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An Evaluation of a Redesigned Developmental Mathematics Course at a Hawaii Community College

Bebi Zamina Khan Davis
Walden University

Walden University

College of Education

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Bebi Zamina Khan Davis, Ph.D.

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Review Committee
Dr. Therese Kanai, Committee Chairperson, Education Faculty
Dr. Cheryl Bullock, Committee Member, Education Faculty
Dr. Paul Englesberg, University Reviewer, Education Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
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Bebi Zamina Khan Davis, Ph.D.

PhD., University of Hawaii at Manoa, 2014

MEd., University of Hawaii at Manoa, 2004, 2018

BEd., University of Hawaii at Manoa, 2001

Doctoral Study Submitted in Partial Fulfillment

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Abstract

Developmental mathematics is a problem for many college students due to high failure rate. The purpose of the study was to evaluate the effectiveness of the redesigned course, Math 24. The evaluation examined success, retention, and persistence outcomes of the redesigned course compared to the previous developmental math course. The course's academic and environmental strengths and weaknesses were assessed from the students' and instructors' perspectives. The study utilized the theoretical and conceptual frameworks of Tinto's retention model, Astin's I-E-O model, and Wlodkowski's culturally responsive teaching. A mixed methods program evaluation was employed for the case study using an ex post facto analysis of quantitative data from the college's student database and interviews from 16 students, 4 faculty members, and 1 program director administrator. Quantitative data on persistence, retention and student success rates were analyzed using descriptive statistics to evaluate the outcomes of the redesigned course. Qualitative data from student focus groups and faculty interviews were analyzed using constant comparison analysis to evaluate redesign effect on students. The findings suggested that the redesigned math course's curriculum, resources, assignments, assessments, and the physical classroom setting had many advantages, and assignments and assessments posed major challenges. Online resources, peer collaboration, indirect instruction were strengths; word problems, and the final exam posed the biggest challenges for most students. Retention, persistence and success rates fluctuated over the years and the expected outcomes were not achieved. The social change implication of the redesigned developmental math project study is that faculty should seek students' feedback to help faculty with effective decision making.

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Dedication

To my scientist husband, Dr. Harry B. Davis IV, who inspired me to be better each day. Though his honest critique, I progressively challenged myself to become a better writer, scientist, educator, student, and most of all an awesome wife. You were the only person that encouraged me to finish this second doctorate! Thank you, Harry, for your love and support, because you are the H in my Humility, Humor & Happiness!

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Section 1: The Problem

Introduction

Developmental mathematics courses in United States community colleges are attempting atypical reforms and redesign with the goal of enhancing learning, retention, proficiency, and success for students. Colleges lack an approach to fundamentally advance the developmental mathematics course's average student retention, persistence, and success to a higher level. Simplifying mathematical techniques and redesigning courses are reform strategies being explored among educational agents to guide future reforms in developmental courses by exploring novel pedagogical approaches to improve student learning outcomes (Ariovich & Walker, 2014; Hartman, 2017; Henderson, 2013; Rufatto et al., 2016; Shugart & Romano, Winter 2008). Developmental mathematics has experienced many transformations, and the student success rate seems to have reached a plateau. Minimal change in the success rate across developmental mathematics has created a challenge for stakeholders to try new or unconventional strategies with the hope of enhancing success outcomes for college students taking developmental math (Bonham & Boylan, 2011).

Typically, redesigning using the Emporium Model is a significant shift in developmental mathematics teaching–learning strategy. Emporium Model is a new instructional design that integrates computer-based learning to engage students to learn math at their own pace (Wilder & Berry, 2016). Classroom lectures and passive notetaking are being ousted and are being replaced with a range of interactive technological tools. A more active-learning and learner-centered approach is favored. The redesign of developmental mathematics courses anticipate better learning experiences and significant improvements in course quality (The National Center for Academic Transformation, 2005).

Millions of dollars have been channeled to community colleges to comprehensively redesign their developmental education courses to bridge the gap in developmental education. An estimated cost of between $1.61 billion and $2.01 billion fund the developmental education courses in community colleges (Collins, 2010). The hope is to better serve 21st century students. However, it is imperative that stakeholders, such as researchers, educators, lawmakers, and strategists collaborate to pinpoint, implement, and evaluate programs and services which can foster students' success in developmental programs. A continuous growth in the number of students needing developmental mathematics skills is a major problem facing community colleges, but research on this population and their success rate has been limited (Benken, Ramirez, Li, & Wetendorf, 2015). Most course redesigns continue to integrate technology and online aspects, but research is lacking on whether this enhances success (Huang, Liu, & Chang, 2012). It is not known if the population of developmental math students has the financial capabilities, and enough technical and educational experience, to succeed. A redesign has to be purposeful and conscientiously tailored to the population it serves. Professionals in the field of interest have an added advantage, but the involvement of constituents from all areas of the educational spectrum should be elicited. Reform inputs and initiatives for developmental mathematics should be gauged for strengths, shortfalls, and applied fittingly to appropriate settings (Ashby, Sadera, & McNary, 2011; Collins, 2010; Kincaid, 2013).

Redesigned developmental math courses are being introduced, tweaked and reimplemented in college. However, many of these modified math courses have never been formally evaluated. In Hawaii, many students struggle with mathematics, and there is an enormous gap in math skills for high school graduates entering college (Hawaii Department of Education, 2019); thus, a significant percentage of college freshmen are placed at the developmental math level and continue to be challenged by math (Davis, 2014). Passing developmental mathematics is a challenge for many students in Hawaii.

Local Problem

Community colleges in Hawaii require that students test into Math 25 or higher, or successfully complete Math 24, before they can take any science courses and other courses that are critical requirements for an Associate Degree or higher. Passing Math 24 can be a challenge for many college students. The local problem this study addressed was the need to evaluate the redesigned developmental Math 24 course at Kapiolani Community College (KCC) to learn what is working and what can be done to help students succeed in developmental mathematics. Failure to successfully complete the developmental mathematics may not only preclude adults from attaining a college degree but may have negative consequences on career pathways and a young adult’s employment in the 21st century. Evaluation of a redesigned course is necessary to guide any future redesign and to ensure that courses are redesigned to improve student success effectively. Program evaluation findings allow for decision makers to facilitate changes (Patton, 2008a).

Successful reform of developmental mathematics programs must implement effective math courses that improve teaching and learning. Approximately 60% of newly enrolled college students have to register at KCC for developmental classes. Also, approximately 40% of first-year college students are placed into a developmental mathematics course (Oudenhoven, 2002). To decrease the attrition rate and increase retention and success in developmental math, colleges are implementing new ways of teaching and learning math. “Math success is an institutional responsibility that needs to be addressed by the college's president and other administrative officers to induce institutional change that will not only help developmental math students but all students” (Boylan, 2011, p. 26). Improving the developmental mathematics course is a critical local and national problem because strong numeracy and analytical skills are essential for adults to successfully integrate themselves into and work in the 21st century. For numerous college students in developmental mathematics courses, the traditional math lessons and the lecture delivery model is unsuccessful in meeting their developmental math needs. So, colleges are exploring necessary developmental mathematics course reforms to innovatively redesign the developmental math courses (Le, Rogers, & Santos, 2011).

At KCC, a new way of teaching Math 24/developmental math, called the Emporium Model Program, was introduced in 2010. Program evaluation is essential to further enhance the Math 24 course at this local college. A growing focus on policy, practice, and research in developmental education plus an increased initiative of colleges, states, and scholars to meticulously analyze student progression through college developmental programs are prompting the need for regularly rigorous evaluation of program interventions and redesigns (Bailey, 2009). Initially, developmental mathematics courses were developed to enable all students to be college-ready and to help decrease the college entrance level gap for students. Unfortunately, developmental mathematics courses once envisioned as the entryway for career preparation and educational growth have become barriers to future opportunity for many postsecondary students (Bonham & Boylan, 2011).

Reforming developmental math is a critical issue locally in Hawaii as well as a major issue nationally. In American colleges, the general trend is that developmental mathematics courses have the lowest success rate and completion rate of any developmental education course (Bonham & Boylan, 2011). A growing challenge is to find ways to increase student success by improving academic achievement, retention, and persistence. To find solutions, colleges are changing their programs with the hope of discovering effective techniques. Redesign of developmental mathematics courses is aimed at meeting the needs of all college students and closing the academic gap in developmental math success rates. Multiple factors hinder student success in community colleges, and the major factor credited for poor mathematics performance is deficient mathematical background, and hence the lack of basic skills. Developmental math is such a critical national academic issue that groups, such as the Carnegie Foundation and other charitable organizations, are investing millions of dollars in community college math initiatives. The aim of the program evaluation is to assist in amelioration of new developmental mathematical programs (Crawford & Jervis, 2011; Dasinger, 2013; Davidson & Petrosko, 2015).

Rationale for Choosing the Local Problem

Enhancing developmental mathematics is a critical local problem at all Hawaii's community colleges because they are seeking new ways to improve students' success. Examination of the experiences and perceptions of both students who succeed (pass) and fail the developmental math course may lead to more effective redesign, strategies, and teaching methodologies. Merseth (2011) stated that "nowhere in the community college curriculum is this failure rate of graver concern than in developmental mathematics courses" (p. 32). Community colleges across America are pursuing new approaches to instruct developmental mathematics courses to increase success rate, retention, and proficiency. Each year, thousands of freshmen enter community colleges with great aspirations, enthusiasm, and high expectations that the college educational journey they are embarking on will enhance their skills and lives (Merseth, 2011). In reality, developmental education, especially mathematics, is a major barrier to college retention and eventual career success. Nationally, over 60% of 14 million college students enroll in developmental mathematics, and within 3 years of college, approximately 80% of these students are unsuccessful at completing a college-level mathematics course (Asera, 2011; Clyburn, 2013; Edwards, Sandoval, & McNamara, 2015; Khazanov, 2011). The academic gap for developmental mathematics is immense, while the failure rate is colossal. Typically, developmental mathematics students meet all admission requirements but are limited in educational options because of poor mathematics skills (Duranczyk & Higbee, 2006).

To curtail the predicament of a large achievement gap in math, community colleges' developmental mathematics courses are facing unconventional reforms and redesign. Developmental mathematics courses are constantly being reformed, and a critical step that is lacking to help with more effective reforms is program evaluation of the reformed courses. Ineffective reform can create a bigger deterrence to success than no reform. Thus, reforming developmental mathematics effectively for students' success is a major local and national problem. It is a problem made more critical due to globalization and the demand for 21st century analytical skills.

The rationale for studying the reformed developmental Math 24 course at KCC was that evaluation of a newly reformed course was critical to learning how the course was doing, to find out what the positive features of the course were, and to determine what aspects of the course needed to be further analyzed and altered to enhance it. A program evaluation highlights problem area in the reformed Math 24 course; program directors can then find possible solutions for the problem areas in the reformed Math 24 course, thus enhancing the course by further redesign. Program evaluation of the redesigned mathematics course may encourage and increase faculty reflection, increase collaborative efforts to improve the course, increase student feedback and involvement in redesign efforts, encourage college/program dialogue, increase efforts grounded in theory, improve the learning environment, promote alignment, and improve the curriculum. Consequently, a program evaluation could lead to positive social change and increased success because the program evaluation findings may help people to "think evaluatively, nurture ego integrity, fend off despair, and lead to wisdom" (Patton, 2007, p. 111). The results of evaluation and possible stakeholder collaborative efforts exploring evaluative practices may have implications for future reform of other developmental math programs and is integral to program transformation processes (Patton, 1997a) .

The problem of developmental math is not unique to KCC; it is both a local Hawaii problem and a national United States problem. Boylan (2011), referring to the National Center for Education Statistics (NCES, 2003), acknowledged that an increasing number of college students are placed into developmental mathematics compared to any other subject area in developmental education. Both nationally and locally, finding ways to effectively redesign developmental mathematics to increasing student retention rate and completion rate to help students to succeed is a valid problem. Many college students perceive developmental mathematics as a barrier and believe that their "potential will never be realized if institutional policies serve as a barrier to their persistence and retention at the institution" (Duranczyk & Higbee, 2006, p. 25). Developmental mathematics has opened the door to success for more than 50% of college students who take developmental or the lower level remedial math in college. Agencies are investing in college developmental math programs and adapting the NCAT's emporium model of instruction where students attend a 1-hour class each week and work an additional 2 hours in a computer lab each week. Integration of the MyMathLab enabled program into developmental mathematics course was found to be successful for many students (Squires, Faulkner, & Hite, 2009; Stewart, 2012). To help local college students succeed, KCC was awarded a grant to reform its developmental math course and has integrated a similar model.

Purpose of Study

There is an urgent local and national need to find effective means to decrease the deficiency of college students' developmental mathematics proficiencies. A significant number of students are precluded from accomplishing their educational goals because they are placed into developmental courses, particularly mathematics, and they never complete these courses. Instead of being the gateway to higher education, developmental mathematics especially serves as an intensive barrier to scholastic opportunities and presents a serious challenge for postsecondary students as well as a major concern for higher education policy makers (Bonham & Boylan, 2011; Lesik, 2008).

The purpose of the study was to evaluate the effectiveness of the newly reformed developmental Math 24 course at KCC, which embraces and integrates features from the Emporium Model, MyMathLab, and technology, and to determine if the course redesign objectives were met at KCC. A program evaluation identified the effective aspects and the problems that the new math course posed for students. Through the program evaluation, data were analyzed to determine how and why there are problems and implications for the future and success of this course. Program evaluation is crucial when evaluating whether changes, redesigns, and new interventions are more fruitful than former techniques and approaches. Programs are evaluated for organizational decision-making and to determine if programs are advantageous (Patton, 1990; Royse, Thyer, Padgett, & Logan, 2001). When programs are initially implemented, formative feedback or program evaluation is especially important to stakeholders and developers in removing kinks before the program can be highly successful. Program evaluation is the process used to examine and assess the program to determine whether the design and delivery of the program were effective, whether the proposed program outcomes were met, to uncover any unintended impact, and to diminish uncertainties (Caffarella, 2002; Lodico, Spaulding, & Voegtle, 2010; McDavid, Huse, Hawthorn, & McDavid, 2013; Patton, 1982). Findings from the program evaluation of the new Emporium Model Math at KCC were expected to provide insight into the course and initiate social changes in how developmental math is taught.

According to Ross (2010), assessing outcomes in program evaluation for reform or redesign should include dispositions such as diversity, knowledge, skill acquisition, impact institution improvement, and student achievement. Newly redesigned courses are introducing more active learning; and the Emporium Model Math which integrates the computer-based MyMathLab program, embraces active learning, technology, and student-centered learning. Inquiry-based, active learning and innovative academic programs are the significant replacements for lecture-based teaching in colleges. Emerging course redesign programs more frequently experiment with and promote experiential learning, critical thinking, group activities, and student engagement. Innovative pedagogies offer unique opportunities and challenges for open-access programs (Kinghorn, 2011). Program evaluation is critical because the results can provide insights that enhance the effectiveness of new programs and initiate educational and social changes.

Significance

This program evaluation was significant in informing and improving future redesign of developmental programs and eliminating barriers for college developmental education students. The significance of evaluating the redesigned developmental mathematics at Kapiolani Community College was to learn what factors in the redesign promote or hinder success in developmental mathematics. An evaluation was significant in addressing the local problem of finding effective solutions or strategies to better ameliorate student success in developmental mathematics. Robust program evaluation is necessary to gauge the effectiveness of, and formulate recommendations towards, course improvement and student outcomes. Although there are inadequate statistics (not many evaluations or studies have been done), a positive correlation exists between program evaluation and retention or success in developmental mathematics programs (Waycaster, 2011). Thus, program evaluation is significant in improving student outcomes in developmental mathematics programs.

Identifying the strengths and weaknesses serve to strengthen redesign, significantly move local and national economies forward, and increase the quantitative or mathematical proficiency of citizens in the community. This project was significant for both micro and macro levels of growth. At the micro level, identifying aspects that were effective and ineffective in order to inform change and tailor programs to assist student retention, diligence, and academic success was critical for individual growth. At the macro level, improving social interaction, collaboration, and implementing changes to enhance educational programs have a positive impact in the realm of education. A program evaluation of the reformed Math 24 course at KCC was expected to sustain program growth by identifying crucial factors to improve the course that are more relevant to the students' success.

Program evaluation is a systematic study of the manner of things, such as institutional programs and individual performance, and the way they should be (Rouda & Kusy, 1995). Performance or effectiveness of a program, such as the Math 24 course, is an important facet in promoting success and growth of all citizens in the 21st century. According to Collins (2010), to better serve citizens, policy makers, and educators, researchers need to identify courses and services that enhance success. An educated citizenry is paramount, and data-driven program improvements are fundamental.

A program evaluation of the reformed developmental math course is significant because it evaluates whether the learning goals are met, and illuminates areas that require attention to accelerate success and meet learning goals. Also, evaluation is important in the enhancement of future reform or redesign of developmental math courses and even other math programs. New programs, redesigns, and interventions need program evaluation to establish which aspects are effective and which elements need to be improved.

Definition of Terms

Blended/Hybrid: the course integrates major online or software to deliver content and instructor/facilitator has limited face-to-face delivery.

Developmental mathematics: mathematics courses that are one or two levels below college mathematics. Also referred to as beginning college algebra, the content is similar to Algebra I in high school.

Emporium model: a redesign mathematics model that eliminates regular face-to-face class meetings and substitutes them with computer lab hours, supplemental digital learning resources featuring online multimedia materials, and a one-on-one on-demand personalized facilitator (Center for Academic Transformation, n.d.).

Math 24: a first level developmental mathematics course that seeks to help students reach the math proficiency to enroll in a college-level math course.

MyMathLab: a math program that uses MathXL (online homework, tutorial, practice modes, online gradebook, eBook, video lectures, animation, and assessment system) to administer electronic assignments, tests, and to provide resources to college math students (Pearson Education, 2012).

Redesigned Developmental Mathematics: A blended program that integrates the components of online instruction and face-to-face (one-on-one) instruction to teach mathematics. MyMathLab is the tool used to enable the blended instruction.

Evaluation Questions - Introduction and Operational Definition

Developmental mathematics continues to be a barrier for many community college students; it "is a stumbling block in the path for graduation" (Míreles, Offer, Ward, & Dochen, 2011, p. 12). The aim of sustaining effective redesigns in developmental mathematics courses is to enhance students' proficiency, retention, and success; this served as the basis for the evaluation of the latest redesigned developmental mathematics program at Kapiolani Community College. Nationally, little has been done in assessing the effectiveness of developmental mathematics courses. For college developmental mathematics courses, only a small percentage of institutions conduct systematic evaluation research of their developmental education programs. Evaluation of developmental programs is sporadic and underfunded (Institute for Higher Education, 1998). Students' feedback and perceptions are integrated into the study because many times research on developmental mathematics does not attempt to integrate feedback from students (P. Johnson, 2007), thus filling a gap in research.

For the parameters of the study at Kapiolani Community College and in the evaluation questions, the term academic strengths or weaknesses of the course related to the developmental mathematics course's curriculum, tests, assignments, books, math resources or supplemental materials, formative assessments, and summative assessments. Environmental strengths or weaknesses of the course related to the college's environment for the course: peer environment (peer tutor, group work, study sessions), classroom environment (instructor behavior, seating, teacher-student interaction, discussions, lectures, course pace, email, tutor, regulations), and physical environment (computers, projectors, classroom setup) (Astin, 1968; Edwards & Beattie, 2016).

The operational definitions for measurable outcomes academic success, retention and persistence were as follows:

Academic success: Final grade – grade C or better and passing score of 70% or better in the Math 24 course.

Retention: Enrolled in a higher-level mathematics class in consecutive semesters (fall to spring or spring to fall).

Persistence: Re-enrolled the next semester in Math 24, or took more than one semester in Math 24, or enrolled in an equivalent or lower level mathematics class after not passing (grade F, NC, dropped, withdrawal) Math 24.

Evaluation Questions

The evaluation questions for the program evaluation are:

Quantitative:

1. What were the trends in academic success, retention, and persistence for students in the redesigned developmental mathematics course as compared with students in the previous developmental mathematics course?

Mixed Methods:

2. How had the redesigned developmental mathematics course and the measurable outcomes, persistence, and academic success changed from 2010 to 2014?

Qualitative:

3. What were the academic and environmental strengths of the course from the students' and instructor's perspectives?

4. What were the academic and environmental weaknesses of the course from the students' and instructor's perspectives?

Literature Review

The purpose of this project study was to formatively evaluate the success, completion, and retention rate of a redesigned developmental mathematics course.

Evaluation of the redesigned course acquired information about the outcome rates, strengths, and weaknesses of the developmental mathematics course. Initially, a focused literature search was executed using the key terms "developmental education," "remedial mathematics," and "developmental mathematics." A preliminary review of the history and issues of developmental education programs was executed followed by an expanded search to incorporate the following keywords: redesign, success, mathematics, retention, retention model, STEM, and program evaluation. The project study was grounded in the following frameworks: Tinto’s theory of student departure; Tinto’s model of persistence and retention, which addresses critical areas of student retention; Astin’s I-E-O model and theory of involvement, which examine the dynamics of students’ qualities in respect to change, development and persistence; and Pascarella’s general model for assessing change which relates to reasons for student retention. Numerous theories and concepts supplement Austin’s, Tinto’s, and Pascarella’s theories (Astin, 1993; Hu & Wolniak, 2010; Milem & Berger, 1997; Tinto, 1993). Towards the development of a better understanding for the project study’s framework, concepts such as self-efficacy, andragogy, learning, motivation, and heutagogy were examined because these terms are associated with change, persistence, retention, and success rate. The following databases were used: Educational Resource Information Center (ERIC), eBook Collection (EBSCOhost), Google, Education Research Complete, and ProQuest Dissertations and Theses. More than 25 current and credible articles were used for saturation of literature.

Overview of Theoretical and Conceptual Framework

Theories and concepts that address learning problems and retention are emphasized by Bandura, Wlodkowski, Knowles, and Tinto. The primary conceptual framework is based in particular on Tinto's model of student retention and supported by Astin's input-environment-output model (theory of involvement) and Pascarella's model for assessing change. Integrated into these models are Bandura's self-efficacy theory, Wlodkowski's motivational framework for culturally responsive teaching, and Knowles' andragogy model.

College success and achievement in developmental mathematics are influenced by many factors such as culture, age, gender, motivation, curriculum pedagogy, learning tools and the environment. The difficulty of the mathematical content seems to be the least of factors that affect self-efficacy toward learning and the road to success. The main goal of any college program is to promote learning. Successful educational programs enhance learning. When redesigning programs, colleges have to consider how adults learn, identify the motivational factors that impact learning, and integrate those factors into the remodeled programs. Adult learners are usually in a college program because of personal and professional goals. Intrinsic and extrinsic motivation also affect a students' success and perseverance (Jacot, Frenay, & Cazan, 2010).

Factors that enhance learning can improve college success rate, persistence, retention, and completion. Learning is significantly linked to motivation, self-efficacy, culture, mind-set, environment, pedagogy, andragogy, heutagogy, and technology as learning enhancers (Astin, 1999; Bean, 1982; Blaschke, 2012; Edwards & Beattie, 2016;

M. S. Knowles, 1980; Mireles, 2010; Tinto, 1987b, 1997, 2000). Thus, strengths and weaknesses of courses can be linked to learning enhancers. Factors such as motivation, self-efficacy, and pedagogy that enhance learning should be part of the field of consciousness in redesigning courses because they are highlighted as positively connected to success, retention, persistence, and completion of college programs (Astin, 1999; Benken, Ramirez, Li, & Wetendorf, 2015; Brock, 2010; Hsu & Gehring, 2016). Also, developmental mathematics students' perceptions of the course affect their success, so understanding what they are and how they are formed is useful information in helping faculty members or programs to help better students achieve success (Howard & Whitaker, 2011; Paulson, 2013).

Motivational Framework for Culturally Responsive Teaching

Developmental mathematics course redesign was intended to increase learning and enhance success. Numerous factors affect learning; some promote learning and some hinder learning. Motivation is a key factor in stimulating learning and is embedded in Wlodkowski's motivational framework for culturally responsive teaching (Wlodkowski, 2008). Motivation is a natural human process that channels intrinsic energy to achieve a goal (Horyna & Bonds-Raacke, 2012; Y. Zhu & Leung, 2011). It has a neurological basis in how much energy the human biological system expends and how much attention the brain assigns to a given stimulus (Nash, Mcgregor, & Inzlicht, 2010). While the brain and body have to be engaged in learning; motivation is important in learning because it improves learning and mediates learning. Motivation, confidence, and many other affective factors play a key role for most students that are not successful in a developmental mathematics class (Guy, Cornick, & Beckford, 2015; Jorgensen, 2010; Yu, 2011).

Motivation is significantly influenced by culture, environment, language, beliefs, values, and behaviors. Being motivated means being purposeful, a notion that influences educators to use their professional capital to build a system of effective ways to promote adult learning (Ding, 2016; Ratey & Galaburda, 2001; Wlodkowski, 2008). Recent areas of inquiry and practice in adult learning are culturally responsive teaching and neuroscientific understanding of adult learning (Horyna & Bonds-Raacke, 2012; Nash et al., 2010; Y. Zhu & Leung, 2011). Faculty members tend to rely on their intuition, experience, common sense, and trial and error when facilitating learning. Augmenting motivation in struggling educational programs is important because, in life, many have witnessed a motivated person surpassing the less-motivated person in performance and outcome although they had the same opportunity and similar capabilities (S. Johnson & Taylor, 2006; Wlodkowski, 2008; Wlodkowski & Ginsberg, 1995).

Wlodkowski developed the motivational framework for culturally responsive teaching to enhance teaching and learning for all learners, including adults. The framework synthesizes constructs of motivation from disciplines such as sociology, philosophy, economics, spiritual ideology, political ideology, and education. One of the central tenets of this conceptual framework, essential in supporting the motivation of all students, is the need to address the relevance of knowledge and skills to practical real-life application. Culturally responsive tasks and pedagogy foster intrinsic motivation (Ginsberg, 2005; Wlodkowski, 2008). Redesigns of developmental mathematics can be informed by Wlodkowski’s motivational framework for culturally responsive teaching. There are many challenges to learning in diverse settings, higher education, and in basic adult education. Educators are charged with finding effective, innovative ways to promote learning and to positively influence the adults they teach. Wlodkowski’s motivational framework that emphasizes culturally responsive teaching where technology and digital media are helpful added tools for diverse adult populations and cultivate a more conducive learning environment (Lawler & King, 2003).

The motivational framework establishes four conditions that are necessary to facilitate participant’s motivation and engagement. The four conditions are: the positive of inclusiveness where all are welcomed, crafting practical connection with the learning tasks, developing a positive mindset towards learning, and developing a high efficacy towards performance. Motivation towards learning can increase with persuasion and the right attitude. Successful persuasion can increase self-efficacy, thus boosting the process and outcome of learning (Hynds & McDonald, 2010; Wlodkowski, 2008; Wlodkowski & Ginsberg, 2003).

Self-Efficacy

Verbal persuasion has a positive influence on learner self-efficacy. Encouraging learners by conveying the message “you can do it” acknowledges the effort and deemphasizes mistakes when learners are struggling to learn. Encouragement can provide the critical push at a fragile moment between advancement and withdrawal. Encouragement can help adults see mistakes as a way to improve future learning and teach learners how to learn and adjust study habits. Working with a learner at the beginning of difficult tasks and establishing challenging and attainable learning goals will strongly support their self-efficacy (Bandura, 1997; Glenn, 2010; Wlodkowski, 2008).

Self-efficacy is a personal belief that impacts how well one thinks he or she can perform or execute a specific task (Bandura, 1997). The concept of self-efficacy is emphasized in Bandura’s social cognitive theory, which views motivation as a function of individual’s thoughts as a result of interaction among environments, personal characteristics, and beliefs (Kitchens & Hollar, 2008). However, research results on self-efficacy and learning seem inconclusive and contradictory (Hofer & Pintrich, 2002; Lin, Lin, & Laffey, 2008; Miltiadou & Savenye, 2003). Although the results are inconclusive, it is still relevant to consider self-efficacy as a factor that impacts students’ learning because of its connection to motivation. Also, Betz and Hackett (1993) utilized a revised Mathematics Self-Efficacy Scale and reported that students in higher level college mathematics indicate higher levels of self-efficacy than developmental mathematics students. Targeting learning experiences designed to enhance self-efficacy has a consequential impact on developmental students and programs. Instructor perception, lesson design, and emphasis on performance versus mastery have a direct impact on developmental students’ self-efficacy which affects learning goals and academic performance (Garriott, Flores, & Martens, 2013; Khoule, Pacht, Schwartz, & van Slyck, 2015; Mesa, 2012).

Heutagogy, Andragogy, and Adult Learning

College students and adults are highly pragmatic learners. Knowles postulated in the andragogy model that adult learners are motivated to engage in tasks that are relevant to their real-life situations and career growth, thus adding to the understanding of adult motivation towards learning (T. W. Knowles, 1989; Wlodkowski, 2008). In the theory of adult learning named andragogy (andragogical model), Knowles proposed that adult urgency to learn is accelerated by cultural and social experiences, and a sense of readiness to learn (M. S. Knowles, 1990). Andragogy promotes self-directed learning as a means of enhancing the learning experience. Adults are problem-centered learners; solving problems or problem-solving tasks motivate adults to learn (Gom, 2009). The instructor's role in the andragogical approach is that of a facilitator (tutor and mentor) supporting and guiding learners to develop into self-directed learners. Self-directed learners understand their learning needs, have learning goals, seek resources to enhance learning, utilize effective learning strategies, synthesize knowledge, and evaluate the outcomes (Blaschke, 2012; Singer & Knowles, 1975).

Due to increased integration of technology into the redesign of educational courses, pedagogy and andragogy are looped with heutagogy. Heutagogy is a self-determined, active, and proactive learning process where learners are the major agents in their own learning as a result of personal experiences (Blaschke, 2012). The instructor facilitates the learning process by providing guidance and resources, while the learner takes ownership of the learning path and learning process and collaborates with the facilitator to determine what will be learned and how learning will happen. Factors needed to be considered to create appropriate learning experiences for adults are the environment, the learner's experiences, and the relevance of the instruction (Finn, 2010; Rogers & Harrocks, 2010). Heutagogy sustains appropriate values and attitudes that enhance self-efficacy that empowers the perception of how to learn (Blaschke, 2012; Hase & Kenyon, 2007; Kenyon & Hase, 2001). Educators are trying to move teaching and learning beyond andragogy, where the framework for teaching to learning embraces facultative tutoring and reflection; thus creating a self-directed learning environment where students build confidence and are actively involved in discovering their own strategies for learning (Canning, 2010).

There is no accurate way to learn, and there is no right way to teach. Effective teaching approaches are student-centered and focused on learning and assessment tasks (Malie & Akir, May 2012). Faculty professional capital is key to promoting academic excellence because students have varied levels of motivation, diverse mindsets toward instruction practice, and unique reactions to specific educational environments. Educators should be knowledgeable in the realm of differentiated instruction, students' attitudes, beliefs, visions, and study habits to guide instructional models to match diverse learners (Malie & Akir, May 2012). Course designers diagnose student learning styles and engage in reflective practices to guide the design of appropriate learning interventions (Coffield, Moseley, Hall, & Ecclestone, 2004; Felder & Brent, 2005; Malie & Akir, May 2012).

Persistence and Success

Academic performance is usually measured by student success rate, retention, persistence, and completion. Persistence is often linked to student success and institutional environment, such as the classroom environment, and influences student persistence (Tinto & Pusser, 2006; Wolfie, 2012). Improving persistence can positively impact learning in higher education. To enable student persistence, course designs should integrate curriculum with self-regulated learning strategies that help students to reflect on their own attitudes and approaches to their coursework; thus, inspiring intrinsic motivation. Educational programs designed with learning community and social integration enhance persistence (Brock, 2010; Cadima, Ojeda, & Monguet, 2012; Heaney & Fisher, 2011).

Learner motivation is known to play a key role in persistence in college courses and self-efficacy is a useful motivational construct because motivation and self-efficacy have been frequently and consistently related to multiple aspects of achievement and performance (Graham & Weiner, 1996; Linnenbrink & Pintrich, 2003; Poellhuber, Chomienne, & Karsenti, 2008). Student success is a principal issue in postsecondary education. Student persistence and engagement are gaining increased attention because they are synonymous with student academic success (Hu, 2011; Kuh, 2007; National Survey of Student Engagement, 2004, 2007).

Astin's input-environment-output (I-E-O) model provides a useful perspective of how environmental factors can influence how academic attitudes, beliefs, self-efficacy, energy, and motivation, affect student persistence. Prior experiences or personality (input), programs, peers, faculty, and other environmental factors (environment) are presumed to shape changes due to college and prior precollege experiences (outcome) (Heaney & Fisher, 2011). Students' experiences (input and environment) may affect outcomes and perceptions of educational programs. When students are socially and academically assimilated into the college environment, they are more likely to persist

(Garcia, 2010; Tinto, 1993). Increased self-confidence can influence higher levels of persistence and higher goals for task achievement (Bean, 1982; Bean & Eaton, 2001; Weng, Cheong, & Cheong, 2010).

Academic and social integration are significant influences on student persistence (Pascarella & Terenzini, 1979). Tinto's theory of student persistence is an alteration of Tinto's model of student departure; it is a process-oriented theoretical plan. Students' background, prior experiences, attitude, campus environment, and courses (academic and social) have the power to influence persistence in college (Tinto, 1997; Winberg & Hedman, 2008). The structure of the curriculum and pedagogy customarily mold both learning and persistence and serve to alter the degree of students' involvement in the academic and social life of the institution (Hodara, 2011; Tinto, 1997). College and program success rates are shaped by the innovation power of the institutional learning environment and curriculum; plus, faculty and peers interaction are critical factors that impact persistence and retention in college (Khazanov, 2011).

Retention and Tinto

Increasing retention rates continues to be a challenge for colleges. Student retention issues are related to multifaceted factors and defy any single resolution or solution (Goeller, 2013; Heaney & Fisher, 2011). Studies have found that developmental programs can have a negative effect on student retention, while quick fix interventions with better and multiple assessment tools have the potential to increase retention (Diaz, 2010; Lesik, 2007). Colleges are making efforts to redesign their programs, but much effort is spent in trying to deliver what is perceived as good strategies versus actually evaluating the strategies for effectiveness (Hodara, 2011).

Research by Tinto (1987a, 1993), generated a model of student departure (Tinto's interactionalist theory); an essential collection of constructs describing student retention. The concept of positive social integration, such as in the classroom, suggests that students are more likely to persist and to graduate. Negative reasons, such as learning difficulties (15–25% of students who leave do so because of academic failure) and social adjustment, are influential reasons for departure (Burks, 2009).

Student retention is affected by many factors including faculty interaction and effective teaching strategies. Good teaching enhances learning, but too much teaching can have the opposite effect. Quality of teaching and tutorial assistance only accounts for 25% of variation in student performance and 25% is explained by affective variables (Khazanov, 2011; Schmidt et al., 2010). Developmental education students have a high rate of dropout. However, taking advantage of any early success in the classroom, and integration of a student's entire educational experience can improve retention (Pascarella & Terenzini, 1991; Umoh, Eddy, & Spaulding, 1994).

Educational program designers have to be aware of the multiple factors that affect retention and success. For developmental mathematics, it is important to note that 4-year colleges often have a more unenthusiastic attitude and are not as prepared to teach developmental classes compared to junior colleges. Remedial students transferring to a four-year college have a lower chance of success (Gandara, Alvarado, Driscoll, & Orfield, 2012; Umoh et al., 1994). Although developmental classes were meant to increase retention, the result is the retention and success rate is at it all time low. Tinto's model of retention suggests that student success is influenced by students' goals, commitment, social integration, and academic involvement. Colleges lending more academic, community, and individual support positively impact student retention (Tinto, 1993, 1997, 2004; Weng et al., 2010).

The model of Bean and Metzner conceptualizes that experience, background, environment, and academic and social aspects dictate student retention and persistence. Developmental mathematics student retention and success are swayed by factors connected to personal attributes, commitment to finish a degree, and financial circumstances (Bean & Metzner, 1985; Brock, 2010; Hoyt, 1999; Morrow & Ackermann, 2012). To better service students and to learn more about individual programs, frequent evaluations of institutional programs, such as developmental mathematics, are necessary to determine what factors are effective to constantly inform remodeling of the program to meet the needs of those who they serve.

Necessity of Evaluating Educational Programs

The core of program evaluation is gauging the merit of education programs, developing clear criteria upon which judgment can be made, support continuous improvement, and knowing that some people who plan programs may not want to judge their own programs (Caffarella, 2002; Hurd & Deutsch, 2017). In any organization, the success of programs is critical for development and productivity, but new programs always have challenges and issues. Two principal functions of educational program evaluation are to determine the extent of the impact of educational changes and inform decision-making process (Lodico et al., 2010; Patton, 1997b). A newly reformed course like the developmental Math 24 course needs a program evaluation that can highlight the effectiveness and challenges in the course. The information from a program evaluation can inform program directors and decision makers if goals and objectives are being met and to guide them in making informed recommendations for modification of the course. Therefore, improving the program's effectiveness and providing possible solutions to the developmental math proficiency problems in college.

A program evaluation combines elements of curriculum to determine whether the students' needs are being met, whether students are satisfied with the course, whether the curriculum materials are effective, whether the instruction environmental factors are conducive to learning, and whether assignment or testing motivates or hinders more learning. Program evaluation attempts to examine a course from different perspectives and guides strategic planning and program improvement (Kim, 2011; Zohrabi, 2012). Results from a program evaluation can sustain improvement in educational curriculum and help resolve achievement gap issues in colleges.

Achievement Gap

Community colleges across the nation are faced with the challenge of closing the achievement gap problem in mathematics through college remedial and developmental mathematics courses. The academic achievement gap in mathematics is recognized as an unequal distribution of opportunities to acquire and learn mathematics among varied groups of students with different college preparation skills (Flores, 2007). Due to the National Defense Act of 1958, the Higher Education Act of 1965, and the Higher

Education Opportunity Act of 2008, more people have access to a college education. Recent populations of college students have a wider range of entry-level math skills and greater cultural diversity. Mathematics has the largest academic achievement gap, and approximately 60% of students entering college for the first time need to have mathematics remediation (Madaus, Kowitt, & Lalor, 2012). Policymakers, scholars, and educators have wrestled with best practices to close academic gaps. Across the nation, mandatory or voluntary developmental programs have emerged in the struggle to close academic gaps and move students forward (Horn, McCoy, Campbell, & Brock, 2009; Perin, 2006).

Socioeconomics, race, lack of confidence, disengagement, and perception of one's mathematics efficacy are factors that influence students' motivation, and that impact the developmental mathematics achievement gap. Post-secondary success in mathematics is aligned with K-12 educational experience. Although student background and educational setting can create hurdles in college readiness, timing of a remedial mathematics course, accurate placement, and assessment are factors that can positively impact successful completion of developmental mathematics (Donovan & Wheland, 2008). The integration of MyMathLab and blended/hybrid instruction with the use of technology, one-on-one instruction, and on-demand lecture has decreased developmental mathematics achievement gap for students with diverse backgrounds and characteristics (Spradlin & Ackerman, 2010; M. R. Young, 2014). Generally, race and background assume a pronounced impact on student success in developmental mathematics remediation (Bahr, 2010; Goldberger, 2008; Spielhagen, 2006; Stewart, 2012).

Community college students have diverse needs and a wide range of skills. To better serve the diverse population, developmental courses are offered to prepare the students for college-level courses (Ashby et al., 2011). Developmental mathematics poses many challenges for students (Cooper, 2011). The major challenge for numerous first-year community college students is their weak numeracy skills which “are judged to be too weak to allow them to engage successfully in college-level work” (Bailey, 2009, p. 11). A study of 15,000 high school transcripts, in nine diverse districts in California, found that schools are underpreparing students by assigning them to non-college track programs. The most affected students are those from lower socioeconomic background. When asked, students responded that schools should require them to take courses that are required for college entrance. Delayed enrollment and timing affect mathematics success and retention. Developmental mathematics is the largest under-supplemented area when it comes to decreasing achievement gap in mathematics course; rather the trend is to regress students backward and supplant with remedial mathematics (Fike & Fike, 2012; Murray, 2012).

Reforming developmental math programs to enhance teaching and learning is anticipated to reduce the achievement gap, the math gap, and to resolve the mathematics proficiency difficulties of community college students. Reforms and redesigns raise questions, such as, what is working, what is effective, what is ineffective, and what needs to be improved? Eradicating the achievement gap is an enormous task. Collaboration at all educational levels to address meeting the needs of all students through a variety of instructional strategies and appropriate educational reform measures is critical (S. Allen, 2008; Brock, 2010).

Technology Integration

Technology integration seems to be the most popular factor in recent redesign of educational courses. Many redesigned educational programs are integrating technology with the hope of improving the learning experience for 21st century learners. Technology has the potential to enhance learning, yield positive outcomes, revolutionize teaching styles, enhance social interactions, increase student engagement, and boost motivation. However, all of this is only possible if the current technology is appropriately designed for instruction (Ben-Jacob, 2016; Huang, Liu, & Chang, 2012). Integration of technology is about effective instructional practices and the tools to better deliver content and implement practices. Redesigns of developmental mathematics have not been tremendously successful. and evaluation has shown that innovations have only modestly improved students' success. Although many factors enhance success rate, such as ambition, enthusiasm, aptitude, institutional environment, academic skills, practical application, and institutional environment, the most effective pedagogies for developmental mathematics are still being sought (Baytak, Tarman, & Ayas, 2011; Earle, 2002; Mellow, Woolis, & Laurillard, 2011; Umoh et al., 1994).

A conducive learning environment, curriculum, and pedagogy promote student motivation and are attributes that enhance retention, success, and growth. Computer-assisted teaching has the potential to enhance learning, but the integration of technology into developmental mathematics courses is designed to support learning and not to replace the instructor. The intent of technology assimilation into developmental mathematics is to offer students more choices such as “how, when, and where”(Kinney & Robertson, 2003, p. 316) they can learn mathematical skills. Kinney (2001) found that students in computer-mediated developmental mathematics courses are less likely to dropout compared to lecture only developmental mathematics courses. Integration of computer-assisted learning in developmental mathematics, such as ALEKS and MyMathLab into the course provides the students with a more structured academic environment, and instant on-demand access to content, lessons, and curriculum. Taylor (2008) found that computer-assisted algebra, using ALEKS, significantly improved some freshman students’ mathematics achievement (pretest and posttest). The integration of Blackboard, to allow for e-learning in a summer developmental mathematics at Allegany College of Maryland, resulted in significantly higher student success compared to the non-Blackboard platform developmental mathematics classes. Digital platforms in mathematics have the potential to transform teaching and learning (Boggs, Shore, & Shore, 2004; Choppin, Carson, Borys, Cerosaletti, & Gillis, 2014; Zientek, Skidmore, Saxon, & Edmonson, 2016).

Allowing students, the flexibility to self-select the instructional model and the mode of learning that is best tailored to their needs and preferred learning style can lead to improved student outcomes such as motivation, retention, and success. A self-paced model allows students the chance to accelerate a course. Technology and interactive multimedia in developmental mathematics allows for more interaction for students than the teacher lecture model and potentially can empower students in reasoning and reflection. Evaluation and implementation of best practices are also necessities in improving developmental courses (Belbase, 2015; Garrett, 2014; Higbee, Ginter, & Taylor, 1991; Kinney, 2001; Kinney & Robertson, 2003; Lemire, 1998; Phillip, 2011; Q. Zhu & Polianskaia, 2007).

Redesigned Developmental Math

The main purpose of redesigning a course is to improve the instructional and learning environment through best practices (Kim, 2011). Continuous learning and achievement problems of student performance in developmental mathematics at a majority of junior colleges have led to constant course redesign. Course redesign is a process of reformulating the whole course to attain better learning outcomes and incorporating 21st century skills by taking advantage of the capabilities of information technology. Putting a course online is not a redesign, but represents rethinking the way instruction is delivered for improvement and for lowering long-term cost (Harrington, Lloyd, Smolinski, & Shahin, 2016; Twigg, 2011). Nationally, developmental mathematics is known for being constantly redesigned and reformed but according to Asera (2011), “among the disappointments were the high failure rate of students in developmental mathematics and the realization of how hard it is to change that rate”(p.28). Constant redesigning of developmental mathematics is still daunted by the slight/negligible increases in success rate because most designers of developmental mathematics are fiddling at the edges devoid of a clear vision of how to generate significant improvement and sustainable change (Twigg, 2011).

There is great urgency to find a redesigned developmental math program that will substantially enhance success rate because students enrolled in developmental mathematics courses are more likely to repeat the courses than students enrolled in college-level mathematics courses, and thus are less likely to graduate from college (Handel & Williams, 2011; McGee, Vasquez, & Cajigas, 2014; Míreles et al., 2011; Taylor, 2008). For almost half of a century, remedial mathematics sustained a static profile. Analysis of the transcripts for students that attended college, who participated in the 1988 National Educational Longitudinal Study while they were in eighth grade, found that students enrolled in two or more developmental mathematics courses for 4-year college had a 5 % less likelihood of graduating than students enrolled in one or no developmental mathematics class, and for 2-year college had a 3% lower probability (Attewell, Lavin, Domina, & Levey, 2006).

Individual Goals and Needs

An academic gap in numeracy or mathematical skills is an acute community college problem. Administrators, faculty, and staff are challenged to effectively instruct mathematics to college developmental students with diverse ways of learning and different needs. Programs and colleges recognize that students' goals differ and that a ‘‘one size fits all’’ and a single teaching-leaning model is not effective in developmental mathematics (Handel & Williams, 2011). Redesigns of developmental mathematics courses are examining factors, such as remediating students' high school deficiencies and backgrounds and are engaged in initiatives to prepare students for their individual educational and career goals (Bassett & Frost, 2010).

College students have different individual abilities, and a spectrum of mathematical abilities are merged in developmental classes. Accommodating multiple abilities and facilitating instruction can become a source of frustration for faculty members when the content is below or above a student's ability. Students are usually placed in developmental mathematics due to their placement test scores; the scores are a range of numbers and represent a broad range of competency levels. The ideal situation would be to identify the appropriate starting point in the developmental mathematics program to accommodate the learners' needs, thus engaging them in the learning process (Galbraith & Jones, 2008). Improving quantitative and analytical skills can be a challenge for developmental mathematics students. Therefore, early engagement is a key factor in students remaining motivated. Endeavors to improve cognitive engagement have a higher impact on academic achievement than efforts to improve emotional engagement. Efforts to provide lower-achieving students with support such as tutoring, and coaching had a positive effect on engagement, learning, and motivation. Mathematics achievement is influenced by motivation and academic engagement (Handel & Williams, 2011; Sciarra & Seirup, 2008; Singh, Granville, & Dika, 2002).

Quantitative and Analytical Skills

Colleges require that students pass a minimum of one college-level mathematics class so that their graduates gain essential quantitative problem-solving skills. A sound proficiency in college algebra level skills is necessary for all college degrees (Mireles, 2010). In today's society, the demands for analytical and quantitative real-life relevant skills are gaining momentum. Preparing citizens to be proficient in mathematics is essential in sustaining a 21st century economy that is propelled by the high-tech digital age. At the macro level of society, effective practical developmental mathematics education is sought to tackle an acute national dilemma of low proficiency in quantitative skills. The 2000 National Assessment of Educational Progress (NAEP) reported that less than 20% of high school seniors were proficient in mathematics (National Center for Educational Statistics, 2004). In 2003, the Program for International Student Assessment (PISA) assessed 15-year old US high school students' mathematics achievement and compared the result with students from 39 countries. The United States (U.S.) ranked 9th, and as a developed nation the U.S. needs to enhance their human capital quantitative skills to achieve a better ranking in mathematics.

As one of the most powerful countries in the world, United States of America is challenged to find ways to enhance quantitative skills due to increased demands for more scientists, engineers, computer technicians, and mathematicians to support the U.S. economy in the 21st century. Post-secondary institutions are facing the serious challenge of increasing interest in science and mathematics in both youths and adults. The National Research Council (2001) proposed that mathematics be more contextualized by teaching it in a more real-life perspective similar to physics and chemistry. As the 21st century economy presents a more global competitiveness in science, technology, engineering and mathematics (STEM) fields, fostering achievement and persistence in quantitative skills for students is fundamental. American students are expected to be proficient in analytical and quantitative skills to be competitive, competent, and constructive citizens. Significant increases in collegiate quantitative or mathematical skills are needed by students so that they can be more competitive globally (Bisk, 2013; Gomez, Gomez, & Rodela, 2015; Larose, Ratelle, Guay, Senecal, & Harvey, 2006; Owens, 2009; Wenner, Burn, & Baer, 2011).

Despite reforms, the need still exists to develop innovative approaches to instructing mathematics and developing mathematical skills that can empower students to move out of the developmental mathematical gridlock (K. Allen, 2011). Developmental mathematics is not just a macro societal dilemma, but also both a local community meso and individual micro societal problem. As a result of weak mathematical skills, students may be unable to complete their college programs, thus affecting positive advancement and growth of society. Due to advancement in technology, more complex thinking skills are required to be competent workers in today’s society.

STEM skills are essential to succeed in a technologically dependent work and learning environment (Feller, 2011). Growth and development of a society depend on its citizens. Thus, a deficiency in community growth will result in undesirable effect on community development and global interactions. The increased demand for STEM skills is a critical issue because an average of about 30 percent of students enrolled in developmental math course will pass or succeed (Bailey, 2009).

21^{st} Century Reform

The purpose of educational reforms in the 21st century is to tailor teaching and learning to today’s students who are exposed to a world of world technical advancements while improving academic performance. To meet the challenge of the 21^{st} century, effective redesign of developmental programs needs bold thinking because higher education has become more important to global competitiveness (Kim, 2011; Simon, 2010). Teaching and learning also have to focus on relevance and application in context that is of interest to the learner. Although technology is being integrated, contextualization is rarely used in developmental college math classes. Contextualized multiple intelligences, globalization, localization, and individualization is a new paradigm of global education in the 21st century (Cheng & Mok, 2008; Perin, 2011).

Research done on a redesigned college algebra class that integrated computer-assisted learning, online homework, mandatory tutoring, collaborative learning, and learning community had a positive impact on student attitude and resulted in a 15% gain in student success (Hodges, Payne, Dietz, & Hajovsky, 2014; Kendricks, 2011). The educational system needs to integrate multiple effective factors and appropriate instructional strategies, such as problem based learning, risk-taking or innovative activities, critical thinking, communication, collaboration time, number sense, and fun or gaming tasks to enhance math programs and classroom experiences so that students can be motivated, engaged, successful, and keep up with the skills needed to work and live in the 21st century (Ali, 2014; Gasser, 2011; Gula, Hoessler, & Maciejewski, 2015).

Quantitative literacy can be enhanced through the focus on life and career skills applications, and activities that engage more of the frontal lobe of the brain which is more stimulated in today’s individuals due to the extensive use of electronic media (Jones, 2014); these are skills currently being addressed in math curricula. Computer-based learning in developmental mathematics improves attitude and engagement and lowers classroom boredom (Gasser, 2011; Jones, 2014; Partnership for 21st Century Skills, 2009; Taylor, 2008).

As developmental mathematics reform initiatives focus on educating for tomorrow's workplace, educators and stakeholders are rethinking the gateway course's curriculum content and delivery methods (Bradley, 2014; Yull, 2008). According to Roth and Barton (2006), elementary literacy in scientific and technological subjects, such as mathematics and the sciences, is critical to provide a rudimentary knowledge-based platform. Living in the 21st century requires a certain amount of technical, quantitative, and qualitative comprehension; that is the ability to use electronic devices, numbers, read, and understand.

To reform the college developmental math curriculum and instruction, the use of active learning techniques can enhance learning transfer (Caffarella, 2002). When students explore math through technology, they are not confined to paper and pencil tasks. Technology enables students' mathematics studies to be more creative and not limited to rudimentary symbolic operation. Real-world problems and interactive tools enhance understanding and inspire interest in mathematics (Franz & Hopper, 2007).

Instructional Technology Application for Developmental Mathematics

Models developed for recent developmental mathematics designs integrate instructional technology applications such as MyMathLab, ALEKS, the Emporium Model, and the Hybrid Model. Redesign of mathematical programs looks to educational simulation to aid student learning. Learning with educational simulations is frequently connected with discovery learning, active learning, and increased student engagement

(Puustinen, Baker, & Lund, 2006). The Emporium and Hybrid Models integrate flexibility for learning and teaching, integration of instructional technology, and allows for adapting to the student's style of learning (Twigg, 2011).

A study of the use of technology, such as ALEKS a computer-based software, showed that it can help enhance teaching and learning in math. ALEKS improves attitude, engagement, and performance (Hagerty & Smith, 2005; Taylor, 2008). According to Cascaval, Fogler, Abrams, and Durham (2008), "the presence of the archived video lectures and lecture notes adds significant value to the learning process with notable improvements in perceived student performance and overall experience in the class" (p. 61). Computer-based learning integrates video lectures and on-demand online help. Designing courses around software such as ALEKS, peer tutors, and facilitators, enables students to have more one-on-one assistance. Redesigns should integrate innovative changes in the way lessons are administered and reduce lectures which are infamously ineffective in motivating and engaging students (Jaafar, 2015; Twigg, 2009). Technology integration, such as computer-based learning, allows for redesign to integrate the student's characteristics with the learning environment to achieve better results in math and aligning with Astin's (1993) input-environment-output (I-E-O) model.

The mathematics arena that integrates web-based software, such as ALEKS and MyMathLab, is a significant shift towards a more 21st century teaching-learning style because it concentrates on more active and learner-centered strategies with the integration of technology. Lectures or face-to-face styles of teaching are substituted with interactive devices shift students from a passive, listening-writing role, to an active-learning student-centered orientation (The National Center for Academic Transformation, 2005). Technology integration in mathematics allows for students to work at their own pace and to get individual help when needed. Web-based software, such as ALEKS, provides a comprehensive gradebook tool in the program that allows the instructor and student to track progress made in the course and areas of challenge. For students who are too timid to ask for help, the instructor can view any area the student is having issues with and render appropriate help to the student.

Recurrent Modification

The achievement gap in mathematics continues to exist, and reforms are continuously being implemented to curtail the deficiency in mathematics. From 2007-2010 in conjunction with the National Center for Academic Transformation (NCAT), the University of Memphis redesigned mathematics courses integrating a highly active and structured blended learning instructional model (introductory lectures and blended instruction technology) that resulted in higher achievement, success, and retention. Active engagement in conjunction with technology use is in step with mathematics pedagogy reforms and a prospective avenue in closing the achievement gap (Bargagliotti, Botelho, Gleason, Haddock, & Windsor, 2012).

Although developmental mathematics has seen recurrent modifications, the course maintains its standing as the college course with the highest failure and drop-out (non-completion) rates (Bonham & Boylan, 2011; Cafarella, 2016b). Colleges are constantly making modifications to developmental math programs, but reviews of the literature suggest only minimal or no increase in the national average success rate for developmental mathematics. Adequate review and evaluation of redesigns to determine whether or not the redesigned programs are effective over time are lacking. The tremendous absence of program evaluation in developmental education is a major drawback to its effectiveness and success. Less than 25% of college developmental mathematics programs employ continuous program evaluation (14% of 2-year colleges and 25% of four-year universities) (Boylan, Bonham, & Bliss, 1994). A systematic way to enhance program effectiveness is to have a program evaluation to inform improvement efforts.

Assessments are usually from faculty input and college database data, and lack students' outcomes. To measure the effectiveness of educational programs the assessment has to integrate positive student outcomes, such as students' satisfaction, students' career success/advancement, program/degree completion, and knowledge/skills attained (Altieri, 1990; Lesik, 2007). Before institutions expend additional money and time to redesign programs, they should increase communication between students and themselves to better comprehend the issues and concerns (Oseguera & Rhee, 2009). Armed with information about students' needs in developmental courses, educators can more effectively address the issues that interfere with success and retention in developmental courses (Zavarella & Ignash, 2009).

The most convenient way to reform educational programs is for stakeholders to attend workshops, examine current and new trends, and integrate new strategies into programs. Regular modifications of programs are a norm, but are often informed by the program chair, curriculum coordinator, and faculty in the hope to enhance the program. What is lacking are the routine evaluations that target students' input or perspective on the effectiveness of the programs (Oseguera & Rhee, 2009; Sparkman, Maulding, & Roberts, 2012). Students' perspectives and beliefs align with Bandura's social cognitive theory about the value of the learning experience, their expectations of success, what motivates them to actively engage and persist, despite initial struggles. These are critical factors that can inform effective redesign of educational programs (Kitchens & Hollar, 2008; Lesik, 2007).

Impediments to Success

Society views community colleges as the golden gateway of success for Americans, and likewise locally in Hawaii. However, developmental programs, especially developmental mathematics, pose the greatest challenge for students to successfully complete. Successfully completing developmental mathematics can pose a profound challenge to students' academic growth and success (Brock, 2010; Merseth, 2011). Studying students' perspectives help colleges focus on what students need instead of what colleges perceive students need. Student input is critical to better inform colleges on how to reform developmental mathematics programs to better tailor to their needs (Gniewosz & Watt, 2017). Nationally, the developmental mathematics curriculum at community colleges experiences the highest failure rate. Developmental mathematics is a grave concern for colleges and is deemed the "gatekeeper" not the "gateway" (Bryk & Treisman, 2010, p. 4) of students' hopes and scholastic visions (Cafarella, 2016a; Merseth, 2011).

Implications

Studying the reformed developmental mathematics course in a local community college and evaluating it highlighted the strengths and weaknesses of the course. Also, the study indicates whether the course in its current state was effective and was achieving its goals and objectives. Using a case study to do a program evaluation of the developmental mathematics course study can showed what occurs, the impact of the programs, and the connection between the course redesign and the outcomes. Findings and results of the evaluation study were prepared into a summary report and shared with the college.

The college has verbally indicated that the study was a valuable resource for them as they continue to redesign the developmental mathematics course (L. Richards, personal communication, September 29, 2014). Insights gained from the study can be cited for future work on their developmental education programs, aid professional development, and be a resource in seeking funding to improve the program. Therefore, the study has had many benefits and implications, such as recommendations in the evaluation summary report, shedding light on the issues, highlighting the strengths, informing future reforms for developmental education, and may lend to valuable pedagogical possibilities and modifications in teaching and learning that can better serve students (Martin & Rallis, 2014; Mitry, 2008). Potentially, improved strategies in developmental mathematics redesign can be implemented to have a positive impact on students' learning, experience, perseverance, retention, and success.

A program evaluation was used to gauge whether redesigning developmental Math 24 by integrating tools such as technology is a mechanism for effectively reforming developmental math, improving proficiency, and decreasing the failure rate. Also, it shed light on areas that are critical to explore when evaluating a program, such as the value of students' perspectives in effective program evaluation. Overall, the evaluation has the potential to impact more effective redesign and positive change for students' experience and success rate in the institution and in other educational institutions with developmental programs. Evaluation is an essential phase in curriculum development and fosters program improvement.

Summary

The ability for educational programs, such as developmental mathematics, to better serve students lies in effective evaluation and effective redesigns of the program. Formatively evaluating the impact of the redesigned developmental mathematics course at the community college can systematically assess the modifications such as, integrated computer-based instruction, MyMathLab, and the Emporium Model, on student success. Program evaluation focuses on the extent that a program attains its intended outcomes and uses information for action and decisions (Patton, 1997b). Evaluation of the redesigned Math 24 spotlighted information needed to address the high failure rate in developmental mathematics and identified ways to improve the course in areas such as student success rate, persistence, retention rate, instruction, and curriculum.

Adult learners' self-efficacy, motivation, environment, and tasks relevant to their real life impacts their perseverance and success in college. Student centered learning and appreciate technology integration can positively affect adult learners' academic attitudes. Redesigning courses and programs that are tailored to needs of the adult learners and fosters social and academic interactions promotes students' motivation and improve student outcomes. Ongoing and timely program evaluation with input from faculty and students are critical in improving course and program outcomes.

The study involved the examination of student and faculty perspectives of the course's impact on students and provided insights that can address the critical failure rate of developmental mathematics students. Evaluation can illuminate important practical aspects of redesign program authenticity (Wholey, Hatry, & Newcomer, 2004). Evaluation of the impact of the course on the students' needs was an effective way of learning from students and faculty members how the course is affecting students. Through effective social interaction between students and educators, developmental math redesign can be empowered, thus yielding positive social changes. The study, through a case study, participatory-oriented evaluation approach, explored the academic and environmental strengths and challenges of the newly redesigned developmental Math 24 course. Also, the study's recommendations will serve as guide to help enhance the course.

Section 2: Methodology

The purpose of the study was to evaluate the outcomes of the redesigned Math 24 course. The purpose of the methodology section is to describe the actions taken and rationale to conduct the program evaluation The methodology section discusses the research design, research approach, justification of evaluation type, data collection procedures, expected data analysis techniques, data validation procedures, ethical treatment of participants, limitations of evaluation, research setting, research sample, the context, and strategies. Mixed methods describes the methodology for this case study program evaluation.

Research Design

Program evaluation is a methodical gathering of information about the activities, characteristics, and outcomes of a program. Educational institutions frequently evaluate the quality of schooling provided to students in remedial programs (Astin, 1993; Patton, 2002; Posavac & Carey, 2003). For the program evaluation, an objective-based evaluation procedure for this mixed methods case study was used to evaluate the Math 24 course. The intent of the objective-based evaluation was to document success or strengths, weaknesses, and challenges of the redesigned developmental mathematics as perceived by students and faculty members, and to determine if the redesigned developmental math course had met its objectives.

New strategies implemented because of program redesign need to be evaluated for effectiveness. A program evaluation is a rational approach to determine if the redesigned developmental course is achieving positive outcomes on student academic and social or cultural experiences. The program evaluation was an assessment or evaluation of the newly redesigned developmental Math 24 course to appraise whether the scheme supports many educational reform theories of integrating technological skills. Technology integration has been credited with being effective in supporting 21st century initiatives and helping today's developmental math learners. According to Kim (2011), colleges can sustain improvement in terms of student achievement through program evaluation procedures that assess the outcomes of program elements and activities. The principal functions of program evaluation are to assess process efficiency and program outcomes. In educational course evaluation, the operation and effectiveness of the course materials and methods can be examined along with the course outcomes (McNeil, 2011; Zohrabi, 2012).

To aid this program evaluation, the evaluator met with, and had phone conversations with, key members associated with the redesigned developmental mathematics course (creators) and the College's Office of Institutional Effectiveness (OFIE) to gain insights into what aspects of the program evaluation would be useful to the college and its developmental mathematics program. The phone conversations were made prior to developing the interview questions and were critical in guiding their development. For example, the college wanted to know what the major strengths and weaknesses of the redesigned math course were. The design of the evaluation was guided by information gathered from meetings, articulations, and phone conversations with developmental mathematics officials from the Community College System in Hawaii.

Levels of Evaluation Review

There are many layers and branches to program evaluation. This program evaluation focused primarily on the student and faculty participants by studying their reactions, transformations, and successes as a result of the institutional or program changes (the redesigned developmental mathematics course). When a program's focus is on the participants' reactions, the program evaluation approach is referred to as a "levels of evaluation review" (Caffarella, 2002, p. 342).

A "levels of evaluation review" program evaluation approach measures four different levels: (1) the participant reactions, this is how the participants feel about various aspects of the program, (2) the participant's learning, that is the measure of knowledge, skills, and attitude, (3) the behavior change, or the use of new knowledge and skills/transfer of training, and (4) the results or outcomes, that is the measure of the final results that occurs. The focus is primarily on the participants' reactions, changes, and on organizational changes (Caffarella, 2002; Kaufman & Keller, 1994; Kirkpatrick, 1996). The levels of evaluation review approach is often coupled with the objective-based model.

Mixed Methods, Case Study, and Program Evaluation

For this objective-based program evaluation, a mixed methods approach was utilized to collect data for the developmental math course evaluation. To evaluate an implemented program, a case study is most frequently used to examine qualitative and quantitative information and to shed light on the context and wider environment (Wholey et al., 2004). The mixed methods approach for the program evaluation involved collecting both quantitative and qualitative data from the developmental mathematics program participants. Originally, program evaluations were merely experimental methods or quantitative in nature. However, with the passage of time the meshing of qualitative and quantitative approaches in evaluation emerged. Qualitative method, or the natural approach, provides explanations and descriptions (Kiely, 2009; Zohrabi, 2012). Mixing of methods is a productive base for intellectual and educational learning discourse, and it maximizes the evaluation effort (Donaldson & Scriven, 2003; Moon, Utschig, Todd, & Bozzorg, 2011; Spaulding, 2008). Mixed methods strategy enhances the validity of the evaluation and sustains the demand for credible evidence in reforms. (Chen, 2005; De Lisle, 2013).

Evaluation study that employs mixed methods design uses multiple methods to evaluate the context of the program changes. The combination of methods contributes to gains in the depth and clarity of information derived from an evaluation and enables a greater outlook of the impact and outcomes of the program (McDowell, Inverarity, O'dwyer, & Lindsay, 2012; Stetler et al., 2007; Williams, 2007). A mixed methods approach is suitable for the evaluation because the evaluation questions involve quantitative aspects: “percentage”, “success rate”, “completion rate” and “outcome rate”, and qualitative “what.” Quantitative evaluation is effective in determining the level of success of program design and implementation. Qualitative evaluation is useful to understand issues that are less amenable to quantification, for example, changes in social and community relations, and impacts of economic, social, and cultural attributes on participation and outcomes (Adato, 2008). Mixed methods is a pragmatic approach which supersedes the adherence to a solitary paradigm, and the main advantage of mixed methods is the flexibility of consolidating the strengths of qualitative and quantitative methods to bolster the evaluation; thus, providing an enriched practical methodology for program evaluators. (Chelimsky, 2012; Patton, 2002).

A qualitative approach is normally related with narrative or verbal techniques, such as observations, focus groups, and individual interviews to gather and summarize data; thus the data is descriptive information (Caudle, 2004; Patton, 1987; Wholey et al., 2004). Studying faculty and student perceptions are qualitative in nature because it concentrates on scrutinizing social occurrences and allowing beliefs, emotions and perceptions of participants to be vocalized. An evaluator uses qualitative means to shed light on statistical outcomes and program variations through a naturalist inquiry process; that is, the evaluator does not manipulate any aspect of the program (Newcomer & Wirtz, 2004; Patton, 1987, 1990). Qualitative approach is concerned with process and description, such as stakeholders' perception and satisfaction with program implementation and effectiveness which are important aspects of program evaluation; this allows the evaluator to gain an in depth examination of the matter (Kim, 2011; Patton, 1990; K. E. Ryan, 2007). The depth and breadth of program reforms can be captured through qualitative data, and the evaluator applies the holistic approach to gain total understating of the multiple aspects of the program.

A quantitative approach in program evaluation is the use of measurement of variables to support evaluation endeavors. Before the redesign, the program set specific measurable goals and objectives. One of the goals was that by May 2012 the persistence rate would increase from 63% to 75% (Kapiolani Community College, 2011). Program outcomes, such as student success rates, persistence, and retention may be best captured by quantitative evidence. Hence, to evaluate the overall effectiveness of the redesigned developmental mathematics course, it is essential to examine the organization's data that are related to the objectives, outcomes, and success rates.

Employing the mixed methods approach to evaluate the Math 24 course provides a wider and deeper depiction of the course and its impact on student success. Mixing qualitative and quantitative approaches can provide a better scope of the state of affairs and triangulation of the approaches can take advantage of the strengths thus counteracting the weakness of each (Chen, 2005; Royse et al., 2001). Triangulation is the processes of using multiple sources of data to build coherent justification for categories, corroborating findings, enhancing accuracy of interpretations for establishing credibility by cross verification from multiple sources (Creswell, 2009; Royse et al., 2001). Through a single case study, the triangulation of qualitative and quantitative data was employed in abetting the evaluation.

Using a case study for program evaluations has emerged as an acceptable way of generating data for change aimed at improving a specific program (Patton, 1986). Case studies are usually used when the evaluation is descriptive and is successful for probing program outcome matters (Fitzpatrick, Sanders, & Worthen, 2004). The "case" is the redesign effort or the focus of the case study, and the case study's strengths enable a case study evaluation by allowing the evaluation to integrate relevant evidences about the reform/redesign (Patton, 1987; A. G. Ryan, 1987; Stufflebeam & Shinkfield, 2007; Yin

& Davis, 2007). The tools for the case study evaluation are the College's operational data store (ex post facto/archival longitudinal information on success, retention, and persistence), focus group, and interview guides.

Case study evaluation's strength is the probing into the sequence of events of a program's new strategies/implementation and evaluating the changes on the program outcomes (Balbach, 1999). The basis for a single case study is that the redesign and implementation of the developmental mathematics course (Math 24) is a unique case distinctive to KCC; although other colleges in Hawaii are redesigning developmental mathematics, the strategies and implementations are all different. The redesign is tailored and localized to the developmental mathematics team at KCC. The Math 24 course at KCC is redesigned internally and the changes are made and implemented on more of a trial and error problem solving approach by tweaking the courses as the experiences and outcomes change. Evaluating a case allocates worth to a particular set of activities and experiences. In program evaluation the case and condition/phenomenon to be studied is referred to as an "evaluand". Every evaluation study is a case study and the program, organization, or individual is the case (Cousin, 2005; Stake, 1995, 2006).

Redesign of programs and new interventions are implemented to improve conditions. Evaluations are valuable in determining if the impact is effective and outcomes are affirmative. The foremost reason why case studies are useful is the need to evaluate individual program or client outcomes (Patton, 1990). The uniqueness of the redesigned developmental mathematics course is justification for a single case study. In addition, the vision of the redesigned course is to individualize developmental mathematics for the population it serves. Evaluation of Math 24 course outcomes and impact on students were relevant for a single case study program evaluation.

A major advantage of a case study is that the detailed qualitative account helps to explore and describe real-life data and helps to explain the complexities of situations which may not be captured through an experimental study or survey. Single case study provides only a minimum basis for scientific generalization and since a small number of subjects is used in the study this can be a key disadvantage (Zainal, 2007). Although a single case study has some disadvantages, for program evaluation it is excellent practice because it is conducted for decision-making purposes, determines the merit of the program, highlights strengths and weaknesses, and drafts suggestions for programmatic modification (Patton, 1987; Spaulding, 2008). Conducting a program evaluation can aid in effective social changes and only enhance the developmental math program (Hodara, 2011). Results of the program evaluation provide insights to determine if changes need to occur and, even if the results prove a change is not justifiable, it establishes the willingness to change if necessary. The overall purpose of program evaluation is to change practice for the program or case (Lesik, 2008; Spaulding, 2008).

Sequential, Explanatory, Mixed methods Program Evaluation Design

In program evaluation, the mixed methods procedure of collecting quantitative and qualitative data can occur sequentially or concurrently. For the purpose of this mixed methods case study, to accomplish the evaluation of the course, the sequential explanatory design was employed where both quantitative and qualitative data are collected consecutively by the evaluator. Sequential explanatory design is a strategy where quantitative data is initially collected followed by qualitative data collection because distinct primary and secondary data are associated to augment or support the evaluation, and the initial quantitative data provide an overall illustration of the evaluation while the follow-up qualitative data aid in refining the evaluation (Creswell, 2009, 2012; Royse et al., 2001).

The sequential explanatory design is suitable because the initial/primary quantitative data (ex post facto data for students in the redesigned developmental mathematics course and the previous developmental mathematics course) collected from Kapiolani Community College's database was used to illustrate trends in student success, retention, and persistence. The quantitative trends for the 2010-2014 redesigned developmental mathematics were further dissected for quantitative changes in persistence and success (measurable outcomes). The measurable outcome changes were further investigated through the secondary qualitative data on the how the redesigned developmental mathematics course had changed over the semesters or years. Finally, qualitative data (academic and environmental strengths/weakness) collected from the participants (students, program director, and faculty members) were aggregated to explain and assess the impact of the Math 24 course.

Program Evaluation Type: Evaluation of Outcomes and Efficiency

In program evaluation different elements of the program can be separately assessed which includes evaluation of need, evaluation of process, evaluation of efficiency, and evaluation of objectives and outcomes (Caffarella, 2002; Posavac & Carey, 1989). To evaluate educational programs such as a redesigned developmental mathematics course, it is essential to examine and evaluate the program implementation and effectiveness. (Posavac & Carey, 1989; Scriven, 1981). Selecting critical characteristics from a program proposal/plan and evaluating the outcomes to determine if the objectives are met is one aspect of evaluating program outcomes. Another aspect that is empowering to the evaluation of outcomes and efficiency process is to take into account the people's perspective (King, Morris, & Fitz-Gibbon, 1987).

The aspects of the developmental mathematics course that were evaluated are the program's outcomes and efficiency which are components of the objective-based approach (Patton, 1997b; Spaulding, 2008; Wholey et al., 2004). The objective-based approach employs the objectives written by the creators of the program, which are specific and narrow statements of the intended outcomes as a result of new program activities (Patton, 1997b; Spaulding, 2008). Through objective-based evaluation, outcomes and the efficiency of the redesigned developmental mathematics course were measured to determine if the redesigned developmental mathematics course had better success outcomes than in the previous developmental mathematics course. Evaluating outcomes of a program provides evidence of the level of success of the program. Accountability or the justification for realistic results as an outcome, and the desire to improve services/practices warrant an outcome evaluation

For educational purposes, the participants in a program are critical in the evaluation of the program. Obtaining quantitative data on student success outcomes and qualitative data on students and faculty members perceptions can aid in judging practice, result, and efficiency (Kim, 2011; Posavac & Carey, 2003). The effectiveness of a program can be gauged by the collective feedback involving the participants. When participants are involved in the evaluation, it is referred to as a participation-oriented evaluation; this type of evaluation is indispensable in the arena of educational program evaluation. Participant involvement in the evaluation process can sometimes be viewed as a limitation to the study due to subjectivity, but it certainly offers powerful and fundamental information about the participants' experience, perception, and satisfaction with the effectiveness of the program (Kim, 2011).

Through the participatory-oriented evaluation approach, the strengths and challenges of the course are explored, and recommendations are sought from the participants. The data can provide insights about the program and can aid the facilitators and the adult learners in the improvement of design, delivery, and efficiency (Spaulding, 2008). Evaluation of program services and undertakings assess the actual degree of implementation, and in what manner content impacts program processes and outcomes. Results of evaluation can guide future revision of similar programs, such as responding to essential needs to foster program enhancement (Patton, 1987; Posavac & Carey, 2003).

The students' perception of the effect of the developmental mathematics program (course content/material, pedagogy/approach/tools, and learning environment/institutional setting) on enabling an increase in motivation, engagement, self-efficacy, and learning is valuable in the evaluation of the program's outcome because the results can enable better and future redesigns. Four elements contribute to an educational program's (classroom's /learning environment's) success or failure: learner needs, instructional/teaching method, course content matter, and learning environment (Grubb & Cox, 2005).

Evaluation Questions Plan

The objectives of the College's redesign were to (1) increase overall student persistence, retention, and success, (2) provide more support to participants (students and faculty) such as interactive tools, instructional software, peer tutors, and responding directly to specific needs of students to facilitate a more active role in teaching and learning that was framed around the Emporium Model, and (3) to move students from course performance to content mastery. Measurable and reportable outcomes were used to determine the course efficiency and if the intended objectives of the course were met (Kapiolani Community College, 2011).

Evaluation Question 1 was answered by examining quantitative data on developmental mathematics (Math 24) success, retention, and persistence for students in the redesigned developmental mathematics course and the quantitative data was compared with students in the previous developmental mathematics course. Quantitative data were requested from KCC Institutional Research Office. Data that addressed Math 24 student success are the percentages of Math 24 students that pass the course, that is, with grades A, B, C and CR. Persistence data accessed for Math 24 students addressed the percentage of students that re-enrolled in Math 24 or took an equivalent or lower level mathematics class after not passing Math 24. Retention data accessed for Math 24 students addressed the percentage of Math 24 students enrolled in a higher-level mathematics class in consecutive semesters (fall to spring or spring to fall). The quantitative data on success, persistence, and retention were requested per semester from Fall 2007 to 2014.

Evaluation Question 2 was answered by tracking the changes of the developmental course and outcomes (measurable and reportable achievement). Data were gathered on success rates, learning experience, curriculum, collaboration, and sustainability. Quantitative data measuring the percent success of Math 24 students, collected from KCC Institutional Research Office, were compared to track the effect (increase/decrease in success rate percentage) of the redesigned Math 24 course on student success from Fall 2010 to 2014. Qualitative data were analyzed to track the semester by semester changes from Fall 2010 to 2014. The qualitative data were gathered via a semi-structured individual interview with the developmental mathematics program director (administrator) on how the course impacts success and learning (outcomes).

Evaluation Questions 3 and 4 were answered by assessing academic and environmental strengths and weaknesses of the course from the students' and instructor's perspectives. Academic experiences and perceptions are associated with curriculum, assignments, assessments and math resources. Environmental experiences and perceptions can be associated with the college environment, peer collaboration, instructor interaction, instructional mode or pedagogy, communication, support, regulations, and the physical environment. Data were gathered from the students through four focus group interviews, and individual interviews with four faculty members and one program director administrator. For academic strengths and weaknesses, the focus groups and individual interviews aided in the collection of data on the developmental mathematics course's curriculum, assignments, books, math resources or supplemental materials, formative assessment, and summative assessment. For environment strengths and weaknesses, the focus groups and one-on-one interviews were geared to collecting data on peer environment (peer tutor, group work, study sessions), classroom environment (instructor behavior, seating, teacher-student interaction, discussions, lectures, course pace, email, tutor, regulations. pedagogy), and physical environment (computers, projectors, classroom setup). The consequence of the redesigned college developmental math course activities can be judged for academic and environmental strengths and weaknesses through experiences and perspectives of the participants in the course and the academic achievement results.

Sample and Setting: Population

The target population was students who had enrolled in the newly reformed Math 24 course, faculty members, and administrator associated with the developmental mathematics program. A target population is a group of individuals with some common defining characteristics (Creswell, 2012). Each semester at KCC, approximately five faculty members facilitate the developmental mathematics classes, one program director (administrator) manages the program design, one administrator oversees the whole program, and approximately 450 students enroll in a 3-hour per week lecture in Elementary Algebra named Math 24. Out of the 450 students enrolled each semester, approximately 40-60 students are enrolled in the afternoon, evening or night (1– 8:00 p.m.) developmental math course. A reason for targeting the later afternoon classes was because these students were not the typical college students that were right out of high school. They were typically working students, returnees to college after leaving high school or college for a few years, returning to college to enhance their jobs and career skills, and more likely to be a nontraditional student population.

Criteria for Participant Inclusion

The desired participants were students from 2012–2014, administrator (program director), and faculty members who have been with the initial redesigned course and were still with the developmental mathematics program. The reason for preferring the latest years' participants was to sample students from the latest version of the redesigned course since the initial redesigned Math 24, implemented in Fall 2010, had been adjusted each semester, and to enlist the input of faculty members that had witnessed the spectrum of changes within the redesigned course. OFIE advised that it was a tremendous challenge to recruit students for studies. Students from 2012–2014 were sought out and asked to voluntarily participate in the study. The desired faculty population sought was four faculty members and one program director administrator that were involved with the initial redesigned Math 24 course.

Sample and Setting: Sample

The sample consisted of students and faculty members who were willing to participate in the program evaluation, and who were respectively enrolled in and teaching or redesigning Math 24 courses from 2010–2014 at Kapiolani Community College. The preferable sample was students enrolled in the Math 24 afternoon to night classes; time frame of 1-8 p.m. in 2012–2014. Afternoon and evening students are a unique group of people because they were mostly working college students, older than the typical morning students, returning to college after a few years away from the educational setting and many of them had families to support. The rationale for using the afternoon or evening students was to have some control over the sample in terms of the sample participants' traits. Students were critical to the study because they have firsthand experience of the course and how it impacts student success.

The sample size for the semistructured interviews was four faculty members and one administrator directly involved with the redesign of the Math 24 course. The targeted participants were the program director who is an administrator and the course instructors who were faculty members. One administrator who was the program director and four faculty members participated in the semistructured interview. For the four focus groups, four students participated per group for a total of 16 students, because four to six participants is the typical number of people in a good focus group (Creswell, 2012).

For the student focus groups and faculty interviews, the sampling technique for the study was convenience sampling. The best nonrandom sampling technique used in educational research settings is convenience sampling because the participants are directly impacted by or involved with the course being evaluated or studied. The participants have personal experiences and firsthand knowledge (Lodico et al., 2010). For the quantitative section, and data from the College's database, the sampling technique was also convenience sampling because the participants were selected from a natural group (students who took developmental mathematics courses from fall 2010–2014).

When a smaller more opportune sample is used in quantitative study, it is referred to as a realistic popluation (Creswell, 2009; Lodico et al., 2010).

The assistance of the College’s Office of Institutional Effectiveness (OFIE) was employed to provide contact information (names and emails) of potential student participants. KCC students from the list provided by OFIE were contacted for possible student participants. An invitation letter was sent via email to potential participants. As the evaluator, I personally contacted the developmental mathematics students from 2012–2014 interested in participating via email, telephone, or in person. Candidates suitable for each of the four focus groups were selected on a first-come basis or earliest initial interest to participate in the study. The developmental mathematics program director provided a list of key developmental mathematics faculty members and administrators who I contacted. An invitation letter was sent via email to potential faculty participants. I contacted the key members by email, phone, and/or in person to enlist their participation. The first four willing key faculty members and one administrator participated in the individual interviews.

Data Collection

The data collection procedure was designed to collect both qualitative and quantitative data that were related to student achievement outcomes and student and faculty perspectives on the impact of the redesigned mathematics course on student success. The sample data collection techniques were collecting pre-existing longitudinal performance review data from the college's Operational Data Store (ODS)/Institutional Data Warehouse, pre-existing data on the Math 24 course outcomes, semi-structured interviews with developmental mathematics faculty members, and focus group interviews.

Data collected from students, faculty members, and Kapiolani's Operational Data Store, on success, persistence, retention, and academic and environmental aspects addressed the impact of the course on student learning. Longitudinal data from school year 2007–2014 (Fall 2007 to Spring 2014) were used and the total enrollment in the course for each year or by semester (depending on how the data are compiled in Star/archive), academic success (final grade – grade C or better and passing score of 70% or better in the Math 24 course, retention (enrolled in a higher-level mathematics class in consecutive semesters (fall to spring or spring to fall), and persistence (re-enrolled the next semester in Math 24, or took more than one semester in Math 24, or enrolled in an equivalent or lower level mathematics class after not passing (grade F, NC, dropped, withdrawal) Math 24).

The data used were aligned to main goals of the program evaluation, that is, to evaluate the relationship of the redesigned course academic achievement outcomes and at the same time determine the impact of the developmental mathematics course on student learning.

The secondary data were qualitative focus group interview question data from 16 students who were enrolled in the redesigned Math 24 from Fall 2010–2014, and individual interview question data from developmental mathematics faculty members and the program direct who were instrumental in the redesign/teaching of the redesigned Math 24 course. Secondary data collection sources were four student focus groups interviews and four individual faculty member and one administrator interviews. The faculty members consisted of four developmental mathematics faculty members, and one the administrator.

The rationale for focus groups in evaluation is the advantage that the moderator can probe by asking participants to elaborate, share their thoughts and perspectives, and provide examples to reinforce or strengthen information provided by participants. Open ended questions, similar to individual interview, are routine practice in focus group interviews. Focus groups have advantages in having deeper discussion of perspectives and thoughts of a cluster of similar people. The main disadvantage of focus groups is that the free sharing of views may be intimidating to individuals and diminish some involvement (Posavac & Carey, 2003). Also, there may be a tendency for participants to conform with others and the non-conforming views may not be as likely to be voiced compared with individual interviews. Probing and reinforcing techniques encourage the participants to elaborate on their responses (Wholey et al., 2004). For data collection from the faculty members, four open-ended questions were used to guide the one-on-one individual interviews. The data that I collected through interviews and focus groups are referred to as secondary data because the qualitative data aid in the further exploration, expansion, and explanation of the qualities of the case.

Focus Groups: Students

The focus groups were categorized by using grades: Focus Group 1 (A/B/C/CR - success) was composed of students who completed/passed the course in one semester, Focus Group 2 (B & C/CR-success) was composed of students that took more than a semester, Focus Group 3 (first time D/NC - No Credit) was composed of students who made satisfactory progress and had good attendance - can continue/complete course in the next semester. Focus Group 4 (Persistence: initially failed/withdrawn/dropped/NC then retake another semester but did not complete/failed; and first-time F) was composed of students who needed to retake course from the beginning. The rationale for creating different categories by grade for the focus groups was to determine if there were differences and similarities between groups that were successful and those that failed, because students who received Fs or dropped may have had different needs and views from the students getting As. Also, the College's Office of Instructional Effectiveness indicated that feedback from students with different grades would provide helpful information about the College's developmental mathematics program; especially in guiding the faculty and staff to better modify instruction and curriculum to meet the needs of all students.

A focus group interview protocol (Appendix E) was used as a guide during the interview to provide structure and to organize notes of observations (Creswell, 2012). The time for each focus group interview was approximately 90 minutes. The interviews were recorded and then transcribed into a word document transcript. There were 10 questions for the focus group interview that targeted student perspectives on the academic and environmental aspects of the developmental mathematics course (Evaluation Questions 3 and 4); that is, the curriculum, assignment, math resources/supplemental materials, assessment, faculty members, peers, tutors, classroom settings, pedagogy/instructional format, and physical classroom/course resources.

The list of focus group questions (Appendix C) was used for the four focus groups because the questions developed for the focus groups address all the factors being evaluated and the uniqueness of the students. There two deviations were (1) students in Focus Group 4 (participants that did not pass the class: grade F, dropped, withdrawn, D, NC) were given an alternative approach (one-on-one interview) as an option if they felt embarrassed, but they all opted to participate in a focus group interview, and (2) questions for Focus Group 4 were suitable for the specific success level. For example, Focus Group 4 was asked the questions labeled for students who dropped/failed: (i) Dropped: Please explain why you dropped/did not complete the course/Math 24. (ii) Failed: What are some factors that led to your failure (not successful) in Math 24. The question for students who passed the course: Describe how prepared you felt for the next level math course or do you feel prepared for the next level math course.

A focus group interview is the process of collecting data through interview with a group of people. For the focus group interviews, “four or five good questions … or one or two broadly stated topic or questions” (Glesne, 2011, p. 132) are recommended. The broad topics for the focus group were the academic and environmental strengths and weaknesses of the redesigned developmental course as perceived by students of different success levels. Some advantages of focus group interviews are the similarities among the interviewees, interaction between the individuals, and the cooperation with each other, which would likely yield the best data/information (Creswell, 2012).

Individual Faculty Interview: Instructor and Administrator

Semistructured interviews with the developmental mathematics faculty members and administrator (program director) addressed the changes in the redesigned course (part of Evaluation Question 2) and faculty perspectives on the goals, objectives, outcomes, and the impact of the redesigned Math 24 course on student learning and success; that is, data on math success, persistence, retention, and their perceptions on the strengths and weaknesses of the course (Evaluation Question 3 and 4). An interview protocol was used to guide the interview and the time for the interview was 1 hour.

One-on-one interview was the mechanism used to collect data from individual faculty members and the administrator. Eight open-ended questions were used for the faculty member and administrator interviews. For the administrator, the eight questions (APPENDIX B) address Evaluation Question 2 about tracking the changes of the redesign math course. For the faculty members, the eight questions (Appendix D) address Evaluation Questions 3 and 4 about the academic and environmental strengths and weaknesses of the course. Open-ended questions and interviews give rise to insights and solutions that yield deeper understanding. Interviews can yield information regarding perceptions, experiences, thoughts, and feelings (Frels & Onwuegbuzie, 2012; Patton, 2010).

Operational Data Store

Primary data, more quantitative in nature, were collected from the college's Operational Data Store (ODS)/Institutional Data Warehouse and targets Evaluation Questions 1 and 2 (grades, retention, persistence and course outcomes). Additional data to track the changes of the Math 24 course from 2010 to 2014 were gathered from the college's developmental mathematics department. The quantitative data are considered as the primary data because, although the data were gathered by other agencies (the College). The evaluator is initially using the data in the investigation/evaluation to establish the main platform or general picture for the outcomes and efficiency evaluation.

Archival data were existing student data (sometimes referred to as frozen data) from the College's Operational Data Store (ODS)/Institutional Data Warehouse (data from STAR/BANNER- Star is a Java run application that allows for the compilation of students' records that is in Banner) and the course quantitative indicator - Instructional Annual Report for Developmental Mathematics. (It should be noted that the terms persistence and retention may be used differently in reports and databases of the College than defined in this study; for example, the College uses the term persistence and retention interchangeably on different reports). For the quantitative data, the independent variable was the treatment (redesigned developmental math) and the dependent variables were the outcomes (success, retention, persistence).

Quantitative data were collected for each semester from Fall 2007 to 2014. Data from Fall 2010 were for the redesigned course and date prior to Fall 2010 were for previous Math 24 course. Data on course enrollment, grades, retention, persistence and success rate were gathered and analyzed to evaluate whether the redesigned developmental math course has achieved its proposed outcomes.

Data Analysis

Sequential analyses of quantitative then qualitative data were performed. The results of the analyses from the quantitative phase were merged with the qualitative phase and the qualitative results were used to aid in the explanation of the quantitative findings, and the efficiencies and outcomes of the course. The analysis integrated findings and explanations from the evaluation analysis that are applicable to answering the evaluation questions and allowed for further interpretations.

Quantitative Analysis

The analysis of the quantitative data was done using the SPSS software program. The quantitative data for evaluation of the redesigned developmental program were explored through an impact analysis design referred to as the ex post facto design, a non-experimental design where the evaluator reports happenings and had no control in manipulating program variables (Mohr, 1995). Longitudinal data recorded over time, per semester, by the College into a student data warehouse on success, persistence and retention, were compared via descriptive statistics to evaluate whether the course outcomes were met.

For the quantitative Evaluation Question 1, longitudinal data (2007–2014) from the College's Operational Data Store (ODS)/Institutional Data Warehouse per semesters or years (whichever is available) on Math 24 students' grades, retention, and persistence were inputted into the SPSS software and analyzed using descriptive statistics to compare mean, mode and standard deviation for the success, retention, and persistence percentages. Both the descriptives and frequencies commands in descriptive statistics were used to determine percentiles, central tendency, measure dispersion, and create histograms. Trends in success, retention, and persistence rates were descriptively compared and presented in tables, graphs, and histograms. The trends in the mean, modes, and standard deviation of the redesigned Math 24 quantitative data (success, retention, and persistence) were compared to that of the previous Math 24 course to determine if there is any significant percentage difference in student success, persistence, and retention between the two math designs and the semesters. Significant percentage difference is defined and based on and parallel with Kapiolani Community College Strategic Plan 2008-2015 expected outcomes for developmental mathematics. As a result of the developmental intervention (redesigned Math 24 course), the expected outcome was that student success in developmental mathematics increased from 45% to 80%; therefore, a consistent increase from 45% per year was considered as a significant percentage difference.

For Evaluation Question 2, the redesigned Math 24 quantitative data on actual student success and persistence rates were compared to the College's expected success and persistence rates (expected outcomes). Descriptive statistics analysis was conducted of actual and expected percent rate data per semester for success and persistence. The frequencies and graphs were used to examine the trend in expected and actual outcomes and to establish whether the redesigned developmental mathematics course achieved, exceeded, or did not met its proposed objectives, as proposed in Kapiolani Community College Developmental Education Continuing Project Proposal, of increasing the average student success rate in developmental mathematics from 45% (Fall 2007-Spring 2010, traditional lecture) to 58% (fall 2012 spring 2012, redesigned course), increasing persistence rate from 63% (fall 2007-spring 2010, traditional lecture) to 75% (fall 2012 spring 2012, redesigned course), and as per Kapiolani Community College Strategic Plan 2008-2015, to increase the successful movement of developmental mathematics students on to degree applicable instruction from 62% to 80%, and by 2015 increase student success to 80%. The actual student outcomes on percent success and persistence rates were requested from the IRO data store and then the data were compared to the proposed College expected outcomes. Each semester data from Fall 2010 on student success and persistence were compared to determine trends in the student outcomes.

Qualitative Analysis

The analysis of the qualitative data from the program director interview and student focus group transcripts was done by constant comparison analysis to identify underlying categories associated with strengths and weaknesses of the redesigned Math 24 course. Qualitative data collected from the college developmental mathematics Program Director (Evaluation Question 2) on the changes of the redesigned Math 24 course over the semesters were summarized and compiled in a table (rows and columns) format per semester. In qualitative analysis, the initial phase of summarizing or data reduction and of organizing the data in categories and categories allows for comparison and pattern identification. To display and analyze for trends/patterns over time or semesters for the changes in the redesign math course, tables were used to organize the condensed data. Coding and clustering allowed for finding categories and displaying patterns (Wholey et al., 2004). The qualitative changes in the redesigned Math 24 course per semester were tabulated with the success and persistence rates (quantitative); thus, providing a means of comparing and analyzing the data from one or more categories or triangulation of data to produce understanding.

For the qualitative data gathered from the student focus groups, and individual administrator and instructor interviews (Evaluation Questions 2, 3 and 4), the analysis was done using framework analysis strategies. The first step was to gain familiarity with the data by reading the transcripts, reviewing interview observational notes, notes taken immediately after interviews, and audio recordings. The second step was to write the pre-set categories in the data (thematic framework) in the form of short phrases/words. The third step was to highlight quotes, reorganize/move data, and compare data from different sources (indexing). The fourth step was to organize data under pre-set categories (managing data). The fifth and the final step, was to interpret the data to answer the research questions (Rabiee, 2004).

The focus group data from the transcripts were coded and analyzed and organized around the pre-set categories. The pre-set categories for academic strengths and weaknesses were curriculum, resources, assignments, assessments, and tests. The pre-set categories for environmental strengths and weaknesses were peers, classroom, and physical. In analyzing qualitative data, the major challenge was the coding of the data which was the process of classifying segments of the data that are related to different phenomena. The phenomena being studied were academic and environmental strengths and weaknesses that affect success, retention, persistence, outcomes, and course impact on student learning. Initially, the coding was open coding where categories are formed, then the open coding categories was selected and mapped to the categories. Common patterns and trends emerged as a result of synthesis of the focus group and interview transcripts (Creswell, 2012; Koch, Slate, & Moore, 2012; Wholey et al., 2004).

The quantitative outcomes from the longitudinal data analysis for Evaluation Question 2 were also compared side-by-side with qualitative data from the developmental mathematics program director on the redesign changes per semester to track redesign changes and to compare the redesign change effects on success and persistence rates. The quantitative data (questions 1 and 2), and qualitative data (questions 2, 3, and 4) were triangulated. The triangulation of the within, and between, the qualitative and quantitative approaches (mixed methods) is essential to effectively evaluate programs; it gives more depth and breadth to the study. In the educational setting, from redesign to implementation to students' outcomes, it is critical to examine quantitative data and qualitative data to dissect and analyze in the search for possible elements that may facilitate future enhancement of the program.

Validation

Triangulation is an important initial step to aid in checking and establishing of validity. Valid and reliable evidence gives credibility to the work. According Kegan (1980), validity is accurately interpreting data collected, and reliability refers to the percent accuracy involved when obtaining data and measuring variables. Reliability has to do with consistency, dependability, and trustworthiness. To ensure that the study is valid and reliable the methodology, instrument, data, and interpretation have to follow validity and reliability protocols. In designing the study, guidance and feedback were sought from the main University of Hawaii System Institutional Research Office and KCC Institutional Research Offices. Research faculty members and staff who are experts for internal institutional research/evaluation, reviewed the focus group and interview questions. Also, developmental faculty members and other educational individuals (peers) reviewed the project study to make sure that the evaluation procedure was valid and reliable. The student focus group interview questions, the faculty interview questions, the focus group categories, and the researcher purpose of the study were shared with some faculty members and OFIE for feedback and face validity.

In the development of qualitative study methodology, peer review is an external check utilized in the development of the interview questions and protocol. The peer review is the strategy used to increase instrument reliability, check for clarity of questions, and alignment to evaluation questions, and is a cornerstone process in establishing validity (Hemlin, 2009; Lincoln & Guba, 1985). Peer review was also used in the data analysis phase to substantiate categories identified through constant comparison.

After the data were collected and analyzed, the interpreted information was shared (email and/or face-to-face in a document format) with a few of the College staffs who work with the developmental mathematics program, OFIE, and the participants from the focus groups and interviews. A common strategy to establish credibility and internal validity is member checks, also known as respondent validation. For internal validity, feedback on the emerging findings was solicited from some of the participants that the analyzed and interpreted information were shared with. Member checking is a technique that allows the participants to review the evaluator's or researcher's data for accuracy. After the faculty interviews and focus group interviews, the transcripts were shared via email or hardcopy to each participant for verification purposes. Through member checking, participants were asked to verify that the emerging relationships can be established from the program evaluation data. Also, the preliminary analysis of the data was shared with the participants to ensure correct interpretation of data. Internal validity, is a critical feature when establishing whether there is a causal relationship between the program and the identified effect, and that plausible rival factors/explanations have been reasonably ruled out (Merriam, 2009; Wholey et al., 2004). For internal validity one needs to consider extraneous variables and controls.

For qualitative data, student focus group interviews were used and individual interviews; where participants were asked open-ended questions and the responses were recorded. In addition, the evaluator has to be non-judgmental and non-authoritarian (Creswell, 2012; Redmond & Curtis, 2009). The questions for the focus group and interviews were open-ended and were reviewed to eliminate my personal biases. The open-ended questions allow for uncovering more accurate meaning from the participants' perspectives than the closed ended questions and can be deemed more reliable and valid. The participants were asked to share their personal perspectives, even if their views differ from other members in the focus groups to encourage that all free sharing of views were necessary for a valid and reliable evaluation. To ensure that the participants provided their best answers, I remained polite and non-authoritarian to get the full cooperation of the participants and reliable outputs.

The two components of validity are external and internal validity. Internal validity is the critical technique in the evaluations of program outcomes where the sufficiency of the design and mechanism in data collection are acute. External validity relies on whether the sample adequately represents a distinctive group, then the results can be generalized to the larger population (Le et al., 2011). For program evaluation, multiple threats to validity can surface when evaluating a college developmental mathematics course over time, such as different students with different characteristics, different faculty members, different environment, different enrollment requirements, and college database duplication of fail and pass records of individual students who failed in a previous semester, and then passed in a future semester. To counter threats of validity, triangulation, examination of data connections, and checking for outcome/result consistency were routine practices (Patton, 1990; Wholey et al., 2004).

For descriptive study and the analysis looking at casual relationships, the internal validity was defined by how well the study was run such as the research design, operational definitions, variable measurement, and the confidence level of the conclusion. Validity helps to support that the observed outcomes were exclusively due to the independent variable/redesign and not external or extraneous factors. Although threats to internal validity can emerge in program evaluation of college courses, such as divergent faculty members, a disparate student body, and changing curriculum and pedagogy, to establish validity the evaluators have to ensure that “plausible rival explanation for outcomes are ruled out to the extent reasonable” (Wholey et al., 2004, p. 549). To aid in the validity of the evaluation, the evaluation design has to be carefully selected, having accurate operational definitions that are aided through research, literature search, institutional feedback, and member checking. Also, to enhance validity, member checking was sought through feedback of the student participants of the study and faculty members on the accuracy of the interpretation of the data and the instrument. Although the members of the focus groups were non-equivalent in success, the participants in the study (sample and sample size) were representative of the general Math 24 course population. Furthermore, the college participants' perceptions and views of the legitimacy of the redesigned course evaluation process and result were critical to the evaluation validity and credibility. The identification of challenges encountered during an evaluation process are usually perceived by faculty members as strengths in a rigorous program evaluation (Wholey et al., 2004). To aid in enhancing validity of the evaluation, a professor outside of developmental mathematics provided critical feedback in the process of validity and reliability of the study. In addition, feedback from the doctorial committee members ensure that the whole project study process was credible. In program evaluation, according to (Gargani & Donaldson, 2011), validity related to outcome evaluation centers on queries of internal validity, basically through questions (Did the redesign work?), and places minimum emphasis on external validity (Will the redesign work?)

For this program evaluation, I followed all program evaluation protocols and code of ethics, such as member checking, triangulation of data, participatory modes of research and clarification of researcher bias for validity. Triangulating various forms of data from mixed methods or multiple methods and by involving an array of participants can boost interpretation and validity of study (Bush, 2002; Posavac & Carey, 2003). Also, the instrument and raw data collected were provided in the appendix of the report. Addressing the reliability, validity, and credibility as part of this study was an important step for academic integrity and was a guide for using innovative intellectual property to provide resources for the world that were credible and honest; thus, making the work more valuable and reliable.

Protection of Participants

Participants in a study or evaluation have to be protected from all harm and bias. In any study or evaluation, there is an ethical obligation to protect participants from harm, and animosity (Patton, 2002). For this study, the institution was given a letter seeking permission to collect relevant data (Appendix J), discussion on making sure participants are protected at all times by the Office of Institutional Effectiveness, a signed Data Use Agreement (Appendix I), and a signed Letter of Cooperation from Community Research Partner (Appendix H) granting permission to conduct the program evaluation. Permission was necessary before entering a site to collect data and the approval usually comes from leaders or persons of authority in the organization and the best way to seek permission was with a formal letter. The letter included the purpose of the study, the amount of time at the site collecting data, the time required of the participants, and how the data or results were used. Also, the letter specifies the activities to be conducted and the benefits to the organization or individuals (Creswell, 2012). A formal letter was sent to the KCC organizational personnel before the study to obtain their permission to enter and study their setting. The data provided by the institution did not include personal identifiers or did not identify any of the students.

After permission was granted from the Kapiolani Community College Chancellor to conduct the study and the IRB was approved by Walden University (Approval No. 10-21-14-0198333), letters of invitation were sent to potential participant, that is the program director (administrator), faculty members, and students. Informed consent forms were given to the participants explaining that they were protected at all times and that they were freely volunteering without any risks. Only individuals who signed the consent form were included in the study because they were voluntary participants. The consent form informed the participants of their right to withdraw at any time without penalty, and that they are protected from any harm and are ensured confidentiality. Also, participants were protected from bias and discrimination in case individuals declined to participate. The purpose of an informed consent form is to enforce the principle of voluntary consent; thus, the participants have the authority to assess participation in the study, and the researcher is obligated to provide truthful and understandable information about any perceived benefits or risks to the participants. The whole process of protecting the participants also involves making sure that the participants do not feel powerless, but feel at ease and valuable; that is the principle of counterbalancing the asymmetry of power (Juritzen, Grimen, & Heggen, 2011).

The interview protocol also reminded students that they could withdraw at any time without any consequences. Student data were to be labeled by codes to protect anonymity. After the study proposal was accepted by the University Research Reviewer, an Institutional Review Board (IRB) application was submitted to the appropriate institutional review board for approval before the study was conducted. Seeking IRB approval for the study ensured confidentiality and that all the participants are protected from harm. Data collection for the study occurred after approval from IRB. If at any time there were changes in the study methodology, IRB approval would have to again be requested to guarantee that all participants are protected. All confidential materials were locked in a filing cabinet to protect the participants.

For the focus groups and interviews, precaution was taken to use number, and letters, in lieu of names. For example, in focus group one, the participants were addressed as 1A, 1B, and so on to maintain participants' confidentiality. Although there was no guarantee that all the focus group participants abided by the confidentiality requirement, the need for confidentiality was emphasized at the beginning and end of each focus group session. Members of each focus group were reminded that they should respect each other's privacy, anonymity, and to not reveal the identities of participants nor relate any specific comments made by participants during the focus group discussion (Mack, Woodsong, MacQueen, Guest, & Namey, 2005). To further guard student participants who were not comfortable participating in focus group, the student participants were given the option to be interviewed separately as a means of protecting the individual's confidentiality and privacy; however, all student participants volunteered to participate in the group interviews.

Limitations and Assumptions of Evaluation

The study, evaluating the redesigned developmental mathematics course at Kapiolani Community College has the following limitations:

1. The evaluation only involved a specific developmental mathematics course (Math 24), which is two levels below college level mathematics; so, generalizing the study to groups outside of the study group may be limited or not warranted.

2. The study was a single case study of the developmental mathematics program at a single college; so, it may not be representative of other similar levels (two levels below college level math) across the general population (that is, as a whole, Hawaii or nationally).

3. The outcomes of a program were affected by multiple factors other than the course. Program evaluation that determines the outcomes (effects) attributed to a specific program has limitations because the outcomes can be affected by numerous remote/other factors in addition to that of the program itself, plus, frequently altering of the course over the semester or semesters can limit the adequate capturing of the program's activities that are due to the program's implementation (Wholey et al., 2004).

4. Quantitative data from the college's database may have duplications, that is, if a student failed in Spring 2011 and retook the class and passed in Fall 2012, that data were counted in both categories. Also, if a student made positive progress (persistence) and then passed the course early the next semester the data were duplicated in both success and persistence. Duplication of data poses a threat to validity.

5. Students in Focus Group 4 (participants that did not pass the class: grade F, dropped, withdrawn, D, NC) opted to all participate in one focus group although an alternative approach (one-on-one interview) was given. As such, participants might have censored some of their views which might have limited free sharing of views.

6. Focus groups may be intimidating to individuals and diminish some involvement. Also, there may be a tendency or group norm for participants to conform where participants match perspectives and attitudes.

The assumption of the study was that each semester the previous developmental math courses, Math 24 before the redesign, were similar and each semester the redesigned courses are similar. However, there were differences over the semesters for the redesigned Math 24 course where changes in assessment and assignment had the potential to change the final course grade and therefore the variables of academic success and persistence. Although, each semester the students, teachers, pedagogy, and course curriculum for Math 24 varied at different levels, the assumption was that the courses in each category were similar enough or different enough to be labeled/grouped as previous or redesigned. Also, the general population and the overall characteristics of the students, each semester in developmental mathematics (Math 24) at Kapiolani Community College, were assumed to be similar by the College.

Data Analysis Results

Evaluation Question 1 – Quantitative

Evaluation Question 1 was used to determine the trends in success, retention, and persistence for students in the redesigned developmental mathematics course as compared with students in the previous developmental mathematics course.

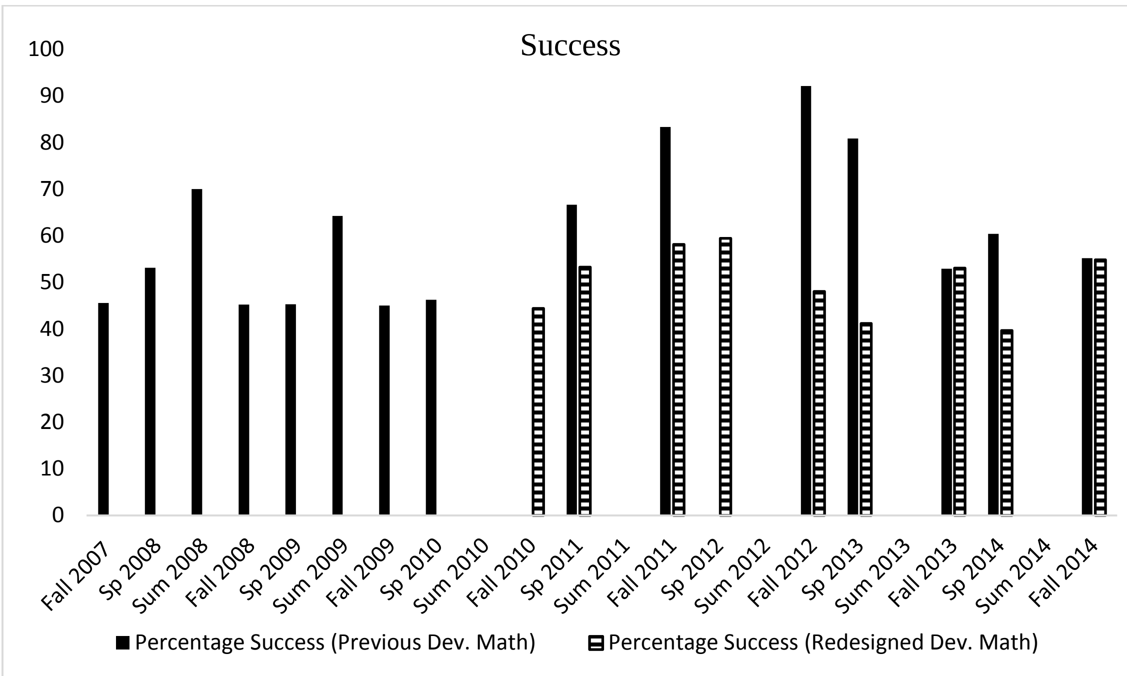

Figure 1. Percent success rate. Success rate = (number of students receiving a grade of C or Credit for Math 24 in a semester/total number of students enrolled in Math 24 for the semester) x 100.

Figure 1 illustrates the success rates of the previous developmental mathematics and the redesigned developmental mathematics course. Success rate is determined as a percentage of the number of students receiving a grade of C or Credit for Math 24 in a semester over the total number of students enrolled in Math 24 for the semester. From the analysis of the percentages on the graph, the success rate for the previous developmental mathematics course fluctuated between 45-55% for Fall and Spring semesters and 64–

70% for summers. From Fall 2010, the redesigned developmental mathematics fluctuated from approximately 40–60% for fall and spring semesters. For lecture style, the success rate fluctuated from 52–92%. Overall, for fall and spring semesters, when previous developmental mathematics course was also offered with the redesigned developmental mathematics, the previous developmental mathematics course success rate for Fall 2011, Fall 2012 and Spring 2013 were above 80%. When both the redesigned developmental mathematics and previous developmental mathematics courses were offered the previous developmental mathematics course success rates were consistently about equal to or higher than redesigned developmental mathematics. For fall and spring semesters when previous developmental mathematics were only offered the success rates were below 60%. The redesigned developmental mathematics success rates were below 60%. By Fall 2014 the success rate of the redesigned developmental mathematics did not reach the college expected outcome success rate of 80%.

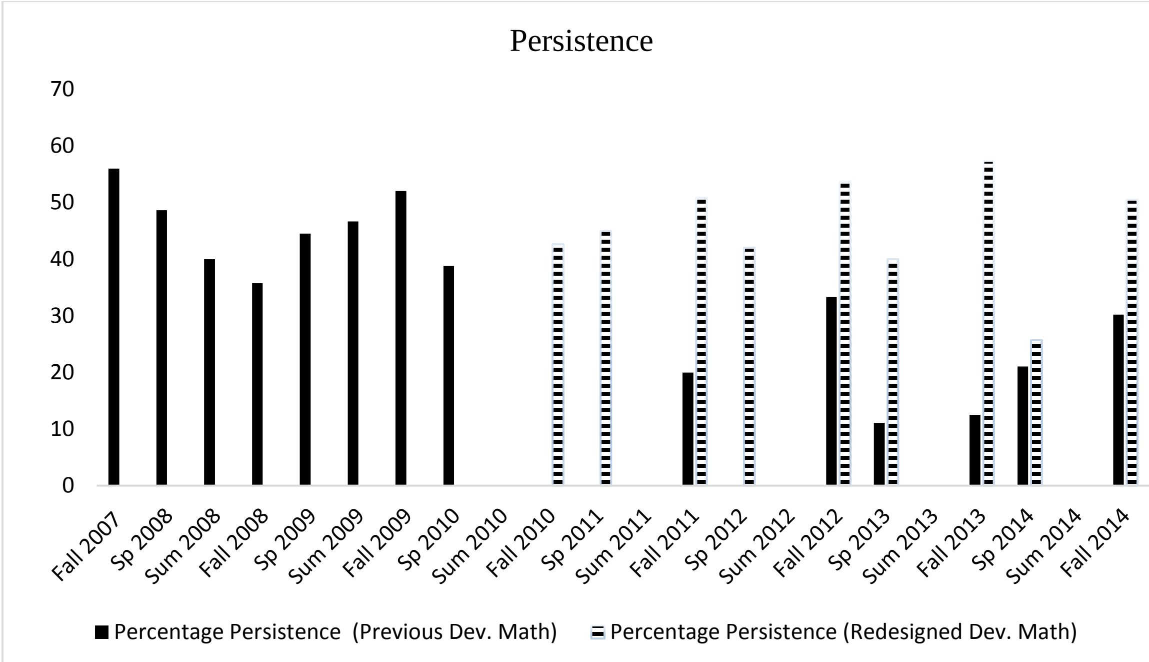

Figure 2. Percent persistence for previous and redesigned developmental math

Figure 2 illustrates the persistence rates of the previous developmental mathematics and the redesigned developmental mathematics courses. The persistence rate illustrates that the percentage of students who re-enrolled in Math 24, or took an equivalent or lower level mathematics class, after not passing Math 24 was consistently higher from Fall 2011 for the redesigned mathematics course compared to the previous developmental mathematics course. After the introduction of the redesigned Math 24 course in Fall 2010, the persistence rate for the previous developmental mathematics course decreased. For the redesigned Math 24 course, student persistence fluctuated from 25.71% to 57.36%. Overall, the persistence for both the previous and redesigned developmental mathematics course were below 60%. By Fall 2014 the persistence of the redesigned developmental mathematics did not reach the college expected outcome persistence rate of 75%.

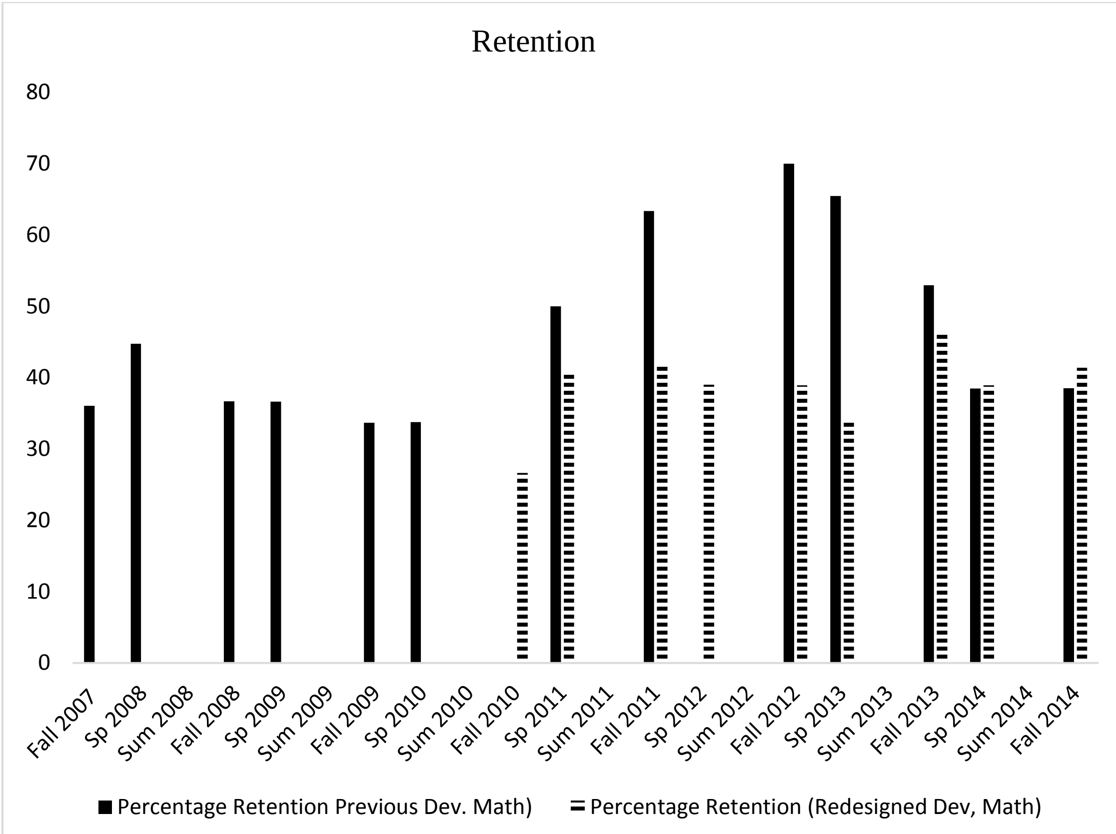

Figure 3. Percent retention for previous and redesigned developmental math

Figure 3 illustrates the retention rate of Math 24 students enrolled in a higher-level mathematics class in consecutive semesters (fall to spring or spring to fall) for the previous developmental mathematics and the redesigned developmental mathematics course. For previous developmental mathematics, the retention rate fluctuated from 33.67% –70.00%. For the redesigned Math 24 course, student retention fluctuated from 26.63% to 46.38%. Overall, the average retention rate for the redesigned mathematics course was lower than that of the previous developmental mathematics course. For semesters with concurrent previous developmental mathematics and redesigned developmental mathematics courses, the redesigned developmental mathematics had lower retention than the previous developmental mathematics except for Spring 2014 and Fall 2014.

Evaluation Question 2 – Mixed Methods

Evaluation Question 2 was used to track the changes of the developmental course and outcomes (measurable and reportable achievement).

Table 1

Redesigned Developmental Mathematics Success Rate Central Tendency

Central Tendency	Statistics
Mean	50.24
Median	53.09
Mode	39.66[a]
Std. Deviation	7.24
Minimum Statistic	39.66
Maximum Statistic	59.45
Sum	452.19

Note. Multiple modes exist. The smallest value is shown

Table 1 shows the mean success rate for the redesigned developmental mathematics course to be 50.24%, median 53.09%, and mode 39.66%. The standard deviation was 7.24; thus, indicating a high variability or spreading out of the success rates compared to the mean success rate (50.24%).

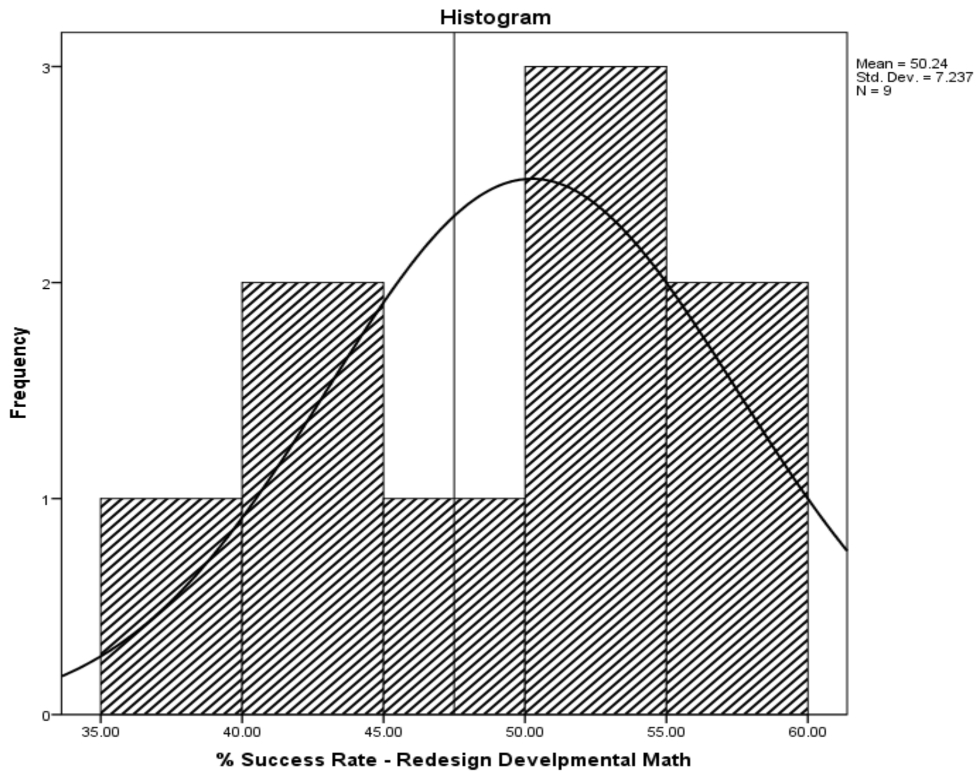

Figure 4. Histogram of success rate redesigned developmental math Fall 2010-Fall 2014

Figure 4 shows a bimodal distribution of success rate percentages which is a measure of statistical dispersion or how spread out a set of values are around the mean.

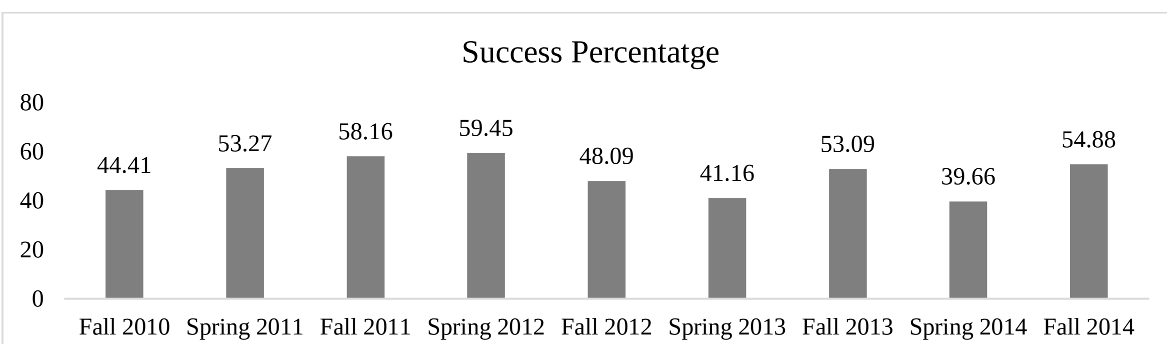

Figure 5. Percent success rate redesigned developmental math course Fall 2010-Fall 2014

Figure 5 illustrates the percent success of the redesigned math fluctuated between 39% to 60%. The expected outcome of a continuous increase in success rate was not achieved.

Table 2

Changes of the Course Outcomes: Success, Persistence, and Retention Rates

Semester	**Self-Pace**			**Hybrid 50/50**		
	S	**P**	**R**	**S**	**P**	**R**
Fall 2010	44.41	42.65	26.63	None	None	None
Spring 2011	53.27	45.00	40.69	66.67	0.00	50.00
Fall 2011	58.16	50.85	42.05	83.33	20.00	63.33
Spring 2012	59.45	42.05	39.00	None	None	None
Fall 2012	48.09	53.68	38.93	92.11	33.33	70.00
Spring 2013	41.18	40.00	33.99	80.85	11.11	65.45
Fall 2013	53.09	57.36	46.38	52.94	12.50	52.94
Spring 2014	39.66	25.71	38.93	60.42	21.05	38.46
Fall 2014	54.88	50.52	41.40	55.21	30.23	38.54

Note. The rate percentages are represented by the following S for success rate percentage, P for persistence, and R for retention,

Table 2 tracks the changes of the success, persistence, and retention rates per semester for Math 24 course.

The average success rate from Fall 2007 - Spring 2010 for previous Math 24 was 45%. The redesigned self-paced redesigned Math 24 course increased to 59.45% in Fall 2012, but decreased to 48.09% in Spring 2012 for the redesigned course. Therefore, the expected outcome of 58% student success by 2012 was not achieved. As of Fall 2014, the student success was 54.88%, which was 25% lower than the expected student success outcome. Spring 2012 had the highest success rate of 59.45%. The college expected student success to consistently increase to 80% by 2015; however, from Fall 2010 to Fall 2014 there was no consistent increase in success rate. Success was measured by the final course grade, and with the hope to increase success in Fall 2011 faculty members eliminated the written midterm as it became an unnecessary obstacle for students to finish the course and in Fall 2013 the paper final exam changed to 40 online free response questions to be consistence with the mode of delivery of the rest of the course. However, the changes did not result in any significant increase in success rate because success remain consistently below 60%. The average persistence rate from Fall 2007-Sping 2010 for previous Math 24 was 63%. The persistence rate for the redesigned self-paced redesigned Math 24 course decreased to 53.68 % in Fall 2012 and decreased to 42.05% in Spring 2012 for the redesigned course. Therefore, the expected outcome of 75 % student persistence by 2012 was not achieved. As of Fall 2014, the persistence rate was 50.52%. A consistent increase of student success from 45% per year to 80% and student persistence from 63% to 80% was considered as a significant percentage difference or increase. Both student success and persistence have not consistently increased to meet the course's expected outcomes. Therefore, a significant percentage increase for both student success and persistence were not achieved. In Fall 2011 Hybrid Math 24 was introduced where class lectures and flexible test times for students to take each test in the testing center, and success and persistence rate increase by more than 5%. In Fall 2013, the paper final exam changed to 40 online free response questions from a written final exam multiple choice test with 30 questions, and success and persistence increased by more than 10% compared to the previous semester. In Fall 2014, the success and persistence rates were the lowest and had a significant decrease compared to the previous semester. The major change in Fall 2014 was new faculty was hired to facilitate the Math 24 course.

Fall 2010 was the first introduction of the redesigned 100% self-paced Math 24 course. From Spring 2011, a hybrid type of traditional Math 24 (previous Math 24) was also introduced along with the 100% self-paced Math 24. Except for Fall 2013. The hybrid Math 24 success rate was consistently higher than the self-pace Math 24. Whereas, the hybrid Math 24 persistence rate was consistently lower than the self-pace Math 24. Therefore, the results suggest that factors such as, scheduled time for teacher-led instruction, set deadlines for assignments and assessments, scheduled pacing of the course material in the hybrid course might have led to better student accountability; thus, higher student success and lower persistence rates in the hybrid developmental math course.

Semester Changes of Developmental Course

The qualitative data from the developmental mathematics program director interview were analyzed to track the redesign changes per semester.

Fall 2010

All the redesigned Math 24 courses were taught using the redesigned self-pace model and MyMathLab was introduced. Students self-enrollment in Math 24 remain the same as previous Math 24 where students had to place in Math 24 after taking the Math Compass Placement Exam at the college or received credit from the preparatory Pre-College Math Program. The classrooms with computers served as both the math lab and the instructional classroom. The MyMathLab program was accessible on the computers. The first 3 weeks of the semester there was more students than computers in the labs, so students were allowed to bring their own laptops to work on their Math. The last 3 weeks, there was an increase of about 50% more students wanting to use the labs in the evening so there was an overflow into Pre-College Math computer lab for students taking the chapter tests or final exam.

A common curriculum, where the faculty members were teaching the same content in the same modules, was introduced. The faculty work was restructured where every faculty member had to spend 2 hours each week in the math lab with Math 24 students from multiple instructors' classes. For example, in addition to the assigned class time, the faculty members spent time in the lab working with students who were in the lab. Which meant, that students might interact with multiple math faculty, and not just their own class instructor. Scheduled classes and labs were taking place simultaneously in the same computer lab/classroom. Instead of lectures, the role of the instructor changed to answering questions. Learning was more driven by the students. The classroom had individualized computers, or computer workstations. Students worked on the computer and raised their hands when they had a question. The faculty member answered students' questions as they come up while the students were working through the math module. Students worked at their own pace in the lab. Later, in the semester, the faculty began introducing mini lectures because the students were requesting some formal instructional time to help them move at a better pace. The quizzes were supposed to be done in class with a passcode and were 5% of the final grade. After a couple of days into the Fall 2010 semester, a major class challenge was all the instructors were inputting passcode for about 80% of the class time, which was deemed as ineffective use of class time, so the protocol was change to open quiz in class or at home. The new open quiz protocol tremendously increased students' completion of the quizzes. At first the course was truly self-paced; then in later semesters, deadlines were introduced to encourage students to work at a pace that will help them complete the course in one semester. The original implementation included a written midterm exam of 20 questions that included the first half of the course material and was 18% of the final course grade, and a written cumulative multiple-choice final exam with 30 questions and was 22% of the final course grade. Student surveys were collected at end of term to get input about possible changes to the course, and the feedback impacted the changes in the next semester.

Spring 2011

Feedback from students for more lecture time led to the introduction of some sections to be changed to more 50/50% self-pace/traditional model. Faculty members were moving back to mini traditional lectures. The redesigned Math 24 was 100% self-paced versus the redesign traditional (50/50). Technology was integrated into both the redesigned Math 24 100% self-paced and the redesign traditional (50/50). One instructor introduced assignment deadlines to encourage students to complete and submit work in a timely manner. Due to the introduction of deadlines the about 70% of students completed their work by the due dates. Whereas, before deadlines about 50% of the students were making timely expected progress.

Fall 2011

Individual faculty members were allowed to introduce additional policies; such as "soft" deadlines for assignments, locking the modules, delivery method for quizzes/exams, attendance policies (are not a departmental or institutional level change but just the math faculty talking with each other. Individual instructors made their own changes rather than having a decision made by the whole math department on what needs to be changed for all Math 24 courses. Faculty members eliminated the written midterm as it became an unnecessary obstacle for students to finish the course. The weighted percentage of the final exam changed from 22% to 25% and the module tests change from 45% to 60% of the final grade to adjust for the elimination of the 18% mid-term exam. Hybrid Math 24 was piloted to see if higher success rates in summer term with this model could be extended to regular academic year. The hybrid course included in class lectures and flexible test times where students had a week to take each test in the testing center.

Spring 2012

Math 98 (combined Math 24/25, 6 credits) first piloted in addition to the existing self-paced Math 24 course. Students were only given a credit grade if they finished the entire course.

Fall 2012

Math 98 continued but was redesigned. At the end of the semester, students were given credit for Math 24/25 separately in case they were able to finish only half the content. The department piloted a “no show” policy where students who did not attend class during the first week (without notifying instructor) were dis-enrolled.

Spring 2013

Math 98 expanded to 3 sections. The pilot finished, and Math 98 has not been offered since due to lack of resources.

Fall 2013

The first department online final exam was implemented with 40 online free response questions. Students input answers on computer and faculty members graded handed in written work for partial credit. Final exam changed from 30 multiple choice questions on paper to 40 free response questions online, and the success rate and persistence rate increase by more than 10% each compared to the previous semester.

Spring 2014

A new faculty member was hired to teach some sections of the Math 24. The new faculty was a part-time hired graduate student.

Fall 2014

No changes occurred.

Explanatory Analysis of Qualitative and Quantitative Data

Each semester’s quantitative data were examined and compared with the corresponding semester’s qualitative data to establish any interrelationships. In Spring 2011 when Hybrid Math 24 was introduced, the success rate of the Hybrid mathematics was 66.67% compared to 58.16% for the redesigned mathematics. The success rate of the hybrid mathematics course was always higher than the success rate of the redesigned mathematics course, except for Fall 2013. Success rate was expected to increase, and it increased in Fall 2011 and Spring 2012, then deceased in Fall 2012 and Spring 2013. For Spring 2012, the success rate increased, and the persistence rate decreased compared to the previous semester. Fall 2012, the hope was to increase success rate, but the success rate decreased, and persistence rate increased compared to the previous semester. For Spring 2014, the semester the new faculty member was hired to teach Math 24 the success rate and persistence rates dropped to the lowest. The decrease in success rate and persistence rate might be attributed to the new faculty having to learn and adjust to the new instructional and pedagogical ways of teaching in the redesign math course. For Fall 2014, there were no changes to the course, however, both the success and persistence rates increased compared to the previous semester. The increase in rates could be due to each individual faculty reflection on how to enhance their craft and student success outcomes.

In Fall 2013, when the paper final exam changed, the hybrid mathematics course had a lower success rate than the resigned mathematics course. Each semester, the success rate of the redesigned mathematics course ranged from 39.66% to 59.45%. There were no substantial change or consistent change in success rate for the redesigned mathematics course that resulted as a change in the course over time. However, from Fall 2011 to Spring 2013, the hybrid mathematics course success rate ranged from 80.85% to 92.11% and was significantly higher that the redesigned mathematics course. In Fall 2011 the final exam changed from having a course weight of 22% to 25% and the module tests change from a course weight of 45% to 60% of the final grade to adjust for the elimination of the 18% mid-term exam. For similar semesters, the redesigned mathematics course persistence rates were always significantly higher than that of the hybrid mathematics course. The persistence rate for both the redesigned and the hybrid courses did not reach the college expected outcome persistence rate of 75%.

Attendance for the first and last 3 weeks of the course was higher than the rest of the semester. After students get accustomed to the self-paced mode of the course the absenteeism increased, and many students fell behind on their course work. However, many of the students showed up the last 3 weeks of the course, power through the course work, and successfully completed the course. The self-paced course allowed for students to catch-up with their work without any grading penalty or decrease in scores. However, some students who put-off doing their work until later and might have given up completing the course because they felt that they could not finish all the course work. Also, these students might have forgotten the earlier material over the many weeks of not doing math which would make it challenging for them to complete the rest of the course material. Due to policy changes, such as, the introduction of assignment deadlines resulted in more students completing and submitting work in a timely manner. The first week "no show" policy where students who did not attend class during the first week (without notifying instructor) were dis-enrolled resulted in lower absenteeism. The policy change from letter grade to a credit or non-credit grade, where students can complete the minimum expected to receive credit, might have had a positive impact on the success rate or number of enrolled students completing the course. One disadvantage might have been that some students who were dis-enrolled might have given-up without a follow-up from the college or giving the change to attend. Due to final exam changing from multiple choice questions to free response questions, where grading allows for partial credit instead of correct or incorrect, resulted in more students successfully completing the course. As such, the policy changes allowed for a lower number of students to retake the final exam, and less students had to complete the course in more than one semester.

Overall, from Fall 2010 – Fall 2014, the plethora of changes to the redesigned developmental mathematics course did not show or coincide with any consistent increase for both student success and persistence rates. The mean success rate for the redesigned mathematics course was 50.24% with success rates fluctuating between 39.66% to 59.45%. The expected course outcome was that success rate would consistently increase increased from 45% to 80%. As of Fall 2014, the persistence rate was 50.52% and the expected outcome was 80%. Neither student success nor persistence consistently increased to meet the course's expected outcomes. As such, the redesigned mathematics course and the changes to course over the semesters did not result in impacting the redesign mathematics course success and persistence rates to reach 80%. Therefore, the expected outcomes for the redesigned mathematics course were not achieved.

Evaluation Question 3 – Qualitative

Evaluation Question 3 was used to examine the academic and environmental strengths of the course from the students' and instructors' perspectives.

For academic strengths the common pre-set categories were curriculum (emerging categories or subcategories: foundational skills, model alignment, and levels of difficulty), resources (emerging categories or subcategories: multimedia, textbooks, MyMathLab, and instructor), assignments & assessments (emerging categories or subcategories: helpful homework/quiz/review, and retake of test). For environmental strengths the common pre-set categories were peer (emerging categories or subcategories: tutors and collaboration), classroom (emerging categories or subcategories: instructor, interaction, course pace, communication, policy and expectations, instruction), and physical (emerging categories or subcategories: computer and setting).

Academic Strengths - Student Perspectives

The academic strengths identify students' perspectives about the traits or factors of the curriculum, assignments, assessments, and math resource that they felt helped them to succeed in Math 24. Math 24 students with different levels of academic performance shared aspects of the course that positively impacted their learning. Recognizing the academic strengths of the course from the students' experiences can help faculty to engage these strengths to enhance student success and improve the academic aspects of the developmental mathematics course.

Student Perspectives on Curriculum Strengths

The subcategories that emerged for the pre-set curriculum category were foundational skills, model alignment, and levels of difficulty. A major academic strength theme was that Math 24 provided the basic foundational skills to prepare students for the next higher-level mathematics course. Math modules were aligned to each other, connected in a manner to build understanding of mathematical concepts, and consistently increased in difficulty of content application and mathematical skills. Word problems and graphs were the most challenging sections. The variations across the groups are that

Focus Groups 1 and 2 perspectives were that the content was basic foundational skills, whereas Focus Groups 3 and 4 that second half of the course with word problems was challenging.

Students found the redesigned developmental math course curriculum material earlier sections to be the foundation for later sections and progresses in difficulty over the semester. The early easier sections of the course prepare students with the content and skills necessary to complete later more difficult sections of the curriculum. Students mentioned that "the course is very basic. The curriculum was fairly easy in the beginning." (Focus Group 1, Participant B) "I feel the course is very basic. It is the foundations of math that prepares you for the higher levels." (Focus Group 2, Participant C) The earlier math content was easier to comprehend and solve because of the basic foundational material, such as real number system, inequalities, and expressions. The basic foundational material prepared the students with the mathematical skills to learn the more difficult content. "You use one in the other and you just keep learning. In the beginning it was pretty easy and around the end it got really difficult." (Focus Group 4, Participant D) The modules are aligned, and the topics are mathematical connected to improve student mathematics proficiency. Word problems integrate multiple mathematical concepts and engage many problem-solving skills. "The modules are aligned, so what you learn in module 1 helps in module 2." (Focus Group 3, Participant B) "Math 24 does include word problems, and it was pretty difficult." (Focus Group 3, Participant A) The self-pace aspect of the curriculum was easy to follow. Students mentioned "I believe that self-paced is very much on your own and it is selfexplanatory." (Focus Group 2, Participant B) Students were expected to be independent learning where the instructor facilitates the learning of the content and students seek their help and guidance as they progress in the course.

However, the variations were that Focus Group 3 and 4 students found the later content to be challenging, such as word problems and systems of linear equations. The mathematics academic abilities of the students impacted how students felt about the curriculum. Word problems were perceived as more challenging for students who were experiencing difficulties with the first section of the course. While students like the self-paced model, Focus Group 4 students found pacing more challenging for them to keep-up abreast with the other students in the class on completion of the course work. Overall, students found the curriculum to enhance their basic foundational mathematics skills.

Student Perspectives on Resource Strengths

The subcategories that emerged for the pre-set resource category were multimedia, textbooks, MyMathLab, and instructor. A major academic strength theme was that virtual and human resources were both helpful. The videos and online presentations were helpful in learning and reviewing the content. Textbook and e-book were useful as learning tools. Faculty members were helpful when needed to explain how to solve problems that were difficult to understand from using multimedia. MyMathLab platform, such as "Show Me an Example" function was useful to learning how to solve problems. The variations across the groups are that the participants of Focus Groups 1 and 3 found the online resources most helpful, whereas the participants of Focus Groups 2 and 4 found the teacher as an additional helpful resource.

Students from all the focus groups found both the teachers and the online videos and multimedia resources to be helpful. The advantage of the online resources was that it was accessible at any time for students to review their work and refresh their memory. Students mentioned that "the videos were helpful. I actually went back to it and reviewed." (Focus Group 1, Participant A) In additional to the online resources, the instructors were a major resource because they provided one-on-one help tailored to the needs of the students. When students could not comprehend some parts of the online resources, they utilized the expertise of the instructors to get a better understanding of the mathematics problem solving strategies. "The math resources are good including the teacher because she helps you out especially if you need it." (Focus Group 2, Participant A) "I thought it was good with the online and with the teacher in class was good. If you have a question and you cannot figure it out, then they are there to help you with it." (Focus Group 4, Participant A) Both the MyMathLab function "Show Me an Example" and teachers were utilized by students to help solve math problems from all the focus groups. The students had the advantage of learning from the MyMathLab tools and the instructors which provided multiple ways or steps for solving math problems. "In MyMathLab, like "Show Me an Example" function, those are very helpful. If you do not know what you are doing, they can show you an example and they can walk you through it without having a teacher." (Focus Group 3, Participant D) When students were stuck on a question, they mostly utilized the MyMathLab "Show Me an Example" function to make progress.

However, the variations were that some students preferred to view the multimedia videos for help while others prefer to use the MyMathLab program to view the step-by-step solution help. While some students preferred to use the “Show Me an Example” tool to problem solve some students preferred to rely on the instructors to assist them with problem solving. Students utilized the “Show Me an Example” more than the instructors because the tool was instantaneously available whereas the instructors were not always readily available because they were working with other students. Overall, both the instructors and the online MyMathLab resources were useful for the students to learn mathematics.

Student Perspectives on Assignments & Assessment Strengths

The subcategories that emerged for the pre-set assignments & assessments category were helpful homework/quiz/review, and retake of test. A major academic strength theme was that the homework assignments and assessments enhanced mastery. They were helpful tools that provided practice to enhance understanding.

The quizzes were similar to the homework, and both supported mastery of content. Completing the homework problems most times results in passing the quizzes. “The quizzes are very similar to the homework so if you do the homework, you should be able to score very well on your quizzes exams.” (Focus Group 1, Participant D) Multiple redo of quizzes helped with better understanding, mastery, and grades. Each section homework helped with the section quiz. Multiple tries for each homework problem helped with better understanding because it allowed for correction of mistakes. Students used “Show Me an Example” to help them better understand how to solve some of the homework questions. Students could not move onto the module exams, unless they scored 85% or higher on all the quizzes for a module. A score of 85% on the quizzes was used to measured proficiency in the modules. “I like the fact that when you took your quizzes and stuff, you have to get 85% in order to pass and if you did not, you got to redo it for exams.” (Focus Group 2, Participant D) The homework questions had to be 100% completed and correct before students could take the quiz for that homework. Students can redo the questions multiple times until they mastered the mathematical content and skills. Redoing of problems help students to improve their critical thinking and problem-solving skills.   “The strengths I think are doing the homework, even though it is long, it really makes me think.” (Focus Group 4, Participant C) “The homework was easy to learn, and it is easier to answer I have got to say, because it gives you a couple of tries, but sometimes to better understand I use an example and that is how I help myself for exams.” (Focus Group 1, Participant C) Students felt that a quiz per each homework was a reasonable expectation because you learn the content and skills from the homework and then the quiz assessed you understanding and mastery of the content. “I think a quiz per homework was pretty doable considering the fact that you learn one thing and then you straight go into examples for it. It’s kind of helped also.” (Focus Group 4, Participant B)

The quizzes, homework, and module review helped to prepare students for the module tests. The repetition of similar homework questions to reinforce problem solving skills and mastery of content was useful for students. Students found homework, quizzes and module review questions useful to learn and reinforce Math 24 curriculum. “Homework is very helpful because of the repetition you do, and you understand it and then it gets you ready for the quizzes and exams." (Focus Group 2, Participant D) "I like the fact that there is a homework and then it is a review for the quiz and then it is the quiz and exams." (Focus Group 3, Participant C) The solving of the homework questions helped students to pass the quizzes, and together with the module review questions helped student to pass the module tests. Redo of tests to get 70% helped with better understanding, mastery, and grades. Students appreciated the opportunities to redo exams because it allowed for them to get better scores and a better chance at succeeding in Math 24. "If you do the homework, quizzes and module review questions you should be able to score very well on your test." (Focus Group 2, Participant C) "I like the redo of the test because it helped with getting a better grade." (Focus Group 3, Participant C) Studying, solving all the module questions, perseverance skills, and techniques of repetition to remember and reinforce the content were necessary to do well on the assignments and assessment. "The course needs you to strive to actually study and get a better grade exam." (Focus Group 3, Participant D) To pass the course, student had to complete all the homework question and passed all the quizzes and exams. The course setup did not allow for students to skip any of the assignments or assessment.

The variations across the groups were process time and retention of information because Focus Groups 1 participants found the homework helped with passing the quiz, whereas Focus Groups 2 and 3 participants also needed to study, Focus Group 3 participants also needed to do the review, and Focus Group 4 participants needed to take the quiz immediately after homework assignment. Overall, the homework, quizzes, review questions and tests were useful assignment and assessment that helped student to progress successfully in Math 24.

Academic Strengths – Faculty Perspectives

The academic strengths were identified from instructors' perspectives about the features of the curriculum, assignments, assessments, and math resource that they felt helped students to succeed in Math 24. All instructors taught Math 24, and shared aspects of the course that positively impacted student learning. The academic strengths of the course from the instructors' experiences can help faculty to better support student success and improve the academic factors of the developmental mathematics course.

Faculty Perspectives on Curriculum Strengths

The subcategories that emerged for the pre-set curriculum category were flow of topic, foundational skills, technology integration, greater students' responsibility, and content mastery. A major academic strength theme was that the alignment of the basic foundational skills supports learning.

The order of the mathematics topics provided a smooth flow and there was higher student responsibility and mastery of all topic expectations. Content per module provided a foundational understanding of the material. Technology integration with lecture allowed for multiple modes of delivery of content. The integration of course objectives and technology allowed individual instructor the flexibility on how to teach or facilitate the course. The software embedded in the curriculum automatically tracked and analyzed items connected to the course objectives and automatically generated math content problems that allowed students to have more practice.

> The curriculum is adequate, and they can move from building block to building block or modules. I think it is a good sampling of the course objectives that we are trying to look at for the course, MATH 24. The fact that faculty members can cover the material the way they want to cover it and to ensure the students really understand how to do things is the primary strength of the lecture with technology. (Faculty B)

The course placed a greater responsibility on the students to learn, seek help, and complete the work. Students spent more of their own time on the content, instead of attending math lectures and listening to the instructors explain the curriculum. One-on-one help was given when students asked for assistance with the content. With the integration of digital teaching, the mental effort was shifted from the instructors to the students.

> The biggest thing is it puts the responsibility of learning on the student. I think that is the biggest part, it makes them realize that you have to spend time on the course in order to succeed. The fact that we do not spoon feed them the material, they have to access it on their own, they have to ask questions, will help them in future courses, both within college and also outside of college. The ability to realize that you need help and to ask for it is the biggest thing I think that we impart on students. In terms of the learning, depending on the student, sometimes it is good. (Faculty C)

Students had to complete the word problem sections and show some mastery. The similarities amongst the faculty was that the math topic order and the technology were strengths. The order of the content and the MyMathLab program enabled completion and competency as student progressed through the math curriculum. The digital tools supported mastery of all aspects of the curriculum where prerequisites required students to pass sections of the course before they can progress to the next stage.

> There was a major restructuring in the order of topics for self-pace course for smoother flow. As an example, we are aware that word problems are a big hurdle for students, so all of the word problems are towards the end of the course. (Faculty A)

> A huge advantage is word problems section. Previously, students can get away with not meeting the minimum pre-requisites or not mastering specific concept. For example, just the act of solving a word problem. They can skip all the entire problem on the exam and still manage to pass in the old traditional method because everything is weighted. Some students are smart to figure out how much can I get away with, without mastering the word problems and still pass. For the redesigned, they cannot, it has to be mastered with a minimum of about 70%. (Faculty D)

As such, student was required to complete and pass all sections of the course, including the word problem section, to successfully pass the course.

However, the variation is Faculty B emphasized that the primary strength was the lecture with technology. “The lecture with technology, the strength is in its name, the lecture.” (Faculty B) The curriculum step-by-step guide on solving problems was readily available and was only a click away. Overall, learning beyond the classroom with instantaneous access of the curriculum and various opportunities to practices enhanced problem-solving skills and mastery of content.

Faculty Perspectives on Resource Strengths

The subcategories that emerged for the pre-set resource category were computer-assisted instruction, MyMathLab, and feedback. A major academic strength theme was that the virtual or online computer-assisted instruction software, MYMathLab, provided lectures and slide presentations that were accessible from anywhere via a web browser.

The use of MyMathLab provided instruction that was individualized based on students’ needs and students were able to view how-to videos. MyMathLab platform provided applicable resources with specific, and immediate feedback. Students could access the online tutorials anytime from home and college and could review the online lectures multiple times and as needed. The exams and tests were password protected and can only be accessed form a secure college location or a test proctoring system. “For the math resources, the online lectures are available at all times. Students are free to review as much as they want, they also have the PowerPoints.” (Faculty A) “I feel like the online lectures are excellent for when they get home. And they are trying to juggle it in their memories.” (Faculty B) “All the course material is accessible 24-7 by the students, except tests and final exam.” (Faculty D) Content resources allowed for various options on how to problem solve, from looking at examples, viewing lectures on video or slide presentations, or contacting the instructor via e-mail

A variation was Faculty C added that the computer-assisted program MyMathLab could provide immediate feedback to students about their math problem solution, so it is helpful to both students and faculty. “The computer materials like MyMathLab provide immediate feedback to students so they don’t have to always check their work with the instructor. It saves instructor time and student stress.” (Faculty C) Also, the online resources allowed students to be more self-directed learned and do not always depend on the teacher for new learning. Instructors were able to provide more intentional one-on-one support to students.

Faculty Perspectives on Assignments & Assessments Strengths

The subcategories that emerged for the pre-set assignments & assessments category were deadlines, mastery, feedback, portfolio, self-paced, accessibility, ease of use, question pool, data collection, and retake. A major academic strength theme was that retakes of assignments and assessments enhanced mastery of content.

The online tools in MyMathLab assignments and assessments were helpful for both students and instructors. For homework assignment and quiz assessment students received immediate feedback on their performance because the MyMathLab program grades assignments and manages student progress. The assignments & assessments in MyMathLab had a practice environment with a multitude of hints and animation videos. The “Show Me an Example” and the “Help Me Solve It” functions allowed for the students to have immediate help with challenging problems.

> The good thing about MyMathLab, and I feel which is really important, is that students get immediate feedback. That is a huge advantage over giving them textbook assignments. If students are stuck, they are able to click on the Help Me Solve button. They have so many resources at hand within the software. They have the “ask my instructor” button, they have the “help me solve this” button. (Faculty C)

Although the course was self-paced, the “soft deadlines” and more accountability for assignments and modules helped to pace the course on a semester schedule. “We have also had a hybrid style method, which may or may not include soft deadlines for all assignments and modules.” (Faculty A) Homework assignments had to be 100% completed and correct; thus, allowing for mastery of all problem types. In MyMathLab students received immediate feedback and the “Help Me Solve” button and “ask my instructor” button helped with solving problems. Also, they can view the online resources to refresh their memory or learn new problem-solving techniques. They can review the online lectures and the PowerPoints. So, I think that is a huge advantage especially when doing the homework.” (Faculty D) To promote mastery of content, homework questions were allowed for multiple retakes until 100% for all homework assignments were achieved. Portfolio was utilized as a means of authentic assessment and helped with organization and notetaking skills. Student who complete their portfolios performed better on the assignment and assessments. “Students who do the portfolio tend to be the more organized ones who keep the math content and their work organized. The ones that are unorganized who do not write things down on paper or take notes, those are the ones who probably do not make it." (Faculty A) The self-paced courses allowed for students to complete the modules at their own pace and allowed for early completion of the course. The math modules were scaffolded from least difficult to most difficult, and purposeful assignments and assessments fostered constructive cognition and assimilation of information. To promote mastery of content, quiz questions were allowed for multiple retakes until 80% for each quiz were achieved. Quizzes could be taken at home or in class and students could use their notes and or textbooks.

> We have what we now call a self-paced model, which allows students to complete the modules at any time that they are ready. Students have to complete the modules in order. They are not allowed to skip around. As soon as they are finished with all the modules, they can take their final exam early. We do allow retakes for every quiz and every test until they get the minimum score, hence the mastery aspect. As far as the quizzes, they are all taken through MyMathLab. What I see is that it is very convenient for students who are going at their own pace. (Faculty B)

Students could retake each module test until they achieved 80%. Re-takes allowed for students to enhance their comprehension, provided the opportunity for students to perform the best of their abilities, and reduced student anxiety or stress. The online platform allowed for easier collection of tests and exams data. "A lot of students like the fact that they can re-do things. Being able to re-take a test does lower the test anxiety to some extent because it is not high stakes testing anymore." (Faculty D) "Obviously, the data collection becomes a lot easier with an online final." (Faculty C)

For the final exam, students had to retake the exam to score a minimum required score of 70%. The final exam was accumulative, so students had to retain the whole course's content material.

> One of the strengths is the fact of mastery forces them to show that they can do every type of problem we have given them at least once through the entire course. Maybe not retain it for the final but at some point, in that course, they were able to do every objective that we set forth. (Faculty B)

The online question pool allowed for a more secure and easier administering of the module tests and final exams. The MyMathLab program randomized the questions for the assignments and assessments so that each student received a different version of the assignments and assessments, and as such, deterred cheating.

> For testing, it makes security a lot easier to handle. We no longer have to cycle between 3 or 4 versions of a test. You can randomize the problems and randomize the order of a test so that it makes it almost impossible for students to cheat off of each other. We no longer have to worry about students cheating because they are taking finals next to each other and stuff like that. (Faculty C)

The variations were Faculty A felt that students with portfolios were the organized ones and tend to be successful, and the unorganized ones who usually wrote on loose sheets were mostly unsuccessful. Also, the assessments were modified to better fit the needs of the program and better support the students. Initially there was a paper mid-term exam which was later eliminated from the course. The final exam was converted from a paper test to an online final exam for consistency with the assignment and assessments platform.

> We first started with a paper midterm and a paper final. We found that the midterm ended up being more challenging than the final. About a year into it, we eliminated the midterm. Shortly after, we converted the paper final exam to an online final, therefore making it a little fairer to the students since all of their other assignments were online and they felt more comfortable with that. (Faculty C)

Overall, the numerous assignments and assessments fostered students' ability to construct new and retain new knowledge.

Environmental Strengths - Student Perspectives

The environmental strengths identified students' perspectives about the traits and features of the peers, classroom, and the physical setting that they felt fostered their succeed in Math 24. Developmental mathematics students with various levels of academic performance shared aspects of the learning environment that positively impacted their success. Recognizing the environmental strengths of the course from the students' experiences could help to further cultivate a nurturing learning environment to enhance student success in the developmental mathematics course.

Student Perspectives on Peer Strengths

The subcategories that emerged for the pre-set peer category were tutors, and collaboration. The environmental strength theme was that free tutoring helped students with challenging math problems. The tutors were friendly, and students felt comfortable working with them. Peer collaboration and peer mentoring helped students to learn from each other.

Students found the free peer tutoring motivates them to seek additional help with their mathematics. Peer-to-peer collaboration was useful in learning, where the students that were performing better in mathematics mentored the students who were struggling with the mathematics. “All the help like the tutoring that they offer, like the free tutoring.” (Focus Group 2, Participant B) “Yeah, all those extra helps on the side. Yeah, they help. Peers, I think we learned a lot from each other as well.” (Focus Group 3, Participant B)

When students mentor other students, the peer mentor and peer mentee both gained knowledge and skills, and the peer mentor better retained the information by repetition. “For me, if I am teaching somebody a certain step. I mean, how to do math. I would remember it more. I guess it is because I am constantly just repeating it to the other person.” (Focus Group 1, Participant D) Students perception of another person as psychological safe or friendly contributes to whether a peer is deemed approachable or not. Early impression of a tutor being friendly helps students to decide who they preferred to work. Relationship and social emotional factors were critical in fostering successful peer collaboration. “I only go to the friendly tutors because they make me feel better.” (Focus Group 4, Participant B)

The variation was that the participants from Focus Group 1 found mentoring others helpful to remember math, whereas the participants from Focus Groups 2, 3 and 4 preferred to be mentored. Overall, through peer collaboration and mentoring, both the mentor and mentee enhanced their problem-solving skills, collaboration skills, communication skills, and social and emotional learning skills. Students found their peers helpful in mentoring them and peer-to-peer inactions might have enhanced their motivation to learn.

Student Perspectives on Classroom Strengths

The subcategories that emerged for the pre-set classroom category were instructor's tone and body language, interaction, motivation, course pace, communication, policy or expectations, and instruction. A major environmental strength theme was that the instructor helped to make the content more understandable by breaking problems into smaller simpler steps and used visual representations. The instructor's positive and engaging tone helped students to stay focused. The instructor provided one-on-one feedback that was helpful for the students to better comprehend mathematics. Foundational skills from previous classes enhanced student performance and motivation. Self-pacing allowed for students to complete the course at their own pace. Instruction was tailored towards students' needs. Online communication with the faculty members, such as "email my instructor", was a positive means of students receiving quicker feedback via MyMathLab.

Students liked when instructors have an engaging and encouraging attitude because the positive voice tone and one-on-one interaction allowed for a safer learning environment. High quality one-on-one interaction with the instructors was empowering for both the students who were excelling and the struggling students. Encouraging one-on-one interaction with the instructor boosted the intellectual and social capabilities of the learners. Instructors walking around, observing and checking on students, and providing individualized instructional support led to a positive learning environment. “The instructor is very outgoing and positive about the math, so it makes you like want to learn about it instead of someone who is monotone. One-on-one interaction with the instructor, I think was really good.” (Focus Group 1, Participant A) “The biggest strength would be the self-paced, and then the second one would be the instructor coming around to ask us questions and helping us, like the one-on-one kind of thing.” (Focus Group 3, Participant C) The instruction played an instrumental role to create personalized authentic learning and utilized visual stimuli such as diagrams so students could better process and retained information.

> We like the way he is; I guess he is a visual learner. He would draw it out for you on a paper and then he will draw a picture, so you will know what the problem is about, so you can understand it more. That really helps. (Focus Group 4, Participant A)

Online access to the course material and instructor communication tools allows for less of a challenge in connecting with faculty, receiving feedback, and reviewing and completing course material. Students appreciated the self-paced course environment that supported independent learning. Students learned at different rates, and the pedagogical shifts of the self-paced learning environment matched the needs and capabilities of the learners. “I really like the self-pace course. I think since it is self-pace, you go right your own phase and you do not have to wait for anyone else.” (Focus Group 2, Participant D) “The teaching strategy was helpful. The instructor would not really put stuff on the board because everybody was ahead of the proposed schedule, but if we did have questions the instructor would answer it then would teach us." (Focus Group 1, Participant D)

The setup of the developmental course allowed for students to retain foundational mathematics skills that enhance student success and motivation. The classroom and course environment generated self-motivated students that helped overall learning. Multiple modes of communicating with the instructor, such as person-to-person, emails and the MyMathLab tools were advantageous for students because they easily contacted the instructor for assistance and received feedback from the instructors. "Maybe, because I already knew some background and material and I remembered from the previous class. Maybe that is why I performed better and just getting motivated. Being motivated." (Focus Group 2, Participant C) "For me personally I think the biggest strength was probably being able to contact your teachers whenever they could answer. You could either do it in person or online, on email." (Focus Group 4, Participant B)

The policy of getting an incomplete and then finishing the following semester helped financially. Student tuition was waived if they had to continue the Math 24 course in a second semester, and students who were on financial aid expressed that the experienced less stress with no financial liabilities.

> I did not have to pay to continue in the second semester. I think that was good because I was actually so scared. I thought I had to pay again, and I was worried about my financial aid because it would be put on my hold. (Focus Group 2, Participant A)

The variations were that participants from Focus Group 2 students took more than a semester to complete the course and the advantage to continue the course was they did not have to pay extra money for the second semester. The participants from Focus Group 4 appreciated visualizations and authentic learning aided by the instructors. Overall, the classroom environment was conducive to learning mathematics.

Student Perspectives on Physical Setting Strengths

The subcategories that emerged for the pre-set physical category were computers and setting. A major environmental strength was that computers were accessible, and students could borrow laptops from the college for the whole semester. Computers and classroom setup were accessible and convenient for students. The classroom was cool, comfortable, and the setting allows for faculty members to walk around and students to engage with peers.

The students perceived that the number of computer stations were satisfactory, accessible was in a reasonable timeframe, and the physical space setting was comfortable. The assignments were readily available on the computer after students login with their college username and password. Students were able to borrow laptops for a whole term to support them with accessibility to computers at anytime from anywhere. The temperature of the classroom was about 60 Fahrenheit and students found the temperature of the room suitable for their comfort. “The computer and setup are convenient too if you need it for your homework because everything is ready and accessible. I borrowed one of KCC laptops. I had it the whole term.” (Focus Group 1, Participant C) “The setting is fine, the temperature is fine, and they do provide quite a number of stations, so it never seems to be that you have to wait long to be able to get some time on the computer." (Focus Group 4, Participant A) The setting and computers acted as a buffer for peer-to-peer distractions. When students entered the classroom, there were students already working on their mathematics. The environmental setting promoted the expectation for student to engage in their learning tasks. Students had more control over their learning and the computer lab setting minimized talking, side conversations, and noise level.   "There is really no peer-to-peer interaction because it is a lab setting where people go in and do their own work on their own, so it is quiet like a library." (Focus Group 2, participant A) The physical setting of the students learning stations, tables, chairs, and computers supported a learning structure of independent learning, differentiated instructions, and individualized instruction. The physical space and setting allowed for instructors to walk around form student to student and instantly saw what the students were working on form the computers screen. Instructors and mentors walked around assisting students, and monitoring student progress. "Yeah, I did. I think the class setting is good. The teachers, they walked around and asked if we were confused in any of the problems and stuff and if we needed help. I really like the set up." (Focus Group 3, Participant A) "They always have lab monitors there so you always have personal help if you need from an instructor who is volunteering at that lab hour." (Focus Group 3, Participant B)

The variations were that the participants from Focus Groups 1, 2 and 4 appreciated the computer accessibility, and the participants from Focus Group 3 appreciated the extra help from the instructors and lab monitors. Some students found the room too cold, especially in the evening, during rainy weather, and low temperature seasons. “Sometimes I wear a jacket in the night to keep warm.” (Focus Group 4, Participant C) Overall, the computers and setting promoted 21st century learning skills in math literacy.

Environmental Strengths - Faculty Perspectives

The environmental strengths were identified from instructors’ perspectives about the features of peers, classroom, and the physical setting that they felt fostered student success in Math 24. All the instructors used the same learning space to teach Math 24, and shared aspects of the environment that positively impacted student learning. The environmental strengths of the course from the instructors’ experiences could help shape a nurturing learning environment to enhance student success in the developmental mathematics course.

Faculty Perspectives on Peer Strengths

The subcategories that emerged for the pre-set peer category were tutors, and collaboration. A major environmental strength is that the tutors were helpful to students and lighten the demands on the faculty members. Some students preferred to work with tutors because they feel more comfortable. Students were encouraged to get to know their peers and collaborate. Team teaching allowed for students to receive help from multiple faculty members.

Both the students and faculty found tutors to be useful and helpful with students learning math. Students had more ready access and timely assistance with the added help. Tutors helped to lighten the instructional workload of the faculty. “The student tutors were a huge resource, both to the faculty members and the students, because it lightened the workload of faculty members. It put one more body in the room to help students." (Faculty A) The one-on-one instructional strategy of getting help and learning encouraged students to learn to collaborate with their peers and seek help from each other. The different ways and strategies that instructors, tutors, and peers used to explained how to solve a problem had different impact on how student comprehend the explanation. Peer-to-peer explanation seemed to be a popular learning technique with students and was an advantage for both parties because they could speak with each other in student friendly language and terms. "A lot of times the students preferred working with the student tutors because they could explain things a different way than faculty members do." (Faculty B) The students suiting in close proximity to each other cultivated an environmental culture of peer relationship building and collaboration. "I see students in close proximity in the lab and it is crowded, but in a way, it is good, because it forces the students to ask the people next to them for help. They collaborate with each other." (Faculty C) Multiple instructors working together promoted faculty collaboration and team teaching. Student bonded with multiple instructors, and instructors developed better working relationship with each other, and integrated a variety of techniques to best serve the students' learning needs. "The redesigned course is in a way team-teaching. Even though an instructor may have their own class in the lab there is always another instructor in the lab that is helping the students." (Faculty D)

The variations were that Faculty C perceived that students sitting in close proximity to each other promoted peer-to-peer interaction instead of overcrowding personal space. Some students preferred to work with the tutors rather than the instructors because they felt they could comprehend better when the person they were talking to seemed less intimidating. Overall, peers and tutors contributed positively to the learning environment.

Faculty Perspectives on Classroom Strengths

The subcategories that emerged for the pre-set classroom category were instructor's tone and body language, interaction, motivation, course pace, communication, policy/expectations, and instruction. A major environmental strength theme was that faculty-student interaction provided more one-on-one support. Faculty members had humorous and motivational conversations with students. The students worked at the pace that was comfortable for them to make positive progress; especially helpful for students who have limited English proficiency and needed for repetition of the material. Students and faculty members had multiple ways to communicate such as email, text message, asking the instructor a question, and face-to-face questioning. Policy that allowed students to continue and complete the course in multiple semesters and continued from where they left off in the previous semester, was helpful for successful completion of the course and financially beneficial to students. Instead of just lecture, the faculty members were able to analyze data and implemented instructional methods that they felt best helped students to learn.

The redesigned math fostered self-directed learning, and collaboration between instructors, tutors, and peers to promote one-on-one learning. Faculty and student interactions in the classroom were beneficial for students because the teachers were inspired to be more relaxed with the learners. The instructor's tone and body language contributed to a constructive classroom learning environment. Humor and friendly competition were added benefits of the redesigned mathematics course classroom environment. Students developed good peer relationships, learned more about real life, influenced each other study habits, and motivated each other to work harder.

> The interaction between faculty and students is the important aspect of our current redesign which I think is a benefit to students over the before version, and also over online, where interaction is mainly not face-to-face. It makes them relax; I think. I joke with them, so they laugh, and they also feel comfortable with the people who are next to them. When they laugh, it is hard to laugh by yourself, right? Sometimes I make them compete against the neighbor. I say look at her she is one module ahead of you. So, I feel like they learn from each other about life too, not just about math and about studying habits and work attitudes. (Faculty A)

The self-paced classroom environment enabled students to work at their comfort level until they mastered the material. The computers and digital tool permitted students to take screenshots and photos of their works on challenging problems and emailed the images to get targeted explanation and guidance. The digital technology classroom environment supported communication and learning.

> It allows students to go as fast or as slow as they can go. Also, for English as second language, they need to hear it many, many times. Students take pictures of their work and send it to me/instructor where they will ask a question. I write the solution on a paper, take a picture and then e-mail or text it back to the students. In that sense, technology has helped. (Faculty B)

The course policy of completing the course in one or more semesters supported a classroom culture of inclusiveness and valued the uniqueness of how individual student learn. Unlike other math college courses, students enrolled in Math 24 and completed more than half of the course in the first semester continued the course for a second semester from where they left off instead of starting for the beginning. The classroom supported multiple semesters to complete the course and motivated the students to successfully complete Math 24 course. "Our policy of allowing students who do not finish the course to return the following semester and continue exactly where they left off is a strength as compared to models before where students had to start all over." (Faculty C) Classroom interaction and reflective practice during instruction between math faculty members increased. The instructors reflected on instructor's interaction, motivational factors, course pace, communication, policies, expectations, and instruction to helped inform their practice and classroom environment. Instructors were relieved that the focus shifted from covering all the math content to ensuring student mastered the content. The self-paced model supported a classroom culture of flexibility to help students to achieve mathematics literacy.

> Doing this redesign allowed us the ability to analyze our individual classes, even within the same semester, and figure out which methods would work best. Faculty members are not tied down by having to cover material through a lecture. They have the ability to do so if they want to but, if something else takes priority, they can do that as well without having to worry about falling behind schedule. The flexibility of this model is probably the biggest benefit. (Faculty D)

The variations were the English language learners had ready access to the course material and can listen to or view the material multiple times to better understand the content and context. The students who struggled the most and did not achieved progress beyond the first half of the course had to retake the course from the beginning. Overall, the positive classroom environment influenced effective teaching strategies and helped students to build their social skills.

Faculty Perspectives on Physical Setting Strengths

The subcategories that emerged for the pre-set physical category were computers and setting. A major environmental theme was that multiple rooms were used to accommodate overflow in the computer lab. Multiple settings allowed for students to have a choice where they felt more comfortable sitting, such as rows of desks with computers and round tables with no computers allowed students to use their own laptops and interacted with faculty members and students.

The physical classroom setup with the computers and seating layout allowed for more flexibly to where a student might feel more comfortable to sit. The access to additional rooms with computers to accommodate overflowing of students helped with high students traffic days. “I feel that it has a different layout. It has the computers that people sit in a row, and there are also people who sit in round tables, so students get to choose what makes them feel comfortable.” (Faculty D) Faculty members from other mathematics courses shared their computer lab space with the Math 24 students when there was an overflow of students. The computer lab next to the Math 24 classroom was a convenient space for overflow and the instructors were very accommodating to the needs of the students. An environment culture of sharing was developed to ensure student access and success. “We have been very fortunate that the faculty members that are using the other room, that is supposed to be our computer lab for the most part, have been very accommodating.” (Faculty A) “The computers and setting are a plus, but on high traffic days we have overflow and struggle to accommodate all student. More lab space would be nice.” (Faculty C)

The variations were that the computer lab setup was a positive, but Faculty C perception was that more designated computer lab space was needed to better accommodate all the students in the redesigned developmental math program. During g overflow, the students that were usually sent to another computer space were the ones who had to take a test because it was less intrusive to the other class and students did not received help during the tests. “When our original room does fill up, we are able to stick a few students over to the other side in order to take their tests or continue working.” (Faculty B) Overall, the computers and physical setting sustained a conductive learning environment for students.

Evaluation Question 4 – Qualitative

Evaluation Question 4 was used to examine the academic and environmental weaknesses of the course from the students’ and instructor’s perspectives.

For academic weaknesses the common pre-set categories were curriculum (emerging categories or subcategories: computer recognized answers, and students’ language skills.), resources (emerging categories or subcategories: multimedia, textbooks, MyMathLab and instructor), assignments & assessments (emerging categories or subcategories: homework and quiz/test questions). For environmental weaknesses the common pre-set categories were peers (emerging categories or subcategories: tutors and collaboration), classroom (emerging categories or subcategories: instructor, interaction, course pace, communication, policy and expectations, and instruction), and physical (emerging categories or subcategories: computer and setting).

Academic Weaknesses – Student Perspectives

The academic weaknesses were identified from students' perspectives about the factors of the curriculum that they felt hindered their success in mathematics. Math 24 students with different levels of academic performance shared aspects of the course that were weaknesses that negatively impacted their learning. Recognizing the academic weaknesses of the course from the students' experiences can help faculty to improve the academic aspects of the developmental mathematics course.

Student perspectives on Curriculum Weaknesses

The subcategories that emerged for the pre-set curriculum category were computer recognized answers, and students' language skills. A major academic weakness theme was that the computer program MyMathLab only recognized a certain way of inputting the correct answers and sometimes will mark answers incorrect due to typo or formatting errors. Word problems were challenging because students' weak language skills can lead to different interpretation of the words.

The MyMathLab software programming allowed for only specific answers to be marked correct. Typos in the answer resulted in the computer program marking the math solution incorrect, and as such was an added frustration for students because it involved student thinking that they solved the problem incorrectly and self-doubt. Students mentioned that "even if you mistakenly put a semi-colon instead of a comma or put a and equivalent decimal instead of a fraction it marks it incorrect." (Focus Group 1, Participant A) The MyMathLab program do not identify for the students that there was a type and not a procedural error. Also, trying to resolve the problem was time consuming and can retard student progress. Students would attempt to redo the problems that the computer marked incorrectly, and tweaked answers, and even tried incorrect ways to resolve the problem. After multiple redone, students experienced frustration, felt embarrassed that they cannot solve the problem, and only to later found out that that their answer only had a typo. Students found the exact formatting with inputting of solutions and answers was a weakness of the computer programming that recognized answers.

> It is very frustrating, actually. It does kind of make you think in a sense like, Oh, what did I do wrong? But when you look at it you do not physically see anything wrong and so you think to yourself, wait a minute, I have done this right, I have done this about three times already, but I still do not see what the exact problem is. It is kind of, I want to say it is, very demeaning. (Focus Group 2, Participant A)

Students disliked that the computer program only recognized one exact correct answer that was coded into the computer software. Student thought the formatting of the answers on MyMathLab wasted valuable student learning time; especially if the typo was an extra space after a decimal or the inputted answer was an equivalent fraction versus a decimal. "I didn't like that the computer only recognized a certain format of answer. It added stress and waste of time to figure out that you inputted the answer differently."

(Focus Group 3, Participant B) Student found the wording of the word problems to be a challenge because their understanding of English does not compliment their comprehension of mathematics English. Students would read the work problem and because of their limited English abilities would not understand what the problem required then to do. “It is horrible the word problems. I do not know, but you guys need to have some sort of Saturday event, where you guys go over the word problems because my English and their English are two different things.” (Focus Group 4, Participant A) Student inability to comprehend the English Language of the word problems was the first step that students got stuck on and was a limitation to students’ ability to progress.

The variations were that while MyMathLab was a useful tool it had many limitations and hindered progress. Some students’ initial limitation was not their mathematics skills but the inability to comprehend the English language used in crafting the word problems. Overall, the computer program recognition of specific answers, and students’ language skills in interpreting word problems were the main weakness of the Math 24 curriculum.

Student Perspectives on Resource Weaknesses

The subcategories that emerged for the pre-set resources’ category were multimedia, textbooks, MyMathLab, and instructor. A major academic weakness was the online MyMathLab access issues. Students needed a credit card to purchase the online access code for MyMathLab and not all student had one. Visually, having all the textbook material electronically was a challenge for some students who preferred hardcopies of course material. For emailing the instructor, the keyboard was not math symbol compatible. The computer program, MyMathLab, would crash. The videos and PowerPoints overelaborated the steps to solving problems. Computer platform allowed for distractions from math resources by social media and games. For the instructional materials and resources, they were sequential, and some faculty members placed prerequisites and would not allow early access.

For the MyMathLab, student has a 15-day trial period, after that they had to purchase access with a credit card. Many students did not have a personal credit card and had to rely on friends, parents, peers, and colleagues to get a credit card to pay for MyMathLab access. “After the trial period MyMathLab locked me out. I had to wait and use my roommate’s credit card to purchase the online access code.” (Focus Group 4. Participant B) The students found multiple challenges with moving ahead if they do not pass the quizzes and tests. Completing a section successfully is the prerequisite for access to the next section and can prevent further progress. The prerequisites to move on to the next section blocked students from accessing the multimedia material and videos. If students were stuck on a single problem and could not move onto the next section but wanted to view the videos for the next section to better prepare to make progress they could not and so blocked access hindered progress and increased students’ frustration.

> When it did not meet my expectations was, I expected to be able to go to online videos and they were locked. That was my biggest thing. I am not asking for the quizzes and the tests. I need the videos. Even the Instructor was telling me, "Oh, you are ahead of the class. You were already taught that. This is building you up to that." I am going, "Yeah, but dude I am hanging here." I am trying to do the math

> and here you want to change the way I was taught, and I do not get you because you are starting off with the first step and I am on seven. Yeah. Like you are learning backward. (Focus Group 1, Participant C)

The resources material, such as the lecture video explanation can be too detail oriented, more difficult to comprehend, and time consuming. “Sometimes the videos are a little funky in the way they are describing things. It is like 100 steps and you only do 20.” (Focus Group 2, Participant A) The computer keyboard was limiting because it did not have math symbols, so students had to learn alternative ways of how to type math symbols in their solutions. “That is handicapped because you do not have math keyboard. You cannot do square root. You cannot do exponents on the keyboard.” (Focus Group 3, Participant D) Working online can pose as a distraction for students because they have ready access to social media and games which can hinder progress. “You are on a computer and there is a lot of different loopholes that you can create. Say you want to go on Facebook, or you want to go on some video game.” (Focus Group 4, Participant D) More computer aided learning and limited instructor access posed a challenged for students who were more the auditory learners and who learned best from instructors and lectures. Some students preferred direct ono-on-one instructor help rather than emailing the instructor. Waiting for email responses from instructors was limited in the problem-solving explanation because there was only so much mathematics one could write via an email. Many visual aspects of mathematics could not be captured via emails.

> It was harder actually, because you were not actually visually seeing everything. Sometimes in the classroom where you could see everything, and you could see the

> whole process, whereas the computer only shortcut it a little bit to the point where it was just the formula itself. There was no process or steps involved. You have to email the instructor for help. (Focus Group 2, Participant B)

The variations were MyMathLab access involved a paid subscription and was a challenge for some students to pay by credit card and some students preferred hardcopies instead of electronic copies of the course material. Also, some students preferred the instructor's help, and some preferred the digital tools. Overall, the multimedia, textbooks, MyMathLab, and instructor had some limitations as academic resources.

Student Perspectives on Assignment & Assessment Weaknesses

The subcategories that emerged for the pre-set assignments & assessments category was homework and quiz/test questions. A major academic weakness was many long and redundant homework questions, answers must be exactly as programmed in the software, guessing when taking quiz, and final exam questions did not align with the module assignments. The instructor created homework problems but did not have examples to assist students. Other people can complete your homework and quizzes because they were not password protected. If the question asked for the answer in fractions and an equivalent decimal was inputted, it was graded as incorrect. The test questions were way different than the homework and some were not aligned to the module material. Each test had to be retaken until a student scored 75%. The final exam was accumulative.

The students found assignments to have many redundant questions and were time consuming. Students felt that even when they understood how to solve certain math problem types the MyMathLab program continued to give them similar problems to solve and the repetition of problems added to their frustration. "What I did not like was sometimes the questions were really long and it is more redundant. Even if you already understand, it just keeps asking you for more, just like a lot of work, tedious." (Focus Group 1, Participant B) Guessing answers and looking for answer patterns prevented mastery of content. The final exam questions were not aligned with the module assignments and instructor created homework questions were limiting because there was no built-in help to solve. The MyMathLab only recognized the exact answer that is programmed into the software and any deviation from the exact format or typos will results in incorrect answers and lower score. The software limitation was frustrating, time consuming for students and prevented progress because they have to retake the exams until they scored 75% even if they scored 74% and had the correct solution with the answer inputted with a typo or incorrect format.

> They want the exact answer. They want exactly, parenthesis, number, comma. They do not tell you; you forgot the negative. Yeah, but I end up doing it 40 different ways and then I am all messed up by the stupid negative sign. If you have a half and you put a point five and you swap it for half, you get it wrong. It is that frustrating. (Focus Group 4, Participant D)

Student felt they failed because they were too many problems on each homework set. One section in a module had approximately 60 homework questions and each module composed of about six homework sets. Students had to scored 100% on the homework problems before they can proceed to the quiz. Some students were stuck on some problems and had to solve each of the problems for more than ten times, so they lost motivation because they were guessing instead of seeking help and were falling behind in their progress.

> I failed because there were too many problems, sometimes like 60 and you have to have 100% correct before you can take the quiz and the quiz was like 85 or 90% to move on, that is like 2 questions wrong and you have to retake, I retake like 11 times, I keep guessing because sometimes you don't know that it is like a typo or the they a fraction. I keep getting it wrong, so I got discourage and gave up. (Focus Group 4, Participant C)

There was an honor system for completing assignments and quizzes at college or home. However, other people could complete them because there was no way to track which person completed the assignment.

> For me, the reason why I did not pass Math 24 in the beginning is because I would pay my sister to do my homework for me. That is the reason why I could not really remember all the stuff. Yes, it was just to finish it. It was just to finish, but not to understand. Five bucks for a chapter- she got better. Way better. (Focus Group 3, Participant D)

Students felt that their performance on the final exam was worse than that of the homework and quiz/test because the final exam questions were not similar to the rest of the course assignments and assessment questions. "The final exam is so different than the rest of the work, so I keep doing bad on it." (Focus Group 3, Participant A)

> I wish that some of the instructions or questions that was on the test had a little bit more to do with what was on the homework. The challenges would be re-taking the module test because you have to pass within a 75%. (Focus Group 3, Participant C)

The final module was composed of mostly word problems and student found it difficult o make timely progress because they felt that the final module was different that the rest of the course. For the teacher made questions that were created and imputed by the instructors, there were no digital tools, such as "Help me Solve", so students relied on the instructors and tutors. The word problems and more dependence on the personnel for help with the last module was viewed by students as a weakness in the course the digital assignments and assessments.

> On the last module it was more word problems. That was the difficult part. In the homework you could not really help yourself. You had to go back, and go back to the question again, because there were no examples shown. The questions, I think were instructor made, so I had to ask the teachers. (Focus Group 2, Participant D)

The accumulative final exam was seemed as a tremendous struggle for students because they had to remember a tremendous amount of material and also inputted the answer correctly into the MyMathLab program. Although students mastered and passed previous sections, retaining the information for the final exam and passing the final exam was a challenge and posed as a barrier to successfully completing the course.

> I think that would be the challenging part where you have to read through it over and over until you actually pass. The final exam for me is hard for me. Even

> though I obviously have passed every section, it is the amount that is covered in the semester. I know that it is something that students seem to stress out about. Because they have already tested on all of these things, but then to have to recall at the very end a whole semester's worth of material. (Focus Group 2, Participant C)

The variations were while the assignments were readily available online, there were no accountability on who was completing the task. Unlike paper and pen math work, where the instructor might recognize the student's handwriting, there is nothing to track who is competing the online assignments when they are done outside of class. The final exam was perceived as being different and not aligned to rest of the course. Overall, the digital curriculum was more work for the students than a regular face-to-face class. The assignments and assessments were overwhelming to complete and time consuming.

Academic Weaknesses – Faculty Perspectives

The academic weaknesses were identified from instructors' perspectives about the features of the curriculum, assignments, assessments, and math resource that they felt hindered student succeed in Math 24. All instructors taught Math 24, and shared aspects of the course that undesirably impacted student learning. The academic weaknesses of the course from the instructors' experiences can help faculty to identify areas that might improve the academic factors of the developmental mathematics course.

Faculty Perspectives on Curriculum Weaknesses

The subcategories that emerged for the pre-set curriculum category were foundational skills, technology integration, and content mastery. A major academic weakness theme was lack of mastery of process and connection to real life. Math classes after developmental math required paper submission of work and showing mastery of process in solving problems, and students lack that foundational skill. The computer modules mostly asked for final answers. Students have a difficult time connecting the content to their real-life.

The faculty believed that students needed to understand the practical relevance of what they are learning, and that there should be more real-life examples integrated into the curriculum. The andragogical approach and relevance of the curriculum to the life of the student was lacking so students could not make connections especially with the word problems.

> The needs of people from different degrees I think are the people who manage the content and go, “what does this have to do with my life?” They just do it to get through the school. I think the problems can be more related to life. Like “train traveling east versus west, what is the total traveling time?” is not a type of life questions we will encounter so towards their degree or towards their life, I think we can certainly make it more relevant to their life. They do not see any connection to their live. (Faculty B)

The computer-based work may take away from the value of solving problems since the students are not expected to write down and master procedures. Students do not have study skills and faculty are not sure if students are really progressing. Digital learning and MyMathLab had its limitations, especially lacking were pedagogical approaches that required writing and solving a problem by showing all the steps and thus limited the development of the students' note taking skills. The implication of all digital learning for Math 24, was that students lacked the accountability of turning in paperwork and how to structure answers for someone else to understand what was written. "The downside, I hear, that most often carry to the next class is the lack of showing process because they do not have to previous turn in as many papers." (Faculty A)

> Another weakness is establishing stronger study skills. For example, note taking. That's basically an expectation in college, especially… I know we're supposed to help students build that up so that when they move on to Math103 or Math100 they would have that. In self-paced, it's not emphasized. (Faculty C)

> In the future math classes, the professors are saying that they don't know where the student is coming from. We don't have hard core evidence that's actually causing them to provide less procedures, but they do say in their classes there are some students who don't show process. They don't know if they are coming from our class. Maybe getting used to hitting buttons on the computer makes them think that's what math is. They don't have to write that down; they don't have to write procedure down. It's kind of like the subconscious message we are sending to students. This is what math is about, you know, hitting buttons on the computer instead of as a way of communication to write down what you think. (Faculty D)

The variations were while students completed the work on the computer and enhance their skills on MyMathLab, they are gaining limited or no notetaking and problem-solving skills on paper which was needed for the higher-level math courses. While the developmental mathematics course was to prepare students with foundational skills for multiple college academic programs, many students could not see the relevance to their lives or future studies. Overall, the curriculum lacked contextualization of mathematics to students' lives.

Faculty Perspectives on Resource Weaknesses

The subcategories that emerged for the pre-set resource category were computer-assisted instruction, and MyMathLab. A major academic weakness theme was that the instructor's explanation and the multimedia's explanation differ. MyMathLab website and software was down for one week.

The faculty felt that some of the multimedia tools were not the best teaching material because they posed to be challenging for students to comprehend. The explanations in the presentations and videos were too long, and the problem-solving techniques were not the most effective for learning mathematics. "Some of the explanations provided in the multi-media tools, the online presentations, and the video lectures, are not quite with the techniques that we, as faculty members, like to use. We have alternate ways of doing certain procedures." (Faculty A) The online textbook, provided by the publisher, material was not fully aligned to the modules in MyMathLab. "The academic resources we currently use, which is provided through our publishing, which is linked to our textbook, is not exactly where I want it to be." (Faculty B) The instructional strategies and problem-solving techniques for MyMathLab problems and examples in the videos and presentations were confusing for students. To help student to better understand and illuminate confuse, the instructors had to reteach many examples with different techniques that were easier for the student to better comprehend. "New examples don't agree with the way they are showing to do the problem and students will ask questions and that's where my role is where their method is not understandable, they can ask a question in class." (Faculty D)

There software website downtimes and updates were inconvenient and set students back on their progress. "This past semester, we had an issue with the software itself. The website was down for about a week, which really hurt our students because they were not able to make any progress." (Faculty C)

The variation was that while the online lectures and videos are useful tools, the explanation of problems are not always the same as the classroom instructors' explanations and can lead to more problem-solving confusions for students. Overall, the instructor and their instructional strategies bridged the gap between the MyMathLab program and student comprehension.

Faculty Perspectives on Assignment & Assessment Weaknesses

The subcategories that emerged for the pre-set assignments & assessments category was mastery and final exam. A major academic weakness theme was lack of mastery because students memorized answers from previous problems. Students do not analyze the problem, and just guess the answer. students can imitate the problem-solving procedure without understanding. Some students can pass module assessments without understanding and mastery. the final exam stresses the procedure or method for solving the problem. Students are expected to remember all methods to solve problems.

The faculty felt that the students are memorizing steps and answers instead of understanding the procedure and application. The lack of procedural and conceptual fluency will be a barrier for students in their next higher-level math course. Students looked for patterns and memorized them and used the similar patterns to successfully complete the assignment. While students were able to complete the assignments and assessments, instructors were not sure whether the students actually comprehended the material and truly mastered the problem-solving skills or was the success due to rote memorization. “I think I mentioned before that sometimes students take to memorization.” (Faculty A)

> They do the repetitiveness, but they are not seeing why to do things. They are just saying, okay here is the problem type I am give, this is how you solve it. I just do that every time I see a problem like this, which is dangerous for the next level of math where they need to really understand, be able to look at a situation, analyze what to do, and then apply the correct technique. Any instructor will say, even if they are not learning it the way you want them to learn it, can they do the problem. (Faculty B)

They were some students who passed the course, but the instructor doubted where the students understood the content or were the students abled to mimic the material in MyMathLab and successfully completed the assignments and assessments. The computer automatically graded most of the assignments and assessments so many questions were raised whether the student guest or actually mastered the work.

> They are basically very, very, similar to the homework questions. Sometimes just the number changes but I am actually quite surprised how students can imitate the procedure without understanding. That, to me, personally, is not possible for me. I

> have to show ten steps, you know, following ten steps. I have to know what I am doing but the students are surprisingly able to mimic the procedure without knowing exactly what is going on. So, I am surprised at certain students who can pass certain modules without understanding what happens. That is another downside of the computer component, but that is a small percentage of the students. Not a very big percentage. I would say probably about 5% of the students. (Faculty C)

The final exam was specific to what technique a student should use to solve systems of equations problems. Faculty had personal preferences about the final exam and did not agree on the content of the exam.

> The final exam sometimes is an issue, mainly because there are certain things that I personally do not necessarily agree are necessary. For example, the stressing of one procedure for solving a system of linear equations, I do not personally agree that they have to know both methods. It is nice that they do. I would be fine if that was just simplified to a student being able to solve a system, not that they have to solve it by substitution, or they have to solve it by elimination. (Faculty D)

The variations were that while the MyMathLab platform allowed for completion of math assignments, students tend to try to complete the problems rather than to understand and master their analytical skills. Also, faculty did not agree on the content and some of the expectations of the final exam. Overall, the faculty felt that the assignments & assessments were limiting in ensuring mastery of content and skills. The final exam stressed specific techniques instead of allowing students to utilize whichever technique they wanted to use.

Environmental Weaknesses – Student Perspectives

Student Perspectives on Peer Weaknesses

The environmental weaknesses identified students' perspectives about the features of the peers, classroom, and the physical setting that they felt hindered their succeed in Math 24. Developmental mathematics students with various levels of academic performance shared aspects of the learning environment that negatively impacted their success. Recognizing the academic weaknesses of the course from the students' experiences can help faculty to improve the environmental aspects of the developmental mathematics course to better support students.

The subcategories that emerged for the pre-set peer category were tutors, and collaboration. A major environmental weakness theme was tutors and they were not always available. There was long wait time for tutor help. Some students disliked some tutors. Some peers were not interactive. Some peers attended class late and often engage in distracting conversations.

The students thought that there should be more interaction with the faculty, tutors, and between students, during class time. Students felt that some of their peers were focused on their computer screen and did not interact with the other students. The computer acted as a barrier to peer-to-peer interaction. "My peers I definitely think there was not as much interaction as I thought there would be. As far as peer collaboration, most people got their face in their screen, so we not really interacting." (Focus Group 1, Participant B) In class help was difficult to get since faculty and tutors were always busy help students with one-on-one support. As the modules became more difficult, the instructors and all the tutors were always busy, and students waited for long period of time for one-on-one help. Especially for students who needed help with every section, long wait time for help was frustrating and led to students losing focus on their work.

> Just like when it gets harder, more people are going to have more questions and then our class was an hour long, if you need help with almost every question that is on the module, it is hard for this one person to be going around doing all of that and being able to get to everybody. I feel like that is one of the reasons why some people will fall behind, so it is like they do not have enough time for me, and I am just going to have to deal with it. (Focus Group 4, Participant C)

Frequently, students resorted to external classroom help from some of the college's volunteered tutors because they did not get an opportunity receive help while in class. Volunteered tutors were not always readily available which led to more frustration for the students. Also, if students did not like a tutor's personality then it was a deterrence for the student from seeking help.

> Then you got to go to the tutors upstairs at Subway and wait to be helped. Sometimes, I luck out and they are free and available. But sometimes, even the tutors they have up there, they could not help because I did not like the tutor. (Focus Group 2, Participant B)

Students were distracted and frustrated when their peers showed up late to class and were noisy settling down. Students engaged in some side conversations that had nothing to do with mathematics or the course were annoying to their peers and perceived as disrespectful.

> Another weakness is I think time wise because some students will come in late. I mean, like, Okay, well, it is 8:10." and then at 8:15, he will come in. They are bothersome because you would sit down, everybody just talking not about Math but about, "Oh, last night this and covers like," oh, my god, it was crazy. (Focus Group 3, Participant B)

One-on-one collaboration was not sufficient, and the strict or less friendly personally of a tutor was a deterrent for students.

The variations were that students' feelings of dislike about some tutors would prevent them from seeking help. When students needed help with many math problems, they tend be discouraged from asking for in-class assistance because they felt it might take the whole class period just to help one person. Overall, for both collaboration and tutors, sufficient classroom help was not available and limited many students form making more timely progress.

Student Perspectives on Classroom Weaknesses

The subcategories that emerged for the pre-set peer category classroom were instructor's body language, interaction, motivation, course pace, communication, policy/expectations, and instruction. A major environmental weakness theme was some students that there was a lack faculty empathy. Students feared some faculty members because they look intense. Some students felt some faculty members did not care and that some instructor's instructional strategies were not effective. The expectations were not high enough for some students and the self-pace allowed for students to put off their work and fall behind on their work. Module 10 was very time consuming.

The students felt that some faculty did not care, and that the social and emotional aspects of learning were lacking which can hinder student engagement. The empathy aspect towards students was lacking from some of the instructors. Varying communication and interaction factors, such as instructor being distracted, and the students' perception of the instructor's intense body language, stern tone, and lack of care negatively impacted student motivation. "He gave me that weird feeling like he did not want to be there. I did not get that warm fuzzy feeling, like he did not care." (Focus Group 3, Participant D)

> He drew his attention to something else. It was like he was always in a hurry to get done, whereas she was there, and she was over your shoulder looking at what you were doing like a hawk. She was kind of scary though. She is very intense. (Focus Group 1, Participant C)

Some students expected a more traditional instructional approach. The self-paced course allowed for many students to procrastinate. Students put of completing their course work because there were no set deadlines. Time management for many students was a challenge because of the course's policy of soft or no deadlines, and the flexibility to complete the course in more than one semester. Due to the course policies, many students lacked the urgency to complete their tasks early, rather they resorted to completing the work later.

> Me, coming from military, five years in school, I kind of need to catchup. So, I expected more. I just expected more learning base like lecture, communication, organization of skills. I thought it was going to be more like a strict kind of teaching at a college because it just seems like high school. It is on your own pace, so we put it off and say, "Oh, we will do it afterwards," or, "We will do it later." As time catches up on you it tends to - the deadlines really start to push in and things get - tests and quizzes and modules start – you are kind of getting behind on it. (Focus Group 4, Participant A)

The variations were that some students perceived the instructors disinterested in what they were doing as a lack of empathy or caring, while other students perceived the instructors interested in what they were doing by hovering over the shoulder as scary. Also, a student who was taking the course for the second semester felt that the first semester instructor's instructional strategies were not as effective as the instructor's instructional strategies form the second semester. "The instructional strategy my previous Math 24 teacher used was not very effective. The instructor does not care a heck on what the students were doing and what they are stuck on and how long." (Focus Group 2, Participant A) Overall, the classroom environment had multiple factors that were perceived negatively by students. Factors such as body language, peer and instructor interactions, course pacing, policies, expectations, and instructional strategies when perceived as negative hindered motivation, communication, and progress.

Student Perspectives on the Physical Setting Weaknesses

The subcategories that emerged for the pre-set physical category were computers and setting. A major environmental weakness theme was limited classroom space. The classroom usually gets very crowed. Computer keyboard did not allow for much room for students to open their books. Depending on which computer was available, students sit next to different people.

> The students felt that the computer and keyboard took up much of the desk space, and as such, made it difficult to use a textbook, or use a notebook to write things down. The desk space with the computer and keyboard felt overcrowded.
>
> I guess when it started getting more difficult, the classrooms are getting more and more crowded. You had to put a keyboard on there too. So, it does not allow enough room to put a book there and open it. You have to put them under the table. (Focus Group 1, Participant D)

Random seating made it difficult to get to know other students and thus limited peer helping each other. Students felts that random seating did not support relationship building to the level where one felt comfortable to seek help for the other person sitting next to them.

> Everyone is sitting down at the computer working and then you have to find an open seat and it is awkward because you are sitting next to somebody you never really talked to or seen before. It is just that barrier. In a classroom setting, you would sit next to the same person and it is a lot easier to ask the person that you sit next to all the time. (Focus Group 2, Participant D)

The number of computers in the classroom were limited. There was about 50 computers in one room that accommodated a class of about 20 to 30 students, and about 20-30 walk-in students doing their math lab hours. “As far as the classroom goes, I think I probably would put more computers in there. Sometimes you come in at certain times of the day to go lab and there are not enough spaces.” (Focus Group 3, Participant C) During peak hours, the classroom physical space and setting lacked the capacity to accommodate all the student needing to work, and many students were turned away. To accommodate all students, there was a need for more spaces in the computer labs, and a need to extend hours of operation. The computer labs were not always opened, and some days the hours of operation were shorter, especially on Fridays.

> The labs are not always open, maybe they could extend the lab hours. I did hear about Friday’s students are wishing there were longer hours for Fridays. The computer lab, the one downstairs where they had that big room. They started shutting the doors on that one. I was going, this is nuts. (Focus Group 3, Participant B)
>
> There was lab while with class. If you did not come at a certain off-peak time like late evenings, you have to look for other options. They would have their half lab, half for the classroom but it would just be scrunched in spaces. (Focus Group 4, Participant D)

The variations were that the classroom was not always overcrowded. especially in the late evening. There were peak and off-peak times when students used the classroom computers, so the evening students experienced less overcrowding than the day-time students. However, the computer lab hours were more of a challenge for the evening students than the daytime students. Overall, the mathematics classroom capacity was limited and could not accommodate all the Math 24 students.

Environmental Weaknesses – Faculty Perspectives

The environmental weaknesses were identified from instructors' perspectives about the features of peers, classroom, and the physical setting that they felt hindered student success in Math 24. All the instructors used the same learning space to teach Math 24, and shared aspects of the environment that negatively impacted student learning. The environmental weaknesses of the course from the instructors' experiences could help shape a nurturing learning environment to enhance student success in the developmental mathematics course.

Faculty Perspectives on Peer Weaknesses

The subcategories that emerged for the pre-set peer category were tutors, and collaboration. A major environmental weakness theme was tutors. Due to budget cuts, the math program was not able to employ tutors. Some students who were weak in math do not like to collaborate because they feel embarrassed. Working with a computer minimized the time students could spend in collaborative conversations with peers.

Peer-to-peer interaction and social networking was perceived by some of the instructors as a challenge for some students. Instructors found trying to connect peer with peers to enhance interaction was a tricky task because some students felt sacred to speak to other students. "Connecting between peers. Sometimes connecting them is scary to them." (Faculty A)

The student mentors in the classroom were part-time hires and the college needed to allocate funds to pay the student hires. The faculty noted that budget cuts decreased student tutors and limited an important way for students to receive extra help. Also, the student mentors had to have a solid math background so that that were effective in helping students with mathematics. “This past semester we were not able to employ student tutors, because of budget cuts. I felt there was lack of support from the college in terms of peer mentor support. Because that requires a budget.” (Faculty B) “You need to hire qualified students in the first place. They have to be student in status, and you need moneys to pay for their presence there.” (Faculty C) Mathematics was already intimidating for most of the developmental mathematics students, and the intimidating feeling fostered an uncomfortable environment. Many of the students were afraid or lacked courage to discourse with their peer because they wanted to focus on the mathematics. Limited student discourse was exacerbated by the computer setting and the self-paced model. The self-paced course encouraged individualized learning and lacked the healthy group discourse.

> In math class it is already threatening enough. I think it is easier to meet friends in English class. You know, you do not want people to know you are weak in math. You feel like you want to hide when you are in math class and then the computer setting makes it even worse. A healthy discourse really helps clarify a lot of concepts; you know. One to one, or even within the group. I think that is what is severely lacking and the self-pace model. That would be considered the weakness, yeah. (Faculty D)

The variations were that students weak in math might have hidden behind the computer screen and did not seek help from tutors or peers. Limited amount of funds was a barrier to hiring sufficient qualified mathematics mentors to assist with one-on-one mentoring. Overall, the self-paced digital learning lacked healthy emotional and intellectual mathematics groups problem-solving.

and might have led to added frustration and loss of motivation.

Faculty Perspectives on Classroom Weaknesses

The subcategories that emerged for the pre-set peer category classroom were instructor’s tone and body language, interaction, motivation, course pace, communication, policy/expectations, and instruction. A major environmental weakness theme was faculty felt that there was a lack of faculty empathy. Students possibly felt that they should not be bothered an instructor sitting in front of a computer. Faculty members not comfortable with self-paced instruction were easily disengaged. Poor online lectures did not address all learning styles. High absenteeism because students felt “invisible”. Faculty members tended to lose track of students. The self-pace was too flexible, and with limited deadlines, students procrastinated, and fell behind. Students were on their own and sometimes used “trial and error” to get the correct answer. Some students complained because they expected a lecture style culture.

Instructors whose strength was teaching the more traditional lecture style instruction displayed body language and interaction that were not the most suitable for providing one-to-one instruction. The faculty felt that the self-paced style and course expectations caused them to lose track of some students’ progress; especially for the ones that needed the most faculty guidance to keep them on track. Instructors were catch up in providing one-on-one help to their class and the walk-in students, and with the digital tool the accountability shifted from the instructor to the MyMathLab gradebook to keep track of student progress. The self-paced learning diminished the urgency to progress throughout the course in a timely manner. Some students did not show up to class, and towards the end of the semester tried to complete most of course material, and many of the students completed the course in the second semester.

> If you have an instructor who is not suitable for this type of teaching, it is very easy to slack off. It may probably be true in any class, but in these classes sometimes I tend to lose track of students. They just do not show up and they do not respond to e-mail, so I do not know where they are and what they are doing. If they are not progressing, I have no way of contacting them. It is too flexible for them. And these are the students you want to catch. So, they end being part of the third-tier students. They are kind of, “oh shucks I did not finish”, but they learn from their errors and they try to finish it in the next semester. But you know how they need pressure. (Faculty A)

Some instructors sat at the teacher table and was on the computer and waited for students to raise their arms for help. Instructors felt that some students might have perceived instructors on the teacher’s computer as busy and felt that they should not interrupt them for help. The perceive classroom environment of not disturbing the instructor hinders communication, interaction, and motivation. “You could be like sitting around and doing nothing if you feel like that is all you can do, and students feel like they are interrupting your internet surfing time when they raise their hand or ask a question." (Faculty B) The online presentations were limiting in addressing different learning styles. The digital MyMathLab platform was inadequate for differentiated instructional tools for visual and kinesthetic learners. Instructors felt that the online lectures were poorly developed. "Poor online lectures. How we are supposed to be able to address a different learning style and you do not exactly address that, whether you are a visual learner, kinesthetic, auditory, learner, you know." (Faculty C) The computer-based system detracted students from interacting between themselves and between the faculty, and thus prevented the faculty from being able to facilitate the classroom dynamics to reach all students. The re-taking of quizzes until passing prevented students from studying between takes because many students instantly retook and guessed their ways through the quiz. Faculty felt that the students were expecting a more traditional lecture approach.

> There are some semesters that I somehow could not create the dynamic of the group. Like if I am not able to create the student interaction and there is a lot of absence because they feel like they are invisible. The draw back sometimes is, we tend to allow students to work on their own and sometimes they like to be left alone rather than having help. Even though I know they can use the help and you get students who are just taking quizzes instead of studying and then retake the quiz. They keep taking it over and over again, the trial and error method of guessing until they get it, and I hesitate to say that the students are grasping the material well enough to get to the next level. The students were complaining that

> they just sit in front of the computer and click click click? This is not what I paid for. Their expectations were different. They expected a traditional lecture style. (Faculty D)

The variations were that some faculty members felt that some of the other math faculty members lacked empathy and their body language was discouraging for students. The online digital platform was not sufficient to differentiate for all styles of learners. Overall, the classroom learning environment posed many challenges for students and was limited in fostering student motivation and promoting student-to-teacher interaction.

Faculty Perspectives on the Physical Setting Weaknesses

The subcategories that emerged for the pre-set physical category were computers and setting. A major environmental weakness theme was computer maintenance which was time consuming and the access time to the classroom computers was limited. The reliability of the wireless network was inadequate. Students who worked during the day had limited hours to access the computer lab. There is a need for a bigger space, more computers, and lab monitors to best implement the self-paced model.

The faculty felt that the computer lab needed improvement with larger space and more computers to accommodate all students wanting access to a computer, so that students do not waste time waiting for a computer. The wireless internet sometimes went down and the MyMathLab had a site update that led to frustration for both students and instructors and paused in progress and downtime for students. Also, many students used their own laptops, and limited or no Wi-Fi access posed a challenged for the students. “I think they could improve the physical computer lab itself—getting a bigger space, more computers, more lab monitors. The reliability of the wireless also plays an issue sometimes with students." (Faculty B) As I said, with limited computers available for students, a number of our students take to using their laptops during class, which we allow. If they cannot have access to the internet, that becomes an issue." (Faculty C) Maintenance of the computers and Wi-Fi was a huge job that required increased support from the College. One instructor had to both teach and ran maintenance and fixed technical digital issues on all the computers for two classrooms. "Maintaining over 100 computers, if one person is doing, is a full-time position itself I would argue. When the wireless does go down from time-to-time, it does become an issue, something I would like to have looked at." (Faculty A) Students who worked during the day needed a more flexible evening access to the mathematics classroom and instructors to take their tests. Limited evening hours prevented many evening students from making timely positive progress. Student having to take or retake a test on a Friday evening usually get stuck and could not make progress into the next module over the weekend. Student could only proceed to the next module after they passed the previous module test.

> The students who work full-time jobs during the day, they should have access to the lab during the evenings when they can come in and do tests and get help or whatever. To me, that is the purpose of this course is to be able to reach students without having them forced to be in a classroom lecture. They can learn this stuff on their own by whatever means of the dissemination, but we do not have the lab hours in the evening to help these guys, so they are sort of at a loss. (Faculty D)

The variations were the need to consider computer lab access hours that would accommodate students who worked all day. Since many students worked during the day, the computer lab should be open as much as possible during the evenings and if possible, on the weekends. Overall, the environmental weaknesses identified, such as computers and physical setting, were limited in meeting the needs of all learners.

Outcomes Summary

The program evaluation concentrated on developmental mathematics success, retention, and persistence rates. Courses were redesigned and modified to best meet the need of students and to meet academic requirements. The participatory-oriented program evaluation of developmental mathematics examined the outcomes of the redesigned developmental Math 24 course to determine if material, activities, and academic and environmental arrangements that constitute the developmental mathematics program promoted the achievement of the course redesigned objectives.

The findings for Evaluation Question 1, trends in success, retention, and persistence rates for students in the redesigned developmental mathematics course as compared with students in the previous developmental mathematics indicate that there was no consistent change in these rates. The persistence rate or percentage of students who re-enrolled in Math 24 decreased in the initial year of the redesigned course; however, it was consistently higher from Fall 2011 for the redesigned mathematics course compared to the previous developmental mathematics course. The retention rate of Math 24 students enrolled in a higher-level mathematics class in consecutive semesters (fall to spring or spring to fall) for the previous developmental mathematics and the redesigned developmental mathematics course.

Evaluation Question 2 was to track the changes of the developmental course and outcomes (measurable and reportable achievement). At the introduction of the redesigned developmental mathematics course, 100% of the courses were taught through the self-paced model and MyMathLab. Computers were used for delivering instruction and faculty members shared the task of supervising the computer lab. The courses had common curriculum and scheduled classes were conducted simultaneously with computer lab time. During the implementation of the resigned course, ongoing and on-demand changes were introduced. Each instructor started to tailor the course to what was deemed necessary. All the developmental mathematics instructors met, shared their insights and experiences on the challenges of the course, and through their collaborative effort decided on specific changes, such as eliminating the written midterm, and introducing an online departmental final.

The major themes for Evaluation Questions 3 and 4 for the academic and environmental strengths were curriculum alignment, MyMathLab usefulness, assignments and assessments relevance, advantage of retaking tests, positive peer tutors and peer collaboration, and effective classroom and computer setting. The findings from Evaluation Questions 3 and 4 for the academic strengths were that the curriculum modules were aligned and sequentially built foundational skills to prepare students for the next higher-level mathematics. The virtual or electronic and human resources were useful to aid learning, and instant feedback and relevant practice of course problems and enhanced mastery of content and mathematical skills. The environmental strengths were that peer collaboration, tutors, faculty-student interaction, and the physical setting were all valuable in promoting teaching and learning of math.

Similar subcategories that emerged from both faculty and student perspectives for academic strengths were the redesigned mathematics curriculum integrated math foundational skills, the usefulness of the MyMathLab resource, and the advantage of test retakes. For environmental strengths, the common subcategories were peer tutors, peer collaboration, and faculty-student interaction enhanced learning. The instructor's tone and body language, classroom interaction, motivation, course pace, communication, course policy/expectations, and instruction were common subcategories that positively impacted the classroom. Computers and setting were important for the physical classroom.

The major themes for Evaluation Questions 3 and 4 for the academic and environmental weaknesses were English language challenge, online resources manipulation, assessments and lessons not aligned, online and peer distractions, overcrowding of classroom, and time-consuming tasks. The findings from Evaluation Questions 3 and 4 for the academic weaknesses were that the math curriculum could be challenging for students with limited English proficiency, manipulating the online resources and computer could initially be challenging and distracting, assignments were long and time consuming, tests were not aligned to assignments, and many students completed assignment for points instead of mastery. The environmental weaknesses were that peers could be distracting, the faculty members seem disengaged and intimidating, the classroom or computer labs were crowed, internet connection was inadequate, and maintenance of computers was time consuming.

The sub-category that emerged from both faculty members' and students' perspectives for academic weaknesses was the MyMathLab resources. Faculty and students felt that internet connect, and website overload were the main disadvantage of using the MyMathLab resource. Mastery of content emerged as a theme that faculty members and students cited as an academic weakness. Both students and faculty members felt that the curriculum, assignments, and assessments did not help student with mastery of foundational skills for the next math class. Similar subcategories that emerged for environmental weaknesses are instructor's tone and body language, classroom interaction, motivation, course pace, communication, course policy/expectations, and instruction can also negatively impact the classroom. The limited computers and setting of physical space were challenging for both faculty and students. Tutors and instructor-student interaction were the similar themes that emerged from both faculty members and students for environmental weaknesses.

The patterns that emerged were the word problems, and final exam posed the biggest challenges for most students in all focus groups. The challenge with the word problems were related to limited English language comprehension. Final exam challenges were related to the assessments and lessons lacking content alignment. Internet connect and access to computer issues posed the greatest environmental challenge for both faculty and students which were related to the classroom and computer setting. Resource manipulation and time-consuming tasks were related to assignment questions being reductant and assessments not reaching the passing scores because of typos or formatting of the answers was not exactly as programmed in the MyMathLab software. The relationship that emerged from the data is that students in Focus Group 1 and 2 cited more positive academic and environmental aspects of the redesigned mathematics course. Whereas, the students from Focus Groups 3 and 4 cited more weaknesses in the course design. The variations that existed were that the redesigned mathematics course underwent multiple changes over time and inconsistent instructional styles that were impacted by instructors' philosophies of how to teach. Each semester there were a few changes, as such, there were no two semesters where the redesigned course was the same. Individual faculty tweaked policies and expectations best meet the needs and challenges of their students. The many changes and disparity in the results did not allowed for any one factor in the redesigned course to be credited for any higher or lower success rates.

The result of the triangulation of the quantitative data (questions 1 and 2), and qualitative data (questions 2, 3, and 4) suggests that although the redesigned course had many favorable factors integrated to enhance teaching and learning in developmental mathematics, the course still poses many academic and environmental challenges for both students and faculty members. As such, the conclusion is that the redesigned course and continuous changes were not sufficient to achieve the course expected outcomes of student success rate reaching 80% and student persistence rate reaching 80%. There is low internal validity because redesigning the developmental mathematics course might not be the only variable affecting the result.

The review of literature emphasized the need for program evaluation where the results could highlight strengths and weaknesses to inform changes. Program evaluation in educational work focuses on what is worthy to know, provides information that are key to educational improvement, and can present subjective perceptions and practical understanding (Patton, 2008b; Royse, Thyer, & Padgett, 2016; Schwandt & Cash, 2014). The results from the project study supported underlying principles of andragogy and social emotional learning in the theoretical and conceptual framework of adult learning and success in developmental mathematics. Noncognitive factors such as self-efficacy, learning beliefs, anxiety, attitudes, and social and emotional learning have both positive and negative impact on adult student learning (McDonald, 2013).

Instructors who fostered a learning environment of social and cultural diversity could promote congenial student-centered learning and interactions. A culturally responsive pedagogy of high expectations and engaging the strengths of all educators and students fosters a positive classroom culture and climate (Samuels, 2018). Positive outcomes where students were more motivated to seek help, engage in peer collaboration, persevere, and succeed were impacted by the academic and environmental conditions of both students and instructors. The heutagogical approach where the adult learners and educators sustained relevant academic rigor within an environment that promoted collaborative relationship, supported students' individual goals based on interest, and had some levels of flexibility led to the enhancement of students' knowledge, skills, and dispositions (Durkin-Boyle, 2017).

Strategic planning, cumulative decisions, and multiple step-by-step actions aimed at specific learning goal is critical in developmental mathematics redesign. Excessive random changes with many goals can spiral and deter positive results (Cafarella, 2016b). Success can be influenced by many factors such as classroom culture, instructor, instruction, policy, expectation, peers, collaboration, communication, beliefs, values, behaviors, motivation, curriculum, pedagogy, learning tools, and the physical environment. Andragogy and the assumption that adults learn best when they perceive a task or skill to be relevant to their development and centered on the learner's life can enhance self-efficacy, confidence, engagement, persistence, and positive outcomes (T. Allen & Zhang, 2016; M. S. Knowles, 1980; Tinto, 1997).

The content or the difficulty of the mathematical concepts seems to have been more of a secondary factor in learning and success. Factors that affected developmental mathematics students' success, persistence, and retention were primarily influenced by motivation, engagement, positive of inclusiveness, positive mindset towards learning, positive persuasion, and the right attitude. The conceptual and theoretical framework supported the themes that emerged during the data analysis from the academic and environmental weaknesses and strengths data of the project study. Collaboration between learners and educators was positively affected by what students perceived as positive body language and tone of the educator. Course pace, course policy, communication, expectations, instruction, assessment, classroom physical setting, accessibility to computers, resources, and time were factors that affected how students and instructors perceived the developmental mathematics course. Students are more engaged, motivated and develop a sense of community when they forge a more personal connection and collaboration with their peers and instructors (Oubre & Rivers, 2017). Intellectual, social, cultural, environmental, and spiritual elements can impact adult students' attitudes, persistence, and perceptions towards learning (Bandura, 1977; Giannoukos, Besas, Galiropoulos, & Hioctour, 2015; Stuart, Rios-Aguilar, & Deil-Amen, 2014).

Tinto's retention model, Astin's I-E-O model, and Wlodkowski's culturally responsive teaching supports that adults learn best when the environment is conducive to cognitive, social, and emotional learning. Astin's conceptualization establishes that student learning outcomes, intellect, self-efficacy, collaboration, interpersonal relationships and goals are affected by demographic background and experiences (Strayhorn, 2008). The culture of the classroom impacts student engagement, self-efficacy, and motivation to learn. Influential factors for learning math and achieving academic success are a teacher integrating cultural and linguistic backgrounds to bridge discontinuity between academics and real life, and establishing a trusting relationship to enhance learning (Brown & Crippen, 2016).

Students with limited English language skills experienced challenges in deciphering math word problems. Language limitation is a major barrier for mathematical reasoning (Bragg, Herbert, & Loong, 2016). Word problem tasks were not relevant to students because many of the questions had no connection to the student real life. Word problems involve linguistic information to construct meaning and drive complex thinking (Kong & Swanson, 2019). Language challenges compounded with analytical reasoning challenges can impede problem-solving performance.

Innovative classroom setting can promote engagement and learning. However, challenges with online resource manipulation, long solution steps, overcrowding, and long wait time for help can lead to online and peer distractions. Adaption to technology can negatively influence self-efficacy for internet-based teaching and learning (Olson & Appunn, 2017) Time-consuming tasks and misaligned lessons and assessments can deter motivation and persistence.

Student collaboration and relationship directly impact academic success. Students learn from their teachers, peers, and the environment (Wlodkowski & Ginsberg, 2003). Peer mentored students have better college retention. Academic achievement is positively affected with social, environmental, and academic integration, and relates to Tinto's persistence theory and Austin's persistence concept (Collings, Swanson, & Watkins, 2014). Student persistence is shaped by course environment, course relatedness to their life, and the support system.

Conclusion

In Section 2, the methodology of the program evaluation which was a mixed methods case study was presented and discussed. Included in Section 2 are the data, data collection, data analysis, and results of the project study. Information on the participant recruitment, research institution, and the focus group interviews were identified. In Section 3, the project is presented, and in Section 4, reflections and conclusions are discussed. For the program evaluation of the developmental mathematics, an evaluation report was generated.

Section 3: The Project

Introduction

The project study findings were presented in an evaluation report (Appendix A) to enlighten the administrative team and developmental mathematics faculty at KCC about the findings and recommendations of the developmental mathematics program evaluation. In Section 3, the project description and goals are presented, the purpose of the evaluation and major outcomes are discussed, the rationale is restated, and an additional review of literature is conducted to guide the development of the project.

Also included in Section 3 are the desirable resources, potential barriers, and the plan or timetable for implementation of the project. The roles and responsibilities of stakeholders involved in the redesign of developmental math programs are presented. Finally, in what ways the results of the study could impact social change locally and on a larger scale, are presented.

Project Description and Goals

The goals of the study were to determine if the redesigned developmental mathematics Math 24 course achieved the College's proposed outcomes, to identify strengths and weaknesses of the redesigned Math 24, course from both the students' and faculty members' perspectives at Kapiolani Community College, and to present some recommendations to guide stakeholders in making improvements. Presented in the evaluation report are the Math 24 success and retention outcomes and the academic and environmental perceptions of the redesigned course.

The evaluation report, *Project Evaluation of the Redesigned Developmental Mathematics*, delineating the key findings of the objective-based program evaluation of the redesigned developmental mathematics, was crafted for the key decision makers of the developmental mathematics program. The group included the developmental mathematics instructors, the program director, and the Chancellor. The redesigned developmental mathematics program had no formal evaluation, and in discussion with the Chancellor, program director, and a few instructors they felt that a program evaluation of the redesigned developmental mathematics course would provide helpful to better tailor the future redesign of the developmental mathematics program to the needs of the students. The program director requested that I track the changes of the redesigned developmental mathematics course over time and study the impact on persistence and success rates. The chancellor was interested in learning the student and faculty perspectives and whether the changes were successful in achieving the expected outcomes of the resigned developmental mathematics course.

The project was developed by answering the following Evaluation Questions: (1) What were the trends in success, retention, and persistence for students in the redesigned developmental mathematics course as compared with students in the previous developmental mathematics course? (2) How has the redesigned developmental mathematics course and the measurable outcomes, persistence and success, changed from 2010 to 2014? (3) What are the academic and environmental strengths of the course from the students’ and instructor’s perspectives? (4) What are the academic and environmental weaknesses of the course from the students’ and instructor’s perspectives?

The main purpose of the evaluation report was to summarize the findings of the program evaluation and analyzed the results for what might be needed to craft possible recommendations for future redesign of the developmental mathematics course. The content of the report would include the proposed expected outcome and actual outcomes with course changes, the academic and environmental strengths of the course from the students’ and faculty members' perspectives, the academic and environmental weaknesses of the course from the students’ and faculty members' perspectives, recommendations, and conclusion. Prior to meeting with the decision makers, the evaluation summary report would be shared via email with the chancellor, program director, and developmental mathematics faculty so that that they can read the report ahead of time. A round table meeting would be scheduled to allow for discussion of the results and to provide the opportunity to address questions.

The evaluation report was to provide answers and insights into the effectiveness of the combination of the curriculum, materials, activities, environment, and faculty members impact the achievement of the program’s success and, ultimately, achieving the proposed goals and outcomes (King et al., 1987). The major outcomes examined were students’ success, persistence, and retention rates. Retention and success rate outcomes were compared with the semester changes of the redesigned Math 24 course. Academic and environmental factors were the evaluation criteria used along with the major outcomes because these outcomes and evaluation criteria highlight the strengths, weaknesses, and effectiveness of the course on students’ success.

Rationale

The project genre chosen was an evaluation report. Since the project study was a program evaluation, an evaluation report is the logical way to deliver the Math 24 course redesign program evaluation. College administrators and faculty members are concerned with identifying what aspects need improvement and what aspects are working to improve student's experience and success rate. The institution was already familiar with the project study's methodology because the proposal was given to the College to get approval for this project study. The College was interested in the program evaluation results, findings, and what it implies for the College, students, and the Math 24 course.

Presenting the project in an evaluation report allowed for the introduction of the main findings and seemed appropriate for summarizing the results of the Math 24 program evaluation. The evaluation report, Appendix A, is organized into sections providing pertinent information needed to assist the College with their developmental mathematics program. The program evaluation report will be shared by me with the College's administrative team, the developmental mathematics faculty members, and the program director. An evaluation report will be easily distributed and communicated to about 20 individuals in a short time period. An electronic copy of the project report will be emailed to all the decision makers for the developmental mathematics program. The program director, administrators, and all developmental mathematics faculty will be invited to a round table meeting to discuss the report and to answer any questions.

Review of the Literature

A scholarly review of literature describes some relevant information applicable to program evaluation.   Peer reviewed journal articles and scholarly literature on program evaluation were examined and synthesized to guide the development of the project. Key words utilized to perform the search for scholarly articles included *program evaluation, program evaluation community college, case studies, research and evaluations, redesign evaluation, and strategic program evaluation.* The databases included Education Research Complete, Academic Search Premier, ERIC, EBSCO Databases, and Educational Resource Information Center. Saturation of literature is demonstrated by the use of more than 25 current and credible (within 5 years of study completion) articles.

Program Evaluation

The reason for conducting a program evaluation of the developmental mathematics redesigned Math 24 course was to determine if the redesigned course attained the proposed outcomes for students' success, retention and persistence rates. Also, to identify the academic and environmental strengths and weaknesses of the course. The evaluation was important because the findings of the project will inform decision making processes for future redesign of the Math 24 course and provide insights into what aspects of the program need to be examined further to enhance its effectiveness (Wholey, 2010). Program evaluation is the exploitation of systematic techniques to address questions about program operations, practices, measures, delivery of services, and results (Franklin & Blankenberger, 2016).

Discerning a program evaluation involves a comprehensive understanding of the program and the identification of stakeholders served by the program. Program evaluation entails understanding and knowledge of operations, management, policy, and agreement on the student outcomes or desired results for students served by the program (Sylvia & Sylvia, 2012). The initial step in program evaluation is comprehending the goals of the program being evaluated. It is critical for colleges to center program evaluation on outcomes (Cohen, Brawer, & Kisker, 2013; Yarbrough, 2011).

Program evaluation is a critical necessity to determine the effectiveness of a program. Researchers can explore basic questions about the efficiency of educational programs, subject matters, and contents. Evaluation is commonly used as a tool for assessing a program's efficiency and involves thoughtful collection of program information that will impact critical decisions for improvement (Foroozandeh, Riazi, & Sadighi, 2008). Evaluating an educational program leads to the discovery of whether the program meets the desired outcomes and expectorations promised by the institution. The primary purpose of educational program evaluation is to enable and direct decision making and shaping programs to better serve the students and educators (Kariminia & Mahjoobi, 2013; Karimnia & Kay, 2015; Rice & Hung, 2015; Yuksel, 2010).

Due to the lack of community college’s research resources, their capacity to conduct program evaluation and research is limited. Academic programs, such as developmental mathematics are usually not fully evaluated or never evaluated. Also, evaluation plans fail to consider vague variables such as students’ perspectives, motivations, and feelings in evaluations (Astramovich & Coker, 2007; Cohen et al., 2013; Nielson, 2015; Simpson, Hynd, Nist, & Burrell, 1997).

College academic programs primarily affect and include students and faculty members. Evaluation of educational programs usually lack the students' perception on learning, and the learners' actions, behaviors, and academic performances. Rigorous and more practical systemic framework for educational program evaluation should comprise of in depth examinations of student experiences (Earley & Porritt, 2014; Hung, Hsu, & Rice, 2012; Rice & Hung, 2015; Xu & Recker, 2012; Yurdakul, Uslu, & Cakar, 2014). To enhance accuracy and credibility of educational program evaluation, it is essential to include learners and participants who are impacted by the program to share their perspectives. The inclusion of course participants, such as instructors and students who were affected by the developmental mathematics program is key to a successful program evaluation plan. Student feedback on their experience is especially important to identify the educational program's strengths and weaknesses, and to make suggestions for improvement to college administrators (Blanco, Maderer, Oriel, & Epstein, 2014; Bryson & Patton, 2010; Sylvia & Sylvia, 2012).

The program evaluation was conducted using a mixed method design. Many educational program and policy evaluations are conducted using the mixed methods design because both quantitative and qualitative methods can have added advantages and offset the weaknesses (Royse et al., 2016; Spaulding, 2014). Program evaluation is important for the evaluation results as well as to the stakeholders that the program supports. Educational program evaluation converges around matters such as a course, class, or a program that concerns the learning institution (Cellante & Donne, 2013). Throughout an educational evaluation, faculty members and administrators are usually involved in developing or redesigning a course and presenting the course. As such, qualitative and quantitative data analysis provides a wider range of insights and understanding of the program (Mohamadi, 2013; Spaulding, 2008; Stull, Varnum, Ducette, & Schiller, 2011).

Educational program evaluations that are conducted by an educator evaluator, who is familiar with and understands the course or program being evaluated and issues related to the program, are more effective in developing strategies to better serve and enhance the program. Program evaluation is a powerful exercise that can generate formative understanding to direct program improvement and summative judgements (Spaulding, 2014). Identifying program strengths and weakness and aligning the program outcomes can inform better course redesign, advocacy, sustainability, and program reform (Martin & Rallis, 2014; Patton, 2008b). Program evaluation is a viable and systematic method that examines goals, activities, and outcomes to document the nature of the program and provides comprehensive information to address desirable improvements for the program (Lam, 2014; Mainieri & Anderson, 2015; Patton, 2008b; Rawana, Sieukaran, Nguyen, & Pitawanakwat, 2015; Yong-Lyun, 2011; M. Young, 2012).

Evidence of college program effectiveness is of utmost importance to student success. Examining the efficacy of an educational program by evaluation provides evidence to support the program or to direct program changes. Evidence-based programs are critical for continued support of developmental college courses (Martin & Rallis, 2014). Evaluation highlights program efficacy and denotes the capability of the program to achieve its expected outcomes. As educational resources pose a challenge for many college programs, evidence of the impact of college programs, such as developmental mathematics, on student achievement is extremely important. Evaluation evidence can advocate the value of a program and strengthens the perceived effectiveness of the program; thus, lending more support for the educational program (Hausheer, Hansen, & Doumas, 2011; Spiegelman, 2016). Educational program evaluation informs improvements and shapes existing and future educational courses (Marshall & Rossett, 2014).

Findings, implications, and recommendations from educational program evaluation are useful to students, administrators, and faculty members. Evaluation findings can measure the learners' satisfaction with a course, the delivery mechanism, and the ability to attain the proposed objectives (Cox, Lenz, James, & Richard, 2015). Program evaluation can inform education, policies, and research trends. Educational programs engaging in evaluative practices fare better than programs that are not evaluated (Rawana et al., 2015). Programs and courses that are proactive in the use of evaluation to inform on-going improvements, thus increasing program effectiveness. Program evaluation has the potential to inform better program development and aid positive social change for individuals and communities (Smith, Elder, & Stevens, 2014). Data generated from an educational program evaluation are vital to the educational institution's reflection on future implementations. Continuous program evaluation serves to enhance a program and aid a better understanding of the program (Karimnia & Kay, 2015; Martin & Rallis, 2014; Nickerson et al., 2014; Venkatesh et al., 2014).

Project Implementation

The findings of the program evaluation were shared with administrators, the Program Director, and faculty of the developmental mathematics program in an evaluation report (see Appendix A) to provide insights on the outcomes of the developmental mathematics course to ensure that the developmental mathematics team was aware of the effective aspects of the course and aspects that need to be improved. The goal was to provide the developmental program advising and decision-making body with information that will help guide future implementation of the developmental mathematics program.

The College's developmental mathematics program director and faculty can implement changes or redesign the mathematics course after gaining insights from the project study evaluation report. The college's Institutional Research Office (IRO) can assist in future program evaluation. Outcome and efficiency evaluation are important to determine how educational courses and programs fare with respect to meeting the academic needs and success of students. Although program evaluation is a challenging undertaking for many institutions, it is an important practice to make a difference and inform positive changes (Royse et al., 2016). Developmental mathematics programs need to be evaluated every 2 years, to determine the impact of changes on the program outcome and efficiency. Thus, program designers can attempt to determine what factors contribute to making developmental educational courses better for the learners.

The use of an outcome program evaluation helped to establish whether the College has utilized the findings as presented in the program report to effectively redesign or redirect their developmental mathematics program to enhance the Math 24 course, student success rate, and stakeholder's experiences. The finding from the project evaluation report will update and guide the administrators, faculty members, and program director on future implementations for developmental mathematics. To determine if the project evaluation findings are shedding light on improving the developmental mathematics course, a system of monitoring and appraising the data-driven organizational changes and development should be established by the college (Waclawski & Church, 2002). Continued collaboration with the college's educational leaders and developmental mathematics program will ensure that the finding from the program evaluation will direct future implementations for the developmental mathematics program. Future evaluation and research is needed to ensure that developmental mathematics program is better serving the learners educational needs and success.

Resources, Barriers and Solutions

The college is aware of the challenges that developmental mathematics poses for community college students. The existing support is that the local community colleges are systemically working together to guide future redesign and directions of developmental mathematics courses. Existing course instructor course evaluation helps to inform faculty of their instructional effectiveness. Some computers and online resources were enabling students to access material beyond classroom time. Tutors and multiple faculty members were collaborating to support one-on-one instruction and differentiated instruction to meet the needs of all learning types. Free tutoring was available at the learning center when there were volunteer tutors. Federal and State funding was allowing for research and redesign of developmental mathematics programs that challenge local and national students. Data on success rates were examined and research were gauged at finding ways to improve the outcomes of developmental mathematics.

The future of college developmental mathematics is challenging due to a lack of resources such as human capital and financial support. Developmental programs need more funding and human resources to better support and evaluate the programs. The redesigned course integrated MyMathLab, online multimedia resources, and computer labs as much needed resources. More classroom space was needed to accommodate all students. Program evaluation is time consuming and costly and it poses a challenge for the college to continuously evaluate the program which already consumes a large portion of the college's budget.

College developmental mathematics is constantly being tweaked and changes are not necessarily grounded in data or driven by data. Faculty and students are slow to adapt to change. Accepting changes and finding funding are major barriers. Another barrier is majority of entry level students who need math remediation do not successfully make it through the course because of inadequate preparation and study skills (Childers & Lu, 2017; Yamada, Bohannon, Grunow, & Thorn, 2018). Students in developmental mathematics are faced with multiple challenges both in and outside of the academic course that need to be addressed to support students’ success (Oubre & Rivers, 2017).

Usually, developmental mathematics programs are costly with poor completion rate and the highest failure rate outcomes (Bishop, Martirosyan, Saxon, & Lane, 2017; Bonham & Boylan, 2011; Wendel & Hu, 2018). Although many developmental mathematics course redesigns integrate computers, MyMathLab, and online teaching, computers and lab space have become a much-needed resource. Due to cuts in funding, paid tutors and many evening courses were eliminated from the program. To implement changes guided by the evaluation will be challenging and will have to align to the college's future strategic plan and goals.

Program evaluation is time consuming and costly, and it poses a challenge for the college to continuously evaluate the program which already consumes a large portion of the college's budget. The solution is the continuous search to find a program design to better meet the needs of future developmental mathematics students. Program evaluation and data-driven decision-making is part of the future solution to enhance the developmental mathematics program. The needed resources for a program evaluation are prompt access to quantitative data on students' success, retention and persistence, program expectations and outcome, and access to all stakeholders for interviews and focus groups. Full support and willingness of the administrators, faculty, staff, and students to participate in the program evaluation is essential.

Proposed Implementation and Timetable

The evaluation report was approved by the Chancellor and was presented to developmental mathematics team. The findings from the program evaluation were discussed with the college's program directors and the developmental mathematics administrator. I met with the developmental mathematics team, shared the findings, and answered any of their questions about the findings.

The timetable for implementation and release of the evaluation reports was within 60 days after approval from the Chancellor to release the report. The evaluation finding will inform and guide changes for the implementation of any new developmental mathematics program and the expected changes will be the within one year. An outcome evaluation at the end of 2 years will determine what other changes might be needed.

Role and responsibilities of Students and Others Involved

The entire college and local community are responsible for the success of all learners. The developmental mathematics students have to be actively engaged and invest time to prepare themselves with basic skills needed to be successful in college. The local secondary schools are also responsible for ensuring that all graduating students master the basic foundational skills in mathematics. The course faculty members and administrators have to ensure that the developmental mathematics program uses mediated instruction to enhance teaching and learning for all learners. Also, the college's administrators and faculty must ensure that they sustain timely program evaluation to inform the redesign of educational programs.

The governing body of the college and developmental faculty have to work closely with the Institutional Research Office and students to find ways that can better support students to achieve success in developmental mathematics and decrease the attrition rate. The academic advisors and counselors have to work closely with students and faculty members to develop an early alert mechanism to help students. Students need to be more involved in the decision-making process of identifying ways that will help them to enhance their success and have a more vested interest in their education and learning.

Implication and Social Change (Local Community and Far Reaching)

The recommendations are that the local college community should engage students in academic decision-making processes and not isolate decision-making to college employees. Administrators should make it mandatory that all developmental students meet with their academic advisor or counselor at least once in the first quarter of the semester; so, students will have early support to address challenges and enhance their college experience. The college needs to develop an online early alert system to help developmental mathematics students. Lecture style and the computer math adaptive program should be further studied with direct and indirect instruction. Developmental students need more nurturing; thus, the college should hire developmental faculty with affective skills that include being able to engage students with math content or have professional development to train developmental program faculty.

The results of the program evaluation might have far-reaching social change due to the insights provided to guide the redesign of developmental programs. Social factors such as students' perception about their instructors' relationship, body language, and tone of voice have a social impact on learning. Social emotional learning strategies for educators and students might change attitudes toward developmental mathematics and might improve academic performance. Instructional strategies such as small group learning, collaborative student-centered instruction, one-on-one instruction, and peer mentoring might be blended to differentiate instruction for each student and studied for its impact on student learning. Engaging the feedback of students might help gauge instruction and support for students. As such, students might feel that they have the proper support and encouragement system to lead them to successful completion of developmental mathematics, or to acquire the proper basic mathematics skills to complete their college degree and enter the job market.

Conclusion

Evaluation of developmental mathematics programs is essential to identifying the strengths and weaknesses of the programs. Most importantly, the results of an outcome and efficiency evaluation can help to determine if the program is meeting its expectations. The goal of the project was to provide insights for the College to aid social changes and the decision-making process. Also, the results will inform data-driven decision making. The faculty and student perspectives and the success rate will help guide and address changes for future redesign of developmental mathematics courses.

Developmental mathematics continues to be the most challenging course locally and nationally. With multiple models, changes, and redesigns, the course failed to show any significant increase in success rate. Developmental mathematics is the most frustrating course for college students. The involvement of student participants in program evaluation is critical to social and academic changes. Students are mostly impacted by the course, and it is essential to gain their perspectives of what should be done to address their need to achieve success and remain engaged.

The project evaluation definitely shed light on how faculty members and students felt about the developmental courses and the success outcomes. Thus, the program evaluation will better inform the implementation of future developmental mathematics courses at the College. The biggest social change implication is that students and faculty felt that they were doing their best and had the best developmental mathematics program. Faculty felt that they developed the best program tailored to the needs of the students so that they would master their basic mathematics skills and be successful and productive citizens. Section 4 includes the reflection and conclusion on the program evaluation, and addresses the strengths, limitations, recommendations, scholarship, importance, and implications.

Section 4: Reflections and Conclusions

Introduction

The project study evolved from the need to find how the developmental mathematics course was meeting expectations and to identify the strengths and weaknesses of the program. The program evaluation examined the measurable outcomes, the changes, and the students and faculty perspectives about the Math 24 developmental course. The design of the evaluation integrated both quantitative and qualitative information to provide the College with evidence of how the course was affecting the academic success rate and the factors that affected the effectiveness of the course. The result of the program evaluation was a valuable medium to guide the College developmental mathematics program towards what aspects to focus on in order to attain the biggest positive improvement.

Section 4 provides a reflection on and conclusion about the project study and includes the project's strengths, limitations, recommendations for alternative approaches to the problem, the researcher's learning curve, and the researcher as a scholar, project developer, and an agent of change. Also included in this section are suggestions for future research and the impact on social change.

Project Strengths

The program evaluation was intended to examine the outcomes of the redesigned course and to evaluate whether the course was achieving the expected outcomes by triangulating success rate data, changes of the course, and stakeholders' perspectives. Examining multiple sources of data provided an in-depth examination of the scope of the mathematics course and provided an opportunity for both students and faculty to voice their perspectives. The views of participants in the program was practical and essential when evaluating an academic course, because they are the ones who experienced the curriculum, delivery and content. Participant input was beneficial and leds to better conceptualization of the evaluation (Chen, 2005; Spaulding, 2008).

Developmental programs are seeking new ways to help improve the results and impact of developmental mathematic programs on student success. This project study provided an extensive evaluation of the Math 24 course for the College which would not have been possible due to the limited funding and research resources in the community college. The utilization of the mixed methods design was an overall strength of the project.

The case study, participatory oriented evaluation approach was another strength of the project. Through the participants in developmental mathematics, the project provided student and faculty perspectives on the course's academic and environmental layout. Students expressed how the course affected their performance. The construction of the program evaluation to examine strength and weakness of a course through the experiences of the faculty members and learners was a powerful approach.

The project deliverable, that is the program evaluation report, provided the college with an in-depth perspective and voice on the strengths and weaknesses of the developmental mathematics course from students and faculty members. The deliverable was an immense resource for the developmental mathematics program because of its insights and recommendations. A participatory approach program evaluation, with feedback from students and faculty about program strengths and weaknesses, was critical in aiding redesign decisions about how to modify program delivery (Patton, 2012; Wholey et al., 2004) .

Limitations and Recommendations for Alternative Approaches

The limitation of the program evaluation deliverable was that a program evaluation is so extensive that it takes a lot of time to collect and analyzed the data before completion. Evaluation findings are often generated too late to have timely meaningful impact on the program participants (Lam, 2014). By the time the evaluation was completed, and the evaluation report was generated from the study, the college had ventured ahead with previous plans and strategies, and new policies to replace the academic courses. Thus, changes are implemented without the guidance of a program evaluation suggestions. The potential personal biases of the participants' responses and the small convenient sample size are possible limitations in the evaluation, and thus limits generalization of the evaluation report.

The evaluation report was shared with the college's leadership team and the developmental mathematics faculty. The report was generated about two years after the collection of data for the program evaluation. Due to the untimely manner of providing the final evaluation report, the College can consider the deliverable as not current and this limits its use in informing future decision-making activities. Timely evaluation reports are more effective in informing redesign of academic courses. Although outcome evaluation is *ex post facto*, and the evaluation report is not timely in affecting immediate changes to address program problems, a timely implementation evaluation would be an alternative approach. (Chen, 2005; Wholey et al., 2004).

Scholarship

As a scholar and practitioner, I learnt the program evaluation process that allowed me to develop critical processing and analytical skills. I have learned to analyze theories and data. During the theoretical analyses and literature reviews, I developed skills to effectively craft conceptual and theoretical framework. Data collection and analysis enhanced my technical skills in organizing qualitative data with relevant categories and quantitative data in SPSS. Learning about descriptive statistics and how to use SPSS to analyze data was a scholastic journey. The process and techniques to effectively interpret and develop a conclusion of the data analysis were skills that I mastered for program evaluation.

I have enhanced my skills to better conduct searches for scholarly materials in EBSCO, ProQuest, and ERIC. I have learned that peer-reviewed journal articles are the most credible sources of scholarly information and add validity to topics and subjects. Through hours and days of searching for relevant and current articles, and to achieve saturation of literature, I learned to use more extensive vocabulary to locate more peer-reviewed journal articles that were relevant to program evaluation and developmental mathematics.

I now better comprehend how literature strengthens a study. Also, I gained a better understanding about the process involved in peer reviewed journal articles. My involvement in the project study, understanding participants' backgrounds, and developing a program report that will inform social change has molded me into a scholar and researcher.

Project Development

Developing a program evaluation, as a project study, was an enormous task and a long learning curve. The task involved planning and designing the program evaluation with the main purpose to influence social change. The project development entailed communication with the college developmental mathematics stakeholders to ensure that the project addressed a current problem and ass relevant and useful to the College's program development.

As an evaluator, I had to review literature and books on practical program evaluation to learn how to design an outcome evaluation. Enlisting students and faculty members to participate in the interviews and the whole IRB process taught me all the facets of safety protocols in research. Designing open-ended questions for the main evaluation questions and open-ended questions for the interviews was challenging. The support and guidance of my committee members helped me learn to design effective open-ended questions.

As a research practitioner, I learned how to construct and conduct a program evaluation using all the steps needed to conduct a project study. I learned to be aware of limitations and biases in developing a project study. Developing a proposal that clearly addresses the local problem, explaining sample and setting, identifying data collection instrument, understating qualitative and quantitative data collection processes, and how to conduct data analysis was a tremendous learning task; these were critical steps that I mastered during the project development. I have become much more knowledgeable about the processes involved in program evaluation.

Leadership and Change

I have developed better leadership skills and am a better agent of change. Effective leadership is about pursuing beneficial and practical transformations. Through the project study, I inspired an environment to improve outcomes. As a result of the project the college can better manage and learn from social change; a critical aspect for the successful operations of any academic institution (Northouse, 2014).

Successful educational leaders are trust builders who are adept communicators and collaborators. Effective leaders are agents of change and usually convey to the team that they are capable and they will rise to the expectation (Fullan, 2014; M. S. Knowles, Holton, & Swanson, 2005). As a practitioner and evaluator, I had to work to build trust through clear communications and expectations with the College and participants in the project study. Engaging others and focusing on the developmental mathematics problem broadened my people skills and helped me to improve become a more successful leader and agent of social change.

Importance of the Program Evaluation Work

The program evaluation of the developmental mathematics courses was critical in determining whether the program ass achieving its expected outcomes. Also, identifying the different aspects of the program that were labeled as strengths or weaknesses by faculty members and students was vital in determining the effectiveness of the program as perceived by the participants. The evaluation provided insightful information from students and instructors on the strengths and weaknesses, and recommendations for improvement of the redesigned developmental math and that can affect possible social change and decision-making processes for the College.

The project study was important work because the results showed that the college did not reached it expected outcomes for the developmental mathematics program, and the findings could help redirect redesign efforts of developmental mathematics to increase success, retention, and persistence rates. The study included the thoughts, expectations, and perspectives of learners and educators directly involved with the developmental course. As such, the work considered the views and reasons for the strengths and weaknesses of the academic and environmental aspects of the developmental mathematics course.

The results of the project study provided a powerful means in abetting effective program redesign and emphasized the importance of continuous program evaluation of academic programs. Future developmental mathematics courses would have the possibility of better outcomes and impact on teaching, learning, and student success. Thus, the project was especially important in sustaining the hope of finding ways to better educate developmental math students for the 21st century and improve academic success.

Implications, Applications, and Directions for Future Research

The project study focused on evaluating the outcomes of the developmental mathematics course. The timely integration of the findings to inform future decision making and redesign of developmental mathematics will impact effective implementation of the developmental math course. The implication would be a more effective developmental course that is tailored to diverse students and addresses the needs of the adult learners.

Learners are more vested in learning content when it is relevant to the improvement of their life and career. Measures taken to improve a course informed by the voices and perspectives of students and educator participants are more relevant to learners and pave the way for better facilitating social change in policymaking processes and redesign of academic courses, especially developmental mathematics. The results of the program evaluation shed light on the strengths and weaknesses of factors such as curriculum, instruction, resources, content, assessment, and how faculty members' and learners' perceptions of the course impacted the outcome. The implication of using and applying findings from a program evaluation allows for all stakeholders to revisit programs and implement better organizational changes.

The typical decision-making processes on designing or redesigning courses most often include college administrators and faculty members. The most powerful social change that the project promoted was the contribution that learners have in effecting positive changes and enabling more strategic changes. Ongoing program evaluation of academic courses and programs will enhance improvement.

Listed below are directions for future developmental mathematics research.

Recommendations for Future Research

1. Examine redesigned developmental mathematics programs that address differentiated learning needs.

2. Examine the positives and negatives of other levels of developmental mathematics courses.
3. Evaluate the program outcomes for all levels of developmental mathematics courses.
4. Track changes and examine outcome and efficiency of future developmental mathematics program redesigns.
5. Examine support to faculty in meeting student learning outcomes.
6. Examine alternative pathways for placement of students into programs to master developmental mathematics content.
7. Examine professional development for developmental faculty.
8. Examine early alert systems for developmental mathematics students to address difficulties.
9. Explore barriers to student achievement and use the information to improve student learning and the learning environment in developmental mathematics.
10. Examine reengineering developmental mathematics courses to accelerate student success.
11. Examine motivational barriers for students.

Conclusion

Program evaluation is very informative in examining outcomes and effectiveness of programs. Evaluating the developmental mathematics course provided concrete information and evidence of matters that enhance and obstacles that affect the outcomes of a program. The evaluation provided a mean of examining courses for better strategies to create better learning opportunities for students, thus possibly facilitating meaningful change that might resulted in positive impact on program participants.

The primary strength of the evaluation report was that it allowed for the college professionals to engage in educational discourse and valued academic press. Academic press is defined as “the extent to which academic excellence is valued and pursued for all students” (Berebitsky, Goddard, Neumerski, & Salloum, 2012, p. 51). Developmental mathematics programs, with a long history of a high failure rate, need stakeholders to advocate for strong academic press. As such, pressure is directed towards one vision with respect to enhancing developmental mathematics by increasing student social capital and academic achievement. Academic press promotes positive social interactions that might transform educational practices and results to enhanced learning opportunities for students.

Program evaluation is an essential component of all successful programs. For the project study, the evaluation report provided insights that will broaden practitioner’s awareness about the Math 24 outcome and efficiency; thus, guiding course improvement and enhancing student success. Engaging the voices of students and faculty members, complemented with quantitative outcome data on student success is a valuable and credible means of evaluating academic course. The evaluation report created an opportunity for decision making bodies to review the strengths and weaknesses of the Math 24 course that the participants communicated.

The findings and recommendations could impact college-wide social change where college leaders can engage the strengths and insights of participants to advance growth and strengthen programs to enhance student academic achievement. The college educational leaders can promote capacity building, thus strengthening the effectiveness of the college's professional and human capital. As such, my evaluation report on the redesigned developmental mathematics course can help stakeholders to learn about the effectiveness of their project approach and the extent of the outcomes compared to the targeted or expected outcomes. Also, the fact that engaging the strengths of program participants in educational program evaluation will provide powerful data and results that can guide academic program improvement and promote collaborative social change (Fullan, 2014; Northouse, 2014; Patton, 2010). While developmental mathematics is being redesigned and many redesigns are integrating technology with the hope to increase success, much work remains because developmental mathematics course continues to have the highest failure. The redesigned Math 24 course did not lead to a dramatic increase in student success. Additional research and program evaluation are needed to find ways to better redesign the developmental mathematics course to support student success.

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APPENDIX A: The Evaluation Report

Strengths and Weaknesses of the Redesigned Developmental Mathematics Course: Student and Instructor Perspectives

The purpose of the program evaluation was to evaluate the effectiveness of the newly redesigned developmental Math 24 course at Kapiolani Community College (KCC) that embraces and integrates features from the Emporium Model, MyMathLab, and technology, and to determine if the course redesign objectives were met. The results showed that the developmental mathematics course, Math 24, was not meeting the proposed expected outcomes. The evaluation report is intended to encourage communication between College decision makers, academic leaders, faculty members, and course participants to shed light on the strengths and weaknesses of the Math 24 course.

Chapter One presents the redesigned course proposed expected outcomes for student success, persistence and retention and the actual course outcomes with course changes. Chapter Two presents the academic and environmental strengths of the course from the students' and faculty members' perspectives. Chapter Three presents the academic and environmental weaknesses of the course from the students' and faculty members' perspectives. Chapter Four presents conclusion and recommendations to assist with future developmental mathematics redesign efforts.

Chapter 1

Redesigned Proposed Expected Outcome and Actual Outcomes with Course Changes

The trends in success, retention, and persistence for students in the redesigned developmental mathematics course was compared with students in the previous developmental mathematics course. The actual redesigned course outcomes for success, persistence, and retention did not met the college proposed outcomes.

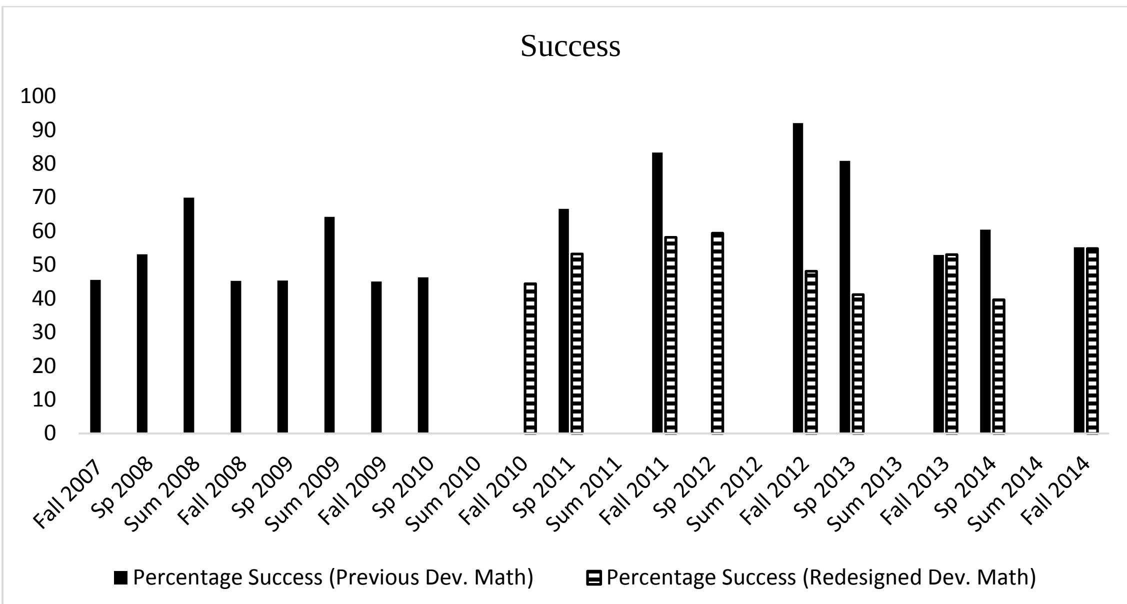

Figure A1.1 Percent success rate

Figure A1.1 illustrates that the success rate for the previous developmental mathematics course fluctuates between 45-55% for fall and spring semesters and 64-70% for summers. From Fall 2010, the redesigned developmental mathematics fluctuates from approximately 40-60% for fall and spring semesters. For lecture style that was similar to the previous developmental mathematics course, the success rate fluctuates from 52-92%.

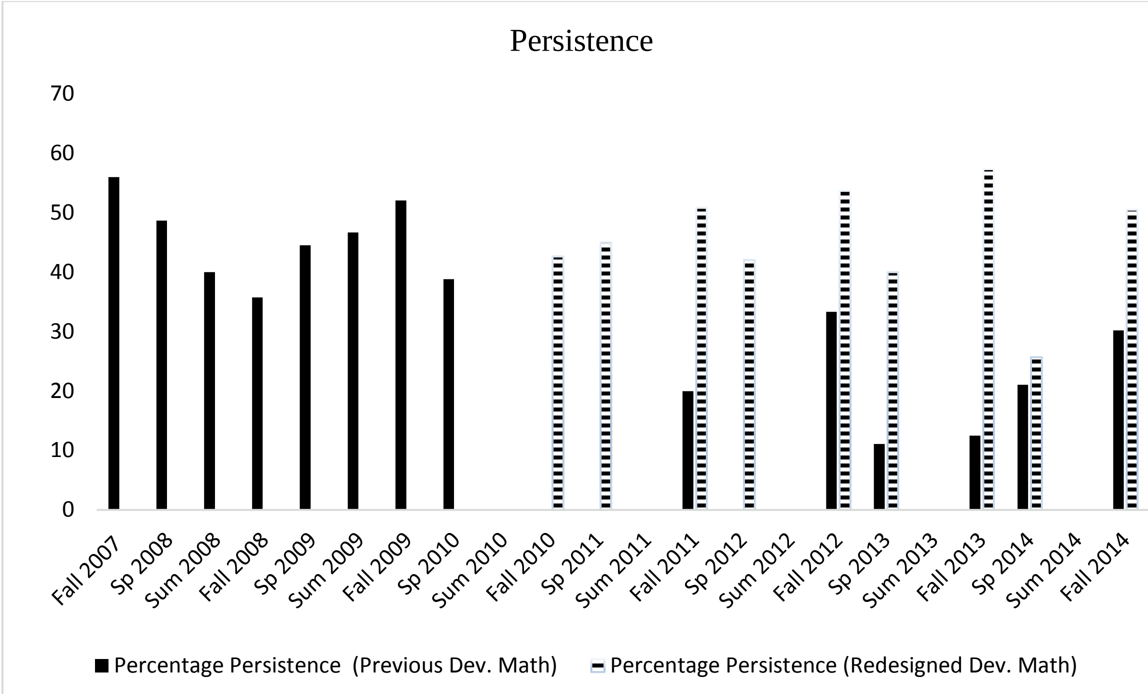

Figure A1.2 Percent persistence for previous and redesigned developmental math

Figure A1 .2 2 illustrates the persistence rates of the previous developmental mathematics and the redesigned developmental mathematics course. The persistence rate illustrates that the percentage of students that re-enrolled in Math 24, or took an equivalent or lower level mathematics class, after not passing Math 24 is consistently higher from Fall 2011 for the redesigned mathematics course compared to the previous developmental mathematics course. After the introduction of the redesigned Math 24 course in Fall 2010, the percent persistence for the previous developmental mathematics course decreased. For the redesigned Math 24 course, student persistence fluctuates from 25.71% to 57.36%.

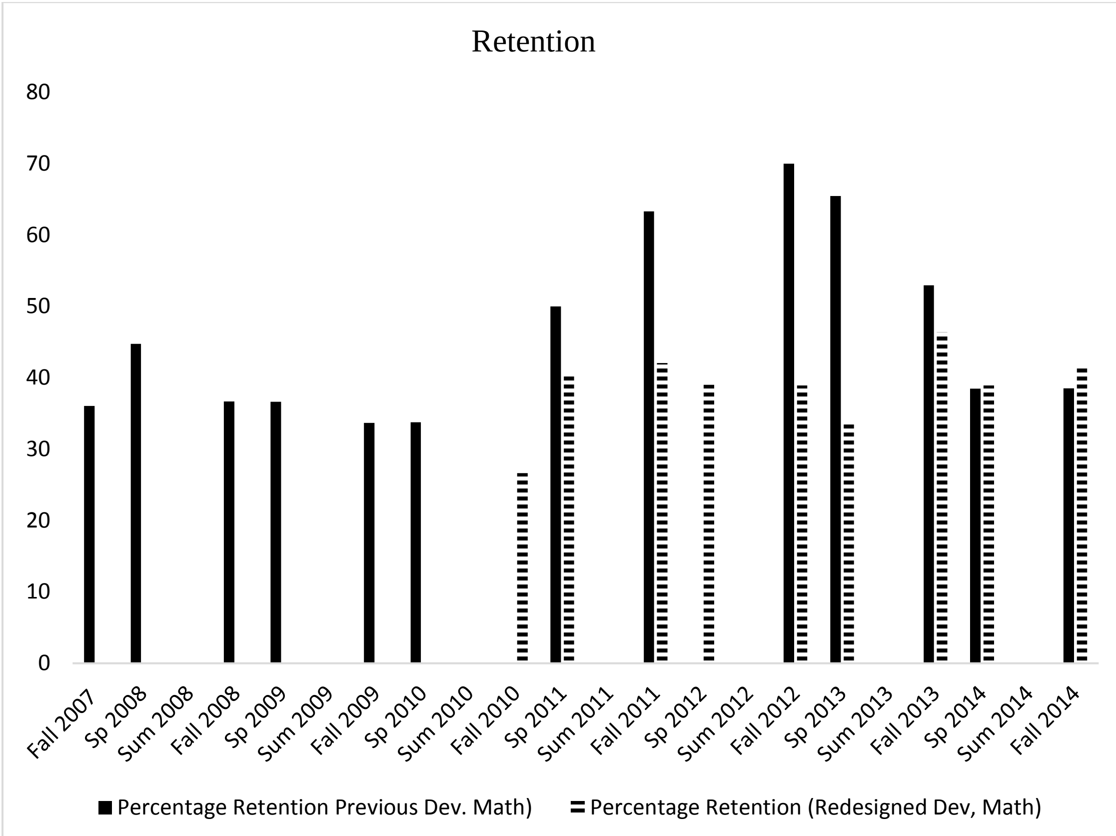

Figure1.3 Percent retention for previous and redesigned developmental math

Figure A1. illustrates the percent retention of Math 24 students enrolled in a higher-level mathematics class in consecutive semesters (fall to spring or spring to fall) for the previous developmental mathematics and the redesigned developmental mathematics. For the redesigned Math 24 course, student retention fluctuates from 26.63% to 46.38%

Table A1

Redesigned Developmental Mathematics Success Rate Central Tendency

Central Tendency	**Statistics**
Mean	50.24
Median	53.09
Mode	39.66[a]
Std. Deviation	7.24
Minimum Statistic	39.66
Maximum Statistic	59.45
Sum	452.19

Table A1 shows the mean success rate for the redesigned developmental mathematics course to be 50.24%, median 53.09%, and mode 39.66%.

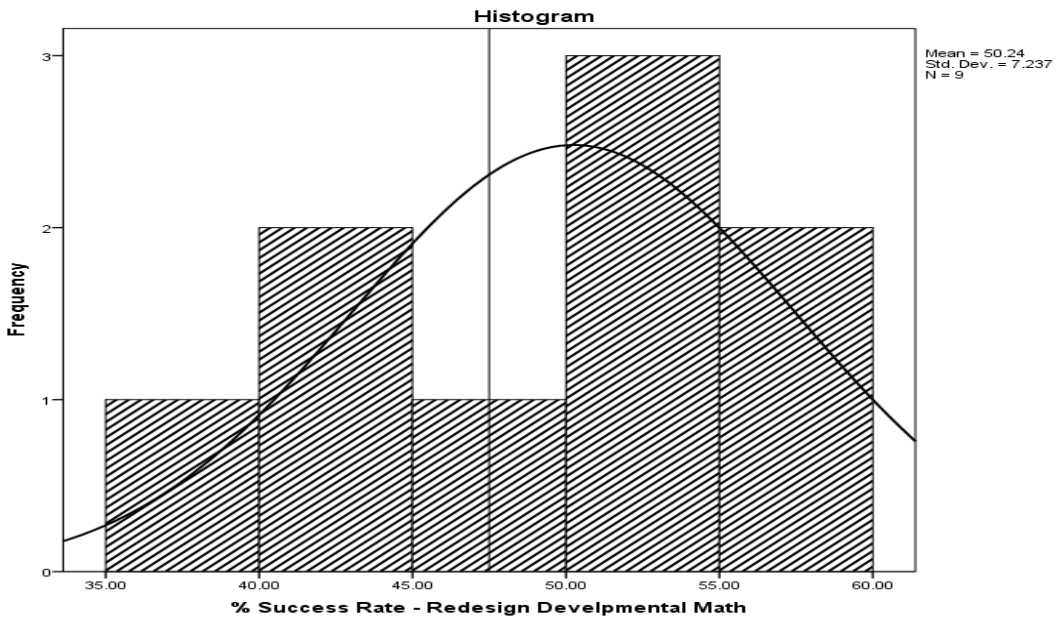

Figure A1.4. Histogram of success rate redesigned developmental math Fall-Fall 2010

Figure A1.4 shows a bimodal distribution of success rate percentages which is a measure of statistical dispersion or how spread out a set of values are around the mean. The standard deviation of the success rate is 7.237; a measure of statistical dispersion or how spread out a set of values are around the mean. An SD = 7.237 indicates that the data points are spread out over a wide range of values.

Table A2

Changes of the Course Outcomes: Success, Persistence, and Retention Rates

Semester	**Self-Pace**			**Hybrid 50/50**		
	S	**P**	**R**	**S**	**P**	**R**
Fall 2010	44.41	42.65	26.63	None	None	None
Spring 2011	53.27	45.00	40.69	66.67	0.00	50.00
Fall 2011	58.16	50.85	42.05	83.33	20.00	63.33
Spring 2012	59.45	42.05	39.00	None	None	None
Fall 2012	48.09	53.68	38.93	92.11	33.33	70.00
Spring 2013	41.18	40.00	33.99	80.85	11.11	65.45
Fall 2013	53.09	57.36	46.38	52.94	12.50	52.94
Spring 2014	39.66	25.71	38.93	60.42	21.05	38.46
Fall 2014	54.88	50.52	41.40	55.21	30.23	38.54

Note. The rate percentages are represented by the following S for success rate percentage, P for persistence, and R for retention,

Table A2 tracks the changes of the success, persistence, and retention rates per semester for Math 24 course.

Success was measured by the final course grade. The average success rate from Fall 2007 - Spring 2010 for previous Math 24 was 45%. The college expected student success to consistently increase to 80% by 2015 but there was no significant lasting improvement despite all of the redesign.

The average persistence rate from Fall 2007-Sping 2010 for previous Math 24 was 63%. The persistence rate for the redesigned self-paced redesigned Math 24 course decreased to 53.68 % in Fall 2012 and decreased to 42.05% in Spring 2012 for the redesigned course. Therefore, the expected outcome of 75 % student persistence was not achieved.

In Fall 2011 Hybrid Math 24 was introduced where class lectures and flexible test times for students to take each test in the testing center, and success and persistence rate increase by more than 5%. In Fall 2013, the paper final exam changed to 40 online free response questions from a written final exam multiple choice test with 30 questions, and success and persistence increased by more than 10% compared to the previous semester. In Fall 2014, the success and persistence rates were the lowest and had a significant decrease compared to the previous semester. The major change in Fall 2014 was new faculty was hired to facilitate the Math 24 course.

Fall 2010 was the first introduction of the redesigned 100% self-paced Math 24 course. From Spring 2011, a hybrid type of traditional Math 24 (previous Math 24) was also introduced along with the 100% self-paced Math 24. Except for Fall 2013. The hybrid Math 24 success rate was consistently higher than the self-pace Math 24. Whereas, the hybrid Math 24 persistence rate was consistently lower than the self-pace Math 24. Therefore, suggesting that factors such as, scheduled time for teacher-led instruction, set deadlines for assignments and assessments, scheduled pacing of the course material in the hybrid course might had led to better student accountability; thus, higher student success and lower persistence rates in the hybrid developmental math course.

Semester Changes of Developmental Course

The qualitative data from the developmental mathematics program director interview were analyzed to track the redesign changes per semester.

Fall 2010:

All the redesigned Math 24 courses were taught using the redesigned self-pace model and MyMathLab was introduced. A common curriculum, where the faculty members were teaching the same content in the same modules, was introduced. The faculty work was restructured where every faculty member had to spend 2 hours each week in the math lab working with Math 24 students from multiple instructors' classes. Scheduled classes and labs were taking place simultaneously in the same computer lab/classroom. Instead of lectures, the role of the instructor changed to answering questions. Learning was more driven by the students. Students worked on the computer and raised their hands when they had a question. The faculty member answered students' questions as they came up while the students were working through the math module. Students worked at their own pace in the lab. Later in the semester, the faculty began introducing mini lectures because the students were requesting some formal instructional time to help them move at a better pace. The quizzes were supposed to be done in class with a passcode and were 5% of the final grade. However, it was soon found that instructors were spending about 80% of class time inputting passcode so the protocol was changed to open quiz in class or at home. The new open quiz protocol tremendously increased students' completion of the quizzes. The first three weeks of the semester there was more students than computers in the labs, so students were allowed to bring their own laptops to work on their Math. The last three weeks, there was an increase of about 50% more students wanting to use the labs in the evening so there was an overflow into Pre-College Math computer lab for students taking the chapter tests or final exam.

At first the course was truly self-paced; then in later semesters, deadlines were introduced to encourage students to work at a pace that will help them complete the course in one semester. The original implementation included a written midterm exam of 20 questions that included the first half of the course material and was 18% of the final course grade, and a written cumulative multiple-choice final exam with 30 questions and was 22% of the final course grade. Student survey was collected at end of term to get input about possible changes to the course and the feedback impacted the changes in the next semester. The average success rate was 44.41%, the average persistence was 42.65%, and the average retention

Spring 2011:

Feedback from students for more lecture time lead to the introduction of some sections to be changed to more 50/50% self-pace/traditional model. Faculty members were moving back to mini traditional lectures. The redesigned Math 24 was 100% self-paced versus the redesign traditional (50/50). All the courses, technology was integrated into them. Due to the introduction of deadlines the about 70% of students completed their work by the due dates. Whereas, before deadlines about 50% of the students were making timely expected progress. The self-paced model, when compared to the traditional model, the average success rate increased significantly to 53.27%, the average persistence increased slightly to 45%, and the average retention increased significantly to 40.69%. The hybrid model (50/50%), when compared to the self-pace model, the average success rate increased significantly to 66.67%, the average persistence decreased to 0.0%, and the average retention increased significantly to 50.00%.

Fall 2011:

Individual faculty members were allowed to introduce additional policies; such as "soft" deadlines, locking the modules, delivery method for quizzes/exams, attendance policies (are not a departmental or institutional level change but just the math faculty talking with each other. Individual instructors made their own changes rather than having a decision made by the whole math department on what needs to be changed for all Math 24 courses. Faculty members eliminated the written midterm as it became an unnecessary obstacle for students to finish the course. The weighted percentage of the final exam changed from 22% to 25% and the module tests change from 45% to 60% of the final grade to adjust for the elimination of the 18% mid-term exam. Compared to the previous semester, for the self-paced model, the average success rate increased slightly to 58.16%, the average persistence increased slightly to 50.85%, and the average retention increased slightly to 42.05%.

Hybrid Math 24 was piloted to see if higher success rates in summer term with this model could be extended to regular academic year. The Hybrid course included in class lectures and flexible test times where students had a week to take each test in the testing center. Compared to the self-paced model, for the hybrid model, the average success rate increased significantly to 66.67%, the average persistence was 20.00%, and the average retention increased significantly to 50.00%. Success rate was expected to increase, and it increased in Fall 2011 and Spring 2012, then deceased in Fall 2012 and Spring 2013.

Spring 2012:

Math 98 (combined Math 24/25, 6 credits) first piloted in addition to the existing self-paced Math 24 course. Students were only given Credit if they finished the entire course. The success rate increased, and the persistence rate decreased compared to the previous semester. Compared to the self-paced model from the previous semester, for Math 98, the average success rate increased slightly to 59.45%, the average persistence decreased to 42.05%, and the average retention decreased slightly to 39.00%.

Fall 2012:

Math 98 continued but was redesigned. At the end of the semester, students were given credit for Math 24/25 separately in case they were able to finish only half the content. The department piloted a “no show” policy where students who did not attend class during the first week (without notifying instructor) were dis-enrolled. The hope was to increase success rate, but the success rate decreased, and persistence rate increased compared to the previous semester. Compared to the self-paced model from the previous semester, for the self-paced model Math 98, the average success rate decreased significantly to 48.09%, the average persistence increased significantly to 53.68%, and the average retention was unchanged at 38.93%. Compared to the self-paced model, for the hybrid model, the average success rate increased significantly to 92.11%, the average persistence decreased significantly to 33.33%, and the average retention increased significantly to 70.00%.

Spring 2013:

Math 98 expanded to 3 sections. The pilot finished, and Math 98 course has not been offered since due to lack of resources. Compared to the self-paced model from the previous semester, for the self-paced model Math 98, the average success rate decreased significantly to 41.18%, the average persistence decreased significantly to 40.00%, and the average retention decreased slightly to 33.99%. Compared to the self-paced model, for the hybrid model, the average success rate decreased significantly to 80.85%, the average persistence decreased significantly to 11.11%, and the average retention increased slightly to 65.45%.

Fall 2013:

The first department online final exam was implemented with 40 online free response questions. Students input answers on computer and faculty members graded handed in written work for partial credit. Final exam changed from 30 multiple choice questions on paper to 40 free response questions online, and the success rate and persistence rate increase by more than 10% each compared to the previous semester. Compared to the self-paced model from the previous semester, for the self-paced model, the average success rate increased significantly to 53.09%, the average persistence increased significantly to 57.36%, and the average retention increased significantly to 46.38%. Compared to the self-paced model, for the hybrid model, the average success rate decreased significantly to 52.94%, the average persistence increased slightly to 12.50%, and the average retention decreased significantly to 52.94%.

Spring 2014:

New faculty member was hired to teach Math 24, and the success rate and persistence rates dropped to the lowest. Compared to the self-paced model from the previous semester, for the self-paced model, the average success rate decreased significantly to 39.66%, the average persistence decreased significantly to 25.71%, and the average retention decreased significantly to 38.93%. Compared to the self-paced model, for the hybrid model, the average success rate increased significantly to 60.42%, the average persistence increased significantly to 21.05%, and the average retention decreased significantly to 38.46%.

Fall 2014:

No changes occurred; however, both the success and persistence rates increased compared to the previous semester. Compared to the self-paced model from the previous semester, for the self-paced model, the average success rate increased significantly to 54.88%, the average persistence increased significantly to 50.52%, and the average retention increased slightly to 41.40%. Compared to the self-paced model, for the hybrid model, the average success rate decreased slightly to 55.21%, the average persistence increased significantly to 30.23%, and the average retention was unchanged at 38.54%.

Chapter 2

The Academic and Environmental Strengths of the Course from the Students' and Faculty members' Perspectives

Academic Strength – Student Perspectives

Student Perspectives on Curriculum Strengths

The findings were that Math 24 provided the basic foundational skills to prepare students for the next higher-level mathematics course.

- Math modules were aligned to each other, connected in a manner to build understanding of mathematical concepts, and consistently increased in difficulty of content application and mathematical skills.
- Word problems and graphs were the most challenging sections.
- Students found the redesigned developmental math course curriculum material earlier sections to be the foundation for later sections, and progress in difficulty over the semester.
- The earlier math content was easier to comprehend and solve because of the basic foundational material, such as real number system, inequalities, and expressions.

However, the variation was that Focus Groups 1 and 2 participants' perspectives were that the content was basic foundational skills, whereas Focus Groups 3 and 4 participants' perspectives were that second half of the course with word problems was challenging.

Student Perspectives on Resource Strengths

The findings were that videos and online presentations were helpful in learning and reviewing the content.

- Textbook and e-book were useful as learning tools.
- Faculty members were helpful when needed to explain how to solve problems that were difficult to understand from using multimedia.
- MyMathLab platform, such as "Show Me an Example" function was useful to learning how to solve problems.

The variation was that some students prefer to view the multimedia videos for help while others prefer the to use the MyMathLab program to view the step by step solution help.

Student Perspectives on Assignments & Assessments Strengths

The findings were that the homework assignments were helpful to provide practice. Each section homework helped with the section quiz.

- Multiple tries for each homework problem helped with better understanding because it allowed for correction of mistakes.
- The quizzes were similar to the homework.
- Multiple redo of quizzes helped with better understanding, mastery, and grades.
- The quizzes, homework, and module review helped to prepare for the module tests.
- Redo of tests to get 70% helped with better understanding, mastery, and grades.

The variations across the groups were process time and retention of information because Focus Groups 1 participants found the homework help with passing the quiz, whereas Focus Groups 2 and 3 participants also needed study, Focus Group 3 participants also needed to do the review, and Focus Group 4 participants needed to take the quiz immediately after homework assignment.

Academic Strengths – Faculty Perspectives

Faculty Perspectives on Curriculum Strengths

The findings were that the reordering of the topics provided a smoother flow in the self-pace course.

- Content per module provided a foundational understanding of the material. Technology integration with lecture allowed for multiple modes of delivery of content.
- The course places a greater responsibility on the students to learn, seek help, and complete the work.
- Students had to complete the word problem sections and show some mastery.
- The similarities amongst the faculty was that the math topic order and the technology were strengths.

However, the variation was Faculty B emphasized that the primary strength is the lecture with technology.

Faculty Perspectives on Resources Strengths

The findings were that the online computer-assisted instruction software in MyMathLab provides lectures and PowerPoints were accessible from anywhere via a web browser. The use of MyMathLab provide instruction that was individualized based on students' needs and students were able to view how-to videos.

- MyMathLab platform provided applicable resources with specific, and immediate feedback.
- Content resources allow for various options on how to problem solve, from looking at examples, viewing lectures on video or presentation, or contacting the instructor via e-mail.

The variation was Faculty C added that the computer-assisted program MyMathLab can provide immediate feedback to students about their math problem solution, so it is helpful to both students and faculty. Also, the online resources allowed students to be more self-directed learned and do not always depend on the teacher for new learning.

Faculty Perspectives on Assignments & Assessments Strengths

- The findings were that although the course was self-paced, "soft deadlines" for assignments and modules helped to pace the course on a semester schedule.
- Homework assignments had to be 100% completed and correct; thus, allowing for mastery of all problem types.

- In MyMathLab students received immediate feedback and the “Help Me Solve” button and “ask my instructor” button helped with solving problems.
- To promote mastery of content, homework questions were allowed for multiple retakes until 100% for all homework assignments were achieved.
- Portfolio was utilized as a means of authentic assessment and helped with organization and notetaking skills.
- The self-paced courses allowed for students to complete the modules at their own pace and allowed for early completion of the course.
- To promote mastery of content, quiz questions were allowed for multiple retakes until 80% for each quiz were achieved.
- Quizzes could be taken at home or in class and students could use their notes and or textbooks.
- Online question pool allowed for a more secure and easier administering of the module tests and final exams.
- The online platform allowed for easier collection of tests and exams data.
- Students could retake each module test until they achieved 80%. For the final exam, students had to retake the exam to score a minimum required score of 70%.

The variation was Faculty A perspective was that students with portfolios are the organized ones and tend to be successful, and the unorganized ones who writes on loose sheets are the mostly unsuccessful. Also, the assessments were modified to better fit the needs of the program and better support the students.

Environmental Strengths - Student Perspectives

Student Perspectives on Peer Strengths

The findings were free tutoring helped students with challenging math problems.

- The tutors were friendly, and students felt comfortable working with them.
- Peer collaboration and peer mentoring helped students to learn from each other.
- Early impression of a tutor being friendly helps students to decide who they prefer to work.

The variation was that Focus Group 1 participants found mentoring others helpful to remember math, whereas Focus Groups 2, 3 and 4 participants preferred to be mentored.

Student Perspectives on Classroom Strengths

The findings were the instructor helped to make the content more understandable by breaking problems into smaller simpler steps and used visual representations.

- The instructor’s positive and engaging tone helped students to stay focused.
- The instructor provided one-on-one feedback that was helpful for the students. Foundational skills from previous classes enhanced students’ performance and motivation.
- Self-pacing allowed for students to complete the course at their own pace.

- Online communication with the faculty members and quicker feedback were possible via MyMathLab.
- The policy of getting an incomplete and then finishing the following semester helped financially.
- Instruction was tailored towards students' needs.

The variation was that Focus Group 2 students took more than a semester to complete the course and the advantage to continue the course was they did not have to pay extra money for the second semester.

Student Perspectives on Physical Setting Strengths

The findings were that students can borrow laptops from the college for the whole semester.

- Computers and classroom setup were accessible and convenient for students.
- The classroom is cool, comfortable, and the setting allows for faculty members to walk around and students to engage with peers.

The variation was that Focus Groups 1, 2 and 4 participants appreciated the computer accessibility, and Focus Group 3 participants appreciated the help from the instructors and lab monitors.

Environmental Strengths - Faculty Perspectives

Faculty Perspectives on Peer Strengths

The findings were that the tutors were helpful to students and lighten the demands on the faculty members.

- Some students preferred to work with tutors because they feel more comfortable.
- Students are encouraged to get to know their peers and collaborate.
- Team teaching allows for students to receive help from multiple faculty members.

The variation was that Faculty C perceived that students sitting in close proximity to each other promoted peer-to-peer interaction.

Faculty Perspectives on Classroom Strengths

The findings were that faculty can better interact with students and provide more one-on-one support.

- Faculty members can have humorous and motivational conversations with students.
- The students can work at the pace that is comfortable for them to make positive progress; especially helpful for students who have limited English proficiency and need for repetition of the material.
- Students and faculty members have multiple ways to communicate such as email, text message, asking the instructor a question, and face-to-face questioning.
- Policy that allows students to continue and complete the course in multiple semesters and continue from where they left off in the previous semester, is helpful for successful completion of the course and financially beneficial to students.

- Instead of just lecture, the faculty members are able to analyze data and implement instructional methods that they feel best help students to learn.
- Classroom interaction and reflective practice during instruction between math faculty members increased.

A variation was that English language learners had ready access to the course material and could listen to or view the material multiple times to better understand the content and context.

Faculty Perspectives on Physical Setting Strengths

The findings were that Multiple rooms are used to accommodate overflow in the computer lab.

- Multiple settings allow for students to have a choice where they feel more comfortable sitting, such as rows of desks with computers and round tables with no computers allow students to use their own laptops and interact with faculty members and students.
- The access to additional rooms with computers to accommodate overflowing of students helped with high students traffic days.

The variation was that the computer lab setup was a positive, but Faculty C perception was that more designated computer lab space is needed to better accommodate all the students in the redesigned developmental math program.

Chapter 3

The Academic and Environmental Weaknesses of the Course from the Students' and Faculty members' Perspectives

Academic Weaknesses – Student Perspectives

Student Perspectives on Curriculum Weaknesses

The findings were that the computer only recognized a certain way of inputting the correct answers and sometimes will mark answers incorrect due to typo or formatting errors.

- Word problems were challenging because students' weak language skills can lead to different interpretation of the words.
- The MyMathLab software programming allows for only specific answers to be marked correct.
- Typos in the answer results in the computer program marking the math solution incorrect, and as such is an added frustration for students because it involves student thinking that they solve the problem incorrectly and self-doubt. Also, trying to resolve the problem is time consuming and can retard student progress.

The variation was that while MyMathLab is a useful tool it has many limitations and can hinder progress.

Student Perspectives on Resource Weaknesses

The findings were that purchasing the access code for MyMathLab. Visually, having all the textbook material electronically was a challenge for some students who preferred hardcopies of course material.

- For emailing the instructor, the keyboard was not math symbol compatible.
- The computer program, MyMathLab, would crash.
- The videos and presentations overelaborate the steps to solving problems.
- For the instructional materials and resources, they were sequential, and some faculty members placed prerequisites and would not allow early access.
- The computer keyboard was limiting because it did not have math symbols, so students had to learn alternative ways of how to type math symbols in their solutions.
- Working online can pose as a distraction for students because they have ready access to social media and games which can hinder progress.

The variation was MyMathLab access involved a paid subscription and was a challenge for some students to pay by credit card and some students preferred hardcopies instead of electronic copies of the course material.

Student Perspectives on Assignment & Assessment Weaknesses

The findings were that homework had many long and redundant questions.

- The instructor created homework problems but did not have examples to assist students.
- Other people can complete your homework and quizzes because they were not password protected.
- Answers had to be inputted exactly as programmed in the software. If the question asked for the answer in fractions and an equivalent decimal was inputted, it was graded as incorrect.
- Many test questions were way different than the homework and some were not aligned to the module material.
- Each test had to be retaken until a student scored 75%. The software limitation can be frustrating, time consuming for students and can prevent progress because they have to retake the exams until they score 75% even if they scored 74% and had the correct solution with the answer inputted with a typo or incorrect format.

The variation was while the assignments were readily available online, there were no accountability on who was completing the task. Unlike paper and pen math work, where the instructor might recognize the student’s handwriting there is nothing to track who is competing the online assignments when they are done outside of class.

Academic Weaknesses – Faculty Perspectives

Faculty Perspectives on Curriculum Weaknesses

The findings were that math classes after developmental math required paper submission of work and showing mastery of process in solving problems, and students lack that foundational skill.

- The computer modules mostly asked for final answers.
- Students have a difficult time connecting the content to their real-life.

The variation was while students completed the work on the computer and enhanced their skills on MyMathLab, they were gaining limited or no note taking and problem-solving skills on paper which is need for the higher-level math courses.

Faculty Perspectives on Resource Weaknesses

The findings were that the instructor's explanation and the multimedia's explanation differ. There software website downtimes and updates were inconvenient and set students back on their progress.

- The explanations in the presentations and videos were too long, and the problem-solving techniques were not the most effective for learning mathematics.
- The instructional strategies and problem-solving techniques for MyMathLab problems and examples in the videos and presentations were confusing for students.

The variation was that while the online lectures and videos are useful tools, the explanation of problems were not always the same as the classroom instructors' explanations and could lead to more problem-solving confusions for students.

Faculty Perspectives on Assignment & Assessment Weaknesses

The findings were that students memorized answers from previous problems. Students do not analyze the problem, and just guess the answer.

- Students can imitate the problem-solving procedure without understanding.
- Some students can pass module assessments without understanding and mastery.
- The final exam stresses the procedure or method for solving the problem.
- Students are expected to remember all methods to solve problems.
- The lack of procedural and conceptual fluency will be a barrier for students in their next higher-level math course.

The variation was while the MyMathLab platform allows for completion of math assignments, students tend to try to complete the problems rather than to understand and master their analytical skills. Also, faculty do not agree on what should on the exams.

Environmental Weaknesses – Student Perspectives

Student Perspectives on Peer Weaknesses

The findings were that tutors were not always available.

- There was long wait time for tutor help. Some students disliked some tutors.

- Some peers were not interactive.
- Some peers attended class late and often engage in distracting conversations.
- In class help was difficult to get since faculty and tutors were always busy help students with one-on-one support.
- Especially for students who needed help with every section, long wait time for help was frustrating and led to students losing focus on their work.

A variation was that students' feelings of dislike about some tutors would prevent them from seeking help, and when students needed help with many math problems they tend be discouraged from asking for in-class assistance because they felt it might take the whole class period just to help one person.

Student Perspectives on Classroom Weaknesses

The findings were that students feared some faculty members because they look intense. Some students felt some faculty members did not care and that some instructor's instructional strategies were not effective.

- The expectations were not high enough for some students and the self-pace allowed for students to put off their work and fall behind on their work.
- Module 10 was very time consuming.
- Also, self-pacing allows many students to procrastinate.

The variation was that some students perceived the instructors disinterested in what they were doing as lack of empathy or caring, while other students perceived the instructors interested in what they were doing by hovering over the shoulder as scary.

Student Perspectives on Physical Setting Weaknesses

The findings were that the classroom could get very crowed. Computer keyboard did not allow for much room for students to open their books.

- Depending on which computer was available, students sit next to different people.
- Random seating made it difficult to get to know other students and thus limits peer helping each other.
- To accommodate all students, there is a need for more spaces in the computer labs, and a need to extend hours of operation.

The variation was the peak and off-peak times when students use the classroom computers, so the classroom was not always overcrowded especially in the late evening.

Environmental Weaknesses – Faculty Perspectives

Faculty Perspectives on Peer Weaknesses

The findings were that due to budget cuts, the program was not able to employ tutors.

- Some students who were weak in math do not like to collaborate because they feel embarrassed.
- Working with a computer minimized the time students could spend in collaborative conversations with peers.

The variation was students weak in math might hid behind the computer screen and not seek help from tutors or peers.

Faculty Perspectives on Classroom Weaknesses

The findings were that students possibly felt that they should not be bothered an instructor sitting in front of a computer. Faculty members not comfortable with self-paced instruction were easily disengaged.

- Poor online lectures did not address all learning styles.
- High absenteeism because students felt "invisible". Faculty members tended to lose track of students.
- The self-pace was too flexible, and with limited deadlines, students procrastinated, and fell behind.
- Students were on their own and sometimes used "trial and error" to get the correct answer.
- Some students complained because they expected a lecture style culture.
- The online presentations were limiting in addressing different learning styles.
- The re-taking of quizzes until passing prevented students from studying between takes because many students instantly retake and guess their ways through the quiz.
- Faculty felt that the students were expecting a more traditional lecture approach.

A variation was that some faculty members felt that some of the other math faculty members lacked empathy and their body language was discouraging for students.

Faculty Perspectives on Physical Setting Weaknesses

The findings were that maintenance for the computers was time consuming. The reliability of the wireless network was inadequate.

- Students who worked during the day had limited hours to access the computer lab.
- There is a need for a bigger space, more computers, and lab monitors to best implement the self-paced model.

The variation was to consider computer lab access hours that would accommodate students who work all day. Since many students work during the day, the computer lab should be open as much as possible during the evenings and if possible, on the weekends.

Chapter 4

Recommendations and Conclusion

The College should ensure courses are regularly evaluated for implementation and outcomes. The findings of the program evaluation were shared with the administrators, program director, and faculty of the developmental mathematics program in the evaluation report to provide insights on the outcomes of the developmental mathematics course to ensure that the developmental mathematics team was aware of the effective aspects of the course and aspects that need to be improved to enhance the course. The goal was to provide the developmental program advising and decision-making body with information that will guide future implementation of the developmental mathematics program. The hope was that the voice of the course participants, students and faculty members, will provide valuable information to inform data driven redesign.

Project Evaluation Recommendations

1. The college decision making team should involve developmental math students to provide insights and feedback on the course. It is necessary that students are engaged in academic decision-making processes, and to not isolate decision-making to College employees.
2. More computers are needed to cater to the needs of all students.
3. Faculty members should collaborate and train new faculty members how to best service students in a self-paced setting.
4. Yearly program evaluation of developmental program should be conducted.
5. Peer tutoring should be continuously integrated into the program.

6. The curriculum should be evaluated.
7. The assessments and final exam should be evaluated to align more consistently with the curriculum.
8. Provide faculty the time to meet and discuss effective teaching strategies.
9. Provide the faculty with professional development on effective developmental mathematics teaching and learning strategies.
10. The Faculty should develop a survey to get students' input/feedback on developmental mathematics courses.
11. Administrators should make it mandatory that all developmental students meet with their academic advisor or counselor at least once in the first quarter of the semester. This will provide students with early support to address challenges and to enhance their college experience.
12. The college needs to develop an online early alert system to help developmental mathematics students. Developmental students need more nurturing; thus, the college should hire developmental faculty with affective and effective skills that include being able to influence positive mindset and engage students with math content. The college may also provide professional development to train developmental program faculty.

The college's developmental mathematics program director and faculty can implement changes or redesign the mathematics course after gaining insights from the project study evaluation report. The recommended timetable for implementation and release of the evaluation reports was within 60 days after approval from the Chancellor to release the report. The evaluation findings will inform and guide changes for the implementation of new developmental mathematics program and the expected changes will be the within a year. An outcome evaluation at the end of two years will determine what other changes might be needed.

The College's Institutional Research Office (IRO) can assist in future program evaluation. Outcome and efficiency evaluation are important to determine how educational courses and programs fare with respect to meeting the academic needs and success of students. While program evaluation is a challenging undertaking for many institutions, it is an important practice to make a difference and inform positive changes (Royse et al., 2016). Developmental mathematics programs need to be evaluated every two years, to determine the impact of changes on the program outcome and efficiency. Thus, program designers can attempt to determine what factors contribute to making developmental educational courses better for the learners.

The outcome program evaluation could help establish whether the college has utilized the finding as presented in the program report to help effectively redesign or redirect their developmental mathematics program to enhance the Math 24 course, student success rate, and stakeholder's experiences. Future evaluation and research is needed to ensure that the developmental mathematics program is better serving the learners educational needs and increasing success.

The governing body of the college and developmental faculty have to work closely with the Institutional Research Office and students to find ways that can better support students to achieve success in developmental mathematics and decrease the attrition rate. The advisory and counselors have to work closely with students and faculty members to develop an early alert mechanism to help students. Students need to be more involved in the decision-making process of identifying ways that will enhance their success and have a more vested interest in their education and leaning.

Conclusion

The findings and recommendations could impact college wide social change where college leaders can engage the strengths and insights of participants to advance growth and strengthen programs to enhance student academic achievement. The college educational leader can promote capacity building, thus strengthening the effectiveness of the college's professional and human capital. The findings suggested that the redesigned math course’s curriculum, resources, assignments, assessments, and the physical classroom setting had many advantages. However, multiple challenges for both students and faculty members remain. Retention, persistence and success rates fluctuated over the years and the expected outcomes were not achieved.

Success, retention, and persistence rates for students in the redesigned developmental mathematics course as compared with students in the previous developmental mathematics indicated that there was no consistency in increase or decrease of rates. The persistence rate or percentage of students who re-enrolled in Math 24 decreased in the initial year of the redesigned course; however, it was consistently higher from Fall 2011 for the redesigned mathematics course compared to the previous developmental mathematics course. The retention rate of Math 24 students enrolled in a higher-level mathematics class in consecutive semesters (fall to spring or spring to fall) for the previous developmental mathematics and the redesigned developmental mathematics course.

The changes of the developmental course and outcomes (measurable and reportable achievement) were at the introduction of the redesigned developmental mathematics course, 100% of the courses were taught through the self-paced model and MyMathLab. Computers were used for delivering instruction and faculty members shared the task of supervising the computer lab. The courses had common curriculum and scheduled classes were conducted simultaneously with computer lab time. During the implementation of the resigned course, ongoing and on-demand changes were introduced. Each instructor started to tailor the course to what was deemed necessary. Some decisions on certain specific changes, such as eliminating the written midterm, and introducing an online departmental final were done through whole faculty collaboration.

The academic strengths were that the curriculum modules were aligned provided the foundational skills to prepare students for the next higher-level mathematics, the electronic resources were useful to aid learning, and the assignments and tests provided instant feedback and relevant practice of course problems, the assessments enhance mastery of content and mathematical skills. The environmental strengths were that peer collaboration, tutors, faculty members, and the physical setting were all valuable in promoting teaching and learning of math.

The major themes that emerged from both faculty and student perspectives for academic and environmental strengths were curriculum alignment, MyMathLab usefulness, assignments and assessments relevance, advantage of retaking tests, positive peer tutors and peer collaboration, and effective classroom and computer setting. The major themes for the academic and environmental weaknesses were English language challenge, online resources manipulation, assessments and lessons not aligned, online and peer distractions, overcrowding of classroom, and time-consuming tasks. Only one similar theme emerged from both faculty and students for academic weakness, which was the MyMathLab resources. The limited computers and setting of physical space were challenging for both faculty and students.

The patterns that emerged were the word problems, and final exam posed the biggest challenges for most students in all focus groups. The challenge with the word problems are related to limited English language comprehension. Final exam challenges were related to the assessments and lessons lacking content alignment. Internet connect and access to computer issues posed the greatest environmental challenge for both faculty and students which were related to the classroom and computer setting. Resource manipulation and time-consuming tasks were related to assignment questions being reductant and assessments not reaching the passing scores because of typos or formatting of the answers is not exactly as programmed in the MyMathLab software. Online resources, MyMathLab, peer collaboration, and indirect instruction were strengths. Retention, persistence and success rates fluctuated over the years and the expected outcomes were not achieved. The relationship that emerged from the data is that students in Focus Group 1 and 2 cited more positive academic and environmental aspects of the redesigned mathematics course. Whereas, the students from groups 3 and 4 cited more weaknesses in the course design. The variations that existed were that the redesigned mathematics course underwent multiple changes over time and inconsistent instructional styles that were impacted by instructors' philosophies of how to teach. No two semesters were the redesigned course delivery the same. Individual faculty tweaked policies and expectations to tailored to the needs and challenges of their students. The many changes and disparity in the results do not allow for any one factor in the redesigned course to be credited for any higher or lower success rates.

Thus, continuous evaluation of developmental mathematics programs is essential to identifying the strengths and weaknesses of the programs. Most importantly, the results of an outcome and efficiency evaluation will determine if the program is meeting its expectations. The goal of the project was to provide insights for the college to aid social changes and decision-making process. Also, the results will provide data-driven decision making, from faculty and student perspectives and success rates, that address changes for future developmental mathematics courses.

Developmental mathematics continues to be the most challenging course locally and nationally. With multiple models, changes, and redesigns the course continues to show no significant increase in success rate for college students. Developmental mathematics is the most frustrating course for college students. The involvement of student participants in the program evaluation is critical to social and academic changes. The students are the ones that are most impacted by the course and it is essential to have their perspective on what can be done to address their needs to achieve success and remain engaged.

The project evaluation revealed how faculty members and students felt about the developmental courses and the success outcomes. The implication for social change is that faculty should include the feedback from students to help more effective decision making. Thus, the program evaluation could better guide the college educators and better inform the implementation of future developmental mathematics courses at the college. As a result of faculty and student collaboration on developmental math redesign, students and faculty might feel that they are doing their best to transform educational practices, and have the best developmental mathematics program, to master their basic mathematics skills and become successful and productive citizens.

APPENDIX B: Program Director Interview Questions

(For Evaluation Question 2- Administrator and Faculty)

1. What were the Math 24 course changes, per semester, that were implemented from Fall 2010 to Spring 2014?

2. What were the rationale(s) for each semester change(s)?

3. How did persistence and success (the measurable outcomes) change from 2010 to 2014?

4. How did the Math 24 actual measurable outcomes (persistence and success) compare to the proposed Math 24 measurable outcomes?

5. What does the Math 24 course changes and outcomes imply for the redesign of the Math 24 course?

6. What are your perspectives on the Math 24 course changes and the measurable outcomes (persistence and success)?

7. For future redesign of the Math 24 course, what are some things you would like to see changed/improved (why)?

8. Any thoughts about Math 24 that we have that not covered? Or anything else you would like to share?

Thank you for your cooperation.

APPENDIX C: Focus Group Questions - Students

(For Evaluation Question 3 and 4)

Focus Group Number/Name: ____________________ Date: _________________

Focus Group Questions:

1. Tell me how you feel about the curriculum, assignments, the assessments (test and quiz), and math resource, that is, the academic aspects of the course.

2. Tell me how you feel about the classroom setting, peer collaboration, instructor interaction, instructional strategies, communication, support, regulations, and the physical classroom environment, that is, the environmental aspects related to the course.

3. What do you see as the biggest strength of the course?

4. What do you see as the biggest weakness of the course?

5. How did the course meet your expectations and needs, and how did it differ from your expectation?

6. Tell me how you feel about the course impact on your learning and **preparing you** for future math or college and real-life experience?

7. For **students who dropped/failed**:

(i) Dropped/Withdrawn: Please explain why you dropped/did not complete the course/Math 24?

(ii) Failed: What are some barriers that prevented you from being successfully in Math 24?

(iii) For **students that pass** the course: How well did Math 24 prepare you for the next math course that you took or are taking now?

8. Describe **challenges** you experienced in Math 24 course and possible ways this **challenge** can be overcome.

9. What are some things you would like to see changed/improved and any **additional services** do you think the college can offer for students who are struggling in the redesigned math course?

10. **Additional student perspectives**: Any thoughts about Math 24 that you have that I did not cover? Or anything else you would like to share?

APPENDIX D: Instructor (Faculty) Interview Questions

(For Evaluation Questions 3 and 4)

Faculty Name: ____________________ Position: __________________________

Date: _____________
Email:_________________________Telephone:_________________

The purpose of the interview is to collect data that on the academic and environmental strengths and weakness of the redesigned Math 24 course, and data that help track the changes per semester of redesigned Math 24 course from Fall 2010 through a faculty perspective.

1. Tell me how you feel about the curriculum, assignments, the assessments (test and quiz), and math resource, that is, the academic aspects of the course.

2. Tell me how you feel about the classroom setting, peer collaboration, instructor interaction, instructional strategies, communication, support, regulations, and the physical classroom environment, that is, the environmental aspects related to the course.

3. What do you see as the biggest strength of the course?

4. What do you see as the biggest weakness of the course?

5. How did the course meet your expectations, and how satisfy are you with the course in respect to meeting the needs of students?

6. Tell me how you feel about the course impact on student learning and **preparing them** for future math or college and real-life experience?

7. What are some things you would like to see changed/improved and any **additional services** do you think the college can offer to improvement to the Math 24 program (why)?

8. **Additional instructor perspectives/observations**: Any thoughts about Math 24 that you have that I did not cover? Or anything else you would like to share

Thank you for your cooperation.

APPENDIX E: Interview Protocol

Thank participants (Initial): I want to thank you/all of you for participating and to let you know that your input will be very valuable to help with providing insights to educators in the future redesign of developmental math programs.

Brief on the Project Study: The focus group is part of the process of collecting data for my Doctoral Project Study with Walden University. The study is to evaluate the developmental mathematics program at Kapiolani Community College.

Confidentiality: Before we begin, I want to reassure your personal information (names) will be kept confidential. Your names will not be written on the interview transcript nor appear on the report summarizing these interviews.

Permission: It would be helpful if I taped our interview. Is that OK with you? Also, can you kindly sign the Participant Consent Form? Would it be okay for me to contact you if I need clarification on any of the information you shared?

Protection: You can withdraw from the study at any time without any consequences. I want you to be comfortable at all time, so please let me know if you are not okay with a question or procedure.

Procedures: The interview will take about 90-120 minutes. I would ideal to have input from all participants for each question, so it would be great if we stick to the questions. Also, for each question, maybe an average of 1 minute per person (some questions may take more or less time). I will address you as participant 1, 2, 3, and4 (and so on –if there are more participants).
Here is a list of questions I will be using as a guide (take a few minutes and read them to be aware of what I will be asking).

Interpretation: As part of the study, I have to validate the interpretation of data with the source of the data. Would it be okay for me to confirm with you that my interpretation of the information you provided is true or correct?

Thank participants (Final): I want to thank you again for your valuable time and input. Would it be okay to contact you again if I need clarification on any of the information you shared? Here is a $5 gift card to say thank you.