EDTC 806: Research Methods in Education Technology Leadership

Mixed Methods Research: Using Mathematics Adaptive Learning in Remedial Courses

A Study of Faculties' and Students' Attitudes

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Chapter 1: Introduction

Introduction

Most students' mathematics anxiety can create a frightening and uncomfortable moment on their learning outcome of the subject. Those students tend to be irritated and frustrated when they are not able to understand a math concept or homework assignments. In fact, due to the anxiety, report shows that most incoming college freshman need remedial mathematics (Baugher, 2012, Rochford, 2004). Additionally, at community colleges, there is an increase percentage of Drop-Failure-Withdrawn (DFW) rates in which the majority of students are in remedial classes (Twigg, 2004, George, 2010, Baugher, 2012). Therefore, most schools tried to implement different technological mathematics assessments to improve students' success in mathematics and other Science, Technology, Engineering, Mathematics (STEM) majors to ease the outcomes.

Liana Landivar (2013), a *U.S. Census Bureau* sociologist, states that STEM majors are disappearing among women and minorities in the United States because students tend to avoid the field due to anxiety and unpreparedness (Landivar, 2013, Ortiz et al., 2015, Bieri Buschor, Berweger, Keck Frei, & Kappler, 2014). However, there is a huge demand for STEM graduates. Years ago, implementing electronic devices in the classroom was not an easy process because the education system had minimum knowledge and teachers were unprepared and untrained with such new tools (Sandholtz, Ringstaff, & Dwyer, 1997). Technology in the mathematics classroom has been a supplementary assessment that has helped many instructors and students in various ways. The use of mathematics adaptive learning assessment has helped closed some achievements gap in most schools by providing the necessary guidance for both students and educators; but it should not replace the traditional method of instruction in which teachers are still important in the classroom. Implementing technology will positively impact and ease students and instructors' learning outcome (Sandholtz, Ringstaff, & Dwyer, 1997). Using adaptive learning assessments have become part of the instructional

tools in most classes, especially remedial mathematics courses. This mixed method research will ask both faculties and students to complete quantitative and qualitative survey questionnaires, class observation, and interviews to understand the importance of using mathematics adaptive learning assessments in two higher education institutes.

Definition

Adaptive Learning: Adam Newman and colleagues describe adaptive learning as a necessary revolutionary data approach that uses electronic device as a teaching tool to help students work at their desired pace (Waters, 2014).

Remedial Courses (or Developmental Courses): The American Association of Community and Junior Colleges (AACJC) defines remedial or developmental education as an educational program that teach academically unready students the necessary skills they require to be more effective learners (AACJC, 1989, p. 115; Wells, 2014).

MyMathlab (MML): MyMathLab (MML) is a Pearson/Addison-Wesley assessment that help students complete their assignments (e.g. homework, quizzes, study guide, tests, watch videos lectures, PowerPoint presentation, and online tutorial), practice; and teachers use the tools to create or develop the classroom assignment and view students' progress and grade (Baugher, 2012). Vezmar (2011) defines MyMathLab as an algorithmic "web-based program that has interactive tutorials, computational examples, videos, animations, practice exercises, and quizzes that coordinate with the students‟ textbook" (Vezmar, 2011).

Mathematics Anxiety: Ashcraft (2002) defines mathematics anxiety as a feeling of stress, pressure, apprehension, or restlessness that obstruct the learning process in math performance (Ashcraft, 2002, p. 181; Baugher, 2012).

Statement of the Problem

There are several issues when using mixed method research methods (Creswell, 2015, p.555); however, these problems are minimum when thinking about the number of students dropping or withdrawing from school because they are unable to understand or pass a math class. Using adaptive learning assessments inside and outside of classroom might not solve all the problems, but it might help some students face their fear and exit the remedial mathematics class. Baugher (2012) states that remedial mathematics classes involve students who usually struggle with mathematics and tend to avoid the subject due to the math anxiety (Tobias, 1993, Baugher, 2012). With a drop-failure-withdrawal (DFW) of 22% to 45%, these students dropout or take a long break before re-entering college; in which they must successfully exit remedial math in order to graduate (National Center for Education Statistics, 2009; U.S. Census Bureau, 2010; Twiff, 2004; George, 2010; Baugher, 2012). As a solution, colleges implemented an adaptive learning assessment for online tutoring MyMathLab programs that is available twenty-four hours to help students.

Another problem involves the disparities of STEM majors and mathematics anxiety among students who are taking remedial courses. García-Santillán *et al.* (2017) reports that students have mathematics anxiety due to tests, quizzes, homework, and just knowing that they are in a math class, (García-Santillán et al, 2017). Hence, scholars choose other field, instead of STEM, because they do not like the subjects, develop unusual anxiety and give up easily, have great concerns, and are not able to relate STEM to real life circumstances (Landivar, 2013; Ortiz *et al*, 2015; Lawson, 1992; Elçi, 2017; Sloan, 2010). The anxiety and concern could be reduced when students practice as much as possible when using adaptive learning assessments and work at their own pace to reinforce the learning outcomes (Griff & Matter, 2013).

Finally, using a mixed method research study can create some problems along the way. For instance, Creswell (2015) states that the sampling in a transformative approach of a mixed method

should be careful of assembling all participants together in one variety that may stereotype them (Creswell, 2015, p.555). In Addition, since a mixed method involves both quantitative and qualitative data collection; both research have their own ethical issues that cannot be mixed. The qualitative ethical issues involve the moving of the study, being aware of potential problems in the data collection, respecting different cultures, and being careful not to disclose private information or describing the participants identity (p.555). Quantitative ethical issues involve the process of getting proper permission and being careful able communicating the study. Another issue of mixed method might be that it takes more time because the data collection involves both quantitative and qualitative data. Instructors think that implement technology in the lectures can also be time consuming (Sandholtz, Ringstaff, & Dwyer, 1997, pg37). These issues can deeply impact teachers and students learning outcome, if something is not accomplished. Therefore, this study will analyze the significance of using adaptive learning assessment to relieve and minimized the stress and enhance students and faculties' perspectives in mathematics.

Purpose

The purpose of this mixed methods research is to determine the significance of using mathematics adaptive learning tools and how to minimize students' math anxiety in remedial courses and STEM class. The purpose of the study is to comprehend teachers' and students' perspective when implementing the assessments.

Research Questions

The following indicate the research questions for this study:

(1) Do students and faculties believe using adaptive learning assessments improved the learning outcome and reduced their anxiety in remedial courses?

(2) What are some concerns scholars and educators have when using adaptive learning assessments?

(3) What are scholars' perspectives toward using adaptive learning assessments?

a. Does using such assessments help improve students' comprehension in Mathematics?

b. Do students' anxiety minimized when using adaptive learning assessments throughout the semester?

(4) What are faculties' perspectives when using adaptive learning assessments?

a. Is there a big difference in using traditional instructions and adaptive learning/technology instruction?

b. Does instructors' teaching approach changed throughout the years, since using adaptive learning assessments in their classroom?

Limitation, Delimitation, Assumptions

The limitation problems might be in the data collection, participants might not want to answer the questions, proper selection of meaningful sampling of participants, or location for the study (Creswell, 2015, p.258). Another limitation is that most of the data collection for both quantitative and qualitative was based on the researcher's classes; the results was not based on the entire college population in the mathematics departments. Further limitations involve students' and teachers' perspectives when using adaptive learning tools; it might be negatives at times (Lawson, 1992; Elci, 2017). Due to the negative attitudes, the participants may not be willing to participate in the research or properly complete the survey questionnaires, which can contribute in a smaller population and sample size for the study. Also, faculties might have difficulties filling out the survey because the majority work in different institutions as an adjunct teachers or part-timers.

The delimitation involving students' perspective in mathematics may influence the outcome of the qualitative and quantitative study. The participants' fear and concern toward mathematics can negatively impact their thinking. Lawson (1992) reports that students do not succeed in mathematics because they developed some bad attitudes towards the subjects (Lawson, 1992). These negative attitudes can influence their attainment and destroy their confidence in the subject (Elçi, 2017). If the instructor is not using the assessment in the classroom during the classroom observation, the report might not be accurate for this study.

The assumptions of a mixed method study are that participants will complete both data collection for qualitative and quantitative and this will result with the same sample size. Since the research will be based on convergent mixed methods, which take both quantitative and qualitative researches as a priority with independent analysis. The data collection for both quantitative and qualitative can be done in a single visit; however, the assumption could be that the participants will be available when distributing the data. In addition, instructors assume that well-educated students should not have an anxiety toward mathematics and should be able to understand how to solve a mathematical problem (Lawson, 1992).

Chapter 2: Literature Review

Introduction

Technology in the classroom does have an impact on both students and teachers', especially in the twenty-first century. Electronic devices can be beneficial, if instructors know how to implement the devices in their classroom, and are well trained to help students. It is necessary to study the importance of adaptive learning assessments through various researchers and related literature.

Thorough review of relevant studies and theory

Baugher (2012), Foderaro (2011), Twigg (2004), and U.S. Census Bureau (2010) report that 65 % of every community college scholars in the entire country require to take remediation; the drop-failure-withdrawal (DFW) percentages are between 40% to 50% or higher in college remedial courses (Baugher, 2012, Foderaro, 2011, Twigg, 2004, and U.S. Census Bureau, 2010). Baugher (2012) did a mixed method research on elderly students in remedial college mathematics and whether they benefited from the online MyMathLab (MML) tutorial assessment and if the assessment affected their achievement and perspective towards mathematics compared to traditional teaching methods (Baugher, 2012). For adult students, no specification of age in Baugher (2012) report, it was determined that the traditional method improved their attitude toward doing their assignment in mathematics; but no extreme change in the online tutorial experienced. However, adult students did appreciate the use of the online tutorial assessment because it guided them to practice and get extra help in mathematics. Eppler, Harju, Ironsmith, & Marva (2003) study was based on 272 undergraduate students who were taken remedial college mathematics to determine an instructional format of self-paced or lecture. It was determined that students' learning goals was greater in scores than those in performance goals; they were also less worrisome (Eppler, Harju, Ironsmith, & Marva, 2003)

Adaptive learning is defined as an innovative instructional technology that automatically respond to students' activities by giving the necessary support and guidance in the required subject (Waters, 2014). Adaptive learning allows learners to work on their own pace at any given time and place without worrying about spend of lecture in the traditional classroom (Chen *et al*, 2018; Zhang & Chang, 2016). Walkington (2013) reports that adaptive learning is growing in the school systems to enhance the learning outcomes in the classroom (Walkington, 2013). Stoyanov & Kirschner (2017)

define adaptive e-learning as an innovative instructional tool that meet the needs of students and teachers (Stoyanov & Kirschner (2017). Adaptive learning is also defined, "web-based application programs that provide a personalized learning environment for each learner by adapting both the presentation and the wandering in content," (Özyurt, Özyurt, Balik, & Güven, 2013). After defining adaptive learning, the researcher will do a convergent mixed methods research study. Therefore, the study will be based on both quantitative and qualitative data collection which will give a good reflection and understanding of the subject being study (Creswell, 2018 & 2015; Segal, 2009; Shamburg & Rabinovich, 2016). The adaptive learning assessments described for this study include MyMathLab, ebook, online tutoring, and multimedia sites.

Callaghan *et al.* (2018) did a mixed method study about instructors' using professional development (PD) to support the use of digital educational games to improve students' achievement. The purpose of the study was to (a) comprehend how teachers use PD resources as an integration; (b) determine how teachers use games into their instruction; and (c) examine how teaching implementations are connected with student's attainment. The study used surveys and interviews from elementary school teachers (n = 863) that already have access to PD resources for applying a math game; such as teachers' training and workshops with teacher-based support available through MIND. The participants (863 teachers survey, including 12 teachers interviews) taught Pre-K to 6th grade. In addition, there were 10,610 student participants within 2nd through 6th grade with 86.9% Latino/Hispanic race. The interviews questions were arranged in advance with the use of audio recording and had a mixture of natural flow discussions; the surveys were open and close ended questions (Likert scales and multiple-choice format). Teachers were asked questions such as "How do you think the math game has impacted your mathematics teaching?" and "What do you think we should know about your experiences integrating the game into your math teaching?" In addition, students test scores were collected from 2008 to 2013 with the school district's permission to measure

their achievement in Math. The challenges and limitations in this study or the use of games were that implementing games into the curriculum was time consuming, not enough access to the technology, conflict with the schools that did not think that integrating technology in the classroom was that important, and teachers (old and novices) may not be reliable. As a result, the study concluded that schools influenced and support for teachers' using digital educational games to improve students' achievement is necessary.

Stuve (2015) did a mixed method dissertation study on students' view and outcomes on adaptive learning system in college algebra. The purpose of this dissertation study was to identify students' perspectives on using adaptive learning system and compared their final exam results with students who do not use the system. Five research questions were raised to accomplish the study: "(1) How satisfied are students on college Algebra with the use of an Adaptive Learning system in the course?; (2) Is there a relationship between how satisfied students are with the system and how much time they invest into using the system?; (3) Is there a relationship between how satisfied students are with the adaptive learning system and their satisfaction of mathematics?; (4) Are there differences in students satisfaction of the adaptive learning system between students taking online college algebra and students taking face-to-face college Algebra?; (5) Are there differences in final grades between students who did not use the Adaptive learning system and students who did use the Adaptive Learning System?" (Stuve, 2015). These research questions were answered through various literature reviews and additional research accomplished throughout the study. The instrument used for this study was the Rasch Model to analyze the survey questionnaire with 17 items. The limitation of the study was that only students at the Midwest Ohio University randomly completing the survey; therefore, the data was gathered through 73 online questionnaires (resulting in 73 participants). In addition, the researcher was unable to verify responses from participants.

García-Santillán *et al* (2017), Tobias (1993), and Lawson (1992) state that students' mathematics fear is related to panic, worrisome thought, concern in tests and homework assignment; teachers' attitudes and lectures giving in the classroom (García-Santillán et al, 2017; Tobias, 1993, Lawson, 1992; Sloan, 2010). Furthermore, these anxieties can create an achievement gap outcome that causes students to major in arts and humanities majors instead of STEM fields (Landivar, 2013; Lawson, 1992). Dreger and Aiken (1957) were the original researchers of *Mathematics Anxiety* (Dreger & Aiken, 1957; García-Santillán *et al*, 2017 p. 242); which was later defined to be a feeling of tension, concern, and worrisome that involves arithmetic's and mathematics' performance (García-Santillán *et al*, 2017 p.242, Dreger & Aiken, 1957 p.344, Ashcraft, 2002). The aim of García-Santillán *et al* (2017) study was to differential two variables that define the fear towards mathematics in college scholars. For this reason, García-Santillán *et al* (2017) report two variables, the Richardson and Suinn (1972) value named the *Pentadimentional Model of anxiety* and the Alexander Martray (1989) value items which mainly center on seven items out of twenty-five (García-Santillán *et al*, 2017 p.247-249; Richardson & Suinn, 1972; Alexander & Martray, 1989). The *Pentadimentional Model of anxiety* include: anxiety happens during exams, for the assessments, toward mathematics worksheets, and activities (García-Santillán *et al*, 2017 p.247-249; Richardson & Suinn, 1972). Alexander Martray (1989) described the seven main cause of anxiety: given assignment of difficult questions that is due the next day, knowing that a math test is coming up, getting the final exam grade through email or school portal, opening a math book and observing many exercises, looking at the board that is full of teachers' math writing, registering for a math class, and walking in the classroom (García-Santillán *et al*, 2017, Alexander & Martray, 1989). In addition, Lawson (1992) reports that there is a huge percentage of students registered in remedial courses, which is mostly due to the enormous drop-

failure-withdrawal (DFW) rate of approximately forty to fifty percent based on students' negative attitudes and mathematics anxiety (Lawson, 1992).

Royer (2002) states in his action research the benefits of using technology to increase students' achievement. His study shows fourth and eighth grade students were improving in their mathematics assignment when they were using computer-based instruction programs (Royer, 2002). In addition, teachers were willing to change their traditional method of teaching if they had good connection and good training to use the technology themselves. For the instrument, interviews, survey questionnaires, recording, focus groups, and classrooms observations were administered for both students and instructors. Hence, instructors were still skeptical in using the new classroom technology because they were not convinced that it will benefits students; implementing professional development workshops was not successful to help teachers understand devices. Royer (2002) research states that through best practice, classroom demonstration, and teacher to teacher interaction and coaching might be beneficial and necessary (Royer, 2002).

The majority of the research study state that implementing the following adaptive learning assessments software: MapleV, Khan academic, MyMathlab from Pearson, Webassign from Cengage, and dynamic mathematics software allow students to study at their desire speed and time, successfully accomplished their homework, get quick response, improve their development skills, can describe concepts, develop better positive attitudes, and are able to answer inquiry on their own (Afonso Gutierrez & Dorta Diaz, 2001; Zengin *et al*, 2017; Zengin (2017; Zhang & Chang, 2016; Stewart, 2012; Brawner, 2000). Bulut *et al* (2011)'s qualitative research study was based on pre-service mathematics educators who uses GeoGebra math software to lecture (Bulut *et al*, 2011). The pre-service instructors describe the software as being easy and useful to create exam questions, develop a web pages and algebraic expression calculation; as well as applying the device in real life problem solving process.

Other studies states that using computer-assisted learning (CAL) or internet-based learning devices ameliorate the educational outcomes (Cooke *et al*, 2008; Lewis, 2003; Griff & Matter, 2013). Griff & Matter (2013) state that software has been renowned using processors as a combining instructional tool that is built on the students' achievement (Griff & Matter, 2013). Chen *et al*. (2018) and Zhang & Chang (2016) report that adaptive learning permit scholars to practice at their own pace; in which fast learners can move ahead and non-fast learner can take their time in studying on their own (Chen *et al*., 2018; Zhang & Chang, 2016). In addition, teachers can identify students that are struggling in the classroom and help them by observing their progress through the grading scale in the assessments. Although, the traditional instruction is useful, online learning can also benefits students in various ways. Therefore, mixing both method of teachers can improve students' achievement gap (Angiello, 2010).

Critique of the literature review

Critique of this literature review might think that using adaptive learning assessment makes no difference in students' progress; therefore, using the traditional method of teaching is more useful (Iannone & Simpson, 2015). Iannone and Simpson (2015) did a mixed method research on mathematics students' liking on using assessment methods in schools. As a result, it was determined in their report that mathematics students tend to like traditional assessment methods instead of the innovative technology methods of teaching (Iannone & Simpson, 2015). However, it is important to state that implementing both traditional method and face-to-face method is more valuable to both students and teachers alike (Angiello, 2010). Another critique of the literature might think that well-educated scholars in college should already know how to solve in mathematics; therefore, remedial courses should not be part of a college curriculum or their math anxiety should not exist in the first place (Lawson, 1992; Smith, Ferguson, & Caris, 2001). Although, teachers use adaptive learning to

implement and create tests, homework, and lectures; a disadvantage is that students can also use the device to cheat on their assignments (Brawner, 2000). Students can get help outside to do their homework assignments when they are at home; which is the reason the tools must be well monitored. These critiques might not really solve any problems because students are still dropping or failing remedial math or STEM courses. As Baugher (2012), Foderaro (2011), Twigg (2004), and U.S. Census Bureau (2010) have all stated in their reports, 65 % of every community college scholars in the entire country require to take remediation; the drop-failure-withdrawal (DFW) percentages are between 40% to 50% or higher in college remedial courses (Baugher, 2012, Foderaro, 2011, Twigg, 2004, and U.S. Census Bureau, 2010). As a result, providing a solution to the problem such as implementing adaptive learning assessment to guide students might break some of the anxiety those students are experimenting.

Summary

As the literature reviews and studies above have shown, adaptive learning is essential in the classroom to close the achievement gap and might help in minimizing students' anxiety so that they can pass remedial classes and maybe major in STEM related fields. Moreover, studies concluded that students can work at their own pace when using the assessments; teachers can create lessons, tests, and homework through the device. In addition, students can always find twenty-four hours help online without disrupting the other learners.

Chapter 3: Methodology

Introduction

After the selection of the research topic and the description of the literature reviews, the data collections and analysis from the teachers and students will be described in the following methodology procedure. The mixed method research will on both quantitative and qualitative data collection (see

table 1 below). The purpose of using both method to describe this study is because a mixed method is defined as "the type of research in which researcher or team of researchers combined elements of qualitative and quantitative approaches for the purpose of breadth and depth of understanding and corroboration" (Johnson *et al*, 2007). The use of qualitative data collection allows participants to be able to express themselves freely and the researcher will code the collected data from students and faculties. Segal (2009) reports in her dissertation that using qualitative research such as action research give good reflection (Segal, 2009). The quantitative data collection will give a breath understanding of why students use adaptive learning and if it minimizes the math anxiety. Creswell (2018) and Johnson et al (2007) described three types of mixed method: convergent, explanatory, and exploratory mixed method research. Convergent mixed methods prioritize both quantitative and qualitative researches equally done with independent analysis and at interpretation (p.217). The benefits of using a convergent mixed method for this research are that the survey will be answered in a single sitting, it can generate well validated and authenticated findings, and the data can be collected within a short period of time (Johnson et al, 2007; Creswell, 2014 & 2018, p.217-220). The issue about the convergent mixed methods might be the unequal sample size because some participants might complete a portion of the survey and leave the other. Explanatory mixed methods mean the quantitative research is done first and has priority than the qualitative with data collection and analysis. Exploratory mixed methods mean the qualitative research is first and the quantitative data collection and analysis is second to generalize the findings. Some of the issues surrounding the exploratory and explanatory are finding time for a second follow-up, and the instrument research might be complexed (Johnson et al, 2007; Creswell, 2014 & 2018, p.220-226). In addition, the participants might not have enough time to complete the questionnaires. The mixed method research questions above will be answered through various data collection, survey, interviews, analysis, and class observation as shown the appendix below.

Research Design

In the above literature review, Baugher, (2012), Foderado (2011, March 3), Twigg (2004), and McCabe (2003) report that most students (freshman or returning) entering colleges or universities are underprepared and the majority end up taking remedial mathematics courses due to math anxiety and college unpreparedness (Baugher, 2012; Foderado, 2011, March 3; Twigg, 2004; McCabe,2003). The report also shows that sixty five percent of every students in community college need to take remedial courses; in which, the drop-failure-withdrawal (DFW) percentages are between 40% to 50% or higher in these courses (Baugher, 2012, Foderaro, 2011, Twigg, 2004, and U.S. Census Bureau, 2010). Due to the anxiety, students failed math or other related developmental classes this results in students changing their majors to non-STEM majors which can create a big gap in education (García-Santillán et al, 2017; Lawson, 1992; Sloan, 2010; Landivar, 2013). This research will use doing a mixed methods research on adaptive learning. Some of the advantages of mixed methods stated by Mahmood (n.d.) are that the quantitative and qualitative method might be weak on their own; therefore, using a mixed method can complete in the gap. In addition, the final report of the research will include both quantitative and qualitative data collection (Mahmood, n.d., Creswell, 2018). Some challenges of mixed methods are that it might take a lot of time because of collecting data from both methods. More resources and researches might be needed and can be complex and less comforted. This research will focus on the convergent mixed methods. The reason for chosen the convergent mixed method is because the majority of the faculties, including the researcher, are adjunct teachers (part-time) and a second follow-up will not be available due to schedule conflict. The qualitative research will be an action research and the quantitative research will be based on survey questionnaires with Likert scale format; which can improve the creativity and effectiveness of both students and teachers by allowing them to speak their mind (Segal, 2009). The data collection and analysis will

help answer the following research questions: (1) Do students and faculties believe using adaptive learning assessments improved the learning outcome and reduced their anxiety in remedial courses? (2) What are some concerns scholars and educators have when using adaptive learning assessments? (3) What are scholars' perspectives toward using adaptive learning assessments? (3a) Does using such assessments help improve students comprehend Mathematics? (3b) Do students' anxiety minimized when using adaptive learning assessments throughout the semester? (4) What are faculties' perspectives when using adaptive learning assessments? (4a) Is there a big difference in using traditional instructions and adaptive learning/technology instruction? (4b) Does instructors' teaching approach changed throughout the years since using adaptive learning assessments in their classroom?

Population & Sample

The population and sample will come from two New Jersey institutions, Hudson County Community College (HCCC) and New Jersey City University (NJCU) because they are both using similar assessments and most teachers teach in both institutions. As described in the table below, the sample size will be approximately sixty students for the quantitative (less) and qualitative (more) research methods collections of the survey questionnaires done in Survey Monkey (See Appendix below). Approximately, ten facilities from the STEM or academic foundation mathematics departments will complete their survey; with three interviews and two classroom observations. The researcher will obtain the students' and faculties' emails through the mathematics department; will email the participants once a week. Also, during the faculty development meeting, the researcher will inform teachers about the survey and ask them for their phone numbers to send them the survey url shown in appendix C. The researcher will ask some faculties members for a fifteen minutes interview after the faculty development workshop or set up another time for the interview. Students from the

students lounge or mathematics tutorial center will also be interviewed; all students will be from age eighteen and thirty.

Researchers' Position

The researcher's position is a mathematics adjunct teacher at both institutions, HCCC and NJCU. Therefore, most of the students filling out the survey might come from the researcher's mathematics classroom. The researcher's interest is in mathematics because seeing students struggling and hating the subject in the beginning of each semester needed to be study. The assumptions of the research might be that the students from the researcher's classroom will willingly fill out the survey; this might create a problem when students choose not to complete the survey or be interviewed.

Procedures

The researcher will get permission from each institutions' Internal Review Board (IRB). As shown in Appendix D, a letter will be mailed or email to the department. After approval, participants (students and faculties) will acknowledge their rights as participants and may continue or discontinue the study. Students in researcher's classroom will be asked to use their cellphone to complete the surveys, the url will be provided or written on the board. Survey Monkey website was used to create the surveys so that the data could be saved and organized.

The researcher produced ten quantitative and ten qualitative survey questionnaires for students and faculties (see Appendix A and B). Due to their schedule and time conflict, some participants might not have time to complete the survey which will result in a low sample size. For instance, the majority are full-time students and worked outside of schools; while, some teachers are adjunct teachers who instruct in various colleges or universities. Nevertheless, the participants will be reminded to complete the survey with an email message. Moreover, interviews will also be conducted

with five random students who are taking mathematics within the semester or previous semester; two faculties will also be interviewed and observed. The adjunct lounge or faculty lounge will be another proper setting for the interview. The qualitative data collection will be coded to discover the importance of using the adaptive learning tools and determine if students' anxiety is improving in remedial mathematics classes or other math class.

Table: Mixed Method Data Collection

*Research Questions	Data Type	***Data Collection Item	Participant	Respondent
1, 2, 3, 3a, 3b	Mixed	Survey	60 or less (Quan) 60 or more (Qual)	**College Students
1, 2, 4, 4b	Quantitative	Survey	10	College Faculties
1, 2, 4, 4a, 4b	Qualitative	Survey	10	College Faculties
1, 2, 3, 3a, 3b	Qualitative	Interview	5 or more	**College Students
1, 2, 4, 4a, 4b	Qualitative	Interview	3 or more	College Faculties
	Qualitative	Classroom Observation	2	College Faculties

Note: * Research Questions: (1) Do students and faculties believe using adaptive learning assessments improved the learning outcome and reduced their anxiety in remedial courses? (2) What are some concerns scholars and educators have when using adaptive learning assessments? (3) What are scholars' perspectives toward using adaptive learning assessments? (3a) Does using such assessments help improve students comprehend Mathematics? (3b) Do students' anxiety minimized when using adaptive learning assessments throughout the semester? (4) What are faculties' perspectives when using adaptive learning assessments? (4a) Is there a big difference in using traditional instructions and adaptive learning/technology instruction? (4b) Does instructors' teaching approach changed throughout the years since using adaptive learning assessments in their classroom?
**College students: between age 18 to 30 years old ***Data Collection: see Appendix A, B, C, D

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Appendix A

Survey: Students Quantitative Questionnaire on Survey Monkey:
https://www.surveymonkey.com/r/JH6VPWP

Title: Adaptive Learning in Higher Education

Purpose: The purpose of this Research evaluation is to determine the importance of using Adaptive Learning Assessments in Higher Education.

Definition: Adaptive learning, also known as adaptive teaching, is an educational method which uses computers as interactive teaching devices, and to orchestrate the allocation of human and mediated resources according to the unique needs of each learner.

Adaptive Learning Assessments:

1. Learning Management System (e.g. Blackboard, Canvas, Moodle)
2. Digital Learning/Homework Program (e.g. MyLab,Webassign Mastering, Connect)
3. EBook (e.g. Pearson eText, Vitalsource, RedShelf)
4. Open Educational Resources (e.g. OpenStax)
5. Classroom Response/Clickers (e.g TopHat, iClicker, Learning Catalytics)
6. Plagiarism detection system (e.g. Turnitin)
7. Online self-quizzing and study tools (e.g. Quizlet, Quizizz, Kahoot, Chegg Study)
8. Online tutoring sites (e.g. Khan Academy, School Online Tutoring)
9. Multimedia sites (e.g. Youtube, Google)

1. Name of School:

2. What Mathematics Class are you taking this semester? (e.g. Basic Math, Basic Algebra, College Algebra,)

3. The Adaptive Learning Assessment helps students learn: (Check Only One)

Always
Usually
Not Usually
Never
Not Sure

4. Adaptive Learning helps students understand Mathematics better: (Check Only One)

Always
Usually
Not Usually
Never
Not Sure

5. Adaptive Learning assessments help improve students grade: (Check Only One)

Always
Usually
Not Usually
Never
Not Sure

6. Amount of information expected to learn and complete using Adaptive Learning: (Check Only One)

Too Much
A Lot
Just Right
Not Enough
Not Sure

7. ONLY the Class Lecture help improve the students grade: (Check Only One)

Always
Usually
Not Usually
Never
Not Sure

8. BOTH the Class Lecture and Adaptive Learning Assessment help improve students grade? (Check Only One)
Always
Usually
Not Usually
Never
Not Sure

9. Hours per week studying outside of class: (Check Only One)

0 - 1 hr/wk
2 - 3 hrs/wk
4 - 5 hrs/wk
6 - 7 hrs/wk
8 or More hrs/wk

10. What are the biggest benefits of using Adaptive Learning assessments? (Check all that apply)

Offers a more personalized learning experience
Gives students better understanding of struggling assignment
Helps to bring real-world concepts to life
Allows students to get more immediate feedback and instruction
Allows students to practice until they achieve mastery
Provides additional examples and applications as needed
Provides students with video tutorials and explanations
Allows students to learn, study, or complete assignments anytime, anywhere

Appendix B

Survey: Students' Qualitative Questionnaire on Survey Monkey:
https://www.surveymonkey.com/r/CTYRCWC

Title: Adaptive Learning in Higher Education

Purpose: The purpose of this Research evaluation is to determine the importance of using Adaptive Learning Assessments in Higher Education.

Definition: Adaptive learning, also known as adaptive teaching, is an educational method which uses computers as interactive teaching devices, and to orchestrate the allocation of human and mediated resources according to the unique needs of each learner.

Adaptive Learning Assessments:

1. Learning Management System (e.g. Blackboard, Canvas, Moodle)
2. Digital Learning/Homework Program (e.g. MyLab,Webassign Mastering, Connect)
3. EBook (e.g. Pearson eText, Vitalsource, RedShelf)
4. Open Educational Resources (e.g. OpenStax)
5. Classroom Response/Clickers (e.g TopHat, iClicker, Learning Catalytics)
6. Plagiarism detection system (e.g. Turnitin)
7. Online self-quizzing and study tools (e.g. Quizlet, Quizizz, Kahoot, Chegg Study)
8. Online tutoring sites (e.g. Khan Academy, School Online Tutoring)
9. Multimedia sites (e.g. Youtube, Google)

1. Name of School and Age:

2. What Mathematics Class are you taking this semester? (e.g. Basic Math, Basic Algebra, College Algebra,...)

3. What do you (Student) think about Adaptive Learning in your Mathematics Class?

4. What are the biggest benefits of using Adaptive Learning in the Mathematics Class? Give at least 5 or more benefits.

5. What problem (s) does the student encounter when using Adaptive Learning assessments?

6. Does using Adaptive Learning assessments ONLY help improve your grade?

7. Does the Class Lecture ONLY help improve your grade?

8. Does using BOTH the Class Lecture and Adaptive Learning Assessment help improve your grade?

9. Do you have a Tutor/Online Tutor?

10. (a) In a weekly bases, How many hours per day do you study for Mathematics?

(b) In a weekly bases, How often do you do your homework assignment?

Appendix C

Dear Educators,

I am recently doing a research on how students and educators use Adaptive Learning assessment in the classrooms.

Survey URL: Teacher's Questionnaire on Survey Monkey:
https://www.surveymonkey.com/r/LDNZGV7

Purpose: The purpose of this Research evaluation is to determine the importance of using Adaptive Learning Assessments in school and in Mathematics classroom.

Definition: Adaptive learning, also known as adaptive teaching, is an educational method which uses computers as interactive teaching devices, and to orchestrate the allocation of human and mediated resources according to the unique needs of each learner.

Adaptive Learning Assessments:

1. Learning Management System (e.g. Blackboard, Canvas, Moodle)
2. Digital Learning/Homework Program (e.g. MyMathLab, WebAssign Mastering, Connect)
3. EBook (e.g. Pearson eText, Vitalsource, RedShelf)
4. Open Educational Resources (e.g. OpenStax)
5. Classroom Response/Clickers (e.g TopHat, iClicker, Learning Catalytics)
6. Plagiarism detection system (e.g. Turnitin)
7. Online self-quizzing and study tools (e.g. Quizlet, Quizizz, Kahoot, Chegg Study)
8. Online tutoring sites (e.g. Khan Academy, School Online Tutoring)
9. Multimedia sites (e.g. Youtube, Google)

1. Are you an Adjunct or Full-Time Faculty?

Adjunct Faculty
Full-Time Faculty

2. Which School (s) do you Lecture?

(State School Name, City, and State)

3. Which Mathematics level(s) class (es) do you teach?

Academic Foundation Math (e.g. Basic Math, Basic Algebra, Intermediate Algebra, Arithmetic...)
College Level Math (e.g. College Algebra, Pre-calculus, Calculus...)
Both Academic Foundation and College Level Math
K-12 Level Math

4. How satisfied are you (educator) with the adaptive learning in your classroom (s)?

Very satisfied
Satisfied
Neither satisfied nor dissatisfied
Dissatisfied
Very dissatisfied

5. How helpful are the tools (e.g. e-book, videos, homework, grading)?

Extremely helpful
Very helpful
Somewhat helpful
Not so helpful
Not at all helpful

6. What type of Mathematics anxiety or problems do you mostly encounter in student (s) in the classroom? (Select all possible answer)

Student state, "I hate Math because..."
The student does not get extra help outside of class (e.g. tutor, khan academy, online videos, online tutoring, relative help, and teachers' help)
The student comes in class late or have many absences
The student does not take note
The student likes Math but do not... (e.g. do homework, study, practice)
The student complains about... (e.g. hard online homework assignment, understanding online lecture or notes or videos...)
The student does not have access online to do homework or test

7. Why using the adaptive learning assessment (s) in the classroom useful or not useful?

8. What are some advantages **and** disadvantages **of using adaptive learning in your classroom?**

9. When students answer the question (s) wrong on the assignment using the assessment (e.g. MyMathLab or WebAssign) for homework or practice. They are given solution supports (e.g. view an example or help me solve it) and tips when necessary. How do you think this affects **students' learning?**

10. Did the adaptive learning assessment (s) helped students see their weaknesses and strengths?

Appendix D

Aminata E. Adewumi
406 Central Avenue,
East Orange NJ 07018

Date

Name of Chairperson/Instructor
School Address of Chairperson/Instructor
Department Phone number

Dear (Chairperson/Instructor Name),

My name is Professor Adewumi, I am a Mathematics Adjunct professor and a Doctoral student in Educational Technology Leadership at New Jersey City University. I am recently doing a research on Adaptive Learning assessment in Higher Education. I would like the Department's or the teachers' permission and approval on the research surveys. The research required students and instructors from the remedial class to fill out the following survey questionnaires on Survey Monkey:

Survey 1: Teacher's Questionnaire on Survey Monkey:
https://www.surveymonkey.com/r/LDNZGV7

Survey 2: Students' Qualitative Questionnaire on Survey Monkey:
https://www.surveymonkey.com/r/CTYRCWC

Survey 3: Students' Quantitative Questionnaire on Survey Monkey:
https://www.surveymonkey.com/r/JH6VPWP

Purpose: The purpose of this research evaluation is to determine the importance of using Adaptive Learning Assessments in Higher Education in the Mathematics classroom. This research would benefits students in a way to help them improve on their assignments.

Definition: Adaptive learning, also known as adaptive teaching, is an educational method which uses computers as interactive teaching devices, and to orchestrate the allocation of human and mediated resources according to the unique needs of each learner.

Adaptive Learning Assessments:

1. Learning Management System (e.g. Blackboard, Canvas, Moodle)
2. Digital Learning/Homework Program (e.g. MyLab,Webassign Mastering, Connect)
3. EBook (e.g. Pearson eText, Vitalsource, RedShelf)

4. Open Educational Resources (e.g. OpenStax)
5. Classroom Response/Clickers (e.g TopHat, iClicker, Learning Catalytics)
6. Plagiarism detection system (e.g. Turnitin)
7. Online self-quizzing and study tools (e.g. Quizlet, Quizizz, Kahoot, Chegg Study)
8. Online tutoring sites (e.g. Khan Academy, School Online Tutoring)
9. Multimedia sites (e.g. Youtube, Google)

If there is any question (s), please fill free to contact me at 201-294-1306 or Email me at aadewumi@hccc.edu

Best Regards,

Aminata Adewumi

Aminata E. Adewumi
Mathematics Adjunct Professor

Appendix E

Interview Questions

Title: Adaptive Learning in Higher Education
Purpose: The purpose of this Research evaluation is to determine the importance of using Adaptive Learning Assessments in Higher Education.

Definition: Adaptive learning, also known as adaptive teaching, is an educational method which uses computers as interactive teaching devices, and to orchestrate the allocation of human and mediated resources according to the unique needs of each learner.

Interview Questions for Students:

1. Do you like Mathematics? Why?
2. How is using adaptive learning assessments (MyMathlab) helping you cope with the mathematics lessons?
3. Is there an improvement in your grade since you use adaptive learning assessment in your math or STEM class?
4. What is some benefits of using the assessments to do your assignments?
5. What is the disadvantage of using the assessments?

Interview Questions for Teachers:

1. How long have you been teaching math?
2. Do you see any improvement in your math class since you have been using adaptive learning in your classroom? (comparing years of experience before/after)
3. Are students motivated in the classroom when using the assessments?
4. What are some advantages of using the assessments in your math or STEM classroom?
5. What are some disadvantages of using the assessments in your math or STEM classroom?