. These questions were to explore the perspectives of participants regarding their learning in the flipped classroom. In responding to the open-ended questions, 70% of the participants responded that they believed flipped model helped them learn mathematical concepts and instructional strategies better. One particularly important reason that resonated with many of the participants was flipped learning allowed for flexibility, that is, learning at home and then demonstrating their learning in classand seeing classmates demonstrate what they have learned as well. This gave them a different way to view or understand a specific concept.

Another reason that the participants believed the flipped model helped them to learn better was that the model allowed space for pre-service teachers to be engaged in class discussion and hands-on activities and practice different instructional strategies(Dickenson, 2016). One participant responded, “It is effective to try different approaches and strategies to help enhance learning.” Another stated, “It provides opportunities for the students to create their own learning.”

Those few respondents who answered “no” felt more comfortable learning in conventional ways of instruction and preferred to be taught “directly by a teacher”. They stated that flipped learning may not be beneficial to all students. One pre-service teacher responded, “I have always had a bit more difficulty understanding math and I believe getting as much instruction as possible would help more.” Some participants raised concerns that they were confused and had difficulty when they were working on the modules at home.

7. DISCUSSION

7.1 Flipped Model and Teaching Self-Efficacy

The pre-service teachers in this study had positive levels of efficacy regarding their mathematics instruction ability as well as positive levels of outcome expectancy for their students in

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mathematics. These findings are consistent with Briley (2012) and Giles and her colleagues (2016), who also found the elementary pre-service teachers in their study to have moderately strong beliefs in their capabilities to teach mathematics effectively.

Results from ANOVA showed that there was a statistically significant difference in Item 5, *I know how to teach mathematics concepts effectively*, wherethe participants in the conventional instruction classroom scored themselves higher than those in the flipped classroom. This result may be derived from the concerns of several participants in the flipped classroom stating that they needed more direct instruction from the instructor. One participant responded, "The method does not fit for everyone." Another participant stated, "A concern may be that the students will begin to lose focus when working with flipped learning, if left alone for individual activities." This finding parallels what Fraga and Harmon (2015) has found, who maintained that participants' preference and learning styles may influence the effectiveness of the flipped model.

The results also showed that there was a statistically significant difference in Item 10, *When a low achieving child progresses in mathematics, it is usually due to extra attention given by the teacher*. The participants in the flipped classroom scored themselves higher than those in the conventional instruction classroom. From the open-ended questions, one participant responded, "It is up to the teacher's abilities and efforts to teach a child/student the necessary skills. Students should be able to get the help they need in order to become an excellent student in mathematics." The flipped classroom replaces the conventional lectures with activities, such as peer discussion and applied practices, which promote more instructor-student interactions and peer-to-peer interactions (Sun & Wu, 2016). Such interactions allow the participants to experience the importance of differentiated instruction (Bergmann &Sams, 2012).

7.2 Some Drawbacks of Flipped Model

The flipped classroom model has drawbacks like other pedagogic methods (Aydin &Demirer, 2016). First, learners who have adopted conventional instruction may resist this model (Herreid & Schiller, 2013), perceiving that it requires more time and work compared to conventional instruction (Akçayır&Akçayır, 2018).The nature of this model prompts students to preview the learning materials for better in-class participation (Hung, 2014)and some students generally consider thisas an extra time burden (Smith, 2013).Also, as some students may have acquired passive learning habits from conventional classrooms, they sometimes do not prefer this new model nor view it useful(Chen, Wang, Kinshuk, & Chen, 2014). Since the flipped model is a relatively new approach for them, there is some uncertainty about what the class may entail. This uncertainty can cause anxiety, adoption problems, and resistance to change.

AkçayırandAkçayır (2018) asserted that most flipped classroom challenges are related to out-of-class activities, such as inadequate student preparation prior to class and students' need for guidance at home.If a student does not take time to study at home, she/he may not perform well in the classroom activities, and this may diminish the effectiveness of the flipped classroom model. Moreover, since students may not be accustomed to this model, they may be confused or

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do not know what to do in a flipped classroom. Another pedagogical issue is students' inability to receive immediate help or feedback when they study at home(Akçayır&Akçayır, 2018).

7.3 Divergent Results

The results of the current study showed that there were no statistically significant differences in the pre-service teachers' self-efficacy across both groups. However, 70% of the participants responded that they believed flipped learning helped them learn mathematical concepts and instructional strategies better. These divergent results emerged because the quantitative instrument and the qualitative questionnaire focused on two different aspects (Bazeley, 2018). The MTEBI measured pre-service teachers' belief of mathematics instruction, while the questionnaire collected the perspectives of pre-service teachers as learners in the flipped classroom. Nevertheless, future research is needed to investigate the differences by conducting focus group interviews and increasing the number of participants.

8. IMPLICATIONS AND CONCLUSION

The flipped classroom model was adopted in response to students' needs. Nevertheless, currently, there is a lack of research about the effectiveness of flipped classroom model and pre-service teachers' self-efficacy (Dickenson, 2016; Fraga & Harmon, 2015; Yough et al., 2019). Also, despite the awareness of the importance of self-efficacy, this concept has been studied in a limited sense among community college students (Amelink, Artis, & Liu, 2015). This current study contributes to the research base by providing evidence concerning the self-efficacy for mathematical instruction of pre-service teachers, who were community college transfer students, and their perspectives of the flipped classroom.

Although there was no statistically significant difference in teaching self-efficacy between conventional instruction and the flipped model, the researchers recommend using theflipped model because it is aligned with a learner-centered approach to instruction (Dickenson, 2016; Yough et al., 2019). The model allowsmore opportunities to scaffold instruction based on learning needs. Also, more time is given for student presentations, providing opportunities for pre-service teachers to demonstrate content mastery.

To eliminate the drawbacks of the flipped model, instructors should (a) give an orientation to students about the model, (b) pay attention to students who are not comfortable with it, (c) give some direct instruction during face-to-face class meetings, and (d) provide clear guidelines on how students should use course materials during pre-class time. Finally, to provide immediate help during the out-of-class activities, instructors may conduct brief, individualized virtual meetings and be available to communicate via text messages to offer instant feedback (Akçayır&Akçayır, 2018).

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