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Journey Toward a Flipped C# Programming Class: An Experience Report

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Abstract

With the current emphasis on student engagement, student success, and active learning a focus on course redesign has hit higher education. While course redesign efforts of varying approaches have been used throughout the years, the flipped classroom is growing in popularity in university classes across multiple disciplines. The purpose of this paper is to discuss the factors driving the movement toward course redesign, the disciplines for which it has been applied, and more importantly to provide examples of its implementation in information systems courses. The paper also serves to present the authors own journey toward the flipped classroom in an introductory C# programming course.

Keywords: Flipped classroom, course redesign, C# programming, information systems

1. INTRODUCTION

Course redesign is currently a growing phenomenon within institutes of higher education. Student engagement, student success, and active learning are the buzzwords of the day on university campuses around the country. The purpose of this paper is to discuss the factors driving the movement toward course redesign, identify disciplines for which it has been applied, and more specifically how course redesign has been applied in information systems education. The concept of "flipping" the classroom is becoming quite popular among college instructors across multiple disciplines as a course redesign strategy. After many years of teaching programming in a more traditional manner (Zhang, Zhang, Stafford, & Zhang, 2013), the author has finally decided to make the move toward a flipped classroom. Consequently, this paper will also illustrate a progressive course redesign effort as the author begins the process of redesigning an undergraduate C# programming course according to the flipped classroom model. As such the first part of the paper provides an overview of course redesign while the second part provides a narrative of the authors journey concluding with a proposed course schedule.

2. OVERVIEW OF COURSE REDESIGN

Factors Driving Course Redesign

Turner and Carriveau (2010) suggest that multiple factors are driving the move toward course redesign. First, in regard to student success the authors indicate that in general education courses the number of Ds and Fs can account for over one-quarter of the students in some courses. For example in a class of 100 students this equates to approximately 25 students receiving a D, F, or withdrawing from the course. Many in higher education are concerned with the rise in drop, fail, and withdraw rates especially with formula funding moving toward a student success-based (i.e., graduation rates) rather than an enrollment-based model.

Second, Turner and Carriveau (2010) argue that higher education is rapidly changing from the traditional 18-22 year old student to a much more diverse demographic. For example,

emphasis on every person having a college education or the 2008 financial crisis are cited as contributing to the increase in higher education enrollment. This along with growth along ethnic lines means college classrooms will continue to be larger and more diverse.
Third, Turner and Carriveau (2010) cite that the decline of state support, increases in administrative expenses, other non-academic related costs, and myriad of other expenses are contributing to the continued rise in the cost of a college education. Fourth, the authors point to the fact that in many classes there has been no discernable change in the way instructors teach although research in the area of how students learn has continued to increase. They suggest that some faculty are so obsessed with "coverage" that the idea of removing topics from the course in an effort to facilitate deeper learning will negatively affect the student, especially if their course is a prerequisite to another.

Finally, accountability is cited as a cause for the move toward course redesign. From state and federal government to accrediting agencies "higher education will be held more accountable in the future" (Turner & Carriveau, 2010, p. 7). As noted above, the move by state legislatures from an enrollment-based funding model to a success-based funding model is forcing many universities to seriously consider the design of courses. In conclusion the authors state, "we know that if we provide an active learning experience that allows students to engage with the content, each other, and instructors, they can and will think critically and develop cognitively" (Turner & Carriveau, 2010, p. 8).

The Flipped Classroom

Various approaches to course redesign have been proposed. Berry (2009) suggested a process-centered business curriculum redesign strategy. Fallahi, Levine, Nicoll-Senft, Tessier, Watson, and Wood (2009) used Fink's taxonomy as an interdisciplinary approach to course redesign. Derting and Ebert-May (2010) redesigned an undergraduate biology course using an inquiry-based, learner-centered approach. Another approach which is gaining popularity across multiple disciplines is the flipped classroom model.

The basic concept of the flipped classroom is to move course content traditionally covered in a lecture format into an online format (e.g., video lectures, voice-over PowerPoint, SoftChalk presentations, podcasts, etc.) and use to class time for active learning assignments, engagement with other students, and interaction with the instructor as a source of assistance. Although the flipped classroom has experienced a recent surge in popularity, it is not a new concept. The concept of "inverting" the classroom or taking "events that have traditionally taken place *inside* the classroom now take place *outside* the classroom and vice-verse" has been around for quite some time (Lage, Platt, & Treglia, 2000, p. 32; Strayer, 2007).

Many identify the implementation of online voice-over PowerPoint presentations in a high school chemistry class in 2007 as the start of the modern flipped classroom movement. Two classroom teachers did this in an effort to assist students who missed classes due to attendance at sporting events. A primary take away was the way that flipping the classroom transformed their classes in terms of increased interaction between teacher to student and between student and student. Strategically students were organized into tutorial groups, mini-lectures were conducted, and just-in-time instruction was implemented. The teachers became tutors and students worked together to help each other. As the authors commented, "It truly is magical to observe. We are often in awe of how well our students work together and learn from each other" (Bergman & Sams, 2012, para. 9). Since this time, the flipped classroom model has been applied across multiple disciplines including cinema and television arts (Enfield, 2013), statistics (Strayer, 2012), business (Findlay-Thompson & Mombourquette, 2014), actuarial studies (Butt, 2014), pharmacy (Ferreri, O'Connor, 2013), and psychology (Talley & Scherer, 2013).

Course Redesign in Information Systems

Course redesign efforts are impacting the information systems discipline as well (Law, 2013; Shi, 2012; Zhang, Zhang, Stafford, & Zhang, 2013). Specifically, instances of the flipped classroom are starting to show up in common information systems courses as discussed below.

Frydenberg (2013) flipped a course in Excel by providing students with screencasts demonstrating the techniques and concepts of spreadsheets ranging in time from 7 to 10 minutes apiece. The author examined whether students would find demonstrating spreadsheet

concepts via screencasts an effective method, would embracing of the flipped classroom model differ between students based on degree of academic ability, and would the use of web-based collaboration tools increase due to students experience in a flipped classroom.
The study involved three sections of the Excel course: a daytime honors section, a daytime accelerated section, and an evening section. A total of 83 students were enrolled across the three sections. All three sections included the same content, structure, and exams. Consistent with the precepts of the flipped classroom model, no lecture was presented in class, the students instead worked on group activities during class time. Quizzes were given at the beginning of each class period to encourage students to watch the screencasts.

A survey method was utilized to illicit data regarding the student's reactions after completion of the flipped classroom meetings. The results indicated that the students were engaged and challenged, recommended the flipped classroom be implemented in other courses, and that it was worthwhile to complete the activities provided during class time. According to the author the flipped classroom appeared to promote "social awareness, camaraderie, and a spirit of cooperation among group members and their classmates, across different sections" (p. 68). Other student comments indicated that the flipped classroom created a more personal experience. Overall, the author reported that in comparison to a traditional classroom a larger number of students believed the flipped classroom was more effective in helping them learn the material.

In conclusion the author stated, while the paper does not claim an increase in student learning over a traditional classroom, anecdotal remarks from students suggests that they learned the material through watching the instructional videos before class and completing in-class exercises and found the experience more engaging than listening to an in-class lecture (p. 70).

Adkins (2013) flipped the MIS course by having students complete the following activities outside of the classroom: read the assigned chapter from the textbook, listen to either an audio lecture and/or read lecture notes provided by the instructor. Quizzes were then used to assess the students learning. The stated purpose of the study was to determine which support materials (i.e., textbook, instructor notes, and audio lecture) were related to quiz grades in a positive way. Additionally, the author wanted to determine if a brief review of the chapter prepared the students adequately to perform well on the quizzes and whether more time spent with the support materials increased the grades on the quizzes. In the study the author proposed six hypotheses which tested the relationship between the support materials and the score on the quizzes as well as preparation in general.

In total 83 students participated in the study. The data collection consisted of a 10-question multiple choice and true/false quiz over the chapter material and a survey. In all 660 surveys and quiz scores were collected and analyzed. To test the relationship between the support materials and the quiz grade a chi-square test of independence was conducted. The independent variable was the quiz grade. To determine the strength of the relationship a phi or Cramer's V test was utilized.

The results of the study indicated that there were statistically significant relationships in quiz grades between students who read or did not read the textbook, those who read the instructor's notes and those who did not, those who listened to the audio lectures and those who did not, those who prepared for the quiz and those who did not, and those who prepared for the quiz for varying amounts of time. No statistically significant results were found between students who briefly reviewed the textbook chapters and those who did not.

The author stated "instructors can tell future MIS students that the use of the textbook and lecture notes were associated with higher quiz grades" (p. 4), but trying to review the textbook just before the quiz or simply just not preparing did not result in higher quiz grades. As noted by the author, "the reason for flipping the MIS classroom was to add collaborative, active learning activities to the class" (p. 5). These included classroom activities related to preparation for essay exams.

3. JOURNEY TOWARD THE FLIPPED CLASS

My journey toward implementation of the flipped classroom began unexpectedly in the Spring semester of 2011 as the North Texas area experienced a massive winter storm dumping

enough snow and ice to cause the closure of a large number of public and private schools as well as many universities. My university was closed for four class days. As it were, being snowed-in turned out to have its advantages. Having begun to teach Java programming online that semester I was looking for a way to provide the examples that I demonstrated in my face-to-face course to my online students. With little else to occupy my time, I decided to take the opportunity to begin working with the version of Adobe Captivate that I recently had installed on my computer. From what I understood about Captivate it appeared to be the tool that I needed.

Captivate allows for authoring and editing of such content as software demonstrations, software simulations, and voice-over-PowerPoint presentations. So using an inexpensive headset with attached microphone I began recording and posting video demonstrations in Blackboard to be watched by my online students. Much to my pleasure Captivate was relatively easy to learn and use and turned out to be quite powerful. The benefit of creating my own video demonstrations was that I could record exactly what I wanted to rather than wading through a multitude of videos on YouTube or other similar sites. Since that time I have a fairly extensive library of video demonstrations for teaching Java, C#, and Visual Basic.

Originally, the video demonstrations were created to provide online students a similar "lecture" as the one provided to students in the face-to-face course and have now become a primary means of instruction for online courses. I then decided to provide the video demonstrations to face-to-face students as well as a means of supplemental instruction. In this way students who missed class or who wanted to review the concepts covered in class could watch the videos as many times as they desired.

However, in the past couple of years I have started to ponder the on a regular basis, "why am I demonstrating course material in the class and then posting the same course material as a video demonstration for my face-to-face students? Why not provide the video demonstrations to the face-to-face students as a way to prepare them to come to class and practice what they learned from the textbook and the video demonstrations?

Consequently, I have been debating for some time whether or not to change my current approach which appears to be effective in terms of student evaluation of instruction through the years. I had the realization one day, "it's not how I teach, but what the student learns that really matters". With this foundation of video demonstrations now in place and a better understanding of flipping the classroom based upon the literature I am ready to make the move toward a flipped classroom model course redesign.

Video Demonstrations

I have been teaching an introductory C# programming course since Fall 2011. In that time I have utilized instructor-created video demonstrations to varying degrees. In online sections of the course the video demonstrations were used extensively. In face-to-face sections of the course, the videos were originally not made available, then on a limited basis, and then extensively. Posting video demonstrations for students to watch outside of class time is a common practice when flipping the class.

To no one's surprise students spend a limited amount of time reading the course textbook (Adkins, 2013). In fact, Sharp & Schultz (2013) found that students in both face-to-face and online courses prefer watching video demonstrations over reading the textbook. Their study indicated that that the mean time spent reading the textbook was 1.81 hours compared to 2.1 hours spent watching videos. After several semesters of creating a comprehensive set of video demonstrations covering C# programming concepts these videos will comprise the primary component of outside of class activity. The content of the video demonstrations corresponds with the chapters of the selected textbook and are summarized in Table 1. The number in parentheses is the length of the video in minutes.

A sample syllabus is provided in Appendix A to show the weeks in which chapter content will be covered and the associated video demonstrations. Viewing of the video demonstrations will be assigned prior to the in-class activities related to the chapter content. To begin each new concept a quiz will be given to motivate the students to view the video demonstrations and to assess their knowledge. The in-class activity will then be assigned based upon the video demonstration content. Individual and group activities will be employed.

Quizzes

Another commonly used component in a flipped classroom is the use of quizzes to motivate students to view the videos demonstrations and to assess their knowledge (Adkins, 2013; Frydenberg, 2013). The current design of the course includes both chapter quizzes and pop quizzes used for daily participation grades. The pop quizzes consists of multiple-choice questions (Kuechler & Simkin, 2004) while the pop quizzes consists of true/false questions. These quizzes will be utilized within the flipped course to motivate and assess.

Chapter 1 - Introduction to Computers and Programming
• Setting up the Visual Studio Environment (2) • Creating a New Project (11) • Submitting a Project in Blackboard (8)
Chapter 2 - Introduction to C#
• Getting Started with Forms (8) • Getting Started with Controls - Buttons (10) • Introduction to C# Code (10) • Working with the MessageBox (8) • Working with the Label Control – Part 1 (9) • Working with the Label Control - Part 2 (9) • Working with the PictureBox Control (9) • Sequence, Comments, & Close Method (11)
Chapter 3 - Processing Data
• Text Box Control and Variables (12) • Data Types, Calculations, Input/Output (14) • Named Constants (10) • Exception Handling (9) • Fields (16) • GUI Details (2)
Chapter 4 - Making Decisions
• Decision Structures (14) • Logical Operators and the Switch (14) • The TryParse Method (18) • Input Validation (14)
Chapter 5 – Loops
• List Box Control (17) • Loops (22) • List Box Control for Output with a Loop (10)
Chapter 6 - Methods
• Methods – Part 1 (20) • Methods – Part 2 (12) • Methods – Part 3 (11)
Chapter 7 - Arrays and Lists
• Array (21) • List (14)
Appendix B – Other User Interface Controls
• Combo Box Control (23) • Menu System (8)

Table 1 – Chapters and Related Videos

In-Class Activities

In-class activities are also a significant component of the flipped classroom (Adkins, 2013; Frydenberg, 2013). These activities allow students to work individually or in groups to practice implementing course concepts to facilitate active learning. Another benefit is the instructor's presence to serve as a moderator and guide. In a study conducted by Zhang et al. (2013) it was determined that a student-centric exercise only approach was shown to have "clear advantages, in that it is more effective than instructor-centric approaches" where the class consisted of both lectures and exercises (p. 53). This has interesting implications for the implementation of the flipped classroom model on programming courses.

Objectives, Measurements, Assessments

According to Turner and Carriveau (2010) the development of learning objectives is a major component of course redesign. In the current design of the course I have identified the following knowledge and skills outcomes which will be retained for the flipped class:

Knowledge Outcomes:

- Articulate the basic syntax and features of the C# programming language
- Define C# constructs which implement the three basic control structures
- Define arithmetic, relational, and logical operators
- Describe object-oriented (OO) concepts related to classes and objects
- Describe the concepts behind sound user interface design
- Describe the concepts behind variables, constants, and calculations

Skill Outcomes:

- Demonstrate the ability to create Object-Oriented (OO) application programs
- Demonstrate the ability to create appropriate classes and objects
- Demonstrate the ability to create windows-based applications
- Demonstrate the ability to create user interfaces (e.g., labels, text boxes, buttons, menus, dialog boxes)
- Demonstrate the ability to apply the three basic control structures and various operators
- Demonstrate the ability to create application programs using appropriate variables, constants, and calculations

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Not only should learning outcomes be developed, they should be measurable and assessments should be created which match the outcomes. Turner & Carriveau (2010) defined an assessment as "any procedure or process that is used to obtain information about students and student learning" (p. 42). In the current design of the course in addition to the chapter and pop quizzes which consists of multiple-choice and true/false questions, in-class activities, outside-class assignments, and exams have been developed to assess student learning. These assessments will continue to be used in the flipped class. In line with the flipped classroom approach, class time will be devoted to activities that support the knowledge and skills outcomes.

4. CONCLUSION

While the popularity of the flipped classroom has recently grown it is important to note that the research supporting the flipped classroom as a means to increase student learning is still lacking. According to Goodwin and Miller (2013) "to date, there's no scientific research base to indicate exactly how well flipped classrooms work" (p. 78). However, there is a growing amount of anecdotal evidence to suggest that flipping the class may results in benefits (e.g., Frydenberg, 2013; Goodwin & Miller, 2013). In the Fall 2014 semester I plan to flip the introductory C# programming in hopes of collecting data to contribute to the literature of whether the flipped classroom model increases student learning. As Miller and Goodwin concluded, "if we only implemented strategies supported by decades of research, we'd never try anything new" (p. 78).

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Appendix A

CIS 333-010 C# Programming – Tentative Schedule Fall 2014

Date				Tentative Schedule	Lab	Lab Due	Quizzes	Video Demonstrations
Week 1	Aug	25	M	Course Introduction	Lab 01			
		27	W	Chapter 1 – Intro to Computers and Programming				Setting up the Visual Studio Environment (2 minutes) Creating a New Project (11 minutes)
Week 2	Sep	1	M	**Labor Day, NO CLASSES**				
		3	W	Chapter 1 – Intro to Computers and Programming				Submitting a Project in Blackboard (8 minutes)
Week 3		8	M	Chapter 2 - Introduction to C#	Lab 02	Lab 01	Quiz 01	Getting Started with Forms (8 minutes) Getting Started with Controls - Buttons (10 minutes) Introduction to C# Code (10 minutes)
		10	W	Chapter 2 - Introduction to C#				Working with the MessageBox (8 minutes) Working with the Label Control - Part (9 minutes) Working with the Label Control - Part 2 (9 minutes)
Week 4		15	M	Chapter 2 - Introduction to C#				Working with the PictureBox Control (9 minutes) Sequence, Comments, and Close Method (11 minutes)
		17	W	Chapter 3 - Processing Data				Reading Input with Text Box Control and A First Look At Variables (12 minutes)
Week 5		22	M	Chapter 3 - Processing Data	Lab 03	Lab 02	Quiz 02	Data Types, Calculations, Input and Output (14 minutes) Named Constants (10 minutes)
		24	W	Chapter 3 - Processing Data				Exception Handling (9 minutes)
Week 6		29	M	Chapter 3 - Processing Data				Fields (16 minutes) GUI Details (2 minutes)
	Oct	1	W	Chapter 4 - Making Decisions				Decision Structures (14 minutes) Logical Operators and the Switch (14 minutes)
Week 7		6	M	Chapter 4 - Making Decisions	Lab 04	Lab 03	Quiz 03	The TryParse Method (18 minutes)
		8	W	Chapter 4 - Making Decisions				Input Validation (14 minutes)
Week 8		13	M	**Exam 1 (Chapter 1-3)**				
		15	W					
Week 9		20	M	Chapter 5 - Loops, Files, and Random Numbers	Lab 05	Lab 04	Quiz 04	List Box Control (17 minutes)
		22	W	Chapter 5 - Loops, Files, and Random Numbers				Loops (22 minutes)
Week 10		27	M	Chapter 5 - Loops, Files, and Random Numbers				Using List Box Control for Output within a Loop (10 minutes)
		29	W	Chapter 6 - Modularizing Your Code with Methods				Methods – Part 1 (20 minutes)
Week 11	Nov	3	M	Chapter 6 - Modularizing Your Code with Methods	Lab 06	Lab 05	Quiz 05	Methods – Part 2 (12 minutes)
		5	W	Chapter 6 - Modularizing Your Code with Methods				Methods – Part 3 Continued (11 minutes)
Week 12		10	M	Chapter 7 - Arrays and Lists				Array (21 minutes)
		12	W	Chapter 7 - Arrays and Lists				List (14 minutes)
Week 13		17	M	Chapter 7 - Arrays and Lists	Lab 07	Lab 06	Quiz 06	
		19	W	Appendix B - Additional User Interface Controls				Combo Box Control (23 minutes)
Week 14		24	M	**Exam 2 (Chapter 4-6)**				
		26	W					
Week 15	Dec	1	M	Appendix B - Additional User Interface Controls		Lab 07	Quiz 07	Menu System (8 minutes)
		3	W	Course Review				
		5	F	**Final Exam, 11:30a-2:00p, Busi 206**				

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