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The Flipped C# Programming Classroom: What Students Had to Say

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Abstract

The purpose of this paper is to report on what students had to say about the flipped C# programming classroom in terms of its strengths, its weaknesses, their willingness to take another flipped class, their willingness to recommend the flipped classroom to other students, and any general comments regarding the approach that they wanted to pass along. An open-ended survey was used to collect data from two sections of an introductory C# programming course in fall 2015 and spring 2016. Data was analyzed using an iterative process to identify common themes. The results indicated that overall the participants viewed the flipped C# classroom positively, although some participants still preferred the traditional classroom environment. Based upon responses of participants and the author's experience recommendations are suggested. As the flipped class movement continues to grow the hope is that this study will make a contribution to its implementation in information systems education.

Keywords: flipped classroom, C# programming, information systems, instructional approach

1. INTRODUCTION

The implementation of the flipped classroom continues to grow across multiple disciplines, information systems notwithstanding. The following paper reports on a study conducted across the fall 2015 and spring 2016 semesters in an introductory C# programming course using the flipped classroom approach. Participants were asked to complete a survey to illicit their comments in regard to the strengths and weaknesses of the flipped classroom, whether or not they would enroll in another flipped class, and whether they would recommend the flipped classroom to other students. Finally, participants were given an opportunity to provide any additional comments related to their experience in the flipped classroom.

2. BACKGROUND

The flipped classroom has been defined as "a pedagogical model in which the typical lecture and homework elements of a course are reversed" (Educause, 2012, p. 1). While it has been suggested that little to no scientific research indicating how well flipped classrooms work (Goodwin & Miller, 2013), there is currently a growing number of empirical studies examining the effect of the flipped classroom. A good portion of those studies examine student perception, but research investigating student performance in the flipped classroom is increasing along with studies specifically related to information systems education.

In regard to student perception, one study found that in an actuarial techniques course that "75% of total respondents viewed the flipped classroom as being beneficial to their learning compared to the didactic lecture structure" (Butt, 2014, p. 41). Another study found that the flipped classroom increased student confidence, engagement, self-efficacy, and independent learning (Enfield, 2013). A final study reported that students perceived that they did better in the flipped classroom, were afforded more opportunities to ask questions of their classmates, and believed

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overall that the flipped classroom provided a better learning environment (Findlay-Thompson & Mombourquette, 2014).

Regarding student performance, one study found that the average grade in the flipped classroom was consistently higher than the average grade in the traditional class when compared across semesters at a statistically significant level (Asef-Vaziri, 2015). Another study compared an inverted classroom to a traditional classroom for an engineering course in terms of course coverage, student performance, and student perception. Students perceived that course content in the inverted classroom moved more quickly than the traditional classroom. Students in the inverted classroom performed statistically better on several concepts than the traditional classroom, and student perception of teaching were similar in both (Mason, Shuman, & Cook, 2013).

Instances of the flipped classroom are also showing up in traditional information systems courses as well. Several studies have been conducted related to introductory and advanced spreadsheet courses (Davies, Dean, & Ball, 2013; Frydenberg, 2013; Urbaczewski, 2013), management information systems (Adkins, 2013), and object-oriented programming with Java (Fryling, Yoder, & Breimer, 2015; Mok, 2014).

3. METHODOLOGY

Participants
Participants in the study were undergraduate students enrolled in an introductory C# programming course in the fall 2015 and spring 2016 semesters. Demographic information related to classification, gender, major, and course grade are provided below in Tables 1, 2, 3, and 4:

Classification	Fall 2015	Spring 2016
Freshman	1	1
Sophomore	3	10
Junior	7	14
Senior	4	3
Total	**15**	**28**

Table 1 - Classification

Gender	Fall 2015	Spring 2016
Male	10	25
Female	5	3
Total	**15**	**28**

Table 2 - Gender

Major	Fall 2015	Spring 2016
Art	1	-
Accounting	1	1
Applied Science	-	1
Business Admin	-	1
CIS	11	21
Computer Sci.	1	2
Gen. Studies	1	-
Finance	-	1
Math	-	1
Total	**15**	**28**

Table 3 - Major

Course Grade	Fall 2015	Spring 2016
A	5	13
B	4	9
C	2	4
D	1	1
F	1	1
Q	2	-

Table 4 - Grades

Data Collection and Analysis
The course was structured with assigned video demonstrations to be watched prior to the class session to cover the associated material. The students were required to take a short quiz over the content of the video demonstration. Over the course of the 16-week semester students watch 29 videos and took 26 quizzes over those videos. During the class session an exercise was distributed in class related to the assigned topic. Students were first instructed to work independently on the exercise, after a reasonable amount of time students were then able to consult with their classmates, and finally students were able to ask the instructor for feedback.

The data collection instrument was an open-ended survey containing five items related to the strengths and weaknesses of the flipped classroom, participant's willingness to take another flipped class, participant's willingness to recommend the flipped class to other students, and any other comments the participants wished to make (see Appendix A). The survey was reviewed for content validity by three faculty colleagues from different disciplines who implemented the flipped classroom. Of the 43 students enrolled across both semesters of the course, 27 students completed the survey for a 62% completion rate. Survey responses were download from Blackboard into an Excel spreadsheet and then copied and pasted into a Word document for analysis. Analysis of the data consisted of an iterative process of examining the

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participant responses and identifying common themes within the larger context of strengths, weaknesses, willingness to take another flipped class, willingness to recommend a flipped class to others, and general comments.

4. RESULTS

Strengths

Use of Online Resources

Consistent with the literature a reoccurring strength listed among participants was the ability to utilize online resources outside of the class at their own convenience and pace. This was especially true of the professor-created video demonstrations that were provided covering specific course content in detail. As one participant commented, "a strength of the flipped classroom is the ability to go back and review the videos over and over. I could stop them and go back if I missed a step". The ability to view the videos as many times as desired and to be able to stop, start, and rewind the videos was a common theme as evidenced by phrases such as "learn at your own pace" and "view materials again and again" (Sharp & Schultz, 2013; Sharp & Sharp, 2016) . Another participant summed it up this way, "I feel that the videos aid also in learning core concepts because of the ability to re-watch the video at later times, unlike a lecture that cannot be rewound". Participants also noted that the videos provided good introductions to the assigned topics, helped them prepare questions before class, allowed for more depth of coverage in class, and served as a convenient reference while working on assignments.

Hands-On Experience and Practical Application

Another common strength mentioned by participants was the ability to gain hands-on experience and practical application of the course content. As one participant noted, "we were able to get a more hands-on approach to learning the material which I thought helped me a lot". Another participant stated that, "by working on exercises in the classroom I was much better able to understand the concepts". This participant indicated that having to figure out things at home without the benefit of the hands-on classroom exercises made learning much more difficult and posed a struggle in previous programming classes.

In regard to practical application one participant commented that, "it allows for material from the text such as terms and syntax to be covered outside of class. This allows for class time to be used for practical application which is beneficial to all." Another participant summed up the application of material very well by stating that, "in a standard classroom, the material is rushed through in an attempt to apply the material at the end of the class. Typically application doesn't occur in a standard classroom"; however, in the flipped classroom, "there is time for application of material".

Increased Participation

Similarly, increased participation was cited by several participants as a strength. One participant commented that by working on exercises in class "students are more prone to get work done and more practice on the material, which increases the chances for a better grade". However, the participation mentioned by participants was not simply with the material, but also with the instructor. The ability to ask questions of the instructor while working on the material and receive instant feedback was also a common theme. One participant likened participation with the instructor as "a chance for one-on-one help with misunderstandings". Another participant indicated that, "the biggest strength [is] having time in class to perform exercises while having the professor present to assist and provide help, instead of doing that at home without instant feedback". Finally, a participant stated that the flipped classroom "holds the student more accountable to actually listen and participate with information they learned on their own". In sum, the flipped classroom allows time for more practice and a helping hand when working through in-class activities.

Weaknesses

Use of Online Resources

The use of online resources was also listed as a weakness by some participants. If the instructor fails to engage the students in the online component, the flipped classroom may suffer the same fate as a purely online course where the instructor is not actively involved with the students in that neither are very effective for learning. Another concern communicated was that the inclusion of the online components "exceeded the expectations of a face-to-face class". One participant in particular indicated that this additional work placed stress on them.

While the professor-created video demonstrations received many positive comments, there were negative comments provided as well. Several participants suggested

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that some people do not learn as well through the use of video. As one participant stated, "I am better at learning something if I am doing it with the teacher and watching them in person. That way if I have a question, I can get it answered right there". This participant also noted that they "get distracted learning from a video approach". Another participant felt like the video content was "not clear until we actually did it in class and had a chance to ask questions". This sentiment was echoed by other participants in regard to the inability to ask questions while watching the videos. A participant summed it up this way, "you can take the questions to the classroom later, but I always forgot what they were by the time I got to class".

Increased Time Requirements

Related to the use of online resources many participants felt the flipped classroom increased the amount of time that they were required to spend on the course. As noted above, the flipped classroom "exceeded the expectations" of a more traditional classroom environment. Some participants felt that the flipped classroom required more from them than the traditional classroom. One participant went so far as to state that "extra work can bog down the ambition to excel in class due to covering material ahead of time". Another participant remarked that "it was kind of annoying to have to watch four videos and take four quizzes before class everyday".

Lack of Preparation/Participation

Some participants responded that students not "preparing themselves before going to class" is a potential weakness of the flipped classroom. Another participant just called this "laziness" on the part of some students. However, it was noted that ultimately the student is responsible for being prepared and that instructors "should hold them accountable for that material". For others it was not necessarily intentional lack of preparation or laziness, but simply forgetting to watch the videos and take the quizzes prior to coming to class. It was suggested that by some that students should not be penalized for failing to watch a video or take an assigned quiz. Lack of participation was also cited as a weakness. One participant commented that while the requirement to watch assigned videos prior to class can be helpful it becomes tedious over time and student participation tends to decrease. Consequently, students often begin to wait until the last minute to watch the videos and take the quizzes or simply stop all together.

Take Another Flipped Class

The participants were also asked if they would be willing to take another course using the flipped classroom approach and to explain why or why not. Of the 27 students who participated in the study, 17 indicated "yes", 1 indicated "no", 6 responded in various other ways, and 3 did not answer. For those who responded "yes", several themes emerged: (1) it was very helpful for learning the course content because the instructor was present while working on in-class assignments, (2) ability to review the videos any time and, (3) studying on my own outside of class and then doing exercises in class, (4) you can set your own pace to learn the material and go back over things if needed, and (5) practical application is more important than lecture. For those responding "no", reasons included that they learn better face-to-face and that their particular learning style is geared toward a more traditional classroom environment. Others indicated that it would depend on the class subject and the amount of out-of-class requirements.

Recommend the Flipped Class to Other Students

In response to the question "would you recommend the flipped classroom approach to other students?" 17 participants responded "yes", 1 responded "no", 3 did not respond, and 6 indicated that it would depend upon the individual student and the course subject. For those who would recommend the flipped classroom the responses echoed many of the strengths that were identified such as the benefits of the hands-on approach through in-class exercises, less emphasis on simply listening to a lecture every day, practical application of course content and more opportunity to get deeper into the subject, and greater understanding of concepts. As one participant summed it up, "it allows you to get more hands on experience with the material in the classroom where you can receive help when you need it as you work on solutions that are very similar to what we are tested over".

The one participant who would not recommend the flipped classroom did not provide an explanation. Finally, several participants indicated that it depends on the individual student since everyone is different and different students learn in different ways and also the subject being taught. It was suggested that if students enjoy preparing outside of the class and working on activities in class then the flipped classroom is a good recommendation for them. On the other hand, one participant commented that it is not for everyone, "it requires a level of independence and

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responsibility that some students just don't have."

Additional Comments

Participants were given the opportunity to provide any additional comments related to the flipped classroom. Responses included both positive, neutral, and negative comments. Positive responses suggested that the flipped classroom approach was very well suited to a C# programming course and that having the ability to work at a self-pace outside of class and then do the actual work in class was very beneficial. The combination of the elements of videos, class summaries, and in-class activities were found to be helpful. As one participant commented, "I feel like as long as you keep the main focus of learning inside the classroom, while using videos to aid and supplement outside of class, things should continue to run smoothly".

Other comments were not quite so positive. One participant stated, "I personally did not like the flipped classroom. It was confusing and took up a lot of time outside of the classroom". Similarly, another participant commented by saying "there was a tremendous amount of work in the class". Still another participant indicated, "Like I have already stated it's not for everyone. Me personally I did not like it". Other participants were somewhere in the middle indicating "I did not hate it. But I am still for the traditional classroom setting". One student recommended that due dates be posted well in advance in order to lessen the pressure and provide students "more control of when they want to learn the material; that way, students would not make the flipped classroom work as much as a hassle and more of a valuable privileged and asset".

5. DISCUSSION AND CONCLUSIONS

Overall, the response of participants to the flipped C# classroom was quite positive. The strengths and weaknesses identified appeared to be consistent with literature on the flipped classroom. Consistent strengths included the ability to review online resources (most often videos) as many times as desired, availability of the instructor to ask questions while working on in-class activities, practical application of course content through hands-on exercises, and increased participation with material, classmates, and the instructor were identified (e.g., Frydenberg, 2013; Fryling et al., 2015; Mok, 2014). In terms of weaknesses increased expectations, failure of videos to meet the needs of some students (notably the inability to ask questions while watching the videos), increase in out of class requirements such as watching videos and taking quizzes which may lead some students to fail to participate in and/or prepare for class were identified as weaknesses. The majority of participants indicated that they would take another flipped classroom as well as recommend the flipped classroom to others.

Based upon what students had to say about the flipped C# programming classroom and the experience of implementing it over the course of two semesters the following recommendations are suggested. First, carefully consider the number of videos to be watched and quizzes to be completed prior to each class period. In hindsight, a reduction of videos and quizzes might have reduced the stress on students and kept them more engaged. For those not familiar with the flipped course it can certainly be a bit overwhelming at first, as noted by several participants. Second, make sure and allow for questions during class time and encourage students to jot down any questions that may arise while they are watching the videos are encourage them to pause the video and sent an email immediately so that they do not forget before the next class period. Finally, encourage more collaboration between students during the in-class activity. This might assist those who do not come to class prepared to get up to speed more quickly, provide some peer motivation, and allow stronger students to help those who are having trouble. Specifically, studies have shown that pair programming provides a benefit to students (e.g., Maguire et al., 2014; Porter et al., 2013; Williams, 2002).

While this study does shed some interesting findings about what students had to say about the flipped classroom it is not without several limitations. First, the sample size is reasonably small and so generalizability is a challenge. Second, the responses are self-reported and it could be that some students were reluctant to provide completely honest answers although participation in the study was completely anonymous, voluntary, and data was not reviewed until after the end of the semester and final grades had been posted. Finally, there was a small set of questions which covered only a subset of potential issues related to the flipped classroom. The study could certainly be improved by increasing the number of participants, ensuring the students felt comfortable in completing the survey, and expanding the question set.

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As the use of the flipped classroom continues to grow in higher education and more specifically in the information systems discipline, and particularly in programming courses, having an idea of what students have to say about the strengths and weaknesses of the approach can assist instructors in improving the learning experience for their students. Hopefully this study can make at least a small contribution toward that end.

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Appendix A

Student Survey

What do you feel are the strengths of the flipped classroom approach?

What do you feel are the weaknesses of the flipped classroom approach?

Would you be willing to take another course using the flipped classroom approach? Why or why not?

Would you recommend the flipped classroom approach to other students? Why or why not?

Please provide any additional comments you would like to make below: