EDTC 809: Assessments and Evaluation

Project 2

Computational thinking and learning in a flipped mathematics adaptive learning environment (Qualitative Research)

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Introduction

Introduction

In recent years, there has been a drop-in students enrollment in universities or colleges and one of the factors was due to the dislike or unskilled knowledge of mathematics or Science, Technology, Engineering, and Mathematics (STEM) related field (García-Santillán *et al*, 2017). García-Santillán *et al.* (2017) stated that students developed a fear in those fields because of exams, problem-solving, deep thinking of the materials, and computational learning skills (García-Santillán *et al*, 2017). Therefore, schools tried to implement technology in their curriculum through the use of blended learning process of traditional face-to-face learning and online adaptive learning. For that reason, computational thinking has become useful in the mathematics classroom and has impacted individuals' critical and adaptive learning skills.

The process of computational thinking allows students to have new concepts and develop their own understanding of computational ideas. According to Sung *et al.* (2017), as school implements programming instruction in the curriculum, students can have a better understanding of programming devices and game design in an educational environment at an early age (Sung *et al.*,2017). In addition, Bers (2008) also states, "computer programming devices for children were found to be beneficial for young learners' cognitive, problem-solving, and sequencing skills" (Bers 2008). As the benefit of computer programming influence students to learn more about technology, the formal teaching method is still necessary for the twenty-first century learning through technology. This blended learning process allows classes to get flipped while using adaptive learning tools to enhance the average mathematics classroom. This qualitative research study will explore the benefit of the flipped classroom while using adaptive learning assessments in a computational thinking mathematics learning environment.

Definition

Adaptive Learning - Waters (2014) reports that adaptive learning is an essential tool in the twenty-first-century technology learning that allows students to work at their own pace (Waters, 2014). Adaptive learning will be used in this study to effectively engage students to their full potential and according to their learning demand. It modified students' learning path and pace as it empowers innovative teaching practices.

Computational Thinking (CT) - Sung, Ahn, & Black (2017) describe computational thinking as a required skill for this technology era by offering learners an incompatible infrastructure for conceptualizing, visualizing, and analyzing situations (Sung, Ahn, & Black, 2017). In addition, Wing (2006) states that computational thinking is a set of thinking or learning skills and strategies that are essential to problem-solving and designing process from a scientist's approach (Wing, 2006).

Flipping Classroom (FC)- A flipped classroom model allows instructors to implement technology in their curriculum by overturning the traditional face-to-face learning process to a technology resource home project. Instructors asked learners to watch selected educational videos and engage in an online and/or classroom discussion. The process allows students to think critically on their own term so that they are able to communicate better in the classroom environment.

Remedial Courses (or Developmental Courses): Wells (2014) explained remedial courses as an instructional program that instructs academically unprepared students the essential aptitude so that they can be more successful learners (Wells, 2014).

MyMathLab (MML): MyMathLab (MML) is an adaptive learning assessment developed by Pearson/Addison-Wesley company to facilitate students' online learning outcome by

completing their classwork and practicing. MML has online homework, computational examples, animations, tests, video presentation and lectures, practices work, study plan, tutoring, and powerpoint slides to guide students and instructors and also synchronize with their textbook. Teachers can also create their own exams, develop their own classroom lectures, view scholars' progress and improvement in their grade (Baugher, 2012).

Statement of the Problem

The statement problem for the qualitative research study is mostly based on students in remedial courses who lack the understanding of mathematical procedure because they did not have the sequencing, cognitive, and problem-solving skills. Furthermore, students choose other majors that are not STEM-related because they are unable to relate the courses to a real-life situation, which can create a low enrollment in the school (Ortiz *et al*, 2015; Lawson, 1992; Elçi, 2017). Therefore, computational thinking has been implemented in the flipped adaptive learning classroom to create a positive learning outcome. In addition, the mathematics concern could be diminished when an adaptive learning or computer-based instruction assessments is blended with the traditional face-to-face instruction so that students can work at their own pace (Griff & Matter, 2013). Hence, the adaptive learning tools will be blended with the flipped classroom as one of the technology tools for students to practice or watch outside of the classroom.

According to Frazier & Hearrington (2017), flipped classroom model is a blended learning process in which instructors offload some activities, that are usually conducted in the classroom for students, done at home; the adaptive learning assessments such as the online video and powerpoint will be used for the activities in this study (Frazier & Hearrington (2017). During the flipped classroom process for this study, students will be asked to watch videos from

the adaptive learning assessments called MyMathLab (MML) so that they are able to engage in the classroom or online discussion. Another problem is that some students will not be able to have the recent technology or have reliable internet access at home (Frazier & Hearrington, 2017).

Another issue is the qualitative research, Creswell (2015) reports five leading complications encompassing qualitative research study: (1) acquiring instructors and/or scholars to quickly respond to qualitative survey or interview questionnaires, (2) collecting data information from previous case studies, (3) inquiring essential questions, (4) participants writing incomplete or unclear response, and (5) having difficulty getting permission (Creswell, 2015). Furthermore, instructors or students might not be cooperative because they do not have enough time to sit for an interview. When it comes to technology, teachers might also feel that they do not have adequate time to implement the technology in their classroom or during the flipped classroom models. These issues can affect teachers, students, and the school and its enrollment process. As a result, this study will examine the flipped classroom model while using the adaptive learning assessment as a computational thinking tool.

Purpose

The purpose of this qualitative research study is to understand how computational thinking process can benefit students' in a flipped mathematics classroom while using adaptive learning assessments. The aim of the study is to understand students' perspective on using flipped instruction and their understanding of mathematics in a computational thinking process.

Research Questions

The research questions will include the following:

(1) What process is used to examine students computational thinking and its' improvement?

a. Have the students computational thinking process improved?

(2) What change develop during the process of flipping the classroom?

a. Have students been able to understand the material better when the class was flipped? Or Before it was flipped?

(3) What are students attitudes when using adaptive learning assessments?

Literature Review

Introduction

The use of technology in mathematics or STEM fields has influence and build the cognitive, critical, developmental skills for the twenty-first-century students. The technology being implemented and blended into the curriculum allows students and teachers to have a better understanding of the traditional face-to-face learning. Hence, computational thinking has been added to the students' learning outcome so that they can build new skills and reflect abstractly when using adaptive learning assessment for the flipped classroom. This qualitative action research will determine the participants' attitudes towards the model.

Literature Review

Se, Ashwini, Chandran, & Soman (2015) report that computational thinking in a flipped linear algebra classroom allows students to learn, develop, and build new skills so that they can make it in this twenty-first-century technology era (Se, Ashwini, Chandran, & Soman, 2015).

The researchers also stated that computational thinking is a necessary competence in individuals' development to think abstractly and critically with a power of present-day technology (Einhorn, 2011; Wing, 2006; Wing, 2008; Fadjo, 2012, Se *et al.* 2015). Computational thinking can lead to computational learning to effectively ease the learning process in a classroom. In their study, the concept of a flipped classroom allows students to work systematically with the teacher's creative video material and interactive assignments in order to facilitate the instructional process and learning time in the classroom environment (Se *et al.,* 2015). Neilson & Campbell (2018) study uses mathematical and computational thinking to describe phenomena which allow students to express their intention more accurately and clearly. Volkova (2006) did a qualitative research study on five pre-service teachers' perspective on computational estimation. The study shows that some teachers' understanding of mathematics is unsettling because they were on different levels of reasoning with regard to computational estimation. For instance, some students were not able to solve a word problem with estimation, despite their knowledge of computational algorithms. Weitze (2017) reports that computational thinking was developed to support and challenge students in mastering electronic devices or games so that they can be more creative and develop problem-based digital work. The main component of the study was that the computational thinking process allowed the students to work together, be creative, and reach learning goals (Weitze, 2017).

Sung, Ahn, & Black (2017) study's purpose was to heighten mathematics and computational thinking ability for underrepresented scholars. The study states that computational thinking is necessary because of its capacity to reflect like a computer scientist when challenged with an issue. This study analyzes the change of two factors, "the degree of embodiment and the presence of the computational perspective practice (CPP), and their

combined impact" (Sung, Ahn, & Black, 2017). According to Sung, Ahn, & Black (2017), "Mathematical thinking is closely related to computational thinking because solving a mathematical problem is a process of construction that requires an analytic problem-solving perspective, which is unique and fundamental to computer programmers or scientists" (Sung, Ahn, & Black, 2017). The study had 66 participants in kindergarten and first-grade; 36 males and 30 females. Results show that the appearance of CPP was remarkable for programming effectiveness, despite the degree of the embodiment.

Smallhorn (2017) explored the flipped classroom model in a depth university second-year biology course (e.g. Genetics, Evolution, and Biodiversity). Smallhorn (2017) qualitative research was to investigate the impact of this model on student engagement, attitude, and achievement and success. The college traditional face-to-face learning was replaced in 2016 by a flipped class. For this report, 110 students were attending one or two flipped classes (called tutorials); in which attendance is largely encouraged but not obligated. The pre-class preparation resources were the Moodle platform Flinders Learning Online (FLO). Students watched short online videos and completed small reading to get prepared for the weekly flipped class which is then followed by a summative quiz. The study used surveys, attendance records, learning analytics, and exam data before and after the implementation of the flipped classroom. Students were surveyed through weekly reflection questions on their perspective to learning and preparing for the flipped class. The study compared results from final exam multiple choice answers from the previous year.

Smallhorn (2017) study did a qualitative open-ended analysis of the weekly reflection responses; in which students were able to respond to the flipped classroom throughout the week. For instance, on the first two weeks of the semester, 328 students responded and were neutral

about preparing for the flipped class; by week three the attitude of students (n = 422) changed from not being prepared to not having enough time so they skimmed through the online content. Finally, only 5% of student discussed the learning experience in the flipped classroom negative. A quantitative report was determined to analyze students engagement as highly engaged, moderately engaged, or poorly engaged, based on the number of flipped classes attended over the semester: 88% of students who achieved a high distinction grade were highly engaged, compared to only 33% of students who achieved a passing grade, students who failed the topic had 57% of poorly engaged, and while 20% were moderately engaged. Therefore, there was a high level of students satisfaction. Since this study is a weekly report study, the sample size from week to week was different; which means it was not the same students (participants) who were doing the study each week; for instance by week 12, n = 214. The following are examples of students responded to the flipped classroom experience from Smallhorn (2017) study:

Student 1, “My approach to preparing for my first tutorial is to work through all information provided on FLO, such as all video links and the topic manual. I will also submit my first quiz which will help affirm what I’ve been looking at before the tutorial”.

Student 2, “...it difficult to find time to watch the videos for a tutorial quiz and fully understand the content before doing the quiz”.

Student 3, “...Previously, watching all of the videos and skimming through online content was sufficient but for this tutorial, I am taking more time to re-read and note down the concepts in preparation for the questions asked during class time”.

Student 4, “They have allowed me to not just have knowledge passed on in a passive manner, like most other topics, but instead apply what we are learning in a practical sense, in an

environment where there is help available. They have also made me feel better prepared for the exam".

Blair, Maharaj, & Primus (2016) study's purpose was to explore the importance of the flipped classroom as whether it improved the test outcomes (Kong *et al*., 2016; Blair, Maharaj, & Primus, 2016; Peterson, 2016). Three types of data were gathered: course performance data, student perception data, and lecturer's reflections. The research was a two academic years research study (2 cohorts of students in the academic year 2012/13-traditional and 2013/14 - flipped); therefore the sample size was different and surprisingly small in most cases. Most of the data study uses percentage to determine the sample size; however in different table of the study, the number of participants were as followed n = 12 (2012/13 report on student centred) and n = 3 (2013/14 report on student centred); n = 9 (discussion 2012/13) and n = 5 (discussion 2013/14); n = 6 (interaction 2012/13) and n = 2 (interaction 2013/14); n = 8 (uncomfortable room 2012/13) and n = 1 (uncomfortable room 2013/14); n = 4 (assignments 2012/13) and n = 1 (assignments 2013/14); n = 0 (Not challenging enough 2012/13) and n = 1 (Not challenging enough 2013/14). This is to state that in a qualitative report, the sample size might differ.

Cabi (2018) reports study was to investigate the significance of the flipped class (FC) model students' educational achievement and the students' perspectives on the model. In the study, there were two groups of participants, the experimental group (taught using a flipped classroom model) and the control group (taught in a traditional learning environment). The groups were in a blended learning environment with an hour for face-to-face and three hours for out of class online learning. There were 59 pre-service teachers participants that were randomly selected for the groups. At the end of the study, 28 students were in the experiment group [22 female, 6 male;18 English Language Teaching (ELT) students, 10 Turkish Language Teaching

(TLT) students]; 31 students were in the control group (27 female, 4 male; 14 ELT students,17 TLT students). The out of class activities were videos and Khan Academy; the in-class activities were using Kahoot and group activities. The results of the study did not show major differences between the results of the two groups. However, in Sahin, Cavlazoglu, & Zeytuncu (2015) and Peterson (2016) report, the flipped participants were performing better in their assignments than the non-flipped scholars (Sahin, Cavlazoglu, & Zeytuncu, 2015; Peterson, 2016). Peterson's (2016) reports compared student outcomes between a flipped classroom and a traditional learning model in an experimental study of a statistics class. There were 19 participants for the traditional learning model and 24 participants for the flipped class model. The sample t-tests of the study show that students in the flipped class did better than the traditional learners on their final exam (Peterson, 2016). The most important result is that the flipped classroom model can benefits participants when they come to class prepared and already accomplished their assignments in or out of class (Cabi, 2018; Peterson, 2016). The FC model does allow the participants to do their assignment in the classroom after listening to the lectures or watching the videos outside the classroom (Cabi, 2018; Sahin, Cavlazoglu, & Zeytuncu, 2015).

Summary

As the research studies have shown, computational thinking can improve students' performance in the flipped adaptive learning classroom environment. The learning outcome can ameliorate significantly and minimize the learning gap in mathematics. Furthermore, students and instructors can also benefit when applying online assessments in their assignments because students are able to work on their own pace and teachers can create exam and view students' result and performances. Scholars can find extra educational help online when the class is flipped

and discuss their findings in the classroom. This process allows them to think critically, abstractly, and cognitively.

Methodology

Introduction

The following methodology procedure will discuss the type of qualitative research for this report. The action qualitative research study is necessary because the researcher would want the perspective of students' on using adaptive learning assessment while their class is flipped in a computational thinking process. This will determine the benefit and improvement of flipping the classroom and the students' interest in mathematics with the model. The researcher will also use qualitative interview questionnaires on Appendix A for students in higher education mathematics class to further answer the research questions.

Research Design

Qualitative research relies on printed or written work and has many designs (e.g. action research design will be used for this study). Patton (2015) and Creswell (2015 & 2018) defines qualitative research as a method that focuses on investigating on participants' attitudes by assembling and analyzing printed or written data (Patton 2015; Creswell, 2015 & 2018). In addition, Segal (2009) states that using action research in her dissertation study gives her good reflection and personal reconstruction of the research study (Segal, 2009). Furthermore, this qualitative study will guide the researcher in determining the benefit of flipping the classroom as a computational thinking process while using adaptive learning assessments.

The action research will be necessary for determining students' attitudes toward flipped classroom and using the adaptive learning assessments as the technology resource. The researcher wants to understand if the computational thinking aspect of technology also guides students in understanding mathematics. The researcher also tends to observe the class before doing an interview. Patton (2015) states that qualitative analysis demand interpretation interviews, observations, and documents (Patter, 2015).

This qualitative research study will gather information through the interview questions shown in Appendix A, to answer the research questions: (1) What process is used to examine students computational thinking and its' improvement? (a) Have the students computational thinking process improved? (2) What change develop during the process of flipping the classroom? (a) Have students been able to understand the material better when the class was flipped? Or Before it was flipped? (3) What are students attitudes when using adaptive learning assessments?

Population and Sampling

The population will be based on students from University X. The researcher teaches mathematics at the university and would like to understand the flipped classroom model while observing another mathematics instructor. The researcher will also use one of her class and randomly select a couple of students who are willing to be part of the interview. The mathematics classes use MyMathLab as the adaptive learning assessments. The sample size will be approximately eight students. The sampling will be a time location sample and complete target population sample. A complete target population is defined as, "Interview and/or observe everyone within a unique group of interest" and time location sample means,

"Interview everyone present at a particular location during a particular time period" (Patton, 2015). The reason for both samplings is because the observation will take place in one location or classroom in a day or two. According to Emerson *et al.* (2011), ethnographers also develop a "written account of what they have seen, heard, and experienced in the field" (Emerson *et al.*, 2011). After the observation, the researcher plan to interview randomly selected students from the instructor's classroom; it will be a one or two days interview process.

Procedures

The researcher will ask a mathematics instructor from University X during a professional development meeting, email, or mailbox letter permission to observe his/her classroom. That instructor must be able to use the flipped classroom model for the day of the observation. Before administering the research, the researcher will get permission from the Internal Review Board (IRB). After approval from IRB, participants (n = 8) will be enlightened of their rights as a participant in a research; and may choose to continue or discontinue the study. The observation would be based on a flipped classroom activity; the students already watch some videos through MyMathLab and practice using the study plans, quizzes, and PowerPoint lecture videos; they come to class to discuss what they learned and do some assignments. The researcher would observe students' reaction and perspective toward using MyMathLab. The observation would be a "naturalistic inquiry" because it observes students' in their natural or normal environment, which is the classroom. Patton (2015) described naturalistic inquiry as, "conducting research in participants' natural environments is essential. The researcher must meet participants where they are, in the field, so that data collection occurs while people are engaging in their everyday practices" (Patton, p.48). The

research takes place in the classroom settings and the researcher does not attempt to affect, control, or manipulate what is unfolding naturally. The interview will be open-ended questions with an in-depth response from the students about their perspective, experience, opinion about computational thinking in a flipped classroom and the adaptive learning assessments. The information will be documented, coded, and well written in a notepad before being transfer to Google Docs. Due to the students' busy schedule and daily school activities, the interview will be right after the class in a classroom or students lounge. Each interview will be approximately fifteen minutes for each participant (n = 8).

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Appendix A

Interview Questions

Title: Computational thinking and learning in a flipped mathematics adaptive learning environment (Qualitative Research)

Purpose: The purpose of this qualitative research study is to understand how computational thinking can benefit students' in a flipped mathematics classroom while using adaptive learning assessments. The aim of the study is to understand students' perspective on the flipped class model and their understanding of mathematics

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Interview Questions (students):

1. What is your perspective on the flipped classroom as computational thinking?
2. Did you understand the material better when the class was flipped?
3. How is using adaptive learning assessments (MyMathLab) for the flipped classroom guide you in your understanding of mathematics?
4. Did you observe any improvement?
5. What benefits do you encounter for the flipped classroom compared to the traditional face-to-face lecturing?
6. What is the disadvantage of using adaptive learning assessments?
7. What is the disadvantage of having a flipped class?
8. During the class discussion, do you feel like you are able to participate more or less because of the flipped class?
9. Are you more or less motivated in the flipped classroom? What about using the assessments?
10. Which models will benefit you in the future, the flipped class model or traditional model?