5 Discussion

5.1 Overview

The purpose of this study was to explore the flipped classroom approach in a community college setting. Unlike previous studies that contrasted flipped classroom implementations with traditional lecture-based approaches, this study sought to compare the flipped classroom to both lecture-based and active/collaborative learning approaches. This study assessed the overall learning experience afforded by each approach, the impact each approach had on student perceptions of cognitive, teaching, and social presence, and finally the impact each approach had on student performance.

5.2 Learning Experience (Lecture, Active, and Flipped Approaches)

In this study, students rated the overall learning experience of each approach on the total core evaluation scale, which was based on all three main elements of Garrison's (2011) Community of Inquiry framework. Students rated both the flipped classroom approach and the active/collaborative approach significantly higher than the lecture/assignment approach. This result matches numerous studies that reported positive student ratings of the flipped classroom compared to traditional approaches (Arnold-Garza, 2014; Butt, 2014; Enfield, 2013; Gannod, et al., 2008; Guerrero, et al., 2013; Hoffman, 2014; Lage, et al, 2000; Love, Hodge, Grandgenett, & Swift, 2014; McGivney-Burelle & Xue, 2013; Schwartz, 2014; Taylor, et al., 2012; Van Veen, 2013) as well as studies that contended that active learning improves student attitudes (Bonwell, 1996; Bonwell & Eison, 1991; Davis & Minifie, 2013; Lou et al., 1996).

Students in this study also rated each teaching approach on the parallel attitudes scale, which included overall ratings of how worthwhile the learning activities were, how

effective they found the approach, and whether this was their preferred approach. On this scale, students rated the active/collaborative approach significantly higher than the lecture/assignment approach, which was supported by the qualitative comments that students made about each teaching approach overall. This result is congruous with previous studies that link active and collaborative learning to positive student attitudes (Bonwell, 1996; Bonwell & Eison, 1991; Davis & Minifie, 2013; Grant, 2013; Järvelä, Volet, & Järvenoja, 2010; Laal & Laal, 2012; Lou et al., 1996; Michael, 2006).

Of note is that the flipped classroom approach was not significantly different than the lecture-based approach on the parallel attitudes scale. Qualitative comments regarding flipped teaching generally indicated that it was not an effective approach for some students. This is consistent with a minority of previous studies that reported that some students preferred lecture-based teaching (Arnold-Garza, 2014; Findlay-Thompson & Mombourquette, 2014; Guerrero, et al., 2013; Larson & Yamamoto, 2013, Van Veen, 2013) and that some students had negative attitudes towards the learning activities of the flipped classroom approach (Amresh, et al., 2013; Butt, 2014; Enfield, 2013; Larson & Yamamoto, 2013), or flipped teaching generally (Amresh, et al., 2013; Missildine, et al., 2013; Strayer, 2012; Tune, et al., 2013).

There are a number of potential reasons as to why the students in this study did not rate the flipped classroom approach as highly as students in most other studies. With respect to cognitive presence, several students in this study found that applying concepts to practical problems in class was difficult. Also, students in this study may not have found that the flipped classroom approach was engaging. Concerning teaching presence, some students in this study had difficulty finding the time to watch the required videos before

class. Regarding social presence, some students in this study disliked group-work. Each of these potential reasons is discussed in further detail in the sections that follow.

5.3 Perceptions of Cognitive Presence

There were no significant differences in student ratings of cognitive presence among the flipped classroom approach, the lecture/assignment approach, and the active/collaborative approach in this study. However, the volume of students' open-ended comments relating to application of concepts and student engagement suggest that there were qualitative distinctions among the approaches. Each of these areas will be discussed in turn.

5.3.1 Application of Concepts

It was suggested in the literature that lectures alone may not be effective for deep understanding or for developing practical skills (Bligh, 2000; Bonwell, 1996; Cashin, 1985; Charlton, 2006). Pairing lectures with other learning activities is common (Bligh, 2000; Brown & Race, 2005; Cashin, 1985). Several students who commented on the lecture/assignment approach in this study noted that the lecture was helpful for completing the practical homework assignment. This may suggest that pairing lectures with practical homework assignments can be an effective approach in terms of enabling college students to apply programming concepts.

Students in this study rated the out-of-class activities for the active/collaborative approach as significantly less difficult than the other approaches, which was reinforced by many students' open-ended comments. This is consistent with other studies that contend that active learning techniques are effective for developing problem-solving skills (Bonwell, 1996; Bonwell & Eison, 1991; Davis & Minifie, 2013; Grant, 2013; Laal & Laal, 2012). A few

students in this study were critical of the active/collaborative approach in terms of the time pressure they felt in completing activities in-class, which is in line with the literature that suggests active/collaborative learning can be less time-efficient than lecture-based approaches (Bishop, & Verleger, 2013a; Bishop, & Verleger, 2013b, Bonwell & Eison, 1991; Davis & Minifie, 2013; Lage, et al, 2000). However, a majority of students rated the amount of time allocated to learning activities in the classroom for the active/collaborative approach units as "About Right."

Several students, commenting on the flipped classroom approach in this study, experienced considerable difficulty applying the concepts from the pre-class videos to the practical problems in class, contrary to the results of many other studies (Boucher, et al., 2013; Critz & Knight, 2013; Forsey, et al., 2013; Gaughan, 2014; Guerrero, et al., 2013; McGivney-Burelle & Xue, 2013; McLaughlin et al., 2013; McLaughlin et al., 2014; Slomanson, 2014; Toto & Nguyen, 2009; Yeung & O'Malley, 2014).

One might speculate that this discrepancy is due to issues with the effectiveness of the videos in this study, however, students reported that the videos were an effective way for them to learn basic concepts. Like other studies, students reported that being able to re-watch videos and move through content at their own pace helped their understanding (Davies, et al., 2013; Guerrero, et al., 2013; Larson & Yamamoto, 2013; McGivney-Burelle & Xue, 2013; McLaughlin et al., 2013; McLaughlin et al., 2014; Taylor, et al., 2012; Yeung & O'Malley, 2014). Alternatively, it is possible that a number of students in this study did not watch the pre-class videos. The audience view and retention data suggests that majority of students did watch videos, just as students in several other studies did (Arnold-Garza, 2014; Gaughan, 2014; Lasry, et al., 2014; Mason, et al., 2013a; McGivney-Burelle & Xue,

2013; McLaughlin et al., 2013; McLaughlin et al., 2014; Pierce & Fox, 2012; Sadaghiani, 2012; Slomanson, 2014; Tune, et al., 2013; Van Veen, 2013). However, a sizable minority of the students in this study did not watch the pre-class videos which may account for some of the difficulty encountered in class.

Another reason why students in this study had difficulty applying concepts might stem from the nature of the in-class problems used in the flipped classroom approach. In the active/collaborative approach, in-class activities tended to be short, highly structured, and instructor-led. Students solved more complicated problems outside of the rigid time-limitations of the in-class session. In contrast, the in-class exercises of the flipped classroom tended to be longer, less well-defined, and minimally guided. It may have been that this form of in-class problem as ill-suited for first year community college students. Although this explanation is speculation, it fits with studies that reported that the flipped classroom approach was not suitable for first year classes (Mason, et al., 2013a; Yeung & O'Malley, 2014), as well as evidence that suggested that minimal guidance approaches are less effective than techniques featuring explicit instructor guidance (Kirschner, et al., 2006).

5.3.2 Student Engagement

Many of the students in this study remarked that the lecture component of the lecture/assignment approach did not hold their attention, which is supported by Cashin's (1985) assertion that the students' attention can wane quickly in a lecture. In contrast, students in the study found that the active/collaborative approach sustained their attention effectively, which is aligned with other studies that report that

active/collaborative learning increases student interest and engagement (Bonwell & Eison, 1991; Davis & Minifie, 2013; Grant 2013; Laal & Laal, 2012).

Student engagement was expected to be high in the flipped classroom approach based on the results of several other studies (Azemi, 2013; Critz & Knight, 2013; Enfield, 2013; Frydenberg, 2013; Gannod, et al., 2008; Gaughan, 2014; Hoffman, 2014; Lasry, et al., 2014; Lucke, et al., 2013; McLaughlin et al., 2013; McLaughlin et al., 2014; Ryan, 2013; Strayer, 2012), but there was little evidence of this in the students' open-ended survey comments.

One possible factor that may be contributing to this discrepancy is that the students in this study were community college students, who are typically more focused on practical skills rather than theoretical concepts. It stands to reason that these students, who found that in-class lectures were boring, would find that watching online videos passively was no more engaging. Another possible factor that may have reduced student engagement in the flipped classroom was that the course content was computer programming, which is essentially applied problem-solving. It might be that the students felt that watching videos about programming concepts was not relevant to their learning goals. Another potential factor was that students in this study that reported having difficulty applying concepts may have felt disengaged as a result.

5.4 Perceptions of Teaching Presence

In this study, there were no significant differences in the student ratings of teaching presence in the flipped classroom approach when compared to either the lecture/assignment approach or the active/collaborative approach. However, the active/collaborative approach had a significantly higher student rating of teaching presence than the lecture/assignment approach. The students' qualitative responses

suggested that teaching presence was most evident in the availability of timely guidance and feedback for both the active/collaborative approach and the flipped classroom approach. In the lecture/assignment approach, teaching presence was predominately about the clarity and amount of detail furnished by direct instruction. Students also commented on the flexibility in the time and place of instruction with the flipped classroom approach. Each of these will be discussed in turn.

5.4.1 Availability of Timely Guidance and Feedback

One aspect of teaching presence which was similar in both the flipped classroom and active/collaborative approach was that students appreciated that guidance and feedback was available immediately in the classroom. This aligns with flipped classroom researchers that reported more frequent interaction between individual students and the instructor (Gannod, et al., 2008; Gaughan, 2014; Lage, et al, 2000; Pierce & Fox, 2012; Slomanson, 2014; Van Veen, 2013), that students recognized that the role of the instructor in the classroom was to provide support (Frydenberg, 2013; Gannod, et al., 2008; McGivney-Burelle & Xue, 2013), and that students liked being able to ask questions and receive feedback in class (Butt, 2014; Gannod, et al., 2008; McGivney-Burelle & Xue, 2013; Yeung & O'Malley, 2014). With regard to the lecture/assignment approach, students also valued the ability to ask questions and receive an immediate answer during a live lecture, but some noted difficulty resolving questions related to the homework assignment.

5.4.2 Clarity and Amount of Detail of Direct Instruction

Anecdotally, teaching presence in lecture/assignment approach was evident in terms direct instruction. Students in this study appreciated the clarity of the lectures, the amount

of detail they covered, and that they signalled what content was most important for them to understand. Each of these observations is aligned with advantages of lecture-based teaching reported in literature (Bligh, 2000; Brown & Race, 2005; Cashin, 1985; Charlton, 2006; Kirschner, Sweller, & Clark, 2006; Race, 2007). Alternatively, there were very few student comments that addressed direct instruction with regard to the active/collaborative or flipped classroom approaches.

5.4.3 Flexibility in the Time and Place of Instruction

A small number of students in this study reported that a benefit of the flipped classroom approach was being able to watch on-line videos when and where it was convenient for them. This sentiment was also reported by a number of other studies (Amiri, et al., 2013; Boucher, et al., 2013; Forsey, et al., 2013; Guerrero, et al., 2013; Lucke, et al., 2013; Yeung & O'Malley, 2014). However, other students in this study indicated that it was difficult to find the time to watch videos before class. One possible explanation is that it may have been harder for some students to establish a consistent study/homework routine because the teaching approach changed each time they started a new unit. While this is just speculation, a number of other studies have noted that students need to adjust their study habits with the flipped classroom approach (Guerrero, et al., 2013; Mason, et al., 2013a; Strayer, 2012). Another possible explanation is that, as discussed previously, college students may not find that watching videos about concepts is relevant to learning a practical skill, so finding the time to watch them before class is not a high priority.

5.5 Perceptions of Social Presence

In this study, the flipped classroom and the active/collaborative approaches showed significantly higher social presence than the conventional lecture/assignment approach.

The strength of the flipped classroom approach regarding social presence appears to stem from the students' appreciation for working with one another in class. In contrast, the lecture/assignment approach in this study did not have a group work component. This is aligned with the current literature which suggests that working collaboratively with peers in class is a positive feature of the flipped classroom (Amiri, et al., 2013; Ferreri & O'Connor, 2013; Frydenberg, 2013; Lage, et al, 2000; Love, et al., 2014; Ryan, 2013; Strayer, 2012).

A small number of students in this study noted negative feelings about the group work requirement of the flipped classroom. Ryan (2013) reported a similar sentiment; that some students had negative attitudes about group-work in the flipped classroom because they were concerned that grade assignment would not be equitable and that individual effort would not be recognized appropriately.

Moderately improved student perception of social presence was also observed when comparing the active/collaborative approach to the lecture/assignment approach. Like the flipped classroom approach, students worked collaboratively in class, however, several students had difficulty keeping pace in class with their peers, or found that pausing activities to help students having difficulty was disruptive. This is likely due to the fact that more of the activities in the active/collaborative classes were guided by the instructor than in the flipped classroom. Despite this, the mean social presence score for active/collaborative approach and flipped classroom approach were not significantly different.

5.6 Student Performance

In this study, quiz grades were used to measure student performance for each of the three teaching approaches. There were no significant differences in quiz grades among the flipped classroom approach, the lecture/assignment approach, and the active/collaborative approach. In the current literature, the impact of the flipped classroom approach student performance is mixed with many researchers reporting significant positive gains (Ferreri & O'Connor, 2013; Mason, et al., 2013a; McLaughlin et al., 2014; Missildine, Fountain, Summers, & Gosselin, 2013; Pierce & Fox, 2012; Talley & Scherer, 2013; Tune, et al., 2013; Wilson, 2013), and other researchers reporting no significant differences (Davies, et al., 2013; Findlay-Thompson & Mombourquette, 2014; Guerrero, et al., 2013; Larson & Yamamoto, 2013; Love, et al., 2014; Mason, et al., 2013b; McLaughlin et al., 2013). This study aligns with the latter group.

Of note is that the quizzes examined in this study focussed on the student's basic comprehension of unit content. The students' ability to analyse requirements and apply concepts in the context of a problem was evaluated, but these grades were calculated differently for each teaching approach, so direct comparisons were not valid. Differences in the method used for calculating grades after implementing a flipped classroom were also found in the literature (Ferreri & O'Connor, 2013; Wilson 2013). With this in mind, lack of a significant difference in quiz grades between the active/collaborative approach and the lecture/assignment approach is aligned with other studies that suggest active learning and lecture-based techniques are comparable for learning content knowledge (Bonwell & Eison, 1991; Grant 2013).

The lack of a significant difference in quiz grades between the flipped classroom approach and the lecture/assignment approach might have a similar explanation. It may be possible that the flipped classroom approach is comparable to lecture for learning content knowledge, but could result in superior student performance when assessing problem-solving and higher order thinking skills, like active learning generally (Bonwell, 1996; Bonwell & Eison, 1991, Davis & Minifie, 2013). This study does not answer this question however.

5.7 Limitations and Future Research

5.7.1 Overview

Careful attention was paid to measures designed to ensure the quality of this study. For example, a thorough description of the participants including their disposition towards certain learning activities was established to provide an appropriate context, a highly reliable scale was developed based on an established framework and a secondary scale was used for additional validation, the teaching approaches were alternated in the study such that participants had the opportunity to evaluate each approach twice, and qualitative data was used interpret the quantitative results.

However, there were a number of limitations in this study that provide opportunities for future research, including issues with the size and representativeness of the sample, issues relating to the researcher also being the instructor, survey fatigue and non-response bias, the constant pedagogical change, the limited qualitative data collected, the limited assessment of student performance, issues with differentiating the teaching approach by in-class learning activity, and issues matching learning activity to learning objective. Each of these will be discussed in turn.

5.7.2 Small, Non-Representative Sample

All of the students in this study were in the same program cluster, taking the same computer programming course, taught by the same instructor, at one community college. In particular, almost all the students in this study were male, which is obviously not representative of the entire community college student population. Given this relatively small convenience sample, generalizations cannot be made about the flipped classroom approach and its suitability for all community college students. Additional research is needed that involves more students with different instructors in a greater variety of programs and courses at different community colleges.

5.7.3 Researcher was the Instructor

In any study of student participants in which the researcher is also the instructor, potential issues arising from the unequal power relationship between the students and the instructor need to be addressed (Clark, & McCann, 2005; Comer, 2009). Students may believe that a decision to decline participation or respond candidly could have a negative impact on their relationship with the instructor or otherwise disadvantage them, which poses ethical problems (Comer, 2009, Clark, & McCann, 2005) and calls into question the validity of the data being collected.

To mitigate these issues, measures were taken in this study to ensure the anonymity of the participants (Clark, & McCann, 2005; Comer, 2009), such as the use of an on-line survey platform so students could take the survey in a private environment, outside of the classroom (Comer, 2009) and avoiding the collection of demographic information that could be used to triangulate certain participants' identities (Clark, & McCann, 2005; Comer,

2009). In addition, the students' right to decline to participate without fear of repercussions (Clark, & McCann, 2005) was explicitly communicated (Appendix B).

While there was no indication that these measures were not effective in this study, it may be prudent in future research to separate the instructor and researcher roles (Clark, & McCann, 2005; Comer, 2009).

5.7.4 Survey Fatigue and Non-Response Bias

The student response rate for surveys in this study decreased from nearly half the students at the beginning of the study, to approximately one-eighth of the students by the end of the study. With seven different surveys for students to complete over the course of the semester, it is likely they experienced survey fatigue (Porter, Whitcomb, & Weitzer, 2004). As a consequence, there were an unequal number of students that responded to surveys for each approach, increasing the probability of non-response bias (Berg, 2005) for the flipped classroom approach surveys in particular.

5.7.5 Constant Pedagogical Change

Research suggests that the flipped classroom approach requires a change in student study habits (Guerrero, et al., 2013; Mason, et al., 2013a) and that acceptance of the flipped classroom approach took time (Butt, 2014; Mason, et al., 2013a; Van Veen, 2013). In this study, the teaching approach changed every two weeks, which did not give students much opportunity to acclimatize. As a result, student ratings of the less familiar approaches in this study may have been different than if the approach was used consistently throughout the course.

5.7.6 Limited Qualitative Data

The open-ended comments collected from students on the Post-Unit surveys provided explanatory information that was useful for interpreting the students' quantitative ratings. However, student interviews or focus groups might have yielded more in-depth qualitative data that would have been valuable for better understanding the differences among the three teaching approaches in this study

5.7.7 Limited Assessment of Student Performance

In this study, comparing student performance among the lecture/assignment, active/collaborative, and flipped classroom approaches was limited to analysing grades from quizzes that assessed the basic comprehension of unit content. Higher levels of learning were assessed in the course, however grades for these assessments were calculated using different criteria from one approach to another. As a result, this study contributed no insight into how the flipped classroom approach might impact the students' performance in reference to more demanding cognitive processes, such as to *apply*, *analyse*, *evaluate* and *create* (Krathwohl, 2002). Further research would be valuable in order to better understand how flipped teaching influences student performance at higher levels of learning and which kinds of performance objectives might be best addressed by a flipped classroom approach.

A second issue related to the limited student performance data in this study was the reliance on the students' self- assessments of how each teaching approach impacted their learning. While there is evidence that how students rate their learning often correlates with objective measurements of their performance (Benton, Duchon, & Pallett, 2013), there

was insufficient performance data collected to test the validity of the students' self-reported ratings of learning in this study.

5.7.8 Differentiating Approach by In-Class Learning Activity

This study compared specific implementations of three teaching approaches. An effort was made to clearly differentiate each one in order to provide the students with definitive items to compare. However, any of the approaches could have been implemented using other learning activities in the classroom. For example, the in-class lectures in this study featured several interactive elements such as active questioning, short class-level discussions, and demonstrations, which were manageable with class sizes of less than 40 students. From another perspective, such interactive lectures might be categorized as active-learning whereas "lecture" could refer to a one-way didactic presentation to hundreds of students at once. In another example, step-by-step guided instruction was the in-class learning activity used most often in the active/collaborative units of this study. In the flipped classroom approach, students solved more substantial problems together in class with less direction from the instructor. Although both activities are considered active learning, they are substantially different in terms of how cognitively demanding they are and the level of competency they are intended to develop. Active learning describes a broad variety of potential in-class teaching strategies, any of which might be used in a flipped classroom or an active learning based approach, potentially to different effect. One would expect that major variations in the learning activities used in the classroom for each of the three approaches might yield different ratings and observations from the students.

Further research is needed to understand any impact of the flipped classroom approach might have beyond the effectiveness of specific in-class learning activities. For example, comparisons between flipped classroom approaches and an active/collaborative approaches in which the same in-class teaching strategies are used might reveal the relative value of pre-class content videos more definitively.

5.7.9 Matching Learning Activity to Learning Objective

Anecdotally, it became evident in teaching this course that certain content lent itself to specific learning activities. For example, one of the learning objectives in one of the units in this course related to *in-line functions* in C++. Students needed to understand conceptually how an in-line function was different than a regular function and what the consequences on using in-line functions were. Procedurally, they needed recognize the conditions in which in-line functions should be used and how to implement an in-line function. In this study, in-line functions fell into one of the active/collaborative approach units, however, a guided hands-on exercise was not ideal for this content. The procedural aspects were very simple and arguably did not warrant the in-class time needed to perform a hands-on exercise. On the other-hand, the conceptual aspects of in-line functions were not easily demonstrated by practical application and would be extraordinarily difficult to discover through exploration. In this case, experiencing in-line functions in C++ seemed far less effective for learning than a direct explanation would have been. There were a few times through the course in which the learning objective and the learning activity prescribed by the teaching approach felt mismatched.

Ertmer and Newby (2013) argue that a full consideration of both the learner and the task is critical in the selection of an appropriate instructional strategy. If that is the case

then perhaps future research should focus on determining which kinds of learning activities (e.g. listening to a lecture, participating in a discussion, watching a video, following hands-on instructions, solving a realistic problem, etc.) are best suited to different learning objectives for students with various aptitudes and levels of experience.

5.8 Conclusion

The flipped classroom approach showed great promise in the literature when compared to lecture-based approaches in a university setting. Overall, the literature indicated that the majority of students had positive attitudes towards the flipped classroom. Although some students took time to get used to the flipped classroom, and others disliked it for the amount of independent learning required, most students reported that flipped approach enhanced their learning, especially when it came to applying knowledge and skills. Many students reported that flipped learning was effective for discussion and collaboration and they liked the increased feedback and interaction with the instructor. Most students in the literature tended to be highly engaged in the flipped classroom environment. Two things were missing from the literature however: first, any examination of the flipped classroom in a community college environment, and second, direct comparisons of the flipped classroom to teaching approaches based on active/collaborative learning. This study sought to address those gaps.

Generally, the community college students in this study had more modest attitudes towards the flipped classroom approach than the students in the literature. They rated the flipped classroom approach significantly higher than the lecture/assignment approach in terms of the overall learning experience and social presence. Key strengths of the flipped classroom approach in this study and the literature are the opportunity for students to

work with one another in class, and the availability of the instructor for guidance and immediate feedback in the classroom. However, when it came to overall attitudes and preferences, cognitive presence, and teaching presence, student ratings of the flipped classroom approach were not significantly different than the lecture/assignment approach. In particular, students in this study found that solving problems in-class was too difficult and they did not report any increased engagement, contrary to the literature.

Moreover, students in this study rated the active/collaborative approach significantly higher than the lecture/assignment approach in almost every category. Like the flipped classroom approach, they appreciated the increased collaboration and instructor interaction, however, they found the instructor-led classroom exercises more engaging.

These results have practical implications for community college instructors seeking a pedagogical refresh. Rather than investing considerable time and resources to develop on-line videos and other pre-class learning materials, it may be advisable instead to focus on carefully selecting in-class instructional strategies and designing better learning activities. These learning activities must align well with the knowledge and skill level of the students as well as the nature of the content or task to be learned (Ertmer & Newby, 2013). After full consideration, an instructor may determine that flipping some teaching is appropriate for their course, however, no singular teaching approach is ideal in all situations, including the flipped classroom approach.