CrossMark

Use of the flipped classroom instructional model in higher education: instructors' perspectives

Taotao Long[1] · John Cummins[1] · Michael Waugh[1]

Abstract The flipped classroom model is an instructional model in which students learn basic subject matter knowledge prior to in-class meetings, then come to the classroom for active learning experiences. Previous research has shown that the flipped classroom model can motivate students towards active learning, can improve their higher-order thinking skills, and can improve their collaborative learning skills. However, most current studies focus on students' experiences with flipped classroom learning. Because so few studies address the instructor's perspective, and instructors' perspectives on technology integration can directly influence their practice of incorporating technology in instruction, this study sought to focus on instructors. This paper is a qualitative case study that reveals instructors' experiences and perspectives on using the flipped classroom model in instruction. Structured interviews were conducted with eight faculty members who either previously had used or planned to use the flipped classroom model. Findings include instructors' perceived definitions of the flipped classroom, how they improved teaching and learning by using the flipped classroom model, their perceived benefits and challenges of the flipped classroom, and perceived approaches of using it in an effective way. The participants also recommended peer assistance among instructors as valuable support to implement the flipped classroom model in instruction successfully.

Keywords Flipped classroom · Active learning · Students · Instructor

✉ Taotao Long
   tlong11@vols.utk.edu

[1] The University of Tennessee, Knoxville, USA

 Springer

Introduction

There has been a growing interest in using the flipped classroom in both K-12 education and higher education (Alvarez 2012; Bergmann and Sams 2012). Recent research also reveals that a flipped classroom instructional model has a positive impact on students' learning (Albert and Beatty 2014; Demetry 2010; Strayer 2012; Wagner et al. 2013). However, most of the studies are based on students' self-reported data regarding their experiences, attitudes, and perceptions during the flipped classroom courses. Research that is focused on the instructor's perceptions and experience of using a flipped classroom instructional model is still lacking. Nevertheless, relevant research suggests that instructors' failure to incorporate authentic, student-centered practices in their instruction is related to their underlying beliefs about teaching and learning, and there is a strong relationship between instructors' pedagogical beliefs and their use of pedagogical innovations (Ertmer 2005; Ertmer and Ottenbreit-Leftwich 2013; Hermans et al. 2008; Overbay et al. 2010; Sang et al. 2010). Relevant research also reveals that a faculty member's belief in the value and relevance of using instructional technologies is an important factor that determines his/her decision to use or not to use them in instruction (Ajjan and Hartshorne 2013; Lynch et al. 2002; Spotts 1999). These studies lead to an understanding that instructors' perspectives on a flipped classroom instructional model might also be strongly related to their practice of adopting this model in instruction. Therefore, this study aimed at examining instructors' perceptions and experiences in using a flipped classroom model in instruction in a broader range of courses and in a variety of subject fields.

This study adopted the Technological Pedagogical Content Knowledge (TPCK) framework as the theoretical framework in this study, with the aim of discovering college instructors' experiences and perspectives of the flipped classroom. The purposes of this study were to examine college instructors' experiences and perceptions of using a flipped classroom instructional model. A qualitative case study method was employed for the investigation.

Literature review and theoretical framework

The flipped classroom is an instructional model in which learning content is not presented during the in-class time (Baker 2000; Strayer 2007), but rather is learned by students prior to the classroom meetings, then in-class time is used for student-centered, active learning (Bland 2006; Foertsch et al. 2002). In contrast to a traditional, lecture-based, instructor-centered instructional model, the flipped classroom model is composed of two phases of instruction that are "flipped," "inverted," or "reversed" (Bergmann and Sams 2012).

The first phase of the flipped classroom learning is the pre-class learning phase. In this phase, students acquire basic subject knowledge by viewing instructor provided learning materials in various media formats, such as online videos, podcasts, or text-format materials, prior to class (Baker 2000; Bergmann and Sams 2012; Strayer 2007, 2012).

The second phase of the flipped classroom learning is the in-class learning phase. In this phase, students have student-centered active learning activities in class, such as interactive lectures, problem solving, laboratory experiments, role play, and collaborative design and creation (Gerstein 2011; Strayer 2012). A flipped classroom course can be taught in various physical facilities, not only a traditional lecture hall, but also in technology-enhanced classrooms, studios, laboratories, computer labs, meeting rooms, outdoor settings, or in online learning spaces. Recent research indicates that students can be kept highly engaged when using the flipped classroom model (Dove 2013). A key advantage of the flipped classroom is that students can take the responsibility for their learning by controlling their learning pace and mastering learning content (Alvarez 2012), and come to the class better prepared than in traditional lecture approaches (Alvarez 2012; Fulton 2012).

Recent research also demonstrates that students perceive that the flipped classroom offers a unique, yet challenging opportunity to maximize learning effectiveness (Demetry 2010; Wagner et al. 2013). Further, the flipped classroom improved students' problem-solving and application skills (Zappe et al. 2009), and provided an interactive atmosphere, contributing to the improvement of students' in-depth communication and collaboration (Gerstein 2011; Strayer 2012). Based on a review of the literature, most current studies focus on investigating students' experiences and perceptions of their flipped classroom learning *in one specific course* (Albert and Beatty 2014; Frydenberg 2013; Wagner et al. 2013). Few studies address college instructor's perceptions of the flipped classroom model. For example, Young et al. (2014) piloted two flipped classroom sessions in an emergency medicine residency course. The instructors' impressions were assessed by having them reflect on the residents' attitudes towards the flipped classroom learning activities. The instructors in this emergency medicine course summarized the most important features of the flipped instruction in the following way: (1) the novice residents' learning could be facilitated through the discussions with senior residents and the instructors; (2) more time should be spent on discussing difficult concepts; and (3) the novice residents had more retention of learning materials. However, this study did not specifically focus on the instructors' perspectives.

A user's intention to use a technology is determined by his/her perceived usefulness of this technology and his/her perceived ease-of-use of this technology (Davis 1989). Recent research reveals that an instructor's perspectives on the usefulness, relevance, and difficulty associated with technology integration strongly influence his/her decision to incorporate technology into instructional practices (Ajjan and Hartshorne 2013; Ertmer 2005; Ottenbreit-Leftwich et al. 2010; Spotts 1999). Although the presence of technology is not necessary a flipped classroom instructional model, flipped classroom is typically technology-enhanced (Bergmann and Sams 2012; Demetry 2010; Strayer 2007). Therefore, these studies led to an understanding that an instructor's perspective on a flipped classroom instructional model may strongly influence his/her practice of using this model in instruction. The Technological Pedagogical Content Knowledge (TPCK) framework was adopted as the theoretical framework in the study reported here because TPCK can help researchers understand the types of instructors' knowledge of technology integration. TPCK is a conceptual framework used to think about teachers' integration of

technology pedagogy by recognizing Technology (T), Pedagogy (P), and Content (C) as interdependent aspects of teachers' knowledge (Harris et al. 2009). TPCK not only emphasizes these three essential components, but also emphasizes the connections, interactions, affordances, and constraints among them (Mishra and Koehler 2006). Good teaching with technology requires understanding the mutually reinforcing relationship between these three components taken together to develop appropriate and context-specific instructional strategies and representations (Koehler et al. 2007; Mishra and Koehler 2006;).

In this study, Technological Knowledge (TK), which refers to an instructor's understanding of any kind of technical tools (Mishra and Koehler 2006), helped to address his/her understanding of the flipped classroom model. Technological Content Knowledge (TCK), which is defined as the knowledge about how technology is used to provide new ways of teaching content (Niess 2005), helped to address how the flipped classroom model was used or planned to be used in each instructor's classroom. Technological Pedagogical Knowledge (TPK), which means the knowledge about the affordances and constraints of technology as an enabler of teaching (Mishra and Koehler 2006), helped to address an instructor's perceptions of the benefits and challenges of using the flipped classroom model. Technological Pedagogical Content Knowledge (TPCK), which is described as the knowledge about the effective and efficient use of technology to increase the effectiveness and quality of instruction in the whole process of teaching content (Koehler and Mishra 2009), helped to address instructors' perceptions of the ways to make their flipped classroom instruction effective. Additionally, this study examined what support they perceived to be valuable in their flipped classroom instruction.

The purpose of this study was to examine college instructors' experiences and perspectives of the flipped classroom. This study addressed the following questions: (1) how do instructors define "the flipped classroom"? (2) how do instructors use or plan to use the flipped classroom model? (3) what are the benefits and challenges experienced by instructors when using the flipped classroom model in instruction? (4) what approaches do instructors think are associated with the effectiveness of the flipped classroom model? and, (5) what types of support do instructors view as important for a successful implementation of the flipped classroom model?

Methodology

A qualitative case study was selected for this study because it can provide an in-depth and intensive examination and, hopefully, understanding of the multiple aspects of a phenomenon in a natural setting (Yin 2003). Further, it can allow a holistic, more comprehensive understanding of meaningful context (Punch 2005), because it can reveal the ideas and opinions of the people involved the case studied, which cannot be considered without the context (Stake 1998; Yin 2003). In this study, each of the instructor's courses, classroom settings, and flipped classroom instructional approach were examined.

Participants

Purposeful sampling was used for participant selection. Eight participants were selected from the 18 faculty members who were trained in a Summer Teaching Institute sponsored by the Teaching and Learning Center at a large research university in Southeastern US, and asked to volunteer in this study (Table 1). As part of the Institute, these faculty members completed a series of workshops on integrating technologies in instruction and student-centered active learning approaches, including the flipped classroom. In this Institute, Brame's (2013) definition of the flipped classroom, which was "flipping the classroom means students gain first exposure to new material outside of class, usually via reading or lecture videos, and then use class time to do the harder work of assimilating that knowledge, perhaps through problem-solving, discussion, or debates," was introduced to the faculty members. The technical training on generating video lectures was also included in the Summer Teaching Institute. These eight faculty members were selected because among the 18 trainees, they had used the flipped classroom in at least one semester, or completed all the preparation work and planned to use the flipped classroom in the coming semester.

Therefore, the four faculty members who had implemented the flipped classroom model (Flipped Instructor, F) in their courses, and the four others who were preparing to use the flipped classroom model (Pre-Flip Instructor, PF) in the coming semester, were selected to participate in this study. Another reason for selecting participants with different levels of experience with the flipped classroom was to examine whether there would be any differences among the perceptions of the instructors who had experienced using the flipped classroom and the ones who had been trained and completed all the preparation work but had not yet taught using it. The eight participants represented seven different academic disciplines (Table 1). This diversity enabled the researchers to have a more comprehensive investigation into the experiences and viewpoints of instructors.

Interview

An individual, face-to-face, structured interview was conducted with each participant. Table 2 contains a list of the interview questions. The participants were asked to share their own experiences of implementing or planning the flipped

Table 1 Summary of the participants	Flip model status	Course	Code
	Flipped instructor (F)	Foreign language	F1
		Foreign language	F2
		Business	F3
		Animal science	F4
	Pre-flip instructor (PF)	Mathematics	PF1
		Architecture	PF2
		Statistics	PF3
		Forestry	PF4

Table 2 Interview questions

1. What lessons did you take from your participation in the training program?

2. Elaborate how you implemented the flipped classroom model, or your plan of using it

3. What difficulties or problems have you encountered upon the implementation of the flipped classroom model, or do you foresee in implementing this model?

4. What is your present definition of the flipped classroom model?

5. In your mind, what concepts or characteristics of the flipped classroom model are essential?

6. As an instructor, what advantages or disadvantages could you see of using the flipped classroom model in your class?

7. What, if any, resources or outside support, other than the Institute, have or may influence your thinking about the flipped classroom model?

classroom instruction first. Then they were asked to share their personal understandings on the flipped classroom instructional model and the types of supports they perceived as valuable. All the interviews were conducted in English. The length of the interviews varied from 30 to 45 min. The interview data were audio recorded.

Data analysis

The audio recorded interview data was transcribed, then coded using NVivo software with identifying recurring phrases and regularities in the data (Miles and Huberman 1994). All initial codes followed closely the concepts used by the interviewees in order to enhance the validity of this study (Punch 2005). Axial coding was conducted to group codes (Corbin and Strauss 2007; Merriam 2009) and to establish common themes, which were: (1) the definition of the flipped classroom; (2) ways to use the flipped classroom; (3) benefits and challenges of the flipped classroom; (4) tips to use the flipped classroom in an efficient way; and, (5) the support received in the process of using the flipped classroom. Then all the data and codes for each scheme were sorted into each theme (Merriam 2009). Each unit of data coded according to each theme was then cut and put together as a category (Merriam 2009). Then constant comparative method was conducted in each theme to search similarities and differences (Glaser and Strauss 1967). Triangulating analysts (Patton 2002, p. 560) was adopted by having two researchers independently analyze the data and compare findings in order to insure the internal validity (Merriam 2009).

Results

Perceived "flipped classroom" definition

All eight participants, whether or not they had yet implemented the flipped classroom model, generally defined "the flipped classroom" as a teaching and learning model in which the subject matter content, which used to be the lecture materials, are experienced outside of class for the students' self-directed learning.

Then students come to class to apply what they have gained from the pre-class learning in a more interactive and collaborative way than in a typical lecture format. The following statements represent definitions of some of the instructors who had already implemented the flipped classroom model:

What I think is the flip model is one in which the students not only study the verb conjugations at home but also study the grammar at home, and they come to class to do their homework (F1).

The flipped classroom is to use the class time doing exercises instead of myself standing in front of them repeating what they could have read in the book (F2).

The flipped classroom is a model in which pushing out information outside class and putting more ownership on students, and students come in at a level of preparation (F3).

Those that had not yet implemented the model had similar definitions such as:

The flipped model to me means the students do a lot of the groundwork outside class and they bring their basic knowledge of the material to class, and then you actually have active learning, where they are engaged in using that material to solve problems (PF3).

The participants had different focuses regarding the definition of the flipped classroom. Instructor F2 focused on the instructor's role change and emphasized that the instructor is no longer the transmitter of knowledge in class. Instructor F3 focused on students' ownership for their learning and their preparation before class.

As a Pre-Flip Instructor, PF3 focused on the predicted students' engagement in problem solving in class with the knowledge gained during pre-class learning. Whether or not had already used the flipped classroom, participants placed emphasis on the students' acquisition of basic knowledge *before* class and the use of in-class active learning activities. These activities emphasize students' enjoyment and knowledge application skills in the classroom setting.

How "flipped classroom" is used or planned to be used

All eight participants whether using or preparing to use the flipped classroom model, held the common aims which were to (1) transfer students' passive learning to active learning, and to (2) create more time and opportunities for students to apply their new gained knowledge during the in-class sessions.

Among Flipped Instructors, Foreign Language instructors, F1 and F2, shifted students' "lower levels of learning" such as "recognition" vocabulary and grammar to occur before class, and gave students more in-class time for "higher level activities," such as "oral translation" and "writing exercises. Instructor F3, who taught one section of a Supply Chain course, required the students to "read, comprehend at a certain level and then come into class." In class, the students "start talking about it [knowledge] in application, strengths, weaknesses and so forth" (F3). The Animal Science instructor, F4, had implemented a "partial flipped course," in which only a proportion of the course was implemented in a flipped

classroom approach. The students' pre-class learning assignment was to upload their presentations online. The in-class time was for face-to-face intense discussion of the pre-class presentations. Instructor F4 perceived it as a way to "allow for much deeper delving into the learning content than using the class time to go through the presentations." The students "had no longer listened to others' presentations as audience," but "engaged into more intensive and detailed discussions about what each presentation said" (F4).

The four Pre-Flip Instructors also planned to integrate more activities that would improve students' practical skills and collaborative skills during the in-class time. For example, PF1, a Mathematics instructor, planned to use in-class time to "emphasize connections between algebra concepts," with the aim of providing students "a better broad overview of the algebra topics rather than several disjoint topics" (PF1). Similarly, PF2, an Architecture instructor, planned to facilitate the students to "engage in complex projects having as many as 500 variables." The Statistics instructor PF3 also had prepared to "use more class time to look at specific examples and work them out" (PF3). The Forestry instructor PF4 planned to "have lectures converted to be an online format that the students can do outside of class and then delicate class time to activities based on those lectures, do application of wildlife habitat management aspects in the field in groups," aiming at spending more in-class time on students' application and collaborative exploration.

Perceived benefits of the flipped classroom

The first benefit the participants perceived in using the flipped classroom is, that students liked it or would like it. The Flipped Instructors indicated that their students liked the new learning experiences. Students found the pre-class learning materials were useful, and enjoyed the independence and freedom enabled by the flipped classroom model. The Flipped Instructors had comments such as:

> I did a survey at the end of the semester and most said that they found useful the Blackboard presentations (F1).
> I did a survey in the middle of the semester and 95 % of the students liked the videos, so useful (F2).
> They were happy to be able to do it [videos] on their own time (F4).

Some Pre-Flip Instructors indicated that their students' resistance to the lecture-based instruction motivated them to innovate their instruction by initiating the flipped classroom. Similar to the Flipped Instructors, they anticipated that their students would be highly motivated in learning after the implementation of the flipped classroom. The Pre-Flip Instructors had comments such as:

> It's going to be more active and more interesting (PF1).
> For them [the students], they don't like it [lecture]. For me, it's really boring to stand up and try to demonstrate something that would take half an hour or forty-five minutes on a spreadsheet and explain all the pieces and parts, so, they [the students] were falling asleep and so was I (PF3).

The second perceived benefit was that in-class time could be freed for active learning. During the in-class time, students could have more practice, and could apply their learned knowledge in an authentic environment. The in-class practice led students' learning into a more interactive and more in-depth way, and improved students' higher-order thinking skills. For example, Flipped Instructors said that the flipped classroom would, "help students to achieve a higher status in application and subject literacy" (F3), and "get students involved in a deep layer of conversation" (F4). Along the same lines, a similar comment was made by a Pre-Flip Instructor, "more in-class time can be spent to emphasize connections between algebra concepts" (PF1).

A third perceived benefit, discovered in the coded interviews, was that students could have instant support during in-class exercises. This was true for both Pre-Flip Instructors as well as for Flipped Instructors. The Flipped Instructors shared that during the in-class sessions, it was easy for instructors to identify which topics were difficult for students, so they could immediately give students more instruction. The following statements represent the benefit that students could have instant support in class perceived by some of the Flipped Instructors:

> Doing homework in class is better than doing homework outside of class because they have me there. They can ask questions and I can solve their questions immediately. Because that's the best way for them to see what they don't understand is when they are applying what they read or heard before class (F2).

The Pre-Flip Instructors also anticipated that the instant support would be critical and helpful in their upcoming flipped classroom instruction.

> I see a lot of advantages that the students who would normally have been sitting at home struggling with the homework and not knowing where to go for help will have instant help, because someone, could be another student, or me or one of the GTAs, will be there to help. So to me that's a huge advantage… I really like to have interactions with students because interacting with students is particularly appealing, I think having flipped classroom will allow me to have a lot more interactions both with the class as a whole and then with groups. I'll enjoy interacting flexibly with a whole class of students, or among different groups (PF1).
> I really think it [flipped classroom] opens up time to have them [the students] practice more with support right there. In an ideal world I think they can actually work through problems and they are not trying to struggle through them on their own in their dorm at night with no help available. That, that's the goal is that is that they are active. Actually, instead of just copying notes in class and copying example problems they are actually working independently (PF3).

Pre-Flip Instructor PF1 anticipated that the instant support for students in class would be "a huge advantage" of the flipped classroom model. Additionally, PF1 foresaw that "interacting with students is particularly appealing" and s/he would have "enjoyed interacting." Pre-Flip Instructor PF3 predicted that the students

would practice more and receive more immediate guidance and scaffolding in a just-in-time situation, so they would be more active in learning.

Perceived challenges of the flipped classroom

In the interviews, the participants were also asked to share challenges they had or anticipated with using the flipped classroom model in their courses. The following are representative responses from the participants.

Possible lack of students' preparation before class

All participants, whether experienced Flipped Instructors or trained Pre-Flip Instructors, indicated that a critical factor for making an effective flipped course is that the students have learned the knowledge in the pre-class learning. This presented a big challenge to both categories of participants. The Flipped Instructors all indicated that the lack of students' preparation prior to class became a main obstacle in the flipped classroom instruction.

> The main obstacle I think is the fact that sometimes students do not read the material before coming to class (F1).
> I have tremendous trouble getting them to do assigned readings…Some of the work will be assessed, but some not, so how to generate incentive for students to do the outside classwork becomes a big challenge (F2).
> I felt disappointed because it [the flipped classroom] put a lot of responsibilities on students, but they show up not prepared… students will get lost, frustrated if they come into class without preparation (F3).

The Pre-Flip Instructors were also concerned about the students' possible lack of preparation before class influencing poor engagement during class.

> My biggest concern is students might come to class without doing the video lecture at home, not be prepared enough to do whatever I have planned on that day, and get stuck in class (PF1).
> I have tremendous trouble my students not going to do it [pre-class reading] and think that they can come into class and be able to participate fully without having the additional work outside class (PF4).

Expressions such as "main obstacle," "biggest concern," "a big challenge," and "tremendous trouble," and "disappointed" illustrate participants' concerns they had about a possible lack of student engagement in the in-class learning activities. This was attributed to a concern about the possible lack of students' pre-class preparation.

Not all students enjoy active learning

Among Flipped Instructors, two indicated that it was a challenge for them to implement the flipped classroom model because not all the students enjoy the active learning format. According to them, students, in general, are used to a passive

learning format. Some students "are more used to the traditional lecture in which instructors stand in the front of the classroom and explain everything" (F2). Some passive learners even kept silent when they had difficulties in learning. This presents a challenge for instructors to know whether the students have acquired the required knowledge or not.

Students may not collaborate well

Although the participants commented that the in-class active learning activities could provide for a more in-depth learning, motivate students' learning interest, and provide convenience for students to refer to help in class, several participants were concerned that students might not collaborate well in the in-class active learning activities.

For example, as a Flipped Instructor, F1 indicated that some students "worked on their own and simply put individual work together, but never come back for reflection, revision, or reviewing others' contributions," with a low level of collaboration. Although PF1 had not implemented the flipped classroom instruction, s/he was concerned that the students might "choose to do [the course work] by themselves."

Instructors' large time and effort investment

An additional challenge that all participants mentioned, whether they had implemented the flipped classroom model or not, was time and effort to be invested in preparation of the flipped classroom instruction. Due to the training during the Summer Teaching Institute, all the participants developed videos for their students' pre-class learning. At times, too much time and effort was invested on creating the videos for the flipped classroom courses. Flipped Instructors commented,

> Time is a major problem because I had to create the videos at the end of the semester, I didn't have time to finish (F2).

> In like manner, Pre-Flip Instructors commented that,

> Making videos involves lots of time and effort to prepare, such as writing script, and practice… A lot more pre-thinking has to be used to provide students what you might do in a lecture plus Q and A or in a hands-on environment…You must have lots of thinking about the outcomes and how to structure things in order to create those outcomes, then be able to verify in some way whether they were achieved or not…Lots more things to improve the course, more on editing the videos, and for future use (PF2).
> Time is a big limitation for a new faculty member teaching four classes to prepare for FLIP, particularly the videos (PF4).

The above statements demonstrate that regardless of their experience with using the flipped classroom, all participants thought video creation was costly in both time and energy. This was true with not only the technical creation and revision but also

the design of the videos, such as content selection, logic design, and the coordination with in-class activities. Moreover, the phrases "a steep learning curve" and "a learning curve" were used by PF4 and F3 to express their concerns for the anticipated time and energy investment in learning and completing the preparation work for introducing the flipped classroom model in their courses.

The Flipped Instructors indicated that according to their experiences, although preparing to initiate the flipped classroom model actually consumed more time than initiating the traditional lecture-based instruction, the time was well spent, because the created materials can be used for future classes. Although sometimes more time might be required to revise the videos for future use, it would not require as much time.

In like manner, Pre-Flip instructors, PF1, PF3, and PF4 anticipated that in the future flipped classroom instruction, due to the experience gained with the initial preparation of both videos and in-class activities and with the available completed video materials, that they too would not have to spend as much time preparing for instruction after the initial classroom experience. For example, PF4 commented:

> I think that will get better with time, once I've done it [flipped classroom instruction] I think it will be quicker for me. And then in the long run the hope is that there may be some small changes to the online content, I may rerecord presentations, but I already have the skills to be able to do that (PF4).

As a Flipped Instructor, F4 illustrated that more time was freed up for the instructor and the GTAs to prepare in-class learning activities, evaluate each student, and "create more time in class to cover more material, have better discussions and get students really involved in a deeper layer of conversation."

Perceived approaches for making an effective flipped course

Interview data revealed four major components instructors should do to make an effective flipped classroom course. These were: (1) ensure students have prepared for in-class session prior to class; (2) be well-organized in instruction; (3) design learning materials and activities based on students' feedback, and, (4) provide appropriate instant support in class.

Ensure students have prepared prior to class

All four Flipped Instructors highlighted the importance of students' pre-class learning. They indicated that in order for the flipped classroom model to be effectively implemented, students must complete the prerequisite learning before coming to class. The four Pre-Flip Instructors also anticipated students' pre-class learning as an important component of the flipped classroom. The participants identified students' pre-class learning was "essential," "important," and "a biggest issue." They all believed that the pre-class learning could equip students with the knowledge required for in-class active learning. The in-class sessions could provide students the opportunities to apply, integrate, and interact the knowledge gained from pre-class learning.

In order to ensure students learned before class, all participants indicated that requiring students to finish some pre-class assignments was necessary. Flipped Instructors shared the approaches they used for pre-class learning assignments, such as posting writing samples before class (F2), pre-class quizzes (F3) and pre-class online demonstrations for instructors and GTAs to review (F4). The following statement represents F3's perceived role of pre-class quizzes in the flipped classroom instruction:

> Believe me if they've invested the time in reading the material to take the quiz, they [the students] are ready to talk, and not about definitions, but they're ready to talk about concepts. And so we found that it really works, so it's kind of carrot and stick. The quizzes are a part of their grade, so some could say that that's the stick portion, but the other thing is that we've let them open book, so the carrot is it's really easy for you to get these points. So there ought to be 10 % of your grade that really is a given, and the reward for us is that it brings them in at a level of preparation (F3).

Instructor F3 drew an analogy between the approach of calculating students' pre-class assignment scores into a final grade and the "carrot and stick" approach. Students would lose the grade if they did not finish the pre-class assignments. The grade jeopardy provided the "stick". However, F3 explained that these assignments were not difficult, so if the students had gained the knowledge through pre-class learning, it would be easy to get this 10 % of the final grade. In F3's opinion, it was a "carrot" that brought students to a good level of preparation for the in-class phase. Instructor F3 also suggested that the pre-class work should motivate students to "think about the integration of facts and concepts".

In like manner, Pre-Flip Instructors shared the approaches they planned to use for pre-class learning assignments, such as note taking about pre-class learning videos (PF1), and pre-class quizzes (PF2, PF3). PF1 suggested that the pre-class assignment should not cost students too much time.

Be well-organized in instruction

All the Pre-Flip Instructors commented that in comparison to the traditional instructor-centered, lecture-based model, the flipped classroom model required them to be better organized in instructional design before the beginning of the courses. Instructor PF2 commented that in the instructional design, instructors should "have very clear objectives as to what students are to do prior to class." Instructor PF1 indicated that "structure, schedule of the course, activities, group arrangement, must be well-organized." Instructors should be well-organized in all aspects of the flipped classroom instruction, such as the syllabus, schedule for activities, activities design, group arrangement for the in-class collaborative work, requirements and deadline for each assignment, in order to avoid chaos in class. Instructors should "organize how to do and how to get started each day" (PF1).

Flipped Instructors confirmed that not only in the preparation, but also during the implementation of the flipped classroom instruction, it was important for instructors to be well-organized. Instructor F1 indicated that having a general plan of the whole

course could enable the instructor to respond to whatever came up in class. Instructor F4 summarized that the teaching and learning would be improved in the flipped classroom if the instructor could "be organized, plan ahead" (F4) during instruction. Moreover, F2 and F4 suggested that when designing and implementing the flipped classroom instruction, the instructor should have a clear and detailed organization of what students should do for the complete semester. They indicated that it was beneficial to guide the students to know when they would have access to the pre-class learning material, the deadlines and requirements for the pre-class and in-class assignments, and how their learning would be evaluated. Additionally, F3 suggested that "success (of a flipped classroom instruction) is marked by students taking responsibility." She also suggested that when using the flipped classroom model, instructors should ensure each student understand his/her responsibility in both pre-class and in-class learning phases.

However, all the Flipped Instructors indicated that being well-organized instruction was not difficult, just that care needed be taken in scheduling the instruction.

Among Pre-Flip Instructors, PF2 seemed to be very confident in organizing the class by anticipating that s/he would feel "really good in standing up and orchestrating a jazz band." Instructor PF4, like the Flipped Instructors mentioned above, also suggested that when designing and implementing the flipped classroom instruction, the instructor should have clear and detailed organization of what students should do for the complete semester.

Design learning materials and activities based on students' feedback

Regardless of whether or not an instructor has experience with using the flipped classroom, all participants indicated that in the instructional design of the flipped classroom course, getting to know more about students, was important. Finding out students' characteristics and needs, viewing instruction from students' viewpoints, and getting feedback from students, would help to make instruction more effective.

Comprehensive and deep probing into students' learning styles and needs provided F3 the guidelines for his/her instructional design. S/he explained that instructors learned to "think as students". S/he found that the students, who were described as "digital natives," were good at using technology, but were bored on the exams. S/he and colleagues designed short time exercises which "could improve and test students' abilities in application and problem solving" and "make students a different level of learning," enabling higher-order thinking, and reducing students' workload, because most students "had to work more than 10 h a week." Additionally, F3 suggested that instructors should "start digging a little bit deeper" on how students prepare for class, and whether they know how to prepare for class.

The Foreign Language instructors, F1 and F2, both suggested that when preparing the pre-class learning materials, instructors should look at the knowledge from students' perspectives, "because students will learn when the instructor is not with them" (F1). Similarly, F2 indicated that "instructors always think some knowledge is simple, but not to the students. The instructor does not recognize it." Instructors should think of students' current knowledge level, making sure students

understand the pre-class learning materials. In addition, F2 paid more attention on collecting the feedback from "silent students," who were used to passively receiving lectures. Instructor F2 "forced" the students to provide feedback in journals and survey.

Pre-Flip Instructors also planned to introduce some approaches to get students' feedback. For example, PF4 planned to "gauge how students are receiving it [flipped classroom learning]," and planned to implement it "in a gradual way." Instructor PF2 had prepared to check students' acceptance to the instruction in each class through post-class survey.

Provide appropriate instant support in class

Flipped Instructors shared how they provided students instant support in class, in order to motivate students' interaction and facilitate their higher-order thinking skills.

"Some exercises are difficult. I plan to challenge them [students], they have to think, they have to analyze. I work with them only if they have problems or instruction is not enough" (F2). Instructor F2's comment demonstrated the rule of providing students instant support in class that students should be motivated and guided to think and explore by themselves. Even though had not used the flipped classroom, PF3 anticipated that in the coming semester instruction, s/he would "balance providing students freedom to be responsible for their learning and giving them support," giving students instant support to an appropriate extent.

Support for a successful flipped classroom instruction

All eight participants indicated that they had some support to use or prepare to use the flipped classroom model effectively in their courses. This support came in the form of either, (1) online resources about the flipped classroom; or, (2) other instructors' peer assistance.

All eight participants indicated that during their preparation for the flipped classroom instruction, they received good ideas from online resources, such as wiki and blog posts about other instructors' teaching experience regarding the flipped classroom. These ideas were modified for use in the instructional design of their own flipped classroom courses.

Among Flipped Instructors, the Foreign Language instructors, F1 and F2, read journals on instruction in their own fields, especially the papers on active learning in foreign language instruction. However, the participants indicated that peer assistance from other instructors was more useful and more valuable to them. Instructor F1 participated in a diverse-discipline pedagogy group. In this group, members shared and read articles about teaching, regularly met to discuss their teaching experiences, shared ideas and challenges, and helped each other to solve problems about teaching. Instructor F1 indicated that through discussion about "different things related to teaching" (F1), s/he "had some articles first time learned about" (F1). During flipped classroom instruction, F1 and other group members "shared ideas and challenges, problems and tried to help each other" (F1).

Instructors F3 and F4 asked the colleagues in their departments for suggestions and support because they felt more comfortable speaking with people in their own fields.

As a Pre-Flip Instructor, PF2 indicated that the communication with the other instructors who were experienced in using the flipped classroom in their courses provided lots of valuable ideas in instructional design of initiating the flipped classroom course. Instructor PF2, like instructor F1, participated in a diverse-discipline pedagogy group. In this group, members regularly met to discuss their teaching experiences, ideas, and challenges, and helped each other to solve problems about teaching.

Instructor PF3 asked colleagues in his/her department for suggestions and support. Instructor PF1 valued the good collaboration with GTAs on the preparation for the course. Although valued the support from the pedagogy group, PF2 felt more comfortable to ask support from a nephew and a sister who both were experienced in using the flipped classroom model in K-12 schools.

All the participants were trained in the same Summer Teaching Institute. They commented that the Institute provided them with great ideas in teaching. They felt, however, that what was even more valuable to them was the opportunity provided by the Institute for peer communication, reflection, and learning from each other about the flipped classroom instruction. Because of this, they kept the peer-support relationship after the Institute ended. They shared teaching experiences with each other, offered suggestions to each other, and encouraged each other.

Discussion

Research has shown that the flipped classroom model can provide students opportunities for engagement in student-centered active-learning experiences, improve students' learning motivations, higher-order thinking skills, and problem-solving skills (Demetry 2010; Frydenberg 2013; Strayer 2012; Zappe et al. 2009). Warter-Perez and Dong (2012) stated that the fundamental idea behind the flipped classroom is that more in-class time can be devoted to active learning and that the instructor can provide immediate feedback during the active learning session. All instructors in this study, whether Flipped Instructors or Pre-Flip Instructors, highly praised the in-class learning activities' role in motivating students to apply their gained knowledge. However, this study indicates that instructors viewed motivating students to prepare for the in-class activities not only a most essential component of the flipped classroom model, but also as a major challenge. Most current research is on the in-class activities, and there is little research on the pre-class learning in the flipped classroom model. This study highlights the importance of the effectiveness of the pre-class learning activities.

Current research on the flipped classroom model centers on the instructional benefit of this model through students' perspectives, showing students' attitudes toward their learning experiences in the flipped classroom courses, and their learning gains. In contrast, this study centers on instructors' observations of the critical instructional design connected with the flipped classroom model. When a college instructor considers introducing innovations in instruction through using the

flipped classroom model, s/he should not only consider students' learning performance, but also the possible time and effort to be invested in initiating the instruction. The results of this study offer suggestions to the college instructors who are considering using the flipped classroom model. Proper motivation needs to be provided to help students prepare before class in flipped classroom courses. The results of this study also suggest college instructors should be well organized in their instructional goals and design. They should think like students (have instructional design based on students' feedback), and provide students appropriate, timely, in-class support.

This study supports the previous finding that sufficient time to explore and practice is necessary for instructors to become adapted to instructional practice with new technologies (Hawkins 1997; Kopcha 2012) and to implement pedagogical innovations (Henderson et al. 2011; Malicky et al. 2007). In this study, the participants believed it took a large amount of time and energy to prepare for initiating the flipped classroom instruction. However, the participants who had experienced using the flipped classroom for at least one semester specified that less time and energy would be required in future instruction. This suggests that the instructors who are considering introducing the flipped classroom in instruction should plan to spend more time in initiating their flipped classroom. However, they can be optimistic that the prepared materials can be preserved for future use in similar classrooms.

Previous research reveals that peer assistance among instructors is critical in adopting innovations in instruction. For example, Albert et al. (2014) found that in K-12 schools, teachers were pleased to have an opportunity to interact with colleagues, and people perceived as peers, to share their experiences in teaching. Shea, Pickett and Li (2005) also indicated that peer assistance could provide instructors real and credible examples of successful adoption of innovations in instruction. Peer assistance was well-received by instructors because they thought learning from experienced peers could help them understand the innovations more easily (Shea et al. 2005). This study sought to understand how the instructors felt about the types of support needed for using the flipped classroom model. The investigation revealed that peer communication and assistance between instructors, such as peer assistance among pedagogy group members and the communications with experienced colleagues, perceived by instructors as an effective type of support.

Based on this, when instructors are considering introducing the flipped classroom in instruction, peer assistance among instructors is a means of efficient instructional effort. Moreover, institutions that encourage instructors to improve instruction by using the flipped classroom could provide opportunities for instructors to have peer assistance and support in a more flexible and more comfortable way. Such peer support groups can provide valuable experiences to both new and experienced instructors, especially if this peer assistance relationship remains for the long run. Institutions could organize pedagogy groups for instructors. Training programs for faculty could focus on instructors' communication, peer commenting, and peer assistance. A "follow-up experience" (Luft 2001, pp. 519), which included many opportunities for instructors to interact after a training program, can play a vital role

in establishing longer lasting peer assistance relationships, and help instructors to implement new practices in instruction (Guskey 2002).

Although this study aimed to investigate the possible differences that might exist among the perceptions on the flipped classroom of the instructors who had used it for at least one semester and those who had not yet used it but completed all the preparation work, results show that no obvious differences exist. Future research should conduct follow-up investigations on the instructors who had prepared to use the flipped classroom to examine if they had any different or further understandings on the flipped classroom instruction.

A limitation of this study is that all the participants were from the same university and had the same training program, so their viewpoints were similar to some extent. For example, due to the introduction of the concept of flipped classroom and the training on making video lectures during the Summer Teaching Institute, all the participants made videos for their flipped classroom instruction, and they all responded that they had to spend a large amount of time to make videos to have a flipped classroom. Future research on the training of the flipped classroom needs to draw upon instructors from more diverse backgrounds.

An additional limitation of this study is that only interviewing was used for data collection. The results may yield to the shortcoming on internal validity (Merriam 2009). Triangulation using multiple sources of data could supplement future research.

Support and training of instructors on how to use the flipped classroom model efficiently were proved to be critical to the acceptance of this model in this study. Future research might focus on a close examination on how instructor's support and training influence their adoption of the flipped classroom model. Future research might also investigate how universities can better support faculty members in gaining knowledge and skills required for building more active, effective, and multi-modal learning environments and a faculty peer-assisted learning community.

Conclusion

In order to gain a complete understanding on how to provide effective flipped classroom instruction in an efficient and time-saving way in higher education, this qualitative study examined college instructors' perceptions on the definition, benefits, and challenges of flipped classroom, and instructors' perceived approaches and valuable support to make an effective flipped classroom course. The participants defined the flipped classroom as a teaching and learning model in which the students learn the subject matter content before class on their own, then come to class for practice in an interactive and collaborative way. Although the learning materials and activities the participants used varied, they all focused on improving students' exploration and active learning, and creating more opportunities for students' practice, application, and interaction on what they learned. The benefits the participants perceived in using the flipped classroom included that students had or would have a strong learning motivation, in-class time could be freed for students' active learning, and that instant support would be available to

students in class. However, the participants felt that the primary challenge of using the flipped classroom model was students' potential lack of preparation prior to class. Other challenges included that not all students enjoyed active learning, students might not collaborate well, and instructors had to make a large time and effort investment in instructional preparation. Additionally, the participants suggested that in order to make an effective flipped classroom course, instructors should: (1) ensure students have prepared for in-class sessions prior to class; (2) be well-organized in instruction; (3) design learning materials and activities based on students' feedback; and, (4) provide appropriate instant support in class. This study also suggests that although online resources offered instructors good ideas about the flipped classroom instruction, peer support among instructors was perceived as a more valuable support for instructors to use the flipped classroom. This points to the need for future research on college instructors' training and support that can promote peer assistance among instructors. It also points out the need for a mechanism for long-term peer assistance relationships, with the aim of improving the application of the flipped classroom in higher education.

In sum, when college instructors plan to introduce the flipped classroom instructional model in instruction, they should be aware that:

- It is a primary challenge is that students might not be prepared prior to class, so proper motivation needs to be provided to help students prepare before in-class meetings;
- Being well organized in instruction is critical to a success flipped classroom instruction;
- Instructional design should be based on students' feedback;
- Appropriate and timely support needs to be provided to students during their in-class learning;
- Large time and effort might be spent on initiating the flipped classroom instruction;
- Peer assistance from other instructors could help to initiate the flipped classroom instruction in a more efficient way.

Additionally, institutions that encourage instructors to improve instruction by using the flipped classroom should:

- Provide opportunities for instructors to have peer assistance and support in a more flexible and more comfortable way;
- Focus on promoting instructors' communication, peer commenting, and peer assistance when designing training programs for instructors.

Compliance with ethical standards

Conflict of interest The authors have no potential conflict of interest with any of the software or tools mentioned in this study.

References

Ajjan, H., & Hartshorne, R. (2013). Investigating faculty decisions to adopt Web 2.0 technologies: Theory and empirical tests. *Internet and Higher Education, 11*, 71–80.

Albert, M., & Beatty, B. J. (2014). Flipping the classroom applications to curriculum redesign for an introduction to management course: Impact on grades. *Journal of Education for Business, 89*(8), 419–424.

Albert, J., Blanchard, M., Kier, M., Carrier, S., & Gardner, G. (2014). Supporting teachers' technology integration: A descriptive analysis of social and teaching presence in technical support sessions. *Journal of Technology and Teacher Education, 22*(2), 137–165.

Alvarez, B. (2012). Flipping the classroom: Homework in class, lessons at home. *Education Digest, 77*(8), 18–21.

Baker, J. W. (2000). The "classroom flip": Using web course management tools to become the guide by the side. In *Paper presented at the 11th international conference on college teaching and learning*, Jacksonville, FL.

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Eugene, OR: International Society for Technology in Education.

Bland, L. (2006). Applying flip/inverted classroom model in electrical engineering to establish life-long learning. In *Paper presented at the American Society of Engineering Education Conference and Exposition*. Chicago, IL.

Brame, C. J. (2013). *Flipping the classroom*. Retrieved from https://cft.vanderbilt.edu/guides-sub-pages/flipping-the-classroom/.

Corbin, J., & Strauss, A. (2007). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (3rd ed.). Thousand Oaks, CA: Sage.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–339.

Demetry, C. (2010). Work in progress—an innovation merging "classroom flip" and team-based learning. In *Paper presented at the 40th ASEE/IEEE frontiers in education conference*, Washington, DC.

Dove, A. (2013). Students' perceptions of learning in a flipped statistics class. In R. McBride & M. Searson (Eds.), *Proceedings of society for information technology and teacher education international conference 2013* (pp. 393–398).

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration. *Educational Technology Research and Development, 53*(4), 25–39.

Ertmer, P. A., & Ottenbreit-Leftwich, A. (2013). Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning. *Computers and Education, 64*, 175–182.

Foertsch, J., Moses, G., Strikwerda, J., & Litzkow, M. (2002). Reversing the lecture/homework paradigm using e-Teach web-based streaming video software. *Journal of Engineering Education, 91*(3), 267–274.

Frydenberg, M. (2013). Flipping excel. *Information Systems Education Journal, 11*(1), 63–73.

Fulton, K. P. (2012). 10 Reasons to flip. *Phi Delta Kappan, 94*(2), 20–24.

Gerstein, J. (2011). *The flipped classroom model: A full picture*. Retrieved from http://usergeneratededucation.wordpress.com/2011/06/13/the-flipped-classroom-model-a-full-picture/.

Glaser, B. G., & Strauss, A. L. (1967). *Discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.

Guskey, T. R. (2002). Professional development and teacher change. *Teacher and Teaching: Theory and Practice, 8*(3/4), 381–391.

Harris, J., Mishra, P., & Koehler, M. J. (2009). Activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education, 41*(4), 393–416.

Hawkins, J. (1997). Imagine the possibilities: The world at your fingertips. In P. Burness & W. Snider (Eds.), *Learn and live* (pp. 212–215). Nicasio, CA: The George Lucas Educational Foundation.

Henderson, C., Beach, A., & Finkelstein, N. (2011). Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature. *Journal of Research in Science Teaching, 48*(8), 952–984.

Hermans, R., Tondeur, J., van Braak, J., & Valcke, M. (2008). The impact of primary school teachers' educational beliefs on the classroom use of computers. *Computers and Education, 51*, 1499–1509.

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60–70.

Koehler, M. J., Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy and technology. *Computers and Education, 49*(3), 740–762.

Kopcha, T. J. (2012). Teachers' perceptions of the barriers to technology integration and practices with technology under situated professional development. *Computers and Education, 59*(4), 1109–1121.

Luft, J. (2001). Changing inquiry practices and beliefs: The impact of an inquiry-based professional development program on beginning and experienced secondary science teachers. *International Journal of Science Education, 23*(5), 517–534.

Lynch, D., Altschuler, G. C., & McClure, P. (2002). Professors should embrace technology in courses…and colleges must create technology plans. *The Chronicle of Higher Education, 48*(19), B15.

Malicky, D. M., Lord, S. M., & Huang, M. Z. (2007). A design methodology for choosing an optimal pedagogy: The pedagogy decision matrix. *International Journal of Engineering Education, 23*(2), 325–337.

Merriam, S. (2009). *Qualitative research: A guide to design and implementation*. San Francisco, CA: Jossey-Bass.

Miles, M. B., & Huberman, M. A. (1994). *Qualitative analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, CA: Sage.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teacher College Record, 108*(6), 1017–1054.

Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and Teacher Education, 21*(5), 509–523.

Ottenbreit-Leftwich, A., Glazewski, K. D., Newby, T. J., & Ertmer, P. A. (2010). Teacher value beliefs associated with using technology: Addressing professional and student needs. *Computer and Education, 55*, 1321–1335.

Overbay, A., Patterson, A., Vasu, E., & Grable, L. (2010). Constructivism and technology use: Findings from the IMPACTing leadership project. *Educational Media International, 47*(2), 103–120.

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Punch, K. F. (2005). *Introduction to social research: Quantitative and qualitative approaches*. London: Sage.

Sang, G., Valcke, M., van Braak, J., & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers and Education, 54*, 103–111.

Shea, P., Pickett, A., & Li, C. S. (2005). Increasing access to higher education: A study of the diffusion of online teaching among 913 college faculty. *International Review of Research in Open and Distance Education, 6*(2), 1–27.

Spotts, T. H. (1999). Embedding ubiquitous use of technology. *Journal of Educational Technology and Society, 2*(4), 92–99.

Stake, R. E. (1998). Case studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *Strategies of qualitative inquiry*. Thousand Oaks, CA: Sage.

Strayer, J. F. (2007). *The effect of the classroom flip on the learning environment: A comparison of learning activity in a traditional classroom and a flip classroom that used an intelligent tutoring system (Unpublished doctoral dissertation)*. Columbus: Ohio State University.

Strayer, J. F. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientation. *Learning Environments Research, 15*(2), 171–193.

Wagner, D., Laforge, P., & Cripps, C. (2013). Lecture material retention: A first trial report on flipped classroom strategies in electronic systems engineering at the University of Regina. In *Paper presented at the Canadian engineering education association*, Montreal, Canada.

Warter-Perez, N., & Dong, J. (2012). Flipping the classroom: How to embed inquiry and design projects into a digital engineering lecture. In *Paper presented at the American Society for Engineering Education Pacific South West (ASEE-PSW) section conference*, San Luis Obispo, CA.

Yin, R. K. (2003). *Case study research* (3rd ed.). London: Sage.

Young, T. P., Bailey, C. J., Guptill, M., Thorp, A. W., & Thomas, T. L. (2014). The flipped classroom: A modality for mixed asynchronous and synchronous learning in a residency program. *Western Journal of Emergency Medicine, 15*(7), 938–944.

Zappe, S., Messner, J., Litzinger, T., & Lee, H. W. (2009). "Flipping" the classroom to explore active learning in a large undergraduate course. In *Paper presented at the American society for engineering education annual conference and exhibition*, Austin, TX.

Taotao Long is a Ph.D. candidate in Instructional Technology in the Department of Educational Psychology and Counseling at The University of Tennessee. Her research interests include flipped classroom, instructor professional development, and integrating technology in classroom.

John Cummins is a research associate in the Department of Plant Science at The University of Tennessee.

Michael Waugh is a professor in the Department of Educational Psychology and Counseling at The University of Tennessee.