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Adult College Students' Perceptions about Learning Mathematics via Developmental Mathematical xMOOCs

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by

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DEDICATION

I dedicate this dissertation to my parents, Michael and Kathy Alesafis, and my sister, Maria de Koter, who have always been my nearest neighbors and have been so close to me I found them whenever I needed them. Mom, Dad, and Maria you are truly my quiet place. I also thank my loving husband, Kent and my extraordinary son, Spyros. It is their unconditional love that motivates me to set higher aspirations. They provide me with a strong love shield that surrounds my being. Thank you for walking along side of me and most of all for showing me consistency of heart.

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ABSTRACT

Debates over the promising change Massive Open Online Courses (MOOCs) might offer to traditional online learning now produce significant attention and discourse among the media and higher education. Ample articles discuss the potential benefits of MOOCs from the perspectives of faculty and administration. However, little is known about students' perceptions of MOOCs. Given the lack of relevant literature and the reality that MOOCs are created to benefit students, it is important to elicit current college students' perceptions of MOOCs since it is well documented learning mathematics online has its problems (Ashby, Sadera, & McNary, 2011; Frame, 2012; Ho et al., 2010; Hughes et al., 2005; Jameson & Fusco, 2014).

In this descriptive exploratory case study, I explored the perceptions of eight adult college students enrolled in a developmental mathematical xMOOC. I utilized constant comparative methods (open, axial, and selective coding) to analyze the data and identified overarching themes related to student perceptions of learning developmental mathematics via an xMOOC. XMOOCs are structured like large online lecture courses, usually with auto grading features for tests and quizzes and video-recorded lectures. I also employed post structural tenets to scrutinize the data through different lenses. My goals were to explore college students' perceptions of learning via developmental mathematical xMOOCs, the reasons students chose to learn developmental mathematics via an xMOOC, students' beliefs of personal characteristics needed to successfully complete a developmental mathematical xMOOC and their ideas about how to improve developmental mathematical xMOOCs. The study provides insights about college students' learning and success via developmental

mathematical xMOOCs and adds needed information to the literature on higher education distance learning.

CHAPTER ONE: INTRODUCTION

The increasing cost of post-secondary education coupled with the rising demand of technology-infused pedagogy create the opportunity for a new type of learning alternative: The Massive Open Online Course (MOOC). MOOCs are in the spotlight as the new technological drivers in online learning. Debates over the possible changes MOOCs may offer to traditional online and face-to-face learning now create significant discourse among higher education institutions (Viswanathan, 2012; Young, 2013). However, the lack of college students' successful completion of MOOCs is an issue at the community college (Cole & Timmerman, 2015; Perna et al., 2014). It is well noted learning mathematics online has its issues (Ashby, Sadera, & McNary, 2011; Boylan, 2011; Chapman, 2012; Chen, Yang, & Hsiao, 2015; Cole & Timmerman, 2015; Ho et al., 2010). One issue is research indicates online and blended adult math students (blended courses have both an online and face-to-face components) perform less effectively than face-to-face developmental math students (Ashby, Sadera, & McNary, 2011). The reason for this low performance may be due to a combination of mathematics anxiety and mathematical low self-confidence (Cercone, 2008; Cook, 2004). Adult learners tend to possess lower mathematical self-confidence than traditional straight-out-of-high-school-college students (Cook, 2004; Jameson & Fusco, 2014). Adult math learners also possess distinct characteristics. For example, many learners are older returning students, have dependents, and work full time (Cercone, 2008). They have families and jobs and deal with transportation concerns, childcare, aging parents, and the need to earn an income. These factors can interfere with the learning process (Cercone, 2008). Scaffold these concerns with the openness, massive nature, and pedagogical issues of MOOCs, and this trend equates to participants' low completion rate ranging from four to 12% (Cole & Timmerman, 2015; Hao, 2014; Ho et al., 2010; Jordan, 2014).

There have been ample articles and discussions on potential benefits and costs of MOOCs from the perspectives of faculty and administration (Cole & Timmerman, 2015; Perna et al., 2014). Several researchers and media outlets have conducted quantitative studies and discovered a range of administration and faculty perceptions of MOOC effectiveness (Cole & Timmerman, 2015; Hao, 2014, Young, 2013). But, there is sparse research that explores college students' perceptions and experiences when using mathematical MOOCs (Cole & Timmerman, 2015; Hao, 2014; Perna et al., 2014). There is even less qualitative research about adult college students' perceptions and experiences of learning via developmental mathematical xMOOCs (Ayala, Dick & Treadway, 2014; Cole & Timmerman, 2015). Since colleges and universities created mathematical MOOCs to benefit students, it is important to elicit current college students' perceptions of learning via developmental mathematical xMOOCs (Cole & Timmerman, 2015; Hao, 2014).

In this descriptive exploratory case study, I used an online questionnaire (I devised and piloted during the fall of 2016) to explore the perceptions of eight adult college students' who were enrolled in the same developmental mathematical xMOOC. The following *A Priori* questions guided the study:

1. What are eight adult college students' enrolled in the developmental mathematical xMOOC perceptions of their learning in the xMOOC?
2. What reasons do these eight adult college students give for enrolling in the developmental mathematical xMOOC?
3. What are the students' ideas about how to improve the developmental mathematical xMOOC?
4. What are eight adult college students' perceptions of personal characteristics needed

to successfully complete the developmental mathematical xMOOC?

I employed constant comparative methods (Glaser, 1965; Merriam, 2009; Neuman, 2004) to analyze the data and identify overarching themes. I also turned to post structural tenets to explore the data through different lenses (see Derrida, 1982; Jackson & Mazzei, 2011; Spivak, 1988). I sought to discover adult college students' impressions and perceptions of learning via developmental mathematical xMOOCs, why they chose an xMOOC to learn developmental mathematics, student beliefs of personal characteristics needed to successfully complete a developmental mathematical xMOOC, and their ideas about how to improve developmental mathematical xMOOCs. The discoveries from this study help to provide insights about adult college students' perceptions of learning and success via a developmental mathematical xMOOC.

My Reasons for Conducting the Study

Martin Heidegger believed the researcher is as much involved in the research as the participants, and researchers' prior knowledge reflect on their ability to interpret data (1988). As the researcher in this inquiry, in this first chapter I reflect on my prior knowledge and experiences about teaching and learning mathematics and my reasons for conducting this study.

My Pedagogical Orientation

I am a lifelong learner. I help my students learn and, in turn, I learn from my students. I consider myself a mathematics facilitator and helper. I believe in fostering learning through active learner participation and exploration. When you do, you learn. I believe in fostering mathematical critical thinking and facilitating lifelong mathematical learning skills to prepare students to function as competent citizens. My overall teaching philosophy is active student learning strongly influences students' attainment of knowledge. I try to reduce my students' mathematical anxieties with a safe, positive, active learning environment. I purposely create a learning environment where students feel comfortable to discuss mathematics and actively engage in mathematical problem solving.

I love to teach. I love to learn. My goal as a learning facilitator is to ignite the passion of mathematical learning within my students and create a positive, safe learning environment that fosters educational experimentation and innovation.

Situating Myself in the Research

"Who we are as educators shapes the tenor of our classes and impacts how and what students learn" (Richards, 2011, p. 784). I love math. I believe mathematics to be the gateway to nature, reasoning, and life. Math makes sense to me. I am a white, middle-aged, female associate mathematics professor at a local four-year community college in the Southeastern region of the United States (Coastal College – a pseudonym). I have taught mathematics for 23 years, in grades seven-12 as well as college-level courses. For the past 17 years, I have taught mathematics at Coastal College. I teach a variety of mathematics courses: - Pre-Algebra, Intermediate Algebra, College Algebra, Geometry, Liberal Arts Math I & II, Elementary Statistics, Trigonometry, Pre-Calculus, and Applied Calculus. I am familiar with the curriculum for each course and write curricula, standards, and common syllabi for many of these courses. I am cognizant of the mathematical concepts students need to grasp to be successful in their future mathematical endeavors.

I facilitate mathematics online as well as face-to-face. I am "Quality-Matters" certified. "Quality Matters" is an international program that verifies online course quality processes. I have certifications in creating "Quality Matters" rubrics, developing "Quality Matters" online courses, and as a "Quality Matters" peer reviewer. I recognize the need for unique online pedagogical techniques. I believe successful online courses are dependent upon effective pedagogy and learning strategies. Most online courses are informed with ideas from constructivist theory (Reiser & Dempsey, 2011), that suggests learners construct new knowledge when they are actively engaged with the learning process, and connectivism theory, that embraces the use of technology when teaching and learning (Downes, 2010; Siemens, 2005). Connectivism theory explains how complex learning takes place in our ever-changing social digital world and believes we learn by being actively engaged and making connections. In today's digital era, one avenue that learners can make connections, is via technology. Together, connectivism and constructivism provide an alternate avenue for acquiring learning skills in a technological era. I believe these two theories work together to create a unique learning opportunity because they provide a model of learning in which students are encouraged and supported to learn, in both educational and professional arenas to work together to create knowledge with the incorporation of technology and open-online networks. The intent of these two theories is not to replace the teacher or facilitator but to improve learner communication and learning.

My Educational History

Words are powerful. I was always a high mathematics achiever. I sat in the front row of every mathematics class I took, ignoring the chit-chat of my classmates. I did well in all my mathematics courses and rarely suffered from mathematical anxiety, not even during test situations. My self-assurance in mathematics was partially due to my third-grade teacher, Mr. C. I knew I was good at math when Mr. C told my class about me. I still remember that day. Mr. C's wife came to class to volunteer. Mr. C turned to his wife and, in front of the entire class, pointed at me and announced, "This girl is good at math. She's gunna be a math teacher." And just like that, with those few words, my life's path was determined.

I do have a variety of passions, which is why I have two undergraduate degrees one in International Business and another in Mathematics Education. I have also earned a MA degree in Mathematics with an emphasis in Education and pursued a Ph.D. in Mathematics Education.

Why I Chose This Study

I am passionate about mathematics, and I am compassionate about the learning needs of my students. I developed my compassion through years of watching my peers and my students struggle with mathematics. I tried to understand where their mathematical struggles originated. Why did I not have those same mathematical struggles and anxieties? I often wondered if mathematical anxiety was a real condition.

I teach all levels of mathematics. Through my lens as a 23-year mathematics instructor, I have found many of my students enrolled in pre-requisite courses (Pre- Algebra and Intermediate Algebra) have low confidence levels about their mathematical abilities. I noticed these mathematical uncertainties in students fresh out of high school as well as in the 40 to 50 + year old, and in military veterans who experienced combat. Thus, I encourage my students to interact and create mathematical discourse whether in class, via email, or in peer tutoring sessions. I strive to create a safe learning environment where students feel safe to ask questions and discuss their mathematical fears and frustrations. I also freely share my personal academic goals and frustrations with my students. I share for two reasons: 1) to help students learn from my mistakes and 2) to show my students I am a caring and approachable teacher, person, helper, and resource.

The question "How can I create an environment that increases student mathematical self-esteem, confidence, and competence?" has always driven my pedagogical philosophy. I have actively researched mathematical MOOCs for the past six years. I have found while there is extant quantitative research literature on MOOCs via faculty perspective, there is scant qualitative research on MOOCs and little extant literature on developmental mathematical xMOOCs from adult college students' perspectives. (XMOOCs are a type of MOOC. The structure of XMOOCs are similar large online lecture courses where the facilitator(s) lays out the course format and content- usually with auto-grading features for tests and quizzes.) As a mathematics instructor in a community college, I had limited understanding into shared and individual adult college students' experiences as they advanced through a developmental mathematical xMOOC. It became apparent to me, qualitative research on these students' perceptions of developmental mathematical MOOCs was urgent to explore. Consequently, to engage in this study, I invited eight developmental mathematical xMOOC adult college students to participate in a qualitative study to ascertain reasons for enrolling in the developmental mathematical xMOOC and their perceptions of learning in a developmental mathematical xMOOC. The discoveries from this study provide insights concerning adult college students' learning and success via developmental mathematical xMOOCs.

Rationale for the Study

Some scholars debate the survival of MOOCs (Barrett, 2013; Delvin, 2012; Masters, 2011; Rivard, 2013; Walters, 2013; Young, 2013), while many have exaggerated the capabilities of MOOCs (Jaschik, 2013; Masters, 2011; Perna et al., 2014; Schaffhauser, 2013). For example, MOOCs "have been overhyped as a simplistic solution to many problems" (Jaschik, 2013, p.3). Some view MOOCs as a positive, disruptive innovation that will transform higher education's pedagogical deliveries over the next decade (Barrett, 2013; MacKay, 2013). Many colleges and universities view MOOCs as a series of self-paced courses with the aim of helping incoming students refresh their prerequisite skills and also to prepare students for placement tests (Adair et al., 2014). Some argue only a brick-and-mortar educational institution can offer a true post-secondary education (Barrett, 2013). That said, many students cannot attend post-secondary institutions due to steep tuition costs. MOOCs provide masses of students' access to lectures, online forums, and other educational materials that normally they would never find available (MacKay, 2013). MOOCs offer more choice, control, and greater ownership of the learning at a much lower cost (MacKay, 2013).

Regardless of scholars' perspectives for or against MOOCs, many agree MOOCs are the emerging, novel method of online teaching in which theoretical pedagogies are largely unexplored (Adair et al., 2014; Cole & Timmerman, 2015; Masters, 2011).

There has been ample information on the potential benefits of MOOCs with the perspectives of faculty and administration (Cole & Timmerman, 2015; Delvin, 2012; Masters, 2011; Rivard, 2013; Walters, 2013; Young, 2013). However, as current college students are the population most affected by the recent adoption of MOOCs in higher education and sparse research has been accomplished on current college students' perceptions and experiences of developmental mathematical xMOOCs, more qualitative research on student perspective is necessary (Cole & Timmerman, 2015; Hao, 2014). Most mathematical MOOCs lie in the xMOOC pedagogical framework. Pedagogical framework designers of xMOOCs structure xMOOCs similar to large online lecture courses where the instructors lay out a detailed course format commonly with auto-grading features for graded assignments. Some perceive xMOOCs as having more accurate content because a qualified professor creates the course and content instead of the participants, as occurs in most cMOOCs. However, there is limited student-instructor interaction and/or collaboration because the learner works independently throughout the course.

Insufficient qualitative research has explored the advantages and limitations of xMOOCs via students' perspective (Hao, 2014; Martin, 2012; Morris, 2011). Extant research had little insight into collective and individual adult college students' perceptions as they progressed through a developmental mathematical xMOOC. It became clear to me that qualitative research on adult students' perceptions of developmental mathematical xMOOCs was necessary. If developmental mathematical xMOOCs are to reach their maximum potential, research must be conducted to address experiences and perceptions of current developmental mathematical xMOOC users (Hao, 2014; Kolowich, 2012; Martin, 2012; Morris, 2011). In this qualitative study, I explored the perceptions of current developmental mathematical xMOOC adult college students' who were enrolled in the same developmental mathematical xMOOC.

The Problem

There is a growing body of literature on the potential benefits and challenges associated with MOOCs (Hao, 2014; Kolowich, 2012; Martin, 2012; Morris, 2011; Rivard, 2013). The extant literature however, does not disseminate information on students' perspectives of xMOOCs. Rather, the information consists of articles that present the perspectives on MOOCs of media outlets, college faculty, and administration. Current college students are the most affected population by the recent adoption of mathematical xMOOCs in higher education. Sparse research has explored current adult college students' perceptions and experiences of developmental mathematical xMOOCs. Thus, more qualitative research on student perspective is necessary (Hao, 2014; Kolowich, 2012; Martin, 2012; Morris, 2011).

Purpose of the Study

In this descriptive exploratory case study of adult college student perceptions about learning via developmental mathematical xMOOCs, I address the lack of information regarding students' perceptions of developmental mathematical xMOOCs. Specifically, I offer insights and themes related to online pedagogy techniques, and methodologies that promote student learning and successful completion of developmental mathematical xMOOCs. The purpose of this descriptive exploratory case study was to meet the calls for qualitative research on adult student perspectives when learning developmental mathematics via a xMOOC (Hao, 2014; Kolowich, 2012; Martin, 2012; Morris, 2011).

A Descriptive Exploratory Case-Study Design

To address my research questions, I utilized a descriptive exploratory case study design (Merriam, 2009; Neuman, 2004). Scholars use descriptive research when a newly explored field or topic needs more information (Neuman, 2004). I wanted to better understand the perceptions and experiences of developmental mathematical xMOOC learners. Descriptive case studies are also useful when the researcher wishes to become familiar with a "new research setting and the particular features of the setting, pulling together various forms of data from a comparatively small community" (Neuman, 2004, p. 15). Descriptive research begins with a well-defined question or questions. A descriptive study's objective is to paint a picture of the research question(s) (Neuman, 2004). Descriptive research is an attempt to provide additional information on a field or topic through exploration and explanation. My objective in this study was to describe in detail, filling in the gaps and broadening understanding of xMOOC participants' perceptions when learning developmental mathematics.

I also concentrated on the exploratory nature of the research because developmental mathematical xMOOCs are new and little is known about student perceptions when learning via developmental mathematical xMOOCs. Neuman (2004) states, "We use exploratory research when the subject is very new, we know little or nothing about it, and no one has yet explored it" (p.38). Researchers conduct exploratory studies when they have a new idea, or have observed a phenomenon and want to investigate it to more fully understand what they have observed (Neuman, 2004). Exploration often lays the foundation for future studies. Exploratory research can either be a new topic, field, or a new angle and has the potential to unearth the unexpected. I wanted to discover student insights when learning developmental mathematics via a xMOOC.

The purpose of using my case study methods was to contribute rich description of single or multiple bounded units situated at a specific context at a specific moment in time to provide insight into real-life situations (Merriam, 2009). Using a case study approach has several strengths such as researchers' ability to obtain rich description that can be possibly transferred to similar situations (Merriam, 2009). Case study research… "examines many features of a few cases" (Neuman, 2004, p. 42). Researchers can compromise the cases of one individual, and the data collected are detailed and varied and focus on a single moment, or duration in time (Merriam, 2009). I wanted to gather rich, thick data of xMOOC participants learning developmental mathematics via a xMOOC.

More importantly, I chose a descriptive exploratory case study design (Merriam, 2009; Neuman, 2004) because it was the best approach to address my research questions. Case-studies are often complemented by exploratory and descriptive research designs and the type of research questions asked in a study often help determine the best research design (Yin, 2009). In Yin's words, "The first and most important condition for differentiating among the various research strategies is to identity the type of research question(s)" (p.7). "In general, case-studies are the preferred strategy when "how" or "why" questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context" (Yin, 2009, p. 1). Using a case study design allows the researcher to capture the complexities of real-life situations by collecting detailed data so the phenomenon can be explored and studied in detail (Merriam, 2009; Yin, 2009). Yin also believes if research questions focus on "what" the best research design fit may be an exploratory, descriptive, or a combination of both (Yin, 2009). My online questionnaire consisted of "what" and "how" questions, which pair well with an exploratory, descriptive case-study design.

In summary, this study is a descriptive, exploratory case study, and the bounded system under investigation is the developmental mathematical xMOOC at a specific four-year community college. Time further bounded the study, occurring over approximately three weeks. My choice of a descriptive, exploratory case study design for this research was driven by the research questions and the purpose of the research study. My aim was to assure the perceptions of the participants were thoroughly examined and reported as intended by the participants.

Theoretical Framework

Constructivism and Connectivism

I recognize the need for unique online pedagogical techniques that differ from face-to-face pedagogical techniques. Successful online courses are dependent upon effective pedagogy and learning theories; specifically, constructivist and connectivism theories (Downes, 2011; Siemens, 2005). Most online courses, particularly MOOCs, rest upon constructivist theory, that states learners construct new knowledge when they are actively engaged, and the teacher becomes the facilitator and not just a knowledge transmitter (Reiser & Dempsey, 2011). Connectivism theory also supports MOOCs that embrace the use of technology when teaching and learning (Reiser & Dempsey, 2011). A fundamental feature of connectivism is learning can happen across connections of online peer systems. In connectivism learning, the teacher is the facilitator and encouraging students to pursue questions/information online on their own and then voice their findings to their connected online community via email, blogs, or online chat groups (Downes, 2011; Siemens, 2005). MOOCs are compatible with both constructivism and connectivism theories. A connectivist MOOC is open to anyone and uses open software systems across the Web to facilitate online learning and sharing. While facilitators guide the MOOC, the MOOC participants are mostly responsible for their learning and sharing, creating a more collaborative learning experience (Downes, 2011; Reiser & Dempsey, 2011).

Motivational and Determination Theories

Motivation and determination theories also undergird this study. Motivational theory explores the reasons for learners' actions, desires, and needs. The social aspect of MOOCs is a great learning asset because MOOCs consider diverse learner needs and learning styles and some learners need more social interactions than others to achieve better learning results. Constructivism is intertwined with motivational theory as it stresses the building of knowledge occurs through meaningful collaboration between people (Downes, 2011; Siemens, 2005). Participants register for a MOOC from diverse backgrounds and with different motivational factors. Completion of the MOOC might not be the reason the learner registered for the course. Researchers suggest students are motivated to participate in MOOCs for several reasons (Belanger & Thornton, 2013; Gov, 2015). A recent study found four different engagement levels of the MOOC participants: completing, auditing, disengaging, and sampling learners (Gov, 2015). The use of motivational theory attempts to understand why students might be enrolling to take MOOCs and what factors may drive them to complete the course (Belanger & Thornton, 2013; Gov, 2015).

Determination theory is a macro theory of motivational theory as human needs are linked to their motivations (Tschofen & Mackness, 2012). Determination theory explores effective intrinsic tendencies of participants. Tschofen and Mackness (2012) employed determination theory to help describe participants' experiences of a MOOC. The authors suggest learners' experiences of MOOCs differ depending in their desire, autonomy, openness, and diversity (Mackness, 2012). Beaven, Hauck, Quinn, Lewis, and de los Arcos (2014) also explored the connectedness between determination theory and MOOC success. They found participants who were not sufficiently motivated, did not adequately collaborate online and felt dissappointed by their MOOC learning experience. According to Downes (2012), MOOC participants decide how and when they want to participate. If participants are not motivated, or determined to learn, then they will not complete the MOOC (Mackness, 2012; Milligan et al., 2013). Motivation and determination theories were important determinants of MOOC engagement in Milligan, Littlejohn, and Margarian's (2013) study on patterns of engagement in MOOCs. In Milligan et al.'s study, most participants described a clear goal that was directly connected with level of participation in the MOOC (2013). The authors argue understanding the nature of MOOC participants as well as participant level of engagement is crucial to MOOC success, where participant self-motivation and self-determined learning are an expectation.

Social Justice in Education

Social justice in education theory helps to explain education's use of curriculum and pedagogy to teach the dominant culture. (Chapman & Hobble, 2010). Instead, schools need to value individual's cultural, religious, and social diversity (Chapman & Hobble, 2010). As Bell (2007) notes, social justice is "equal participation of all groups in a society that is mutually shaped to meet the needs (of the masses) …in which distribution of resources is equitable…" (p.1). Bell (2007) goes on to say that the aim of social justice in education is to help learners develop critical thinking skills, so they understand oppression, their level of oppression in the educational system, and how to interrupt education's oppressive cycles.

Currently there is a good deal of communication by researchers, educators, and administrators about the social justice of teaching and learning mathematics. Scholars say social justice pedagogy should become the practice of freedom across curricula (Chapman & Hobble, 2010; Gutstein, 2003; Gutstein, 2017). Yet, many researchers, educators, and administrators refer mathematics as 'white' math (Burris, 2014; Chapman & Hobbel, 2010; Gutierrez, 2017; Gutierrez, Gerardo, & Vargas, 2017). Some believe teaching mathematics is "straightforward, universal and culture free" (Gutierrez, 2017 p. 11), when in fact many educators and researchers believe the opposite is true. Today, mathematics operates as "whiteness" and "who gets credit for doing and developing mathematics, who is capable in mathematics, and who is seen as part of the mathematical community is generally viewed as White" (Gutierrez, 2017, p.17). Gutierrez, (2017) argues, mathematics is perceived as pure and thus has become the discipline by which many in education measure other disciplines.

Gutierrez expounds and argues we (as a society) believe math operates with no values, judgments, or agendas (2017). Yet we have tied the assumption that knowing mathematics equates to being intelligent (i.e.: If one knows mathematics, they are better than those who do not know mathematics).

Gutstein (2017) agrees with Gutierrez and argues understanding mathematics is perceived as having an elevated status in society, as it serves the needs and goals of the corporate elites who largely control the educational system. Mathematical knowledge can serve and benefit the few or the masses. Social Justice Education argues, “Educators and students can collaborate to re-envision and re-create mathematics classrooms supporting social justice and put an end to oppression and exploitation” (Gutstein, 2017, p. 262). XMOOCs provide a way, due to their unique characteristics, for marginalized learners (i.e.: older learners, low-income leaners, and learners of color) to attain mathematics practice and expertise and end the cycle of oppression in the teaching and learning of mathematics. MOOCs in conjunction with social justice pedagogy, have the ability to broaden “the concept of equity work in mathematics classrooms and may help promote a more just society” (Gutstein, 2003, p.1).

Post Structuralist Tenets: Derrida and Spivak

As a 22-year mathematics instructor I found many of my adult students who are enrolled in pre-requisite mathematics courses lack confidence about their mathematical abilities. Many adult students also enter college having to take at least one remedial mathematics course (Challenges of Remedial Education, 2006). Many adult students have lower levels of algebra skills and higher levels of math anxiety (Meeks, 1989). They have also forgotten basic arithmetic skills and need a refresher course or courses to become proficient in the mathematics required for their intended major. These students are often marginalized in a traditional college setting due to their age and/or mathematical abilities. Marginality is defined as the state of being excluded or outside the center (see Jackson & Mazzei, 2011; Spivak, 1988). Exclusion not only applies to race, gender, and socio-economic status, but is also defined as whoever is outside of the center, or norm at any given time (Derrida, 1982; Derrida, 1992; Spivak, 1988; Spivak, 2013). In this study, I learned many students were marginalized due to several factors that include there: age, socio-economic status, family situational factors, mathematical ability, or a composite of these elements.

The question, "How can I create an environment that increases adult college students' mathematical self-esteem, confidence, and competence for my adult marginalized students?" always drove my pedagogical philosophy. When my college introduced their first developmental mathematical xMOOC six years ago with the aim of helping students of all levels and backgrounds grasp college level mathematical concepts and build mathematical confidence, I was naturally curious about adult student perceptions of learning via the developmental mathematical xMOOC and how these adult math students fit within and outside the margins of academia.

The concept of margins holds participants within and beyond frames (Spivak, 2013). The premises of margins and frames are vague in their way of understanding and describing power relations in academia, and this vagueness has not always been recognized (Jackson & Mazzei, 2011; Spivak, 1988; Spivak, 2013). Derrida (1982) and Spivak (1988) both recognize this ambiguity as well as the need to explore and describe what the margins want (understanding there are multiple margins). These post structural tenets go beyond constant comparative coding methods of mechanical coding and push "data and theory to their limits in order to produce knowledge differently" (Jackson & Mazzei, 2011, p.1) by exploring and describing the silent voices in the data and by viewing the data via multiple perspectives.

To explore adult student perceptions of learning via a mathematical xMOOC beyond constant comparative methods, I utilized post structural tenets, particularly ideas from

Derrida and Spivak. For example, following Derrida's deconstruction notions I determined what was absent from the data (what was not there or what was not said) (Derrida, 1982; Guha & Spivak, 1988), and Spivak's ideas of marginality helped me focus on the margins and who was inside and outside of the center and why (Jackson & Mazzei, 2011; Spivak, 1988; Spivak, 2013). I specifically utilized two analytic post structuralist questions when reading the data. The questions I asked myself as I read and reread the data were as follows: (1) How does the presence of the participants in the developmental mathematical xMOOC make visible the excesses of class, age, and mathematical ability? (Derrida, 1997; Jackson & Mazzei, 2011); (2) How are the developmental mathematical xMOOC participants outside and inside the teaching machine? (Spivak, 1988; Jackson & Mazzei, 2011). Derrida and Spivak both contribute a unique perspective in analyzing data (Derrida, 1982; Derrida, 1992; Derrida, 1997; Guha & Spivak, 1988; Spivak, 1988; Spivak, 2013). Through their lenses, I found where constant comparative methods ended, post structural tenets made the data richer and more meaningful by digging deeper into the words and perspectives of each participant. One example of utilizing post structural tenets to gain deeper insight into the data was viewing the data through the eyes of Derrida. Derrida reads the silence between the lines and understands what was not said by participants is just as important as what was said. Through the lens of Derrida, I noted study participants were technologically savvy learners. Although participants did not directly quote they were technologically competent, it was implied by their willingness to voluntarily register for the developmental mathematical xMOOC to learn.

Epistemology

Part of my data analysis approach reflects a specific epistemological perspective; namely, post structuralism. Post structuralism addresses social theory, a type of hermeneutics (the belief in multiple interpretations or truths) that rejects the idea we ever arrive at a final interpretation of text (Williams, 2014). Post structuralism also recognizes the power of categories and how these categories are defined and shape our thinking. Post structuralism tries to keep definitions of things and categories fluid and argues all definitions are partial and dependent on perspective. Post structuralists (such as Derrida and Spivak) reject rigid definitions (Derrida, 1997; Guha & Spivak, 1988; Jackson & Mazzei, 2011; Spivak, 1988). Spivak elaborates on this subject and argues fixed or rigid ideas are a kind of epistemic violence by making a claim of truth to one perspective and thus denying all other interpretations (Guha & Spivak, 1988; Spivak, 1988). Post structuralism also continuously redefines marginality and power relations, constantly determining who is in the margins and who holds power.

Post structuralism tenets posit the investigation of the social world is not, and cannot be, the search for a detached objective truth (Williams, 2014). Post structuralism understands the world as it is from a subjective perspective. The value of the understanding that emerges from a post-structuralist study is derived by how well it fits and works with the participants' perspectives (Glaser & Strauss, 1967).

In post-structuralist research, the standards for judging trustworthiness in research are dependability, credibility, and transferability (Williams, 2014). Credibility refers to how well the researcher's description of participants' experience matched the participants' actual perceptions. Dependability relates to the quality of the data collection and analysis. Finally, transferability refers to the degree to which the findings of the study can be applied to other similar situations (Lincoln & Guba, 1985). It is also important to consistently report all evidence, so readers can confirm whether the findings come from the data and participants' perspectives rather than from the researcher's subjectivity.

Definition of Terms

Adult Student

In this study, an adult student is any student 18 years or older who continues their education intentionally. Adult learners have characteristics that may affect in their learning. For example, many adult learners have families, jobs, childcare, aging parents, and the need to earn an income (Cercone, 2008).

Marginality

"All children … deserve full access to richly resourced classrooms led by caring, qualified, and generously compensated teachers" (Richards & Zenkov, 2015, p. xv). Access to learn algebra is center in the fight for social justice and marginalized students. Harper and Orr state, "equity, both inside and outside of the classroom, requires … that students have access to high-quality instruction to excel in algebra" (Richards & Zenkov, 2015, p. 203). Mathematics teachers should work to ensure their students are treated fairly and equitably as many math students are marginalized. Marginality is defined as the state of being excluded or outside the center or norm. Spivak and Derrida both believe any text is without margins and what was left out or not said is simply another text, another set of data and postulations (Derrida, 1997; Jackson & Mazzei, 2011; Guha & Spivak, 1988). In this study, exclusion is not only related to race, gender, or socio-economic status but also to age, family position and/or situational factors and mathematical ability. Participants are mathematics learners who are outside of the center or norm of the mathematical community college setting (Jackson & Mazzei, 2011). In this study, participants fall into the margins due to age, socio-economic status, mathematical ability, family situational factors or a combination of these factors.

Social Justice Education

The National Council of Teachers of Mathematics (NCTM) position paper, *Access and Equity in Mathematics Education,* argues that Social Justice Education should create and support a culture of access and equity that is responsive to students' backgrounds, cultural perspectives and traditions when designing and implementing mathematical curriculum (NCTM, 2014). All schools should serve as places that perpetuate cultural, religious, and social diversity (Chapman & Hobbel, 2010). Bell (2007) states, the aim of social justice education is to help students develop critical thinking skills, so they can better understand oppression, their perceived degree of oppression, and ways they can interrupt education's oppressive patterns. Oppression in education can stem from a learner's disposition toward mathematics to their racial, ethnic, linguistic, gender and socioeconomic backgrounds (NCTM, 2017). Social Justice Education encompasses critical theories such as critical race, post-structural, feminist, and multicultural (Chapman & Hobble, 2010).

Political Conocimiento

Political conocimiento is a term used by Rochelle Gutierrez to define the politics of teaching mathematics (2017). She considers 'political conocimiento' as the type of knowledge that helps teachers "deconstruct and negotiate the world of high stakes testing and standardization" (p. 20). Political conocimiento helps teachers advocate for their students, helps educators understand how politics invades our educational system and helps teachers question authority when corporations take over. Specifically, political conocimiento "helps deconstruct deficits in our educational system so we can better defend students, teachers, and public education" (Gutierrez, 2017, p.21).

MOOC

MOOC is an abbreviation for Massive Open Online Course. A MOOC is usually a free online course open to an unlimited number of participants for an unlimited time. Some MOOCs limit time restrictions and number of participants. Some MOOCs choose to charge a small fee, either for enrolling in the course or if students wish to take a mastery test for credits or a certificate.

xMOOC and cMOOC

MOOCs consist of various and sometimes conflicting pedagogical philosophies. In today's educational arena, there are cMOOCs and xMOOCs. CMOOCs are based upon connectivism principles and focus on peer learning. In cMOOCs, much of the instruction for the course comes from the discussions, emails, and contributions of the participating students themselves rather than the startup instructor (Cole & Timmerman, 2015; Masters, 2011). In cMOOCs, teachers usually supply some material depending on the course; the students supply the rest themselves via blogs, YouTube, wikis, chat rooms, etc. (Masters, 2011).

XMOOCs are structured like large online lecture courses, usually with auto grading features for tests and quizzes and video-recorded lectures (Cole & Timmerman, 2015). In an xMOOC, the active role of the learner is crucial, as the role of the instructor is that of the guide or facilitator (Masters, 2011).

Developmental Mathematical xMOOC

The developmental mathematical xMOOC in this study is a free online developmental mathematics readiness class created by mathematics professors at a four-year community college. All content including videos, quizzes, tests, and tutorials are created the college. The developmental mathematical xMOOC is designed to help students review key mathematical concepts at their own pace. The developmental mathematical xMOOC referred to in this study is situated in the Desire2Learn learning management system (LMS). It is a self-paced course without a live instructor. Participants may take up to six months to complete the course before their registration expires. Students can reregister as many times as is needed. The xMOOC offers access to mathematical videos and other helpful resources such as quizzes, tests, video tutorials, and practice problems. The mathematical xMOOC was designed to help prepare students for college level mathematics; namely, college algebra and has concepts that parallel pre-algebra and intermediate algebra. The developmental math xMOOC also helps students bridge the algebra gap by ensuring all students are treated fairly and have universal access to algebra. The topics covered by the developmental mathematical xMOOC appear in Table 1 (see Appendix C).

Table 1.

Topics Covered by the Developmental Mathematical xMOOC.

Module 1	Introduction to Integers Integer Operations Order of Operations Fractions, Decimals & Order of Operations Percents, Decimals & Fractions Linear Measurements (US/Metric Conversions)
Module 2	Evaluating and Translating Algebraic Expressions Simplifying Algebraic Expressions Solving Linear Equations & Literal Equations Linear Inequalities in One Variable Compound Inequalities
Module 3	Exponents and Order of Operations Exponent Rules Negative Exponents Scientific Notation Simplifying Rational Expressions Multiplying and Dividing Rational Expressions Adding and Subtracting Rational Expressions Complex Fractions Rational Equations
Module 4	Radicals Review Radical Expressions and Rational Exponents Simplifying Radical Expressions Pythagorean Theorem Adding, Subtracting, Multiplying and Dividing Radicals Solving Radical Equations
Module 5	Adding and Subtracting Polynomials Multiplying Monomials & Polynomials Dividing Polynomials Factoring: Greatest Common Factor/Grouping Factoring: Trinomials with No Coefficient Factoring: Trinomials with Coefficients Factoring Difference of Two Squares Special Factoring Solving Quadratic Equations by Factoring
Module 6	Translating Word Problems Word Problems and Problem Solving Percent Review Ratios and Proportions Introduction to Geometry Perimeter and Circumference Area
Module 7	Graphing Review Graphing Concepts and the Equation of a Line Graphing Linear Inequalities in Two Variables Systems of Linear Equations in Two Variables Systems of Linear Inequalities

Significance of the Study

The significance of this study lies in its potential to add new and needed information to the literature on higher education distance learning and post-secondary mathematics distance learning. A qualitative study of adult college students' perceptions about learning via a developmental mathematical xMOOC helps address the lack of research of learning via developmental mathematical xMOOCs and reveals themes of student perceptions when learning via a developmental mathematical xMOOC. This study also provides insights on unique online teaching techniques and methodologies that promote student learning and thus may increase successful completions of developmental mathematical xMOOCs.

Through this research, I explored insights of adult students' impressions and perceptions of learning via a developmental mathematical xMOOC, in what ways students perceived the advantages and disadvantages of developmental mathematical xMOOCs, why they chose an xMOOC to learn developmental mathematics, personal characteristics needed to successfully complete a developmental mathematical xMOOC, and their ideas about how to improve developmental mathematical xMOOCs. This inquiry also provided insights into adult student experiences and perceptions of learning via a developmental mathematical xMOOC for curriculum designers and facilitators of distance learning classes, regardless of the field. Developmental mathematical xMOOCs are comparatively new and educational researchers have only begun to unravel and analyze their complexity so they can be incorporated effectively in today's educational institutions.

Chapter Summary

There have been ample articles on potential benefits and costs of MOOCs with the perspectives of faculty and administration. Researchers and media outlets have conducted quantitative studies and discovered a range of perspectives on administration and faculty's perceptions of MOOC limitations and effectiveness. However, there is sparse research that explores college students' perceptions and experiences when using developmental mathematical xMOOCs (Cole & Timmerman, 2015; Perna et al, 2014; Young, 2013). As MOOCs are ultimately created to benefit students, it is important to elicit current adult college students' perceptions of learning via developmental mathematical xMOOCs.

In this descriptive exploratory case study, I explored the perceptions of eight adult college students, who were enrolled in the same developmental mathematical xMOOC, perceptions of learning developmental mathematics via xMOOCs with the use of an online questionnaire. I wanted to discover students' impressions and perceptions of learning via developmental mathematical xMOOCs, why they chose an xMOOC to learn developmental mathematics, student beliefs of personal characteristics needed to successfully complete a developmental mathematical xMOOC, and their ideas about how to improve developmental mathematical xMOOCs. The discoveries of this study provide insights about adult college students' learning and success perceptions via developmental mathematical xMOOCs.

CHAPTER TWO: REVIEW OF THE LITERATURE

There are both critics and enthusiasts of MOOCs (Jaschik, 2013, Masters, 2011, Schaffhauser, 2013). In this chapter, I drew on scholarly journal articles, newspapers, dominant blogs, and the research literature relative to students' beliefs of learning via MOOCs to describe the history and contestations around MOOCs. In this review, I categorized the literature related to the background information of MOOCs and research studies related to students' beliefs and their relationship to learning (in general, through online environments, and through MOOCs and/or non-formal education). I organized the literature review as follows: (1) a historical background of MOOCs including: key issues, controversies, learning theories and popular perspectives, and (2) current research literature relevant to adult student beliefs and experiences of learning mathematics via online and in particular MOOCs.

Historical Background of MOOCs

Background of the Problem

The National Council of Teachers of Mathematics (NCTM, 2008) states technology is an essential tool for learning and teaching mathematics in the twenty-first century. Distance education has a long history, but during the last decade, there has been an exponential growth in online distance learning. This rapid growth has changed the pedagogy of post-secondary education. Specifically, the reputation, quality, and popularity of online courses have increased (Lytle, 2011; Borba & Llinares, 2012). Regardless of the criticisms and negative perceptions of online education not being as good as face-to-face instruction, online education enrollment exceeds face-to-face enrollment rates in many colleges and universities (Lytle, 2011). With the birth of technologies such as smart phones, iPads, tables, high-speed internet, Wi-Fi, and media sites like YouTube, the perspective of learning is no longer viewed under a brick-and-mortar façade. These recent technologies have created an avenue to open connectedness, communication, and interaction (deWaard et al., 2011). The expanse and ability for students to use social media and online search engines to information search has changed the role and requirements of education.

MOOCs as a Disruptive Innovation

MOOCs are disrupting the existing paradigms of higher education (Jaschik, 2013; Masters, 2011; Schaffhauser, 2013). Many agree MOOCs offer learning alternatives for both teachers and students (Masters, 2011; Perna et al., 2014; Viswanathan, 2012). MOOCs also offer an opportunity for mass student learning via open-access courses that are free of charge. Nevertheless, their business-like landscape is threatening to higher-education institution's degree models (Perry, 2013). Some argue MOOCs "have been over-hyped as a simplistic solution to many problems" (Jaschik, 2013, p.3). Many faculty groups have declared war against MOOCs because they believe corporations at the expense of student education and public interest exploit the fast expansion of MOOCs in education (Schaffhauser, 2013). According to an article by Perry (2013), scholars describe MOOCs as having reconditioned the "idea of a university into that of an educational enterprise that delivers content through big platforms on demand" (Perry, 2013). Perry argues, learning should teach students how to think, question, and debate with other individuals, and the delivery structure of a MOOC opposes this pedagogy.

Regardless of scholars' viewpoints for or against MOOCs, many agree MOOCs are the emerging, innovated system of distance learning whose theoretical pedagogies are largely unearthed and still maturing (Masters, 2011). MOOCs are everywhere (education, business, and private arenas) and are gaining popularity. A settling out of the overexposed MOOC needs to occur so that the true nature of the MOOC can be discovered and correctly utilized.

Educational Concerns about MOOCs

There are many components of MOOCs, and teaching institutions have much to consider especially in the face of technological innovations that are continuously increasing the complexities of teaching (Rivard, 2013; Walters, 2013). Some complexities are the lack of support for instructors who are new to open online learning, learner autonomy, learner motivation and determination, and the various design structures of MOOCs. In many post-secondary educational institutions, MOOCs do not fit the institutions' mission or pedagogical approach. Amherst College voted against working with EdX, a major MOOC distributor. Amherst stated EdX is incompatible with their mission statement to "provide education in a purposefully small residential community through close colloquy" (Rivard, 2013, p.1). Some extreme critics argued EdX would be "the destruction of higher education as we know it" (Rivard, 2013, p.1). Some Amherst faculty voiced concern about EdX offering completion certificates bearing Amherst's name. Regardless of the concern, Amherst felt a partnership with EdX would leave them on the losing end and questioned whether MOOCs follow a sound pedagogy and deliver a high-quality learning experience.

Some literature argues, universities are on the verge of a MOOC makeover. Prominent schools such as Harvard, Stanford, and MIT are investing millions in MOOCs and even considering accepting credits earned in MOOCs (Delvin, 2013; Rivard, 2013). However, not everyone is embracing the birth of the MOOC. Critics argue MOOCs will do more harm to higher education's financial future. Quality and completion rates are another challenge concerning MOOCs. Critics worry "prepackaged MOOCs can't possibly deliver the same quality experience that a live instructor can provide" (Waters, 2013, p.1) or an online quality matters certified course (Adair et al., 2014). Many claim MOOCs will hinder professors engaged in educational research, limit perspectives and discourse found in a face-to-face and traditional online classroom, and lessen the need for faculty (Waters, 2013).

Implications for Higher Education

Some view MOOCs as a positive disruptive innovation that will transform higher education's pedagogical deliveries over the next decade (Barrett, 2013; MacKay, 2013). Many colleges and universities view MOOCs as a series of self-paced courses whose aim is helping incoming students refresh their prerequisite skills and prepare for placement tests (Adair et al., 2014). MOOC advocates are determined to make MOOCs work. This ambitiousness makes colleges and universities anxious, as they may have to compete with free courses given by top-ranked universities such as Harvard, MIT, and Berkeley (Young, 2013). Stanford president John Hennessy described the changes in current online education as "an approaching tsunami" (as cited by Delvin, 2012, p.1). Whether MOOCs are a precursor to an educational tsunami is still up for debate. For those embedded in traditional education, a major attitude adjustment is required if MOOCs are to survive as many traditional (face-to-face and online) educational pedagogies are dismissed. Colleges and universities will have to step forward to provide support for MOOC students, teachers, and designers.

Some argue only a brick-and-mortar educational institution can offer a true post-secondary education. Barrett states it clearly, "As higher education seeks to change and adapt, it is important to preserve its best aspects. The college experience should be centered in a physical place where students and faculty members feel they belong to an institution that has transmitted knowledge for generations" (2013, p.1). That said, only the top five percent of the population can attend institutions such has Harvard or Princeton, and many more cannot attend any post-secondary institution due to the ever-increasing tuition costs. MOOCs provide masses of students with access to lectures, online forums, and other educational materials that normally they would never find available (MacKay, 2013). There is potential for MOOCs to offer free unrestricted access to education in a global context. MOOCs offer more choice, control, chances for contribution and participation, and greater ownership of the learning at a much lower cost. MOOCs continue to be a valuable experiment within higher education and provide students a free avenue to see if they are interested in a discipline (MacKay, 2013).

Debates of the Analysis of MOOC Initiatives

MOOCs offer students opportunities to learn. Still, there are MOOC skeptics. Some debate against the educational value of teaching a course to thousands of students with a goal of critical thinking to be tested, while others support the MOOC initiative as it provides students an opportunity to learn (Barrett, 2013). Andrew Ho, a Harvard professor responsible for Harvard's MOOC content, believes skeptics of MOOCs are correct to an extent but also suggests even more reason for MOOCs to be researched empirically (Barrett, 2013). Lytle (2011) found only ten percent of students who begin a MOOC, complete the course. Although a MOOC does not offer the same experience as a traditional face-to-face or online course, it is a rational equivalent for many if credits are offered, as the cost is low and class times are customized to each individual (Sumell, 2013). Some debate that a MOOC will not offer the college experience nor level of prestige traditional college courses offer and, thus, will not lower the enrollment of most educational institutions (Sumell, 2013).

Types of MOOCs

There are many types of MOOCs. EdX, Coursera, and Udacity are a few major names in MOOCs (Jaschik, 2013; Kolowich, 2013; Masters, 2011). EdX is a non-profit effort run by MIT, Berkeley, and Harvard. EdX's software platform is free to any institution who wishes to use it (Young, 2012). Coursera is a for-profit company founded by two Stanford professors. It provides MOOC platforms for universities such as Princeton and University of Virginia and receives a percentage of any revenue the college or university brings in. Udacity is also a for-profit company also founded by a Stanford professor, Sebastian Thrun (Masters, 2011; Young, 2012), and it works with individual professors and well-known scholars (Young, 2012).

Other MOOC companies include Khan Academy (non-profit) and Udemy (for profit) (Masters, 2011; Young, 2012). Khan Academy is a type of online video library that received financial backing from the Bill and Melinda Gates Foundation and Google. Udemy deals with individual instructors and encourages them to charge a small fee as the instructors themselves teach or facilitate most of the courses (Young, 2012). There are many other MOOC companies. The ones named here describe only a few more popular in the educational arena today. Many colleges and universities create their own MOOCs on their individual LMSs to help potential incoming students grasp concepts and gain confidence in high-anxiety, low test-scoring subjects such as mathematics, writing, and reading.

MOOC companies create platforms depending on each university or college needs. EdX is offered only at Harvard, Berkeley, and MIT, while Coursera offers a universal platform any college or university can use. Udacity focuses on its own specialized curriculum. Currently, most are free for students to access, and some offer a certification fee (if the student desires or needs a certificate of completion). Coursera, Udacity, and Udemy are in the process of institutionalizing academic credits. MOOCs such as these have generated much interest from governments, educational institutions, and corporations. However, for the most part MOOCs are viewed as extensions of online education that expand student academic access (Young, 2012). Many educational institutions view MOOCs not as the solution to affordable post-secondary education but as the platform to finding the solution.

cMOOC and xMOOC

There are two major types of MOOCs: cMOOCs and xMOOCs. CMOOCs are based upon connectivism principles and focus on peer learning. In cMOOCs, much of the instruction of the class comes from the discussions, emails, and contributions of the participating students themselves rather than the startup instructor (Cole & Timmerman, 2015; Masters, 2011). In cMOOCs, students register for the MOOC and then receive daily newsletters or emails of the activities of the course. Students reflect on the information in the email, respond, and the process continues. In cMOOCs, teachers usually supply some material depending on the course; the students supply the rest themselves via asynchronous forums such as blogs, YouTube, wikis, chat rooms, etc. (Masters, 2011).

XMOOCs are structured like large online lecture courses where the instructor lays out a format and provides detailed course content with auto grading features for tests and quizzes (Cole & Timmerman, 2015). XMOOCs are commonly a series of video-recorded lectures, videos, or PowerPoints. They are sometimes perceived as having content that is more accurate because a qualified professor creates the course and content instead of the participants, as occurs in most cMOOCs. However, there is limited and sometimes no student-to-student or student-to-instructor interaction and/or collaboration, as the learner works independently throughout the course. However, in both types of MOOCs (x and c), the active role of the learner is crucial as the role of the instructor is that of a facilitator (Masters, 2011).

Many institutions and organizations offer MOOCs. Table 2 below describes the above-mentioned providers of MOOCs.

How xMOOCs and cMOOCs Work for Teachers

In a MOOC, the instructor's role is that of a facilitator-helper. Learner attendance is optional; however, the instructor can offer live online sessions that are usually recorded for students to access at their leisure. MOOC facilitators understand students may appear to be absent, and there is no student follow-up or participation grade. "The instructor must trust that the learners are learning according to their own wishes" (Masters, 2011, p.1). The instructor can also track events and discussions but are unlikely to interact with all learners (Masters, 2011). This new role may leave some long-time lecture professors uncomfortable.

Table 2.

Description of Various Types of MOOCs.

MOOC	Date Start	Credential	Cost $	Pace	Backing Organization(s)	For Profit/ Not for Profit	Taught by	Known for /Early Critiques
EdX	2012	Certificate	$ for Certificate	Synch but self-paced	$65 million from MIT &Harvard (along with U. of Calif - Berkeley & U of Texas)	Non-Profit	Harvard & MIT professors	Open source delivery platform/research outcomes/Essay grading software
Coursera	2012	Certificate	$ for Certificate	Synch but self-paced	Venture funds from Silicon Valley, World Bank, NEA	For Profit	Professors From top Universities and organizations (i.e. Stanford & Yale)	Andrew Ng's Stanford MOOC spinoff/ Peer evaluating/lack of instructor interaction/long videos
Udacity	2011	Certificate	$ for certified exam	Synch but self-paced	Venture funds; $20 million from Andreessen Horowitz	For Profit	Stanford Professors	Stanford startup/connect talent with companies/robot graders
Udemy	2010	Certificate	Instructors choose price for their course. MIX of FREE and $ courses	A synch	$16 million in Venture capital and angel funding & 30% of course sales.	For Profit	Professors & professionals	Monetization Option
Khan Academy	2008	Badges	$ 0	A synch	Grants from Google & Bill and Miranda Gates	Non-Profit	Khan & others	Video chunk library/not interactive

How xMOOCs and cMOOCs Work for Students

It is crucial for the learner to play an active role in any MOOC, as the course is built upon the learner's participation. In many MOOCs, participation occurs via blogs, emails, or videos on YouTube (Masters, 2011). A MOOC's online learning environment integrates an online collaborative communication process that supports student-to-student interactions (Borba & Llinares, 2012; Masters, 2011). MOOC learners are usually independent, individual learners, but some learners may form online support groups and even meet off-line if they choose. MOOC learners set individual goals according to their personal needs. CMOOC learners construct their perspective of the material, post it in an email or blog, then engage in discourse, or debate with other learners. XMOOC learners watch videos of the material embedded in the course and then take auto-graded quizzes or tests to determine whether the content was mastered.

Educational Credits

Many MOOCs do not teach to a test, as there is not always a test to administer or take. Although some MOOCs may assign activities, quizzes, or tests, they are optional to take and pass. Some MOOCs offer accreditation (educational credits or certificates) a learner can buy to confirm their participation in the MOOC and understanding of the material (Young, 2012). The goal of participating in a MOOC is not necessarily to pass or receive college credit. To many MOOC learners, the goal instead is to learn.

In November 2012, a MOOC pilot project considered offering some MOOC courses for possible admittance in the College Credit Recommendation Service (Young, 2012). In January of 2013, Georgia State University announced they would begin to give credit for some of the MOOCs they offer. The educational philosophy around the credit offering is the hope it will encourage more students to begin their degree with a MOOC and finishing the program at an existing university (Jaschik, 2013). Arizona State, Cleveland State, Florida International, Lamar, and Utah State Universities and the Universities of Arkansas, Cincinnati, Texas at Arlington, and West Florida have followed and plan to treat MOOC accreditation that is similar to granting credit for Advanced Placement courses (Haynie, 2015). Arizona State charges $200 per credit for their MOOC courses, which is a lower rate than the school's normal online course cost of $490 to $550 per credit hour (Haynie, 2015). For the students whose goal is not to earn credit, they can still take the course for free.

Regardless of the growing interest of credits for MOOCs, the number of educational institutions that are allowing credit is small and the number of students taking advantage of MOOC credits is even smaller (Haynie, 2015; Negrea, 2014). Some believe the workload of the for-credit MOOCs, coupled with the cost per credit and proctored exam fee might be the reason for the low number (Haynie, 2015; Negrea, 2014). Marie Cini, provost and senior vice-president at University of Maryland University College, believes it may be easier for students to take a face-to-face class rather than go through the rigorous MOOC credit process (Negrea, 2014). Cini expounds about MOOCs in academia and argues MOOCs will be an addition to the educational arena but will certainly not replace it. Many educational institutions may utilize some aspects of the MOOC. For example, they may possibly focus on creating MOOC courses that would cater to continuing education courses for professionals to maintain their licenses or cater to new students who perform low in high-anxiety subjects like mathematics (Negrea, 2014).

Cost

Teacher/Student Cost

With the amass of student-loan debt, MOOCs could be the answer to affordable education. Many colleges are exploring MOOCs in hopes to help the student as well as the institution, due to years of budget cuts and increasing student-loan debt. Most MOOCs are free with the only student demand being technology and reliable internet access. Some MOOCs (the for-profit or for-credit) are charging a fee. San Jose State University partnered with Udacity announced on January 2013 they will charge students a fee of $150 per MOOC with a cap enrollment of 350 for each course and possibly award academic credits if the course is passed (Fain, 2013). Coursera collaborated with Stanford University and the University of Michigan at Ann Arbor and plan to offer credits for MOOCs at a small fee (Young, 2012). Other colleges may soon follow. Many argue these MOOC courses are not truly open as a MOOC should be, as the student must pay, and enrollment is capped. Some believe credits for MOOCs will cause uproar with faculty. Parry (2013) argues if colleges begin to award credits for MOOCs, the result might be a lessening in the need for faculty members who teach those courses. This debate alone creates a rift in faculty buy-in of MOOCs. Whether teachers see the value in MOOCs will affect MOOCs' success (Chapman, 2012).

Educational Institution Cost

Many educational institutions provide all the resources for the MOOCs at no cost to the student. Resources include server, helpdesk, video make up and changes, and the subject matter expert (SME), all of which cost the institution money. Some educational institutions provide MOOCs to help potential students interested in studying at their institution get ahead or pass their entrance exam. The push for MOOCs by some institutions is philanthropic, but for others it is a business proposition. Business-minded trustees pressure some presidents of colleges and universities to make MOOCs work, regardless of numerous complaints from faculty members that MOOCs are not the panacea for higher education's high tuition cost (Jaschik, 2013). There are also faculty concerns about the design and pedagogy quality of MOOCs. According to the *Chronicle of Higher Education,* some MOOC providers such as Udacity and Coursera are officially bringing in revenue by selling high-performing student information to employers with job openings (2012). This type of revenue is in its introductory phase; thus, there is not sufficient data whether this trend will lead to student job placements. Some predict the largest source of revenue will come from selling certificates rather than selling high-student performing information (Chronicle of Higher Education, 2012). These fees might also help cover the educational institution's MOOC cost.

Mathematics, Social Justice and Political Conocimiento

Social Justice Education should create and support a culture of access and equity that is responsive to students' backgrounds, cultural perspectives, and traditions (Chapman & Hobbel, 2010; NCTM, 2005). Some believe teaching mathematics is culture free, when in fact the opposite is true (Gutierrez, 2017). Today, mathematics operates as "whiteness" and all too often, who is view as part of the mathematical community and gets credit for doing mathematics is seen as ‘White’ (Gutierrez, 2017). Many educators and learners believe math operates with no judgments, or agendas. However, many tie the assumption that knowing mathematics equates to being intelligent (2017). Gutstein (2017) agrees with Gutierrez and writes, “mathematics knowledge with its valorized status, often serves the needs and goals of capital, the financial and corporate elites who largely control our world” (p. 262). It is true; math knowledge can serve and help the few elite or the colorful masses. Social Justice Education posits, that educators and students should collaborate to recreate a mathematics pedagogy that supports social justice and ends “oppression and exploitation” and supports the colorful masses (Gutstein, 2017, p. 262).

Simply understanding mathematical content, finding quality instructional activities, and developing meaningful relationships with students, does not address understanding equity in mathematics education (NCTM, 2014). Many teachers do not understand the equity and the politics of teaching math because they have not been trained to do so. Thus, they do not address the politics of mathematics and its connection to equity (or social justice) in their daily pedagogy (Gutierrez, 2017).

Rochelle Gutierrez, a professor at the University of Illinois, argues that math is racist. She claims, mathematics curricula focus on terms developed by Greeks and other Europeans (i.e. Pythagorean Theorem and pi) thus insinuating mathematics was developed mainly by white Europeans (Gutierrez, 2017). Although Gutierrez admits much of mathematics was developed, improved, or passed on by the Greeks or other Europeans she adds, in today’s educational arena knowing mathematics equates to being intelligent and thus superior (Airaksinen, 2017; Gutierrez, 2017). Gutierrez debates whether mathematicians more deserving of grants and accolades than their Social Studies or English counterparts (Airaksinen, 2017; Gutierrez, 2017).

Gutierrez worries standardized testing of mathematics perpetuates white privilege by discriminating against minorities who may not know math (Airaksinen, 2017). She argues our society gives an unearned privilege to those who have math skills, adding even mathematics professors are disproportionately white (Airaksinen, 2017). Gutierrez argues only when teachers can understand and negotiate the politics outside the classroom will social justice in mathematics education come to fruition (Gutierrez, 2017).

Gutierrez describes the politics of teaching mathematic as 'political conocimiento' (2017). Gutierrez believes teachers who understand and teach with 'political conocimiento' "…participate in more sophisticated ways with others (peers, instructors, people in schools), are more like professionals who have a clear stance on the field and less like students who are pleasing their professor" or those simply following corporate Americas guidelines (p. 25). Teachers who identify with 'political conocimiento' do not blindly teach to standardized tests, but instead teach according to social justice pedagogy (2017). Gutierrez argues, all mathematics teachers should be trained to deal with the politics of teaching-so they can question today's teaching practices through the lens of a social justice framework and in turn interrupt the educations cycle of oppression (2017).

John Wilkin, the University of Illinois Provost, where Gutierrez is employed told Fox news Gutierrez is an admired scholar. He stated, "The issues around equity and access in education are real – with significant implications to our entire educational system. Exploring challenging pedagogical questions is exactly what faculty in a world-class college of education should be doing" (Gearty, 2017, p.1).

Politics and Mathematics

The role of mathematics in politics and political decision-making is an issue in today's mathematics pedagogy and curriculum design (Burris, 2014; Stanic & Kilpatrick, 2003). Some Politicians and lawmakers believe, American children have been 'bad' at mathematics since

1895 (Stanic & Kilpatrick, 2003). These same politicians and lawmakers do not agree with teachers using their professional judgement when teaching. They, along with corporate America, and billionaires such as Bill Gates, Eli Broad, and Betsy DeVos, are taking over our schools and are robbing teachers the use of their professional judgment (Cohen, 2015; Gutierrez, 2017; Ravitch, 2007). One example is teachers' salaries and positions are dependent on student standardized testing success. Pearson controls student standardized testing success (cooperate America). Thus, Pearson is controlling teacher positions and salaries. Pearson also wanted PARCC (Partnership for Assessment Readiness for College and Careers) to replace ACT (American College Testing) but refused to take accountability on the results of the test as they claim they are only "the people who make the test" (Gutierrez, 2017, p. 14). Another example of lawmakers and corporations taking over mathematics pedagogy and making huge profits is by renaming old standards. The Common Core is *Adding it Up* from 2001 plus *NCTM Standards* from 2000 (CCSS, 2014; Gutierrez, 2017; NCTM, 1989; NCTM, 2000; Stanic & Kilpatrick, 2003). Interestingly, the Common Core state standards erased any language of equity principals (that suggest mathematics pedagogy connect students' cultural and religious diversity with mathematics) that were previously stated in the NCTM Standards (CCSS, 2014; NCTM, 1989; NCTM, 2000; Stanic & Kilpatrick, 2003).

As lawmakers, politicians and corporate America's influence expands, individuals are gathering to reclaim their profession and professional judgement (Gutierrez, 2017; Stanic & Kilpatrick, 2003). Because there is not one right pedagogical approach, these debates and controversies are unlikely to be resolved soon. It seems, these same politicians, lawmakers, and billionaires will ultimately determine the future of what is deemed appropriate educational standards and standardized testing. Many researchers and educators are now discovering is, it is not student mathematical content knowledge that is changing, but instead the federal government's initiatives and attitudes toward mathematical knowledge (Burris, 2014; Stanic & Kilpatrick, 2003).

Supporting Social Justice with MOOCs

The National Council of Teachers position paper, *Algebra as a Strand of School Mathematics for All Students,* states "…all students should have access to algebra, including opportunities to generalize, model and analyze situations that are purely mathematical and ones that arise in real-world phenomena" (2014, p.1). Access to learn algebra is center in the fight for social justice (NCTM, 2014; Richards & Zenkov, 2015). "Equity, both inside and outside of the classroom, requires … that students have access to high-quality instruction to excel in algebra" (Richards & Zenkov, 2015, p. 203). Mathematical MOOCs are meant to help a variety of students: the high school student who wants to earn college credit and or increase their confidence, the adult student who may want to test out online learning before ensuing an online degree, or the international student who desires to earn credit at an U.S. educational institution (Haynie, 2015). For many the tuition-free course is the encouragement many working adult students need to enroll and begin a degree that may change their lives (Jaschik, 2013). Many agree, MOOCs must be implemented in higher education as a broader online learning component to provide flexibility and choice and to accommodate the needs of today's students trying to navigate in our higher education system (Haynie, 2015; Jaschik, 2013; Nanfito, 2014).

"Social justice always involves the striving of people … to achieve greater freedom, fairness, equity, access, agency, recognition, openness and sustainability" (Richards & Zenkov, 2015, p. xiii). MOOCs have the ability to define the moral and social nature of higher education via its open access pedagogies (Prinsloo, 2011). With the accumulation of student educational debt, MOOCs might be the answer to affordable education. Many are calling for an end to the ever-increasing cost of post-secondary education. "Educators, students, residents, and citizens … press now for an end to starving schools … an end to the rapidly accumulating educational debt, the resources due to communities historically segregated, underfunded and underserved" (Richards & Zenkov, 2015, p. xiii). There is potential for MOOCs to offer unrestricted access to education in a global context. Most MOOCs are free of charge, thus evening the playing field in the social justice arena. "MOOCs can make an emerging form of higher education available to many who are excluded because of space limitations or inability to pay" (Nanfito, 2014, p. 34). MOOCs offer more choice, control, chances for contribution and participation, and greater ownership of the learning at a much lower cost (Jaschik, 2013; Nanfito, 2014; Prinsloo, 2011).

Social justice in MOOCs refers to more than providing masses free access to education, although this is a central and essential characteristic. MOOCs have the ability to defend the moral and social nature of higher education. "Access in the social justice sense therefore means much more that meeting quotas of previously disadvantaged or excluded races, genders, or cultures. Broadening access to (MOOCs) brings to the fore issues of social, cultural and epistemological capital, of students and institutions alike" (Prinsloo, 2011, p. 93). MOOCs can create a virtual classroom in which diverse students feel welcome to discuss topics related to social justice and action (Nanfito, 2014). Teaching for social justice is a dynamic, complex pedagogy and has the potential to engage students more fully by having students recognize and react to problems or concerns in their community (2014). Each online connection can become a learning and teaching moment. Educators and facilitators can create this environment within their online classes or MOOCs (Ayers, 1998; Nanfito, 2014). By interweaving today's global technologies and social justice pedagogies, online teaching and learning can encourage students to solve problems on local and global levels and even challenge students to address issues of justice and oppression. MOOCs have the potential to become powerful online classrooms where students explore values and ethics and apply them to promote social action. Moreover, MOOCs can help bridge the educational gap so all learners, regardless of their marginalization have full access to rich educational resources. Awarding MOOC credit can also be a way for non-traditional students to earn degrees and demonstrate students from any background can achieve academic success. As Nanfito (2014) notes "MOOCs offer a form of education to those for whom education is off limits. In MOOCs there lies hope for a system that has the capacity to connect elite educators with eager learners who have access to few- or no- alternatives" (p. 35).

Learning Theories and MOOCs

Some researchers suggest MOOCs are a "poor fit for people who are not academically prepared" (Wiley, 2011, p.1) as MOOCs are best for self-directed, self-driven learners. Why throw more barriers in front of students who already do not possess the prerequisite skills they need? While MOOCs do provide a great learning opportunity for many students, they are simply not suited for every learning style (Weigel, 2013; Wiley, 2011). Some argue MOOCs are courses that help the well-prepared student who has succeeded with the prerequisite experiences as well as being computer savvy (Wiley, 2011). A MOOC's open nature does create challenges with some learners, some of which include learner discomfort with "interfaces and procedures, questions about the courses pedagogical rigor, and technical issues" (Weigel, 2013). Grunewald, Meinel, Totschnig, and Willems (2013) agree, MOOCs can accommodate a variety of learning styles. Grunewald et al. believe intrinsic motivation is the foundation to the MOOC culture. They go on to argue MOOCs provide multiple pedagogies. "Hands-on exercises allow learners to feel personally involved in the problem domain through their active experimentation and to grasp the complex relations to their own concrete experience … group discussions support awareness and reward contributions allow learners to feel responsible and to collaboratively strengthen the learning process and to provide richer perspectives for reflective observation" (p.11). Every learner is unique and acquires knowledge in many ways, each having their own learning style. Some may learn by watching (visual), some by listening (auditory), and others by doing (kinesthetic). MOOCs naturally incorporate these learning styles, thus catering to learners of different learning styles. Learner buy-in as well as personal intrinsic motivation is also key to MOOC success (Grunewald et al., 2013).

Successful online courses require unique online pedagogical techniques, and they are dependent upon effective pedagogy and learning theories; specifically, constructivist and connectivist theories (Downes, 2011; Siemens, 2005). Most online courses, particularly MOOCs, are based upon constructivist theory, that states learners construct new knowledge when they are actively engaged, and the teacher becomes the facilitator and not a knowledge transmitter or lecturer (Reiser & Dempsey, 2011). MOOCs also rest on connectivist theory, which embraces the use of technology when teaching and learning (2011). A fundamental feature of connectivism is that learning can happen across online peer networks. In connectivist learning, the teacher is the facilitator and students are encouraged to pursue questions or information online on their own and then voice their findings to their connected online community (Downes, 2011; Siemens, 2005). MOOCs are compatible with both constructivist and connectivist theory. A connectivist MOOC is open to anyone, uses open software systems across the Web to facilitate learning and sharing, and takes place online. While facilitators guide the MOOC, the MOOC participants are mostly responsible for their learning and sharing (Downes, 2011; Reiser & Dempsey, 2011; Siemens, 2005).

Motivational theory is often used to describe behavior and explore the reasons for people's actions and needs for enrolling in a MOOC. The online community aspect of MOOCs provides a great learning value because multiple learner needs, and learning styles are considered. Some participants need more social interactions than others to obtain better learning results. Constructivism is intertwined with motivational theory as it emphasizes knowledge construction occurs through meaningful collaboration between people (Downes, 2011; Siemens, 2005), which is the essence of how cMOOCs operate. Participants register for a MOOC from diverse backgrounds and with different motivational factors. Completion of the MOOC might not be the reason the learner registered for the course. Learner engagement can vary from completing the MOOC to simply sampling the MOOC design and motivational theory helps understand why students enroll in a MOOC (Belanger & Thornton, 2013; Gov, 2015).

Determination and motivational theories are linked as both explore underlying tendencies of learners (Tschofen & Mackness, 2012). Tschofen and Mackness (2012) used determination theory to help describe MOOC user's experiences and perceptions. The authors suggest student's perceptions of MOOCs vary according to learner desire, autonomy, openness, and diversity (2012). Beaven, Hauck, Quinn, Lewis, and de los Arcos (2014) explored the relation between learner MOOC success and determination theory. They found participants who were not sufficiently motivated and did not know how to create online discourse felt disappointed by their MOOC learning experience. Both motivation and determination theories were found to be principal factors of MOOC participation (Milligan et al., 2013). MOOC learners who described a clear goal correlated to a higher level of MOOC completion (2013). Understanding the motivation and determination of MOOC participants is crucial to understanding student MOOC success.

Current Literature Relevant to Student Beliefs and Experiences of Learning via MOOCs

In the following paragraphs, I discuss research studies related to students' beliefs and experiences and their relationship to learning in general through online environments and, specifically, via MOOCs. Various researchers have explored numerous facets of distance learning courses and MOOCs. The main facets of distance learning courses and MOOC research are: characteristics of MOOC and distance learners, predictors of retention and completion in MOOC and distance courses, enrollment and persistence of distance learners, and, given the openness of the MOOC structure, the differences in MOOC learner goals versus traditional distance learning courses (Lovell & Elakovich, 2016; Stigler & Thompson, 2010). I also discuss research studies related to adult students' beliefs and experiences of learning mathematics through online environments and, specifically, via MOOCs.

Learning via Online

Over the past decade, online learning has grown rapidly. Liu (2008) writes 97% of higher educational public institutions offer at least one or more online degree programs. Online education fosters traditional educational pedagogy and is viewed as having more potential and promise in "promoting student interactions and enhancing learning outcomes by utilizing advanced computer technology" (p.2). Liu's phenomenological study focused on student interactions in online learning, specifically on student-to-student interactions via online learning. After researching student interactions and student perceptions of their interactions, Liu discovered, to create effective online learning communities and encourage student online interactions; administrators, faculty, and staff need to work together to create online learning communities.

Regardless of the potential of online learning, because of the limited opportunities for face-to-face interactions with teacher and learner, there exists a lack of understanding of the characteristics of the online learner (Lin, 2007; Lui, 2008; O'Rourke, Main, & Cooper, 2014). This lack of understanding of online student characteristics, attitudes, and beliefs has created many challenges in teaching and learning online (Lin, 2007; Lui, 2008; O'Rourke, Main, & Cooper, 2014). Some of these challenges include: (1) effective online curriculum, (2) faculty training to adjust to the unique pedagogy of online teaching and learning, and (3) student technical support beyond the course material (Lin, 2007; Lui, 2008; O'Rourke, Main, & Cooper, 2014).

Lin (2007) states, eight barriers compromise student online learning; namely, administrative problems, lack of social interaction, learner academic abilities, learner technical skills, learner motivation, time, and support for class, cost, and access to the internet, and technical problems within the course. Lin found these barriers vary significantly per learner gender, age, ethnicity, online learning skills, enjoyment, and number of online courses completed, and more quantitative and qualitative research needs to be conducted. Lin's results also suggest the learning management system (LMS), information, and service quality of online courses have significant effect on student satisfaction. In short, learning online has its issues, but distance learning also provides multiple avenues for learning, greater control over accessing information, as well as providing more opportunities for reflective discourse (Lin, 2007; Lui, 2008).

Moore's Transactional Distance Theory

Moore (1993) believes, distance education focuses on dialogue, structure, and learner autonomy. Moore believed distance learning requires unique pedagogies and learning characteristics different from traditional face-to-face learning. Moore emphasized distance learning is a function of three variables: course structure, instructional dialogue, and learner autonomy. The author also believes the transactional distance theory helps explain the interaction among learners, teachers, and course structure. Moore argues the separation of time and space between learner and teacher in distance learning "leads to special patterns of learner and teacher behaviors" (p. 1). Moore's theory focuses on faculty-student interaction, which is influenced by educational philosophy, course subject matter, and context. Moore noted distance-learning communication can be a one-way street and may lead to a less favorable student learning experience. Other researchers agree with Moore as regards the importance of faculty-student interaction (Mupinga, Nora, & Yaw, 2006; Swan, 2001).

Swan's (2001) research found "students who had perceived high levels of interaction with the instructor also had high levels of satisfaction with the course and reported higher levels of learning than students who thought they had less interaction with the instructor" (p. 316). Mupinga et al. (2006) found, the top three expectations of the online students are "communication with the professor, instructor feedback, and challenging online courses. The majority of online students (83 percent) expected the professor to communicate with them. Frequent communication with the instructor puts the students at ease to know they are not missing anything or not alone in cyberspace" (p. 186).

Moore's (1993) transactional distance theory also helps explain characteristics of adult distance learners. Moore argues students' learning experiences are dependent upon the personalities of students themselves. An important personality element of distance learners is the ability to work independently. Moore argues learner autonomy is a naturally learned skill for most adults. The author defines learner autonomy as "the extent to which in … the learner rather than the teacher ... determines the goals, the learning experiences, and the evaluation decisions of the learning program" (p. 5).

Learning Developmental Mathematics

Some researchers agree more adult students who are not prepared for college-level mathematics are now attending community colleges (Boylan, 2011; Frame 2012; Lovell & Elakovich, 2016). For many of these adult students, developmental mathematics has become a barrier for them in completing their intended major. Many students take the community college placement test, are placed into a developmental mathematics course, and may have to take four or more extra mathematics classes before they can register for a college-level mathematics course (Stigler & Thompson, 2010). Adult students were also found to have lower levels of algebra skills and exhibited higher levels of math anxiety (Meeks, 1989). However, Meeks's same adult students were found to have higher motivation and determination. Meeks found adult students had forgotten their basic arithmetic skills and only needed a refresher course to become proficient in the college level mathematics. However, some adult students never learned their basic mathematical skills at all and required several mathematical prerequisite courses. Because of these various barriers and levels of mathematical knowledge, developmental mathematics has become an issue for adult students to complete a degree.

There is growing interest in reforming developmental mathematics education at the community-college level and in focusing on changing the pedagogy of developmental mathematics (Boylan, 2011; Frame 2012; Hodara, 2013; Lovell & Elakovich, 2016; Stigler & Thompson, 2010). Boylan (2011) argues adults learn mathematics differently, and changing their learning style to incorporate access technology-based math information and materials may be in an inaccurate assumption. Nonetheless, learning mathematics online, eliminating costly books, and using web-based materials may be the way to go for many adult learners needing the motivation to learn mathematics. According to Meeks (1989), adult students were also found to have the higher motivation and determination needed to complete an online course. In addition, many researchers have noted students' frequent choice of online developmental mathematics courses over the traditional face-to-face mathematics courses (Lovell & Elakovich, 2016; Meeks, 1989). Students can have equivalent learning experiences online without printed texts and face-to-face instruction (Hodara, 2013; Lovell & Elakovich, 2016). Reforms for developmental math are necessary, and using multiple pedagogical representations (including online pedagogy) in the math classroom can improve students' developmental math performance (Hodara, 2013; Lovell & Elakovich, 2016).

Learning Mathematics Online

Learning mathematics online adds to the challenges of the distance learning. Pass rates for online mathematics courses tend to be lower than pass rates for other online courses

(Chiu & Churchill, 2015; Hughes; Lowe, Mestel, & Williams, 2016). One reason some students take their mathematics courses online is, so they can avoid feeling embarrassed for their lack of knowledge about mathematics (Kim et al., 2014). Kim et al. maintain most colleges and universities offer both regular and remedial online math courses with a constant complaint of low passing rates. Kim et al. also remark many students' sign up for online mathematics courses under the false assumption they are easier to pass when, in fact, online mathematics courses typically require students to put more hours toward their mathematics work. In addition, online mathematics students do not have the ability to ask a question and get an immediate answer because not all online math classes have the same level of student engagement and one-on-one interaction with the instructor (Chiu & Churchill, 2015). An online student requires higher motivation and determination levels to successfully complete a course (Chen et al., 2015; Kim et al., 2014). Although learning mathematics online is challenging, there are some positive aspects such as convenience and anytime access to quality mathematics content (Hughes, McLeod, et al., 2007; Lowe et al., 2016).

Kim et al.'s (2014) study attempted to understand why some online mathematics students succeed and some do not as well. They also researched what might be done to help increase student success. Their results showed highly motivated students performed better than less-motivated students. However, when self-efficacy and mathematics achievement emotions (anxiety, shame, boredom) were added to the analysis, the results were inconsistent; thus, calling for more qualitative research on student motivations when learning mathematics online. Chen et al. (2015) agree with Kim et al.'s (2014) study that more research on student perceptions must be considered on student online motivational strategies to help effectively teach and learn mathematics online. "Students' perceptions should be considered as motivational strategies in teaching and learning … (and) for improving grades" in online courses (Chen et al., 2015, p. 1). Chen et al. found inconsistent results when researching why some online mathematics students succeed and others do not. The authors investigated course satisfaction and course interest, along with student feedback and gender differences. The results of their study showed student feelings about the course predicted the final grade with male participants, while course design predicted the final grade with female participants. The authors also noted both male and female participants, regardless of course interest, performed equally well.

Lowe et al. (2016) studied student perceptions of mathematical online tutorials. In their study, they found both student and faculty perceptions value synchronous online teaching sessions to supplement face-to-face sessions. Students agreed, although interaction within the sessions was limited, the recorded sessions were convenient and helpful. Students also commented the ability to interact with other participants online was positive, but the need for more interaction between students and instructors was necessary. Several recommendations regarding mathematical online teaching and learning sessions were made because of their study. Some recommendations were the use of online chat sessions, better support for the needs of disabled users, and, when appropriate, online chat sessions should be recorded (Lowe et al., 2016).

Hughes, McLeod, et al. (2007) examined Algebra students' achievement and perceptions of their classroom environments and compared online and traditional face-to-face learning. Their research addressed two primary questions: (1) Does Algebra achievement differ between online and traditional face-to-face students? and (2) Do perceptions of the Algebra classroom learning environment differ between online and traditional face-to-face students? The researchers used three online and three traditional face-to-face classes. They found online students consistently outperformed traditional students. Traditional students were more likely to have higher averages in their perceptions of student community and involvement, while online students were more likely to perceive higher teacher support in their online environment. The study revealed online students have the same opportunity to access quality mathematics content as well as skilled pedagogical techniques as their face-to-face counterparts. Hughes, McLeod, et al.'s study results indicate online courses provide successful, alternative learning opportunities.

Learning Developmental Mathematics Online

Community colleges are increasing their enrollment faster than four-year universities and boast a higher growth rate in online learning enrollments (Ashby et al., 2011). The growth in community college enrollment has led to an increase in the need for developmental mathematics courses (Ashby et al., 2011; Bol, Campbell, Perez & Yen, 2016; Epper & Baker, 2009). Ashby et al. compared student success in a developmental mathematics course offered three ways: online, blended, and face-to-face. The researchers used quantitative instruments and data from 167 participants. They found significant differences between the three learning environments. They argue not all learning environments are equally effective. According to the researchers, online and blended students performed worse than face-to-face developmental mathematics students. Ninety-three percent of face-to-face students, 70% of the blended students, and 76% of the online students completed the developmental mathematics course. The researchers argue student discomfort with technology may be the cause for the differences in student completion rates and more research needs to be done.

The 2005 Office of Vocational and Adult Education (OVAE) report reviewed several studies related to developmental math pedagogy in community colleges (Hughes, Karp, Fermin, & Bailey, 2005). Some OVAE's recommendations were: greater use of technology, integration of classroom and laboratory instruction, and offering students a variety of instructional delivery methods. Although the OVAE recommended more technology in the classroom, they found no clear correlation on the effectiveness of technology-based delivery methods as a replacement to traditional face-to-face courses. Many researchers in the field of developmental mathematics are challenging OVAE's assumption that technology is best used as a mere supplement to traditional pedagogical approaches (Ashby et al., 2011; Bol, et al., 2016; Epper & Baker, 2009).

Most universities and community colleges agree students should be familiar with technology as it is an essential skill used in everyday life, in the workforce, and in pursuing academic goals (Ashby et al., 2011; Bol et al., 2016; Epper & Baker, 2009). Epper and Baker argue it is impossible for educational institutions to meet developmental math student success goals without the incorporation of technology in the pedagogy. The implementation of effective technology in a mathematical course design can strengthen and expand developmental mathematical pedagogy efficiencies (Epper & Baker, 2009). "Despite an expanding knowledge base in developmental math practice and the rapid expansion of technology in education, critical challenges remain in maximizing the promise inherent in these innovations. These include blending best practices in developmental math with leading technological innovations" (p.1). Although technology based curriculum is here to stay, many community colleges fall behind four-year institutions in their use of technology for instruction. "With growing demand from students, colleges are struggling to implement the latest technologies, both in IT infrastructure and in academic technology innovations" (p.2). Epper and Baker claim colleges and universities must embrace technology base pedagogy and implement technology-based curriculum if they are to meet today's developmental mathematical success goals.

Adult Learners and Mathematics

Mathematics is a major issue in education (Ausburn, 2004; Cook, 1997; Jameson & Fusco, 2014). Many agree adults do not solve mathematical problems the way children do (Ausburn, 2004; Cook, 1997; Jameson & Fusco, 2014). Children and adults think differently. After reading the literature on adults and mathematics education, I discovered adult mathematics is perceived as difficult by adult mathematics students (Ausburn, 2004; Cook, 1997; Jameson & Fusco, 2014; Shapka, Domene, & Keating, 2006). Much of adult math education is based on drill and practice and unrelated to the adult learners' experience. There is a definite gap between the application-based, problem solving mathematics required on the job and the traditional mathematical skills taught in the classroom.

Today, mathematical literacy is often regarded as an important filter through which students must pass to attain high-paying and technologically driven careers (Gutierrez, 2017; Shapka et al., 2006). "Mathematics is viewed as so pure that it has become the discipline by which we measure other disciplines" (Gutierrez, 2017, p. 18). Because of math's percieved purity – many assume mathematics should be the basis for how we view the world (2017). Some perceive mathematics to be a natural reflection of the universe (i.e. Fibonacci sequence, e, pi, fractals) and view mathematics as an avenue of encoding the universe (2017). Regardless of math's importance in society, many adult students dislike and circumvent mathematics. Shapka et al. considers a probable reason for this aversion may be due to a combination of mathematics anxiety and low mathematical confidence. Mathematics anxiety is defined as a feeling of "tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551). Richardson and Suinn state mathematics anxiety is also associated to a limited exposure and low self-confidence in mathematics.

According to Jameson and Fusco (2014), the adult learner population is steadily growing. Adult learners tend to possess lower mathematical self-confidence than traditional-straight out of high school-undergraduate students (Cook, 2004; Jameson & Fusco, 2014). Adult learners tend to be non-traditional students and possess distinct characteristics. Some of these characteristics include they are usually older returning students, have one or more dependents, and work 20 to 40 hours a week (Cercone, 2008). Many adult learners have families and jobs and deal with transportation, childcare, and are caregivers to aging parents. Most adult learners need to earn an income. Cercone points out most adults voluntarily enter college and manage their classes around work and family responsibilities, while being highly motivated, task-oriented, autonomous, practical, and purposeful. They learn by experience, enjoy a learning community, and carry mathematical emotional barriers. Simply said, adult learners are diverse and have their own back-stories to consider. These factors can interfere with the learning process. "Most distance education students are adults between the ages of 25 and 50. Consequently, the more one understands the nature of adult learning, the better one can understand the nature of distance learning" (Moore & Kearsly, 1996, p. 153).

Jameson and Fusco (2014) examined differences in math anxiety and self-efficacy between adult learners and traditional college students. The researchers collected data from 60 traditional students and 166 adult learners and found adult learners have lower levels of mathematics self-efficacy and higher levels of mathematics anxiety. For many adult learners, the college classroom is a new context. Within this unfamiliar environment, they are surrounded by younger, more recently educated, and more technologically experienced learners. These environmental factors may result in low mathematical confidence. Ausburn (2004) found many adult learners also value blended online mathematical learning environments. A blended course is an online course that meets once a week, at a face-to-face location, to review material, answer questions, and create community through discourse. Ausburn also noted adults valued course designs that were personalized, contained more learning style options, and embraced an active learning community. Cook (1997) also studied the relationship between mathematics anxiety level and the learning styles of adult students. Cook argues mathematics pedagogy should embrace the adult learner’s backstory.

Adult mathematics education should be a model of mutual respect and confidence between both student and facilitator.

Learning via MOOCs

MOOCs are an important new online pedagogical avenue that is more adapted to today's technological age. They are a form of online learning suited to learners with particular skills, motivations, and dispositions (Hao, 2014; Milligan et al., 2013; Zheng, Rosson, Shih, & Carroll, 2015). Little is known about the learning experience and perception of the MOOC student (Cole & Timmerland, 2015; Milligan et al., 2013). Milligan et al. (2013) conducted a study in which they interviewed 29 participants and found three distinct types of MOOC engagements: active, passive, and lurking. They added the key factors in identifying these types of engagements were learner confidence, prior experience, and motivation. Depending on the level of these key factors, they labeled MOOC students as active, passing, or lurking. The authors argued more research was needed to understand student MOOC motivations, dispositions, and needs for MOOC learners to be successful in the course.

In their 2015 qualitative study on understanding student motivation, behaviors, and perceptions of MOOCs, Zheng et al. concluded there are still many questions that need to be answered in ordered to understand MOOC student needs and MOOC high dropout rates. Their study identified learning motivations and patterns that may affect student retention. Some examples are: how the course was organized, certification issues, and the intention of the learner to finish the MOOC. Zheng et al.'s study also identified MOOC learning patterns and motivations that influence student MOOC retention. They contend retention should be viewed via two mindsets: retention as a problem, as well as retention as an opportunity, as the definition of what counts as finishing a MOOC differs greatly from student to student. Zheng et al. believe more research is needed to understand the student needs that are met by MOOCs and how to effectively implement these needs into all MOOCs.

Cole and Timmerman's (2015) qualitative study on MOOCs centered on students' MOOC experience. Cole and Timmerman argue there have been many studies that focus on faculty and administrators' MOOC perspectives. Nevertheless, as MOOCs are ultimately created to help students, more research needs to be done examining current college students' understandings of MOOCs. They concluded less research should be done on whether MOOCs are good or bad, and more research should be done on the capacity of MOOCs to serve current college students.

Learning Mathematics via MOOCs

College students frequently choose technology when registering for developmental math courses (Boylan, 2011; Hodara, 2013; Lovell & Elakovich, 2016). Finding an innovative approach to improve students' developmental math learning and utilizing the MOOC is education's newest idea to incorporate technology-infused mathematical pedagogy. Many students, faculty, and researchers agree MOOCs can increase connectivity to mathematical learning (Lovell & Elakovich, 2016). Upon studying students' perceptions about learning developmental mathematics via a MOOC, researchers found developmental mathematical MOOCs can improve student math success (Greene, Oswald, & Pomerantz, 2015; Lovell & Elakovich, 2016).

Research on student's achievement and success via MOOC's is sparse (Greene et al., 2015; Lovell & Elakovich, 2016). There is even less qualitative research about the learning experience of the developmental mathematic xMOOC student. Learning mathematics online has its issues. Couple these issues with the openness, massive nature, and pedagogical issues of MOOCs, and this equates to low student completion rates ranging from four to 12% (Adair et al., 2014; Cusack, 2014; Ho et al., 2010; Koller, NG, Chuong, & Chen, 2013; Jordan, 2014; Lytle, 2011). In Jordan's (2014) quantitative study on trends of enrollment and completion of mathematical MOOCs, she found completion numbers decreased as student enrollment time increased. Jordan contends completion rates are only a starting point in understanding the mathematical MOOC student. Jordan concludes more research needs to be conducted on MOOC student experiences and perceptions of learning, so mathematical MOOCs can be improved for students.

Adair et al. (2014) researched four different case studies on MOOCs, one of them focusing on a developmental mathematics xMOOC. They concurred there are many shades of MOOCs that are designed for a variety of different learners and debate if low completion rates even matter. The question that should be asked is, if completion or a certificate is not the goal, what other MOOC success measures are important? Quality Matters, an international program that assures online course quality processes, has reviewed a few dozen MOOCs, and only a few have met the Quality Matters Rubric standards. Adair et al. (2014) argues although the educational content of these MOOCs is strong, less attention is paid to the instructional design that is very important for the open-enrollment nature of MOOC courses. Design considerations such as orienting the learner to the purpose and structure of the MOOC, as well as relating resources and expectations, are also important for MOOC learners. Still, these design standards were not frequently met in the MOOCs they studied. Adair et al. also argue the instructional design of MOOCs must be effectively met for MOOC students to be self-directed learners and be able to succeed, considering the limited faculty interaction that is normally associated with a MOOC. According to the authors, identifying MOOCs by purpose and audience is also important to understand. Finally, MOOC design considerations should focus on the way technology is experienced by the MOOC participants, instead of the possible benefits of the technology itself.

Greene et al. (2015) scaffold on Adair et al.'s (2014) study to better understand the MOOC audience. They used survival analysis in their qualitative study to describe characteristics of students enrolled in a MOOC, their prior experience with MOOCs, their self-reported commitment to completing MOOCs, as well as participant hours devoted to the MOOC. They found the MOOC participants expected investment (that includes level of commitment, hours devoted, prior level of schooling, and intentions to obtain a certificate) foretold MOOC achievement. Many MOOC researchers agree the massive open nature of a MOOC varies significantly from the traditional online course, and terms like dropout, completion rate, and enrollment need to be redefined (Adair et al., 2014; DeBoer, 2014; Greene et al., 2015). MOOC researchers in many studies, define enrollment as: (1) active participants; (2) passive viewers; (3) samplers (those only engaging in a particular module); and lastly (4) curious bystanders (who were looking for information on MOOCs). Greene et al. (2015) believe researchers, designers, and facilitators must not simply foster retention but understand how to foster retention and achievement for MOOC participants who truly want to complete the MOOC. Many MOOC researchers have found many students who earned a certificate were active in discussion posts and assignments (Adair et al., 2014; Adamopoulos, 2013; Breslow, 2013; DeBoer, 2014; Greene et al., 2015). Age, gender, and prior education are still strongly debated and need further research (Adamopoulos, 2013; Breslow, 2013; Greene et al., 2015).

There is an ongoing debate concerning the educational value of MOOCs and the needs they meet in today's educational arena. High dropout and low completion rates are major MOOC concerns but are not the only concerns (Adair et al., 2014; Jordan, 2014). With MOOCs, bringing together hundreds of learners, one of its biggest attributes is also the one of its biggest challenges. The designing of a MOOC's learning community is made more difficult by the grand scale of a MOOC (Jordan, 2014). This challenge is one reason the next MOOC design might involve blended learning, where the learning community is fostered inside and outside of the MOOC course (Adair et al., 2014).

Characteristics of MOOC Learners

After reading the literature on MOOCs and MOOC learners, I found there seem to be characteristics many MOOC learners have in common. These MOOC characteristics span across all types of MOOCS, regardless of the type of MOOC (xMOOC or cMOOC) or the content the MOOC possesses (mathematics, writing, philosophy, or computer technology). Next is a brief overview of the literature on MOOC learner characteristics and goals.

Low Completion Rates

One major characteristic of MOOC learners that differs from traditional distance learners is the low completion rate. Although MOOCs attract a massive number of registrants, low completion rates consistently characterize them. Christensen et al. (2013) states, only 12% of over 300,000 users of a seven-week MOOC course completed and submitted assignments for week five. The definition of a low completion rate varies from 5% to 12% depending on the researcher and research study (Adair et al., 2014; Cusack, 2014; Ho et al., 2010; Koller, NG, Chuong, & Chen, 2013; Jordan, 2014; Lytle, 2011). Ho et al, (2014) states out of 840,000 registrants, two thirds accessed the course, and only 5% (42,000) of those who accessed the course received certificates of completion.

User Progression and Predictors of Retention

Due to the open nature of a MOOC, there is limited understanding of learner progress from the time of enrollment to the time of completion. Registration and completion are the first and last events of MOOC users, but what happens in between these events are the predictors of retention and completion and are the key to understanding successful MOOC completion. Perna et al (2014) believe there are quantitative predictors of retention and completion of MOOCs. For them, some predictors are number of lectures viewed and discussions posted by MOOC participants. Ho et al.'s (2014) discovered, the number of posts to a forum combined with the number of clicks (discrete actions a registrant takes during a course) and number of active days were linked to course completion. Ho et al.'s study found the higher number of clicks and active days were linked to registrants who explored more or completed the MOOC.

Differences in Learner Goals: MOOC vs Traditional Distance Course

MOOCs differ from traditional distance learning courses, as they are not meant to attract massive numbers of learners or to have free, unrestricted access for an unlimited timeframe. MOOCs are less regulated and more flexible than traditional distance courses. As mentioned earlier, one major characteristic of MOOC learners, that differs from traditional distance learners, is the low completion rate (Adair et al., 2014; Cusack, 2014; Ho et al., 2010; Koller, NG, Chuong, & Chen, 2013; Jordan, 2014; Lytle, 2011). Many argue this may be due to user purpose of MOOC (Ho et al., 2010; Koller, NG, Chuong, & Chen, 2013; Jordan, 2014). Some MOOC users register for a MOOC to focus on one unit or module and do not need to necessarily complete the entire course. The differences in the characteristics of MOOC course structure can also affect learner completion rate. Out of the 17 MOOCs Ho et al (2014) researched, they found variations in every MOOC design, content, duration, learner expectation, MOOC learning philosophy, video design, distribution and duration, assessments, and criteria for certification. The variations may breed confusion and frustration with MOOC learners, causing them to drop out or lose interest in the course (Jordan, 2014).

Enrollment, motivation, and persistence of MOOC learners were also predictors of retention and completion rates in studies by Belanger and Thornton (2013) and Gov (2015). The researchers suggest students are motivated to participate in MOOCs for several reasons. MOOC learners register for a MOOC with various back-stories and purposes and MOOC completion may not be the reason the learner enrolled in the MOOC. For these authors, studying MOOC student motivation is important as the use of motivational theory attempts to understand why students might be enrolling to take MOOCs and what factors may drive them to complete the course(s).

Conclusion

There is a growing body of literature on the potential benefits and challenges associated with MOOCs (Hao, 2014; Kolowich, 2012; Martin, 2012; Morris, 2011; Rivard, 2013). The extant literature, however, does not disseminate information on students' perspectives of developmental mathematical xMOOCs. As current college students are the most affected by the recent adoption of MOOCs in higher education, more qualitative research on students' perspectives is necessary. Underlying questions must first be addressed for MOOCs to be utilized at their maximum potential. More qualitative research on student beliefs and perceptions needs to be done for developmental mathematical xMOOCs to increase student opportunities to learn.

CHAPTER 3: METHODS

Introduction

In this chapter, I discuss the methodology I employed to conduct this descriptive exploratory case study of adult college students' perceptions when learning developmental mathematics via an xMOOC. I explain my research design, describe the participants, delineate my role as the researcher, and provide the context, data collection, data analysis, ethical considerations, and limitations. I chose a qualitative research design as best fit for this study because "qualitative research allows researchers to get at the inner experience of the participants, to determine how meanings are formed through and in culture, and to discover rather than test variables" (Corbin & Strauss, 2008, p. 12).

Purpose of the Study

MOOCs are in the spotlight as the new technological drivers in online learning. Debates over the potential change MOOCs may bring to traditional online and face-to-face learning now generate significant attention and discourse among the media and higher educational institutions (Viswanathan, 2012; Young, 2013). Several researchers and media outlets have conducted quantitative studies and discovered a range of perspectives on administration and faculty's perceptions of the MOOC effectiveness. Yet, there is sparse research that explores adult college students' perceptions and experiences using MOOCs (Cole & Timmerman, 2015; Perna et al, 2014; Young, 2013). Since MOOCs are ultimately created to benefit students, it is important to elicit current adult college students' perceptions of MOOCs. In this descriptive exploratory case study, I explored eight adult college students' perceptions of learning developmental mathematics via xMOOCs with the use of an online questionnaire. My goals were to explore adult college students' impressions and perceptions of learning via developmental mathematical xMOOCs, why they chose a xMOOC to learn developmental mathematics, their beliefs of personal characteristics needed to successfully complete a developmental mathematical xMOOC, and their ideas about how to improve developmental mathematical xMOOCs.

Research Questions

The following *A Priori* questions guided the study:

1. What are eight adult college students' enrolled in the developmental mathematical xMOOC perceptions of their learning in the xMOOC?
2. What reasons do these eight adult college students give for enrolling in the developmental mathematical xMOOC?
3. What are the students' ideas about how to improve the developmental mathematical xMOOC?
4. What are eight adult college students' perceptions of personal characteristics needed to successfully complete the developmental mathematical xMOOC?

Context for the Inquiry

I conducted the study at Coastal College (a pseudonym) in the Southeastern region of the United States. Coastal College is an ethnically diverse community college considered average in overall diversity according to national averages. The male to female student ratio is also above the national average of a ratio of 40:60 (predominantly female). Over 90% of the students attending Coastal College come from within the state. Coastal College is also designated a state college and offers four-year bachelor's degrees in nursing, business, biology, education, and legal studies. Coastal College also offers dental, veterinary technology and prosthetic programs. The College is accredited by the Southern Association of Colleges and Schools (SACS). It has an annual enrollment of 65,000 students; 36,133 are enrolled in degree seeking programs; are 25,797 were non-degree seeking students. Coastal College has actively offered developmental mathematics xMOOC courses over a period of six years.

My Role as the Researcher

Only when researchers recognize their preconceived notions, is it possible for them to try to view the experience from the perspective of the participant (Creswell, 2013). Based on the information from the literature review and my own experiences as a developmental mathematics professor, I acknowledge I have preconceived ideas about adult college students' perceptions when learning developmental mathematics face-to-face as well as online. I recognize my preconceived perceptions and did my best to analyze the data via the experience of the participants and not through my own personal tenets by using an online journal to add my thoughts as I read and reread the data.

I am a female mathematics professor at a local four-year community college in the Southeastern region of the United States. I have taught mathematics (both face to face and online) for 23 years. I teach a variety of mathematics courses and I am familiar with the curriculum for each course and write curricula, standards, and common syllabi for many of these courses. I recognize the need for unique online pedagogical techniques. Through my lens as a mathematics educator, I have discovered many of my developmental mathematics students have low confidence levels. When my college introduced their first developmental mathematical xMOOC six years ago, with the aim of helping students of all levels and backgrounds, grasp college level mathematical concepts and build mathematical confidence, I was naturally curious about the mathematical MOOC's effectiveness.

I have completed three courses in qualitative research and conducted two qualitative studies, one based on face-to-face interviews, and one with an online questionnaire. I used online journals to collect and organize the data and to add my thoughts about the data.

When conducting qualitative research, a researcher should not interpret information based on their own perspective but rather via the perspective and experience of participants (Merriam, 2009). My role in the current study was that of learner and observer. I conducted research *with* my adult developmental mathematics xMOOC students, listening and learning from participants to accurately portray their views of learning developmental mathematics via an xMOOC.

The Developmental Mathematical xMOOC Described

The developmental mathematical xMOOC in this study is a free online mathematics preparation class created by mathematics professors at Coastal College. It is a self-paced course with no instructor. The developmental mathematical xMOOC is designed to help students review key mathematical concepts at their own pace. Coastal College developed the developmental mathematical xMOOC in the Desire2Learn learning management system (LMS).

I justify defining this developmental mathematics course as a MOOC because Coastal College's advertised description is a free, online mathematical preparation course that reviews key concepts and is open to anyone who has access to the internet. Students have up to six months to complete the developmental mathematical xMOOC for a certificate. If students do not finish the course in the six-month period, they can reregister and begin the xMOOC again. Traditional online courses have a beginning and ending date and are open to a limited number of students for a fee per credit. The developmental mathematics course in this study has unlimited, unrestricted enrollment, is free, online, and open to anyone with connection to the worldwide web; thus, qualifying the course as a Massive Open Online Course (MOOC).

The xMOOC offers access to free mathematical videos and other helpful mathematical and tutorial resources such as auto -graded quizzes and tests, video tutorials and practice problems. The developmental mathematical xMOOC's purpose is to prepare students for college level mathematics, namely college algebra and has concepts that parallel pre-algebra and intermediate algebra. The developmental mathematical xMOOC is divided into seven sections. Each section has a pretest compromised of 30 questions. If a student's pretest scores indicate adequate knowledge (90% or above) of the content, the students can move on to the next section/module. If a student's score is less than a 90%, then they are encouraged to work through the units within the module. They can review their pre-assessment answers, and work on their specific areas of weakness. Students can work their way through online videos and instruction for each section at their own pace. Each module has specific unit folders with printable lecture notes, lecture videos reviewing the examples within the notes, randomly generated practice problems, and optional material to supplement the unit. Students can work on any of the units in which they need remediation, based on their pre-assessment or the entire course; whichever best suits their need(s). Students must pass each post assessment with a 70% or higher to successfully complete module. At the end of the class, students can take a final assessment. Students must pass the final assessment with a minimum of 70% to print a passing certificate and retake the placement test with the test fee waivered. I present the course syllabus in Appendix C.

Participants

Sample Selection and Procedures for Human Subject Protection

The population for this study was adult developmental mathematics xMOOC users at Coastal College. I offered an opportunity to participate in the study all adult college students actively participating in the developmental mathematical xMOOC at Coastal College. The online questionnaire (see Appendix D) was open to all adult developmental mathematics xMOOC users for three weeks. After the three-week period ended, 66 developmental mathematics xMOOC users voluntarily consented to the study and submitted the developmental mathematical online questionnaire anonymously. Coastal College used an honest broker to collect the questionnaires and electronically mail them to myself, the researcher, to ensure student privacy. (An honest broker is a person who has access to student confidential information but can distribute parts of the information to other parties who should not have access to the entire information set. An honest broker acts on behalf of the researcher to collect and provide de-identified information to the researcher or research team.)

I did not know the study participants' names or email addresses. After receiving all 66-developmental mathematical xMOOC questionnaires, I discarded eight questionnaires. I discarded six of the eight questionnaires because the respondents did not qualify as adults (they were under the age of 18) and two of the eight questionnaires were dismissed because they were blank. After I excluded the unqualified questionnaires, I employed the quantitative simple random sampling approach to choose eight adult participants for the inquiry. I chose the simple random sampling approach for my inquiry to decrease bias and increase trustworthiness of the data. Simple random sampling is a sampling technique where all samples are chosen at random. In a simple random sample approach, the sample is truly random, and each sample of the population is equally likely to be chosen. There are many ways to determine the random samples. For example, excel or google both provide random sample generators for larger populations. For smaller populations the 'lottery bowl' method (put the population in a bag/box and blindly choose your samples) works fine. For this study I utilized the 'lottery bowl' method.

Marshall and Rossman (2014) note that a researcher must secure proper entry and protocol to interview participants. Accordingly, I obtained Institutional Review Board (IRB) approval by both Coastal College where I conducted the research, and the University of South Florida, where I was the student- researcher. I required participants to electronically consent to the IRB. There were no known risks to participants because I interviewed them via email, which is a regular part of their teaching and learning experience. I used numbers as pseudonyms to protect participants' privacy. I assigned each participant a number directly correlating with the order in which they submitted their questionnaire. For example, the first study participant to submit their questionnaire was 'Participant #1'. Participants had the right to decide not to participate at any time. Their decision about participation did not affect their completing or passing the course.

Sample Size

The sample size for this study was eight adult students actively participating in a developmental mathematical xMOOC. This sample size is in line with published guidelines for a descriptive exploratory case-study (Creswell, 2013; Merriam, 2015; Morse, 1994; Neuman, 2004). Creswell (2013) recommends five to 25 participants in a qualitative research study as the data is rich and thick in description. Morse (1994) recommends a minimum of six participants depending on the openness of the questions. Case-study research … "examines many features of a few cases" (Neuman, 2004, p. 42). The cases can be individuals and the data collected are detailed, varied and focus on a single moment or duration in time (Merriam, 2009). Descriptive case-studies are useful when the researcher wishes to become familiar with a new research setting, and the particular features of the setting from a "comparatively small community" (Neuman, 2004, p. 15). Using a case-study approach has the ability to obtain rich description that can be transferred to similar situations. Thus, using eight participants in this study was deemed adequate and appropriate considering the rich and thick data analysis process in this descriptive exploratory case study.

Participant Criteria

In this study, I used three criteria to select qualified participants: 1. Participants must be adults over the age of 18; 2. Participants must be enrolled and actively participating in the developmental mathematical xMOOC at Coastal College; 3. Participants must electronically consent to IRB forms.

Researcher-Participant Relationship

I situated myself in the study because I teach mathematics online at Coastal College where a developmental mathematical xMOOCs is offered. I however was *not* the instructor/facilitator of the developmental mathematical xMOOC. To follow the criteria for population selection, I used the following steps to select the participants:

1. I prepared and send a statement of purpose to an honest broker at Coastal College. The honest broker emailed the statement of purpose to all students who were enrolled and actively participating in the developmental mathematical xMOOC. The statement included the intention of the study, the criteria, and an invitation to participate in the inquiry (See Appendix A).

2. The participants who agreed to the study, read the IRB agreement that was attached to the statement of purpose via a direct link (See Appendix B). The IRB informed the participants the purpose of the study and their rights in the study process. In general, the purpose of the IRB was to remove "any misconceptions and anxieties that the participants had about the research" (Blanck etc., 1922, P. 961). If participants consented to the study, they clicked on the 'IRB Agreement Link' and were directly connected to the anonymous online developmental mathematical xMOOC questionnaire and demographic survey.

Pilot Study

In the fall of 2016, I conducted a pilot study of the perceptions of college students learning developmental mathematics via an xMOOC. The pilot study was done to ensure validity and reliability of the instrument and of the study schedule used in this study. Pilot studies are frequently used as a pre-testing of a research instrument such as a questionnaire or interview schedule and are a crucial element of a good study design (J. Richards, personal communications, December 1, 2016). The pilot study was deemed of good design as an adequate number of learners participated in the study and adequately articulated their perceptions of learning via a developmental mathematical xMOOC.

I did however, eliminate one question as the participant responses for that question were redundant, I revised two questions to read smoother and finally, I add a demographic survey to this study to help describe characteristics of the participants in the study. I did not add the demographic survey to correlate the demographics with student perceptions of developmental mathematical xMOOCs but instead to help me when I analyzed the data via post structural tenets. In particular, I found the demographic survey gave me insight to each participant's age, gender, ethnic background, intended major, and class level. For example, the demographic survey helped me understand that the majority the developmental mathematical xMOOC respondents were adults, over the age of 35. I also noted, many respondents were single parents who had been out of the academic arena for many years and were looking for ways to increase their earning opportunities and decrease their schooling costs. Thus, utilizing the demographic survey, participants had opportunity to provide their unique characteristics that the developmental mathematical xMOOC questionnaire did not afford.

Data Sources

Online Questionnaire

I employed an online questionnaire for this qualitative inquiry. Online questionnaires provide opportunities for researchers to more deeply explore participants' perspectives about phenomenon. Questionnaires can provide rich data collection via comments made by participants (Creswell, 2009). The online questionnaire was comprised of nine open-ended questions about student experiences when learning via a developmental mathematical xMOOC. Brookfield (1995) created a series of questions to help trigger Critical Incident

Reflection (CIQ). This type of information is invaluable and useful in discovering how students are experiencing an academic course (Brookfield, 2006). Brookfield's original purpose for the CIQ was meant for classroom teachers to obtain rich, reflective information about the course. The CIQ has also been used as an instrument by other researchers in both online and face-to-face educational contexts (Gilstrap & Dupree, 2008; Glowacki-Dudka & Barnett, 2007). The open-ended questions are an adaptation of Brookfield's CIQ and meant to spur students' reflections of their developmental mathematical xMOOC.

The original piloted questionnaire contained eleven questions. After I piloted the questionnaire in the fall of 2016, I omitted two of the questions due to redundancy. I noted with the two deleted questions, respondents consistently repeated similar themes, attitudes, and perspectives that were voiced via the other questions in the developmental mathematical xMOOC survey. I also changed some questions to read smoother and more exact. For example, one original piloted question read: '*What personal intrinsic characteristics are needed to successfully complete a mathematical xMOOC?*'. For this inquiry the question read: '*What personal characteristics do you think are needed to successfully complete a developmental mathematical xMOOC*'.

Demographic Survey

I also included a brief five question demographic survey along with the developmental mathematical xMOOC questionnaire. Demographics are the characteristics of a particular population. These characteristics may include race, ethnicity, gender, age, education, and profession (Sheehan & Grubbs, 1999). A demographic survey *can* help researchers classify data into meaningful groups (1999). Demographic questions are a key component of qualitative research and are designed to help the researcher collect information to *possibly* cross-examine and compare subgroups. I used the demographic questionnaire in this study *only* to describe unique characteristics of the participants in the study and not to correlate the demographics with student perceptions of learning via developmental mathematical xMOOCs. I found the demographic questionnaire helped me when analyzing the data via post structural tenets as the survey gave opportunity for participants to provide characteristics of themselves that the developmental mathematical xMOOC questionnaire did not request.

Data Collection

An honest broker of Coastal College notified study participants of the objectives of the study, the voluntary nature of participation and the confidentiality of all the data collected via electronic mail (see Appendices A and B). All participants agreed to informed consent through an electronic IRB consent link (see Appendix B). By clicking on the IRB 'Agreement Link', the participants were directly linked to the developmental mathematics xMOOC questionnaire and demographic survey.

The honest broker from Coastal College also embedded the invitation to participate, the IRB consent form, the developmental mathematical questionnaire and demographic survey as a submodule in the developmental mathematical xMOOC. The submodule was labeled "Voluntary Developmental Mathematical xMOOC Survey." The participants could access the IRB consent form and developmental mathematical questionnaire through the email sent out by the honest broker or via the submodule embedded in the course.

Throughout the study, researcher's respect for participants' privacy was a priority for participants, the Coastal College, and the University of South Florida. Coastal College's honest broker sent developmental mathematical xMOOC students the invitation to participate and I, the researcher, was not permitted student emails or names. Additionally, numbers (pseudonyms) were used to refer to participants throughout the data collection and study.

I collected data through an anonymous survey generator located on Coastal College's secure LMS. There was a three-week opportunity for students to participate in the study. After the three-week period ended, an honest broker at Coastal College collected the data and electronically mailed the 66 submitted questionnaires to me. After I received all 66-questionnaires, I looked to see if any submissions did not meet the qualifying criteria of this study. I then discarded eight questionnaires. I threw out six questionnaires as the participants were under the age of 18 and I dismissed two questionnaires, as they were completely blank. After I discarded the unqualified questionnaires, I used simple random sampling to choose eight adult participants for the inquiry.

Data Monitoring

I stored the data collected in this study on a sixth-generation Intel Core i7-477os processor, Asus 24-inch computer with sixteen gigabytes of memory. As backup, I also stored data on a Seagate five terabyte removable external hard drive and kept paper data in a locked cabinet in my office at my college only accessible to me. The data I collected for this study- including questionnaires, researcher's journal and analyzed data- will be kept for at least 5 years on a password-protected computer on a secure server.

Data Analysis

The purpose of this descriptive exploratory case study was to explore the perceptions of students as they participated in a developmental mathematics xMOOC. Post structuralists agree language is power and we must no longer solely think quantitatively (Derrida, 1997; Jackson and Mazzei, 2011; Spivak, 1988). As qualitative researchers, we do not use statistics to help us analyze or as instruments in our research but instead we use the power of words (J. Richards, class notes, January 11, 2017). "Interpretation is not derived from rigorous, agreed -upon, carefully specified procedures, but from our efforts at sense making, a human activity that includes intuition, past experiences, emotion-personal attributes of human researchers can be argued endlessly but neither proved nor disproved to the satisfaction of all" (Wolcott, 2009, p.33). The interpretation of words and stories is the process of examining data in terms of what people see (Wolcott, 2009). The data I analyzed in this study came from the lived experiences of adult students, learning developmental mathematics in an xMOOC via an open-ended questionnaire.

In this study, I utilized constant comparative methods to analyze the data and identify overarching themes. I collected the data and I carefully read and reread the questionnaire responses. I added and dated my thoughts to an online journal. Next, constant comparative analysis ensued. Constant comparative analysis requires the researcher to take one piece of data and compare it to all other pieces of data that are either similar or different. I took one piece of data (one interview, one statement, or one theme) and compared it to all other pieces of data that are either similar or different. During this process, I began to consider what makes this piece of data different and/or similar to other pieces of data (Corbin & Strauss, 2007; Creswell & Clark, 2007). I created categories from the data and I created themes from the categories.

I followed the six steps below to analyze the data.

1. Initial coding.
2. Revisit initial coding.
3. Develop an initial list of categories for the revisited coding.
4. Modify initial list of categories based on additional readings.
5. Revisit categories and subcategories.
6. Identify concepts and themes from categories (Lichtman, 2012; Merriam, 2015)

I created thirty preliminary coding categories after two reviews of the collected data. I then carefully analyzed the questionnaire responses using thematic analysis. After a third review of the data, I categorized the data into the following five themes: teacher social presence (instructor involvement, support, and communication), student cognitive presence (learner engagement with content), learner characteristics (dispositional factors), and learner needs (situational factors) and course characteristics (developmental mathematical xMOOC key traits-both positive and negative- tangible and intangible).

I also turned to post structural tenets to view the data through different lenses. For example, post structural tenets posit that margins hold participants within and beyond frames and are also a way of understanding and describing power relations (Derrida, 1997; Jackson and Mazzei, 2011; Spivak, 1988). Spivak believes margins are a subjective perspective of being both outside the margins and inside the center at the same time. Spivak believes she (and others) can be both outside and in the center simultaneously (Spivak, 1988). Spivak scaffolds Derrida's deconstruction notions of looking for what is absent from the data, along with her perspective of margins and turns the 'inside out' (Jackson and Mazzei,2011; Spivak, 1988). One example of turning the 'inside out' is how Spivak herself holds conflicting positions and is both in the margins and the center as she is a third world woman who holds power and privilege in academia. Spivak believes the definition of marginality is consistently inconsistent and argues the center can also be marginalized. She views the 'center' like the center of the road (where the center of the road is also the margin between two lanes) rather than viewing the 'center' like the center of a city (Jackson and Mazzei, 2011; Spivak, 1988). Via this perspective, Spivak re-centers the center and the margins, thus changing position, power, and status of who is inside and outside the margins (Jackson & Mazzei, 2011; Spivak, 1988).

In this study, marginality was not only related to race, gender, and socio-economic status but also extended to age, family status and situations and learner mathematical abilities (Derrida, 1997; Jackson and Mazzei, 2011; Spivak, 1988). For example, two participants identified themselves as older single parents. Most single parents have limited time and money. They are busy working, raising children, and searching for a better life/career to better their families and are thus marginalized as they are outside of what is the norm college student. At the same time, adult students tend to be more motivated and apt to use and learn technology and other new methodologies to save time and money, thus being in the center of educations digital pedagogical expansion. It is not only the older students who are sometimes lost in the margins. Younger, less mathematically savvy students can also be marginalized. Many high school students just get by in math and have never really learned or been taught mathematics and thus have elevated levels of math anxiety and low levels of mathematical confidence. Yet these same students tend to be technologically savvy and adjust better to newer pedagogies like a flipped classroom and computerized homework and testing.

Thus, to further explore student perceptions of learning via mathematical xMOOCs, I utilized post structural tenets, specifically ideas from Derrida and Spivak (Derrida, 1982; Derrida, 1997; Guba & Spivak, 1988; Jackson and Mazzei, 2011; Spivak, 1988). For example, following Derrida's deconstruction notions I determined what was absent from the data (what is not there or what is not said) and I used Spivak's ideas of marginality that focus on marginality in the teaching machine (Derrida, 1988; Derrida, 1997; Jackson & Mazzei, 2011). These post structural tenets go beyond constant comparative coding methods of mechanical coding and "…push data and theory to their limits in order to produce knowledge differently" (Jackson & Mazzei, 2011, p.1).

Derrida and Spivak both contribute a unique perspective to data analysis. Both recognize the need to go beyond the mechanical method of qualitative coding and push text and theory beyond their margins to view data differently. Following Derrida's deconstructions ideologies, I searched for what was absent from the data or what was there but not said. In addition, following Spivak's perspectives of marginality, I looked for who was outside of the margins of the academic arena and why. I wanted to peel back the layers of data to unearth a new data set and reveal general themes related to student perceptions of learning via a developmental mathematical xMOOC. I found where constant comparative methods ended, post structural tenets made the data richer. My intentions were not only to identify what perceptions are most predominant but also rather to understand students' perspectives and concerns of learning via a developmental mathematical xMOOC.

Ethical Considerations

I used pseudonyms for the context and the participants of the study, and there was no identifying personal information of the participants in this study. Before data collection ensued, approval was obtained from both Coastal College and the University of South Florida's Institutional Review Board (see Appendix G). In addition, I achieved certification of completion from the social and behavioral investigators and key personnel refresher course in 2015 (see Appendix F). Obtaining informed consent is an important part of conducting research. I made participants aware participation was voluntary and they had the right to withdraw from the study at any time without affecting participants' ability to finish the course (see Appendices A and B). I also completed three qualitative research courses as part of my graduate course work at the University of South Florida. These qualitative research courses afforded me insight regarding how to correctly and ethically conduct a descriptive exploratory case-study.

Verisimilitude, Credibility, Dependability, and Transferability

There has been an abundance of literature attempting to describe the characteristics of what embodies good qualitative research and qualitative researchers have debated for decades how to evaluate the quality of their research analysis (Freeman, Preissle, Roulston, & Pierre, 2007; Lincoln & Guba, 1985; Merriam, 2009; Ponterotto, 2006). Many qualitative researchers disagree, over terms such as: validity, reliability, rigor, and parallel terms such as verisimilitude, credibility, dependability, and transferability (Lincoln & Guba, 1985; Ponterotto, 2006). Verisimilitude (or truthlikeness) is a perspective that differentiates between the relative and apparent truth (Freeman, Preissle, Roulston, & Pierre, 2007; Ponterotto, 2006). Although some researchers argue verisimilitude means absolute truth that is never challenged; truth and verisimilitude are different as verisimilitude can always be challenged and varies according to perspective. Verisimilitude is truth as best as can be constructed and carried out in a study. In this study, I described the best truth I could tell of the story and the best truth I could represent of the study participants. Qualitative research also depends upon the participants' perspectives for credibility and dependability (Lichtman, 2012; Merriam, 2015). Dependability and credibility of a study are involved in establishing that the results of the research are believable and reliable. Lincoln and Guba (1985), use these terms to replace 'reliability' and 'validity' that are usually linked to quantitative research. Dependability is the degree to which results are consistent with data and emphasizes the importance of the researcher to account for the ever-evolving context of the research (Lichtman, 2012; Merriam, 2015). Credibility is also linked with verisimilitude/trustworthiness of the study. "Part of ensuring for the trustworthiness of a study - is credibility- is that the researcher himself or herself s trustworthy in carrying out the study in as ethical a manner as possible" (Merriam, 2015, p.265). Transferability is associated with the extent to which findings can be applied to other similar situations (Merriam, 2015) and "…rich, thick description facilitates transferability" (p.265). My role in the study was not to generalize, but rather to describe the environment through those who experience it.

Finally, verisimilitude, credibility, transferability, and dependability are largely dependent upon the ethics of the researcher. Patton (2002) identifies credibility, dependability, and transferability as key factors of qualitative research. "These qualities are essential because as in all research, we have to trust that the study was carried out with integrity and that it involves the ethical stance of the researcher" (Merriam, 2015, p. 260). I carried out this study with integrity following Patton's 12 step Ethical Issues Checklist (Merriam, 2015). The Ethical Issues Checklist states:

1. Explaining the purpose of the inquiry and methods to be used
2. Reciprocity (issues of compensation)
3. Promises
4. Risk assessment
5. Confidentiality
6. Informed Consent
7. Data access and ownership
8. Interviewer mental health
9. Ethical advice (who will be your counselor on ethical matters)
10. Data collection boundaries
11. Ethical and methodological choices
12. Ethical verses legal (Merriam, 2015)

Limitations

As in all research, there are several limitations in this inquiry. One key limitation is researcher subjectivity. There is no doubt my interpretations of the data were influenced by *my* life experiences, epistemology, and attitudes. As Richards notes, as researchers "we must be careful because otherwise we will see what we want to see and hear what we listen for" (J. Richards, class notes, January 11, 2017). Although I bracketed my beliefs and perceptions, my preconceptions of the focus of this study were unavoidable, thus possibly affecting the data analysis. Hermeneutic considerations are another limitation and suggest the same data, can be read, and interpreted several ways due to researcher subjectivity (Tappan & Brown, 1992). Hermeneutic tenets contend all interpretation involves using one's own preconceptions, so the meaning of the object can become clear and may prompt different researchers to analyze the same data and reach different conclusions. Participant memory distortion is another limitation. Study participants may have only remembered part of their experience when asked them to recall a particular event (see J. Richards, class notes, January 11, 2017). Another limitation related to self-reported data was the participants' possible unwillingness to expose their truths via e-mail. Furthermore, study participants may struggle to communicate their thoughts.

Conclusion

The growing body of literature on the potential benefits and challenges associated with MOOCs does not disseminate information on students' perspectives of developmental mathematical xMOOCs (Hao, 2014; Kolowich, 2012; Martin, 2012; Morris, 2011; Rivard, 2013). As current college students are the most affected by the recent adoption of MOOCs in higher education, more qualitative research on students' perspectives is necessary. Underlying questions must first be addressed for MOOCs to be utilized at their maximum potential and more qualitative research on student beliefs and perceptions needs to be done for developmental mathematical xMOOCs to increase student opportunities to learn.

Through this study, I attempted to understand current developmental mathematical xMOOC adult students' perceptions by examining this major research question: *What are adult college students' perceptions about learning via a developmental mathematical xMOOC?* Eight developmental mathematical xMOOC users took part in this qualitative study in which I explored adult college students' perceptions of learning via a developmental mathematical xMOOC with the use of an online questionnaire and demographic survey. In the next Chapter, I discuss the results of the data collection via constant comparative analysis and post structural tenets.

CHAPTER FOUR: RESEARCH FINDINGS

Introduction

MOOCs have altered higher education's landscape and have created a contemporary method of teaching and learning. The purpose of this descriptive exploratory case-study was to describe adult learner's perceptions of learning via developmental mathematical xMOOCs. The data I analyzed for this study came from the lived experiences of adult students, learning developmental mathematics in an xMOOC via a nine-question open-ended questionnaire and five-question demographic survey.

Participant Demographics

For this study, I utilized a demographic survey to visually represent the characteristics of developmental mathematical xMOOC participants. Participation in the demographic survey was voluntary. I created a relative frequency chart to help organize the data collected from the demographic survey (see Table 3). Table 3 depicts the relative frequency chart of participant characteristics; specifically, the table documents the study participant's gender, age, ethnic background, intended major, and class level.

I also created graphs to display the information in the relative frequency chart to help focus on each demographic question separately. For each graph (shown below in Figures 1 to 5), the blue bar represents male participants, the orange bar represents women participants, the grey bar represents total participants for each category and the yellow bar represents relative frequency.

Table 3.

Relative Frequency Chart of Participant Characteristics.

Characteristic	Male	Female	Total	Percent
Age				
18-25	0	2	2	25%
26-33	0	1	1	12.5%
34-41	0	0	0	0%
42-49	2	1	3	37.5%
50-57	0	1	1	12.5%
58 +	1	0	1	12.5%
Gender				
Male	3	0	3	37.5%
Female	0	5	5	62.5%
Ethnic Background				
African-American	2	0	2	25%
White-Caucasian	1	3	4	50%
Hispanic/Latino	0	1	1	12.5%
Asian	0	0	0	0%
Indian	0	1	1	12.5%
Other	0	0	0	0%
Intended Major				
Business	0	1	1	12.5%
Physical Therapist	0	1	1	12.5%
Drafting	1	0	1	12.5%
Technology	1	0	1	12.5%
Nursing	0	1	1	12.5%
Agriculture	1	0	1	12.5%
Undecided	0	2	2	25%
Class Level				
Freshman	1	2	3	37.5%
Sophomore	0	1	1	12.5%
Junior	0	0	0	0%
Senior	0	1	1	12.5%
Other	2	1	3	37.5%

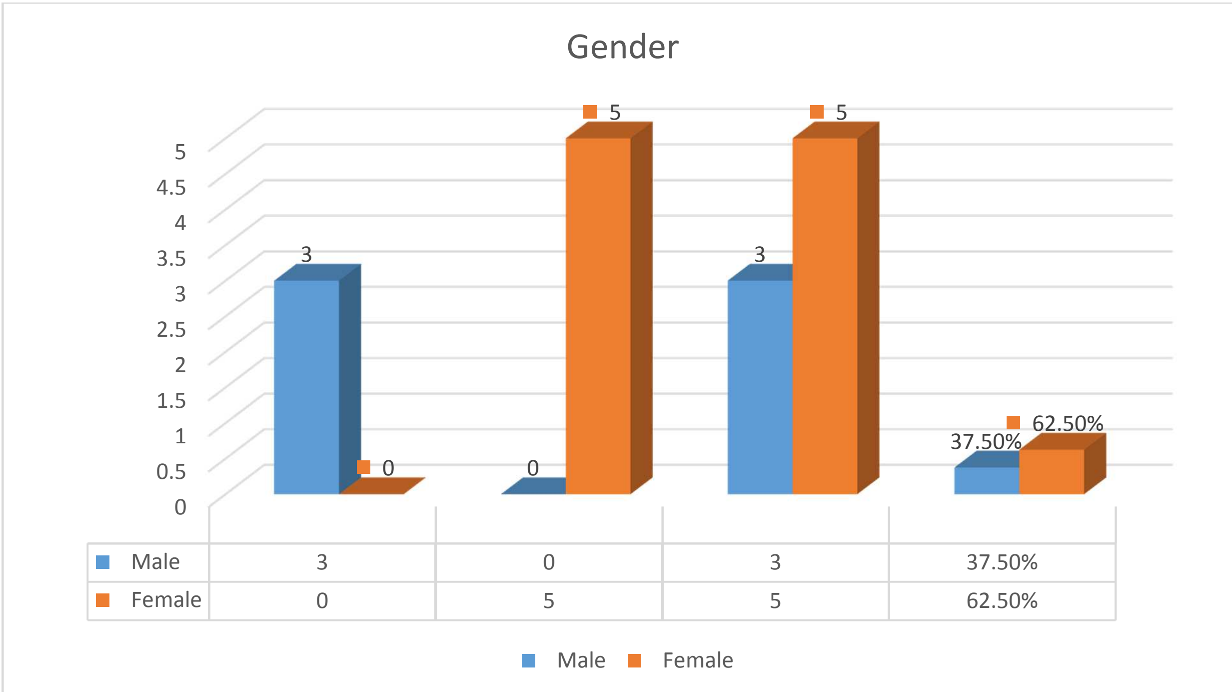


Figure 1. Gender bar graph

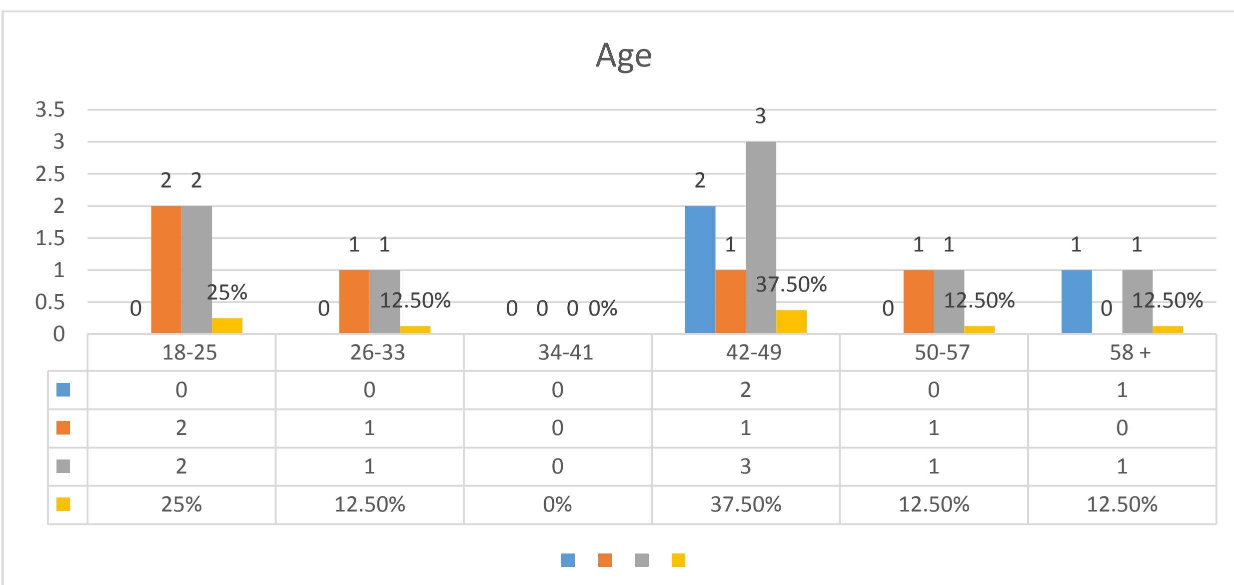
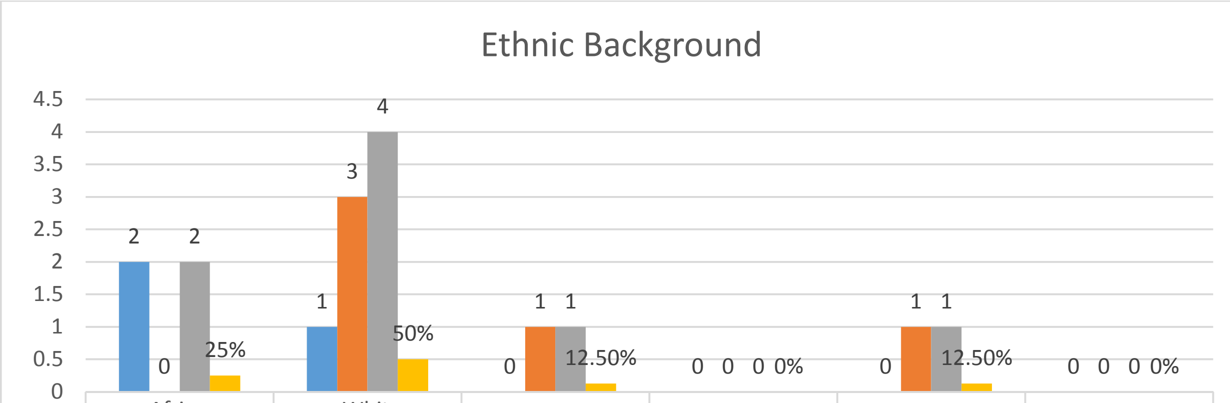
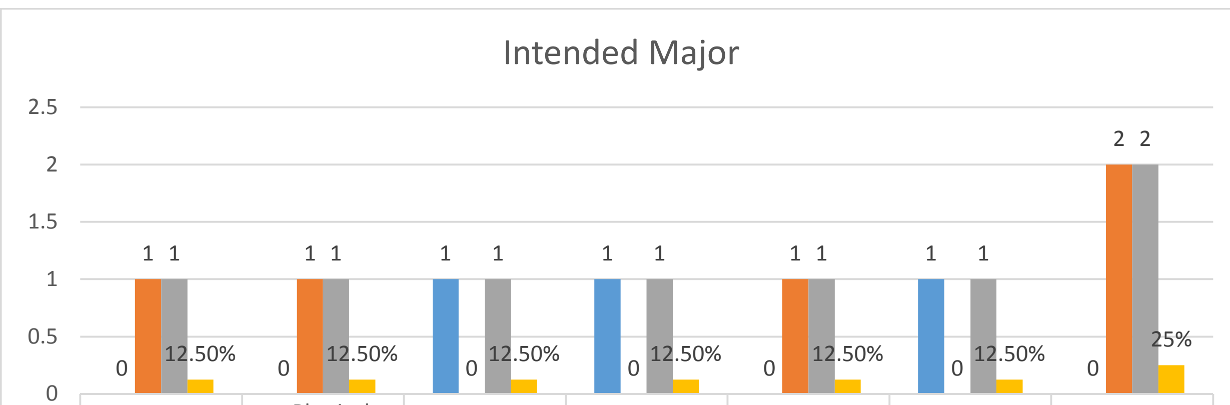


Figure 2. Age bar graph



	African-American	White-Caucasian	Hispanic/Latino	Asian	Indian	Other
■ (blue)	2	1	0	0	0	0
■ (orange)	0	3	1	0	1	0
■ (gray)	2	4	1	0	1	0
■ (yellow)	25%	50%	12.50%	0%	12.50%	0%

Figure 3. Ethnic background bar graph



	Business	Physical Therapist	Drafting	Technology	Nursing	Agriculture	Undecided
■ (blue)	0	0	1	1	0	1	0
■ (orange)	1	1	0	0	1	0	2
■ (gray)	1	1	1	1	1	1	2
■ (yellow)	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	25%

Figure 4. Intended major bar graph

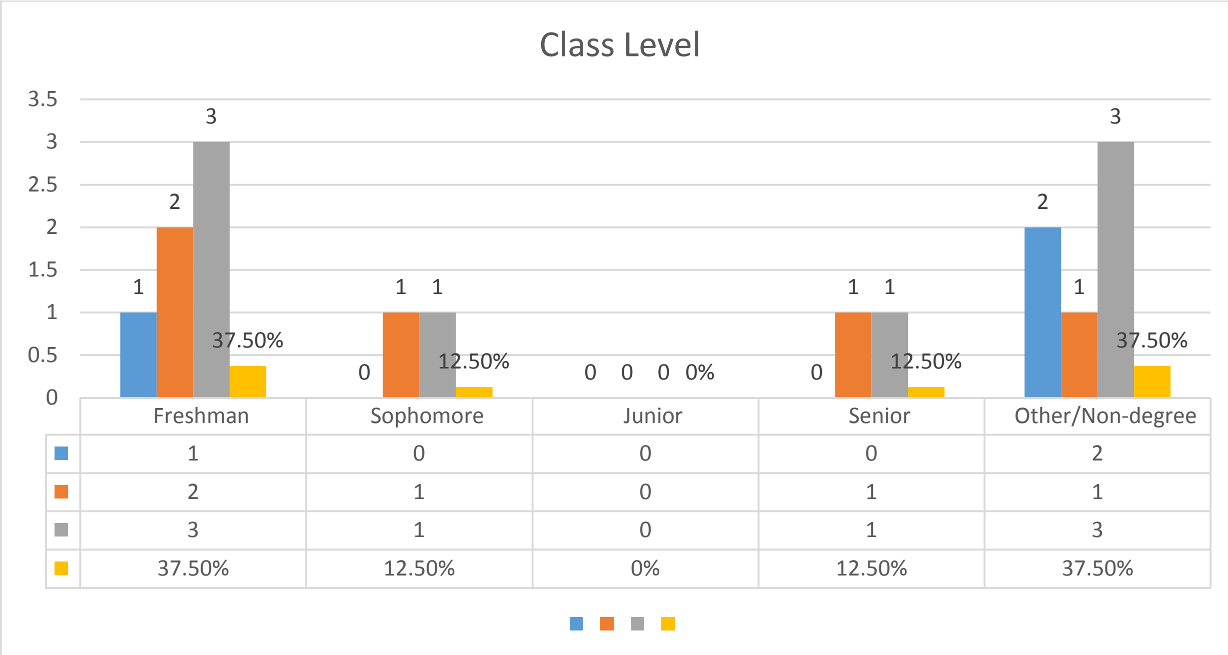


Figure 5. Class level bar graph

After I reviewed the data in the relative frequency chart (see Table 3) and in the graphs (see Graphs 1-5), I found, 37.5% of study participants were male and 62.5% were female. I found study participants' ages ranged from 18-61 years of age. Twenty-five percent of study participants were between the ages of 18-25, 12.5% were between the ages of 26-33, 37.5% were between the ages of 42-49, 12.5% of were between the ages of 50-57 and 12.5% were 58 or older. I discovered study participants' ethnic backgrounds varied. Twenty-five percent of study participants were African-American, 50% were Caucasian, 12.5% were Hispanic or Latino, and 12.5% of study participants labeled themselves as Indian. I also observed study participants' intended majors also varied. I noted study participants' intended majors were also diverse. Study participant listed their intended majors as Business, Physical Therapist Assistant, Technology, Agriculture, Drafting, and Nursing. Two of the eight study participants (25%) were undecided about their major at the time they submitted their developmental mathematical xMOOC questionnaire. I also found study participants' class levels ranged from freshman to non-degree seeking students. Thirty-seven percent of study participants were freshman, 12.5% sophomores, 12.5% seniors and 37.5 % of study participants were non-degree seeking students.

Participant Characteristics

I informed the participants I would use pseudonyms (numbers) in the written results of this paper to protect study participant's privacy and assure anonymity. The numbers I chose to identify each participant corresponded directly to the order each participant submitted their developmental mathematical xMOOC questionnaire. For example, the first study participant to submit their questionnaire was labeled 'Participant #1'; the second study participant to submit their questionnaire was labeled 'Participant #2'. Next, I briefly describe the characteristics of each participant according to their corresponding developmental mathematical xMOOC questionnaire and demographic survey.

Participant #1 was a 47-year-old African-American male with an intended major of Technology. Participant #1 enrolled in the developmental mathematical xMOOC to refresh his math skills and to gain mathematical confidence before enrolling at Coastal College. Participant #1 believes MOOCs are "the wave of the future" and more institutions should offer free refresher courses to aid returning students. He added, "…this area has been over looked for a long time. It is nice to have a device that allows ease of pace and allows for family life and the unexpected." Participant #1 also commented on the MOOCs ability to reach a variety of mathematical ability levels as well as the allowance for progression at one's own speed rather than the dictated time-line of traditional courses. Participant #1 wrote, "I will be able to test into higher level courses and save money in the process." Participant #1 appreciated the open period of the developmental mathematical xMOOC and wrote he was making "headway" weekly. He did suggest the addition of an online tutorial chat to help "frustrated" students who were struggling with the xMOOC content. Participant #1 also added developmental mathematical xMOOC learners should be "tech savvy" to successfully complete the developmental mathematical xMOOC. In general, Participant #1 believed he was greatly served by the free course and perceived that this course will help him achieve his higher educational goals. "I learn each day and have another goal to accomplish with each module. It (the course) is getting me back into the swing of learning and college success."

Participant #3 was a 55-year-old Indian female with an intended major of Nursing. Participant #3 enrolled the developmental mathematical xMOOC to help her understand her mathematical "weaknesses and strengths". She wrote determination is a key characteristic needed to successfully complete the developmental mathematical xMOOC. Participant #3 "liked" the course as it saved her time and money. Participant #3 wrote, "If I had this when I first went to college, I would have completed my courses more successfully." Participant #3 also added she wished Coastal College offered more free courses like the developmental mathematical xMOOC to help her with her educational endeavors.

Participant #4 was a 61-year-old Caucasian male whose intended major was Agriculture. Participant #4 described himself as an "older returning student" and "single parent" when asked why he enrolled in the mathematical MOOC. Participant #4 registered for the developmental mathematical xMOOC to "know (his) weaknesses and to pick the correct (mathematics) course." He also wrote the developmental mathematical xMOOC was interesting and helpful. Participant #4 added the course helped him gain mathematical confidence. "(I) learned a lot and gained confidence." Participant #4 believes self-motivation and being goal oriented are key characteristics to successfully complete the course.

Participant #7 was a 19-year-old Caucasian female with an undecided major. Participant #7 registered for the course via the recommendation of her current mathematics instructor. "My math instructor saw I had a gap in knowledge-specifically (in) reducing fractions and factoring and recommended this course." Participant #7 did not want to complete the entire course but instead had intentions to explore the modules and work on the mathematical concepts suited for her specific mathematical needs. "I have explored the modules and plan to work on only the concepts I need." Participant #7 commented she enjoyed the free mathematical tutorial videos as well as the ability to work on mathematics at home on her specific time schedule. "I am getting tutored for free without having to leave my home and on my own time!" Participant #7 added, she "want(ed) to get/understand math" and she appreciated the recommendation of the course from her mathematics instructor. Participant #7 added self-motivation, determination and the "want to learn" were all critical characteristics for developmental mathematical xMOOC learners to be successful.

Participant #19 was a 49-year-old Caucasian female with an intended major of Business Administration. Participant #19 registered for the course in preparation for Coastal College's placement test. She wrote she enjoyed the course and it took her three days to complete the first two modules. At the time, Participant #19 completed the xMOOC questionnaire; she was beginning the final module and felt her mathematical confidence had increased. "I am on the final module now, and my confidence has built up a lot." Participant #19 commented she enjoyed the course and it was a helpful mathematics refresher. "I like it because it gets me back in practice." Participant #19 did however, comment on lack of online support/tutoring connected with the course. "I do not like it that one of the equations on the test seems to have incorrect answers, or I am missing the necessary technique to solve it, and I cannot find the correct formula or explanation anywhere. I would appreciate it if there was a contact person, who I could ask for help." Participant #19 wrote, determination and the "desire to learn" to be key personal characteristics to successfully complete the developmental mathematical xMOOC.

Participant #32 was a 21-year-old Latino female with an undecided major. Participant #32 registered for the course via recommendation from her mother-in-law who is enrolled at Coastal College. Participant #32 believed she needed more mathematical practice, particularly with adding and subtracting fractions. Participant #32 wrote, being a “hard worker” is an important characteristic to do well in the developmental mathematical xMOOC. She also added the developmental mathematical xMOOC has helped her more than any previous mathematics book or instructor.

Participant #41 was a 45-year-old African-American male with an intended major of Drafting. Participant #41 registered for the course to prepare for Coastal College’s placement test. Participant #41 had just begun the developmental mathematical xMOOC at the time of his developmental mathematical xMOOC questionnaire submission, but wrote it “looked promising” and liked the “great videos” explaining the mathematical algorithms. He also appreciated the course was free. Participant #41 wrote persistence is a key characteristic needed to successfully complete the developmental mathematical xMOOC.

Participant #53 was a 31-year-old Caucasian female with an intended major of Physical Therapy Assistant. Participant #53 also registered for the course to prepare for Coastal College’s placement test. Participant #53 had also recently enrolled in the course at the time of her developmental mathematical xMOOC questionnaire submission, but believes the embedded videos and practices problems will likely help refresh her math skills. Participant #53 wrote discipline is a key characteristic needed to successfully complete the developmental mathematical xMOOC.

Data Analysis

For this descriptive exploratory case study, I utilized constant comparative methods to analyze the data and identify overarching themes. I also turned to post structural tenets to study the data through different lenses. I, specifically, turned to ideas from Jacques Derrida and Gayatri Spivak (see Jackson & Mazzei, 2011). I found post structuralist tenets made the data richer and more meaningful. My intentions during data analysis were to understand the general perspectives and concerns of adult students learning via a developmental mathematical xMOOC.

I constructed this descriptive exploratory case-study to answer the following research questions:

1. What are eight adult college students' enrolled in the developmental mathematical xMOOC perceptions of their learning in the xMOOC?
2. What reasons do these eight adult college students give for enrolling in the developmental mathematical xMOOC?
3. What are the students' ideas about how to improve the developmental mathematical xMOOC?
4. What are eight adult college students' perceptions of personal characteristics needed to successfully complete the developmental mathematical xMOOC?

For each question, I first discuss the overarching themes I discovered in the data utilizing constant comparative methods, I then turned to post structural tenets to look at the data through different lenses; specifically, through the ideas of Derrida and Spivak. By utilizing the post structuralist ideas of Derrida and Spivak, I unearthed what was not said (or what was implied by each participant) and which participants were the margins of the teaching machine and why. In short, I was exploring … "the silence (in the data) as a purposeful and productive way to think about what else participants might be saying in the gap" (Jackson & Mazzei, 2011, p. 7). I wanted to understand, explore, and describe study participants' thinking voice within the data. I also wanted to understand, explore, and describe both the center and the margins of the teaching machine (specifically, post-secondary institutions) and offer an exploration of: How developmental mathematical xMOOC participants were outside the norm of the teaching machine?

Discoveries

After I collected the data, I read and reread the questionnaire responses and added and dated my thoughts to an online journal. I used constant comparative analysis to take one piece of data and compare it to all other pieces of data that were either similar or different. I created thirty preliminary coding categories after two reviews of the collected data. After a third review of the data, I created five themes from the categories: 1. Teacher social presence (instructor involvement, support, and communication, 2. Student cognitive presence (learner engagement with content), 3. Learner characteristics (learner dispositional factors), 4. Learner needs (learner situational factors) and 5. Developmental mathematical xMOOC characteristics (developmental mathematical xMOOC key traits-both positive and negative-tangible and intangible) (see Table 4). I found some categories overlapped multiple themes depending on perspective and voice of the study participant (see Table 4). I then appropriately connected themes to each research question. After constant comparative analysis, I turned to post structural tenets to explore the silence or what was not said in the data and who was in the margins in the teaching machine and why (Jackson & Mazzei, 2011). I wanted to understand, explore, and describe how the participants were marginalized (outside the norm of the teaching machine at Coastal College). I also wanted to understand the importance of what was not said by the participants by deconstructing the data and exploring and describing the traces of discarded data (Jackson & Mazzei, 2011). Next, I discuss the results of the data analysis as related to each research question through both constant comparative analysis and post structural tenets.

Table 4.

Themes and categories.

Teacher Social Presence (instructor involvement)	Student Cognitive Presence (learner engagement with content)	Learner Characteristics (dispositional factors)	Learner Needs (situational Factors)	Course Characteristics (dev. math xMOOC traits- both + & -)
No collaboration	More practice	Not mathematically inclined	Gain (math) confidence	free
No one to email for help	Weakness /strength in math	Determination Persistent hard-working	Pass entrance exam	Flexible schedule
No contact person	Learned a lot	Self -motivated Have the desire to learn	Understand math	Interesting /helpful
No Online chat times	Only doing parts I need	disciplined	Older returning student	Wave of the future
Lack of teacher presence	Exploring modules plan to work on weak concepts	Technologically savvy	Single parent/work full time/flexible schedule	Auto graded tests and quizzes
More student to student collaboration	I want to learn/want to understand math	Single parent	Passed over in math in HS	Video tutorials
More teacher to student collaboration	Making head way. I learn each day & add another goal	Older student	Let's me know what math to take next	Certificate to retake the PERT for free

Constant-Comparative Analysis to Answer Question One

What are eight adult college students' enrolled in the developmental mathematical xMOOC perceptions of their learning?

After I reviewed the data via constant comparative analysis of college students' perceptions of learning developmental mathematics via a xMOOC, I discovered three overarching themes: 1. Teacher social presence 2. Student cognitive presence and 3. Developmental mathematical xMOOC characteristics.

Teacher social presence, which includes instructor support and communication, was mentioned by four of the eight (50%) participants. Study participants focused on the absence of instructor presence and felt it to be a negative attribute of the developmental mathematical xMOOC. Participant #1 wrote, "If I can't find an answer, I will take the problem to a friend or look for the solution online. I do wish there was an instructor I could ask too." Participant #19, also commented on lack of instructor involvement, "I would appreciate if there was a contact person, who I could ask for help." Participant #7 added, "I wish there was more collaboration with an instructor…"

The next theme I discovered after reviewing the data was student cognitive presence or learner awareness of their engagement and/or progress with the developmental mathematical xMOOC content. I found study participants were aware of their level of learning engagement in the developmental mathematical xMOOC. Participant #1 wrote, "I am making head way. I learn each day and have another goal to accomplish with each module." Participant #7 wrote, "Like I said I am now only doing the parts I need. I am learning what I need for now. If I have time I will definitely revisit this course for more math help and learn more." Additionally, Participant #4 expressed he learned a lot via the developmental mathematical xMOOC and now understands his mathematical weaknesses.

I found developmental mathematical xMOOC characteristics (traits-both positive and negative- tangible and intangible) to be a prevalent theme in xMOOC study participants' perceptions when learning developmental mathematics. All study participants noted the developmental mathematical xMOOC's unique characteristics. For example, the developmental mathematical xMOOC's flexible schedule, the fact it is a free course and the helpful video tutorials and auto graded tests and quizzes embedded in the course. Participant #41 expressed he liked how the videos embedded in the course explained the mathematical algorithms. Participants' #3, #7, #19, #41and #53 all commented they enjoyed the fact the course was free and self-paced. Participant #7 wrote, "I like that this course is free, and the examples really help. I am getting tutored for free without having to leave my home and on my own time!" Additionally, Participant #1 wrote, "I believe this is the wave of the future. It is nice to have a device that allows ease of pace and allows for family life and unexpected. I believe …these moocs are created to reach a variety of ability levels and allow for progression at one' s own speed rather than a dictated time-line of traditional courses. I will be able to learn and save money in the process."

Post-Structural Tenets for Question One

What are eight adult college students' enrolled in the developmental mathematical xMOOC perceptions of their learning?

Next, I turned to post structural tenets to study the data via the ideologies of Derrida and Spivak. I first reviewed the data through the eyes of Derrida and his notions of deconstruction to determine what was absent from the data. Using Derrida's post structuralist perspective of analyzing data, I found study participants may prefer the use of technology when learning. Although study participants did not write they preferred the use of technology when learning developmental mathematics, it was implied by their willingness to register for the developmental mathematical xMOOC. These same study participants may also prefer use of a virtual classroom to a traditional classroom context. I also inferred by reading between the lines, these same study participants felt they were technologically adequate or competent with their computer skills; as noted in their willingness to voluntarily register for an online course to learn developmental mathematics. I finally noticed, none of the participants commented on difficulty when using any of the technology embedded in the developmental mathematical xMOOC. In fact, most study participants commented they found the videos, quizzes, and tests that were embedded in the course, interesting and helpful. Thus, confirming the study participants were technologically competent learners.

During my analysis of the data via post structural tenets, I also discovered many of Derrida's deconstruction notions scaffold upon Spivak's ideas of marginality in the teaching machine. Using Spivak's notion of thinking with marginality, I wanted to understand how study participants were inside and outside of the margins in today's post-secondary institutions. I found by reading the silence in the data, many developmental mathematical xMOOC study participants fell in the margins due to age, socio-economic status, mathematical ability, or a combination of these. Three fourths of the study participants (75%) were older returning students over the age of 35. Participant #4 wrote, "(I) am an older returning student. (I want) to know my weaknesses to pick the correct (mathematics) course." I also noticed, many study participants commented on their lack of mathematical confidence and they also had been away from a mathematics classroom for an extended period time. Participant #19 (a 49-year-old returning student) commented, "I like (the developmental mathematical xMOOC) because it gets me back in practice." Participant #1 (a 47-year-old, single father) wrote, "I wanted to refresh my math skills before enrolling and gain my courage prior to fully enrolling." At the same time, these adult students were motivated to use technology and the xMOOCs new methodologies to save time and money, thus being in the center of educations digital pedagogical expansion.

I also noticed, it was not only the older, returning students who were outside of the center of today's post-secondary academic arena. Younger, less mathematically savvy students were also marginalized due to their lack of mathematical knowledge and abilities. Many high school students just 'get by' in mathematics and have never learned or been taught mathematics. Because of this, some students have elevated levels of mathematical anxiety and low levels of mathematical confidence. Two study participants, who identified as under 21 years of age, also commented on their gap in mathematical knowledge. Participant #7 wrote, “I had a gap in knowledge-specifically reducing fractions and factoring…” Participant #32 echoed Participant #7 and wrote, “…adding and subtracting fractions (are) hard for me- I was never taught this…” These younger, more traditional college students, felt less confident with their mathematical skills, in contrast to their peers, and thus were outside the teaching machine’s societal norms. I also noted these same students were technologically capable and seemed to adjust quickly to newer pedagogies like an xMOOC which incorporates a flipped classroom teaching style along with computerized homework and testing thus placing participants in the center of today’s newest tech-friendly pedagogical methodologies.

After exploring these data, I also observed all study participants commented on the developmental mathematical xMOOC characteristics. They said they enjoyed it was free, flexibility and self-paced and open to anyone with internet and computer access. Participant #1 wrote, “I have been greatly served just by the offering of a FREE course and review.” Participant #19 added she enjoyed getting math help without having to leave her home and on her own time. What was not said however was many community college students are not the traditional straight out of high school learners and are in fact, marginalized. Many are older adult students, head of households with dependents with full time jobs who need a flexible school schedule. The study participants in this study were either parents or single parents, working full time and in need of a free flexible classroom environment. Single parents and parents who work full time find flexible courses such as an xMOOC a necessity to reach their higher educational goals. Participants #1, # 4, and #19 articulated they were parents or had dependents. Many families and single parents have limited time and money. Study participant parents are busy working, raising children, and searching for a better life/career to better their families. Participant #1, who characterized himself as an "older returning student" wrote, "It (the xMOOC) is getting me back into the swing of learning and college success." Participant #4 wrote, "I am a single dad that wants to elevate his position." What was implied by reading the silence between the lines was a free flexible course, such as a MOOC, is a key attribute for 'older adult' learners who work full time, have dependents, and have limited funds for school. Although many of these inferences were not directly written by the marginalized study participants, they were implied by reading between lines of what was not said and looking deeper into the layers of the data.

Constant-Comparative Analysis to Answer Question Two

What reasons do these eight adult college students give for enrolling in the developmental mathematical xMOOC?

After I reviewed the data via constant comparative analysis, I discovered learner situational factors (learner needs), learner dispositional factors (learner characteristics) and developmental mathematical xMOOC characteristics (traits-both positive and negative-tangible and intangible) were major themes in understanding reasons adult college students enroll in a developmental mathematical xMOOC.

I discovered study participants articulated several learner situational factors that led them to enroll in the developmental mathematical xMOOC. Study participants' situational factors included: the desire to gain mathematical confidence and knowledge, passing the college entrance exam, being an older returning student in need of a flexible mathematics course to refresh their mathematical knowledge. Six of the eight participants were over the age of 30; three of the eight participants commented on their age being a factor for enrolling in the developmental mathematical xMOOC. Participants #1, #3 and# 4 both wrote they were 'older returning student' and needed a mathematics refresher course to refresh their mathematical knowledge. I also noted three study participants' situational factors included the need to pass the college entrance exam. Participants #19, #41, and #53 all wrote they enrolled in the developmental mathematical xMOOC as preparation for Coastal College's placement test. Participant #19 wrote, "I want to prepare more for the placement test, so I don't have to take any (math) pre-requisite classes." All study participants mentioned they enrolled in the developmental mathematical xMOOC because they needed more mathematical practice. Participant #1 expounded and wrote, "I wanted to refresh my math skills before enrolling and gain…courage prior to fully enrolling." Participant #32 added, "…I need more practice (with) adding fractions because it is hard for me." Another situational factor articulated by study participants was a need for a flexible course schedule due to work and/or family commitments. Study participant's #1, #3, #7, and #19 commented the flexible schedule to be one of the factors they enrolled in the developmental mathematical xMOOC. Participant #1 expounded on this and wrote, "It is nice to have a device that allows ease of pace and allows for family life and the unexpected … (for) returning students with commitments."

I also discovered learner dispositional factors and developmental mathematical xMOOC characteristics were themes in understanding reasons adult college students enroll in a developmental mathematical xMOOC. Many study participants enrolled in the developmental mathematical xMOOC due to their dispositional factors; they had dependents and/or needed a flexible class schedule due to work and home responsibilities. I noticed study participants dispositional factors and developmental mathematical xMOOC characteristics were intertwined as study participants dispositional factors influenced their decision in enrolling in the developmental mathematical xMOOC as it was free, had a flexible schedule, and was open to anyone with internet access and a computer. Participant #19 wrote, "The schedule of open time will allow me to work around my work and family schedule." Participant #1 added, "I feel this is a tool that provides an opportunity to many learners in a variety of situations…with commitments." Thus, they chose to enroll in the developmental mathematical xMOOC due to its unique characteristics; it is free, it has a flexible schedule open to anyone who has access to the world wide web with intentions to learn. Participant #1 wrote, "I like the open time frame and work at your own pace." Participant #3 added the developmental mathematical xMOOC has saved her money.

All study participants mentioned the developmental mathematical MOOC characteristics. Some of these developmental mathematical xMOOC characteristics were its flexible schedule, auto-graded tests and quizzes, video tutorials, and the fact it is free and open to all learners having access to the internet. Participant #41 expressed he liked the free videos explaining the mathematical algorithms. Participants #3, # 7, #19 and #53 all commented they enjoyed the fact the course was free and self-paced. Participant 7 wrote, "I like that this course is free, and the examples really help. I am getting tutored for free without having to leave my home and on my own time!" Participant #1 added, "I believe this is the wave of the future. It is nice to have a device that allows ease of pace and allows for family life and unexpected. I believe …these moocs are created to reach a variety of ability levels and allow for progression at one's own speed rather than a dictated time-line of traditional courses. I will be able to learn and save money in the process." I also noted the developmental mathematical xMOOC characteristics were perceived as an advantage when considering learner situational factors, such as being an older returning student, a parent, or single parent with a full-time job or not being mathematically inclined. Participant #19 wrote, "I want to improve my math skills after so many years out of college. I will have the ability to work at (my own) pace. The schedule of open time will allow me to work around my work and family schedule."

Post-Structural Tenets for Question Two

What reasons do these eight adult college students give for enrolling in the developmental mathematical xMOOC?

Next, I turned to post structural tenets (specifically ideas from Derrida and Spivak) to further explore why adult college students enroll in a developmental mathematical xMOOC. From the perspective of Derrida's deconstruction notions, I explored what might be absent from the data. Influenced by Spivak's ideas of marginality, I explored the data focusing on marginality in the educational system (Jackson & Mazzei, 2011). Using these post structural notions, I found there were many unspoken reasons study participants enrolled in the developmental mathematical xMOOC; some reasons were caused by study participants' marginality in the teaching machine.

I discovered study participants enjoyed free access to a college level course that provided scheduling flexibility for learners with challenging life demands. Some study participants wrote they enrolled in the developmental mathematical xMOOC because they were older returning students. I noted, regardless of participants' age, some participants wrote they also wanted to pass the placement test. What all study participants did not directly articulate was that participating in the developmental mathematical xMOOC's helped learners fill the gaps of their mathematical educational backgrounds and obtain more mathematical practice. Looking further into the traces of the data and what was not said, I also found study participants enrolled in the developmental mathematical xMOOC to improve their basic mathematical skills and test into college-level courses without having to pay or take time out of their work and/or family schedules for remedial (non-credit) mathematics courses. New college students, or current students with expired mathematical prerequisites, are typically placed in remedial (non-credit) mathematics courses based on placement exam scores. Many students take these placement exams with minimal preparation or after a long break since their last mathematics class. What study participants' silent voice articulated, when asked why they enrolled in the developmental mathematical xMOOC, was the study materials embedded in the developmental mathematical xMOOC helped them prepare for the placement exams that might equate to fewer required remedial mathematical courses.

After reading and rereading the data, I discovered another message hidden in the data. Study participants were not aware or did not articulate feeling outside the center of the community college norm. I noted most study participants were not the typical straight from high school 18 to 23-year-old college learners. Study participants did not acknowledge they felt different from societal norms of what defines a typical college student. I also discovered all study participants were marginalized from the center of the teaching machine norm by either their age, mathematical ability, structured work or family schedule, preferred learning style or any combination of the mentioned. Many study participants wrote they were older returning students and hinted about their demanding work and family schedules. For example participant #1 wrote, "It is nice to have a device that allows ease of pace and allows for family life and unexpected." All study participants regardless of their age, were cognizant they had a gap in mathematical knowledge and/or lacked mathematical confidence. I wondered, as I read the data, if the study participants realized, developmental mathematical xMOOCs were created for learners who struggle with the pace or methodology of conventional mathematical coursework due to situational and or dispositional factors? Developmental mathematical xMOOCs help bring the marginalized student back into the center of the teaching machine by increasing their mathematical ability and confidence via a free, online, open course. Regardless of study participants' awareness of being in the margins, they ultimately enrolled in the developmental mathematical XMOOC to redefine the teaching machine by redefining what the center is and bringing the outside in.

Constant-Comparative Analysis to Answer Question Three

What are the students' ideas about how to improve the developmental mathematical xMOOC?

After I reviewed the data via constant comparative analysis of college students' ideas about how to improve the developmental mathematical xMOOC, I discovered teacher social presence (instructor/facilitator involvement, support, and communication) to be the major theme. Four of the eight participants mentioned teacher social presence. I found study participants viewed the absence of instructor presence as a negative attribute of the developmental mathematical xMOOC. Study participants expressed the need for more teacher communication and collaboration. For example, Participant #1 wrote, "If I can't find an answer, I will take the problem to a friend or look for the solution online. I do wish there was an instructor I could ask too." Participant #19, also commented on lack of instructor involvement, "I would appreciate if there was a contact person, who I could ask for help." Participant #7 wrote, "I wish there was more collaboration with an instructor…" Participant #53 added, "Wish there was more ways to have instructor chats or tutors."

Post-Structural Tenets for Question Three

What are the students' ideas about how to improve the developmental mathematical xMOOC?

Next, I turned to post structural tenets to view the data differently through the ideology of Derrida and Spivak, focusing on the deconstruction of the data and marginality in the educational system (Jackson & Mazzei, 2011) when exploring students' ideas how to improve a developmental mathematical xMOOC. Following Derrida's deconstuction ideas, I determined what was absent from the data and following Spivak's ideas of marginality I focused on which study participants were in the margins or center the teaching machine that is post-secondary educational. I discovered from reading the silence between the lines similar themes seen in Question 1. I again noted, study participants might perceive the addition of *student* online collaborations via online free synchronous sessions (discussion chats, forums, illumination or skype sessions), with other developmental mathematical xMOOC participants or with other advanced mathematical students to be another way to improve the developmental mathematical xMOOC. Participant #19 brings attention to this lack of student mathematical discourse and community when she wrote, "I do not like it that one of the equations on the test seems to have incorrect answers, or I am missing the necessary technique to solve it, and I cannot find the correct formula or an explanation anywhere. I have asked several other, more math-eloquent people than me to solve it, and they do not think it is correct either. I would appreciate it if there was a contact person, who I could ask for help." Here Participant #19 expresses her frustration with the mathematics and wrote how she turned to her circle of 'math-eloquent' peers. Student to student online chats and collaboration can help create an online mathematical community to help these frustrated marginalized students. Mathematical discourse is a necessity in any mathematics course as it can help flush out student questions, concerns and creates a classroom community. These marginalized students should not be shoved further out of the center of the mathematical academia arena. The need to create student mathematical forums might also create a sense of community that goes beyond the online setting restrictions of an online course.

Constant-Comparative Analysis for Question Four

What are eight adult college students' perceptions of personal characteristics needed to successfully complete the developmental mathematical xMOOC?

After I reviewed the data via constant comparative analysis of college student's perceptions of characteristics needed to successfully complete a developmental mathematical xMOOC, I discovered learner dispositional factors or learner characteristics to be a key theme. Categories that fall under the theme of learner dispositional factors include: determination, self-motivation, being technologically savvy, having the desire to learn, persistence, and discipline. All study participants agreed there are intrinsic characteristics needed to successfully complete the developmental mathematical xMOOC. Participants #19, # 7, #4, and# 3 believe determination, self-motivation, and the desire to learn to be intrinsic characteristics needed to successfully complete the developmental mathematical xMOOC. Participant #1 concurred with Participants #9, #7 and #13 and added being technologically savvy is also an important personal characteristic needed to successfully complete the developmental mathematical xMOOC. Participants #32, #41 and #53 all agree discipline, persistence, and being "hard working" to be key in successfully completing the developmental mathematical xMOOC. Regardless of the personal characteristic(s) each participant perceived to be key in successfully completing the developmental mathematical xMOOC, all characteristics help define independent learners.

Post-Structuralist Tenets for Question Four

What are eight adult college students' perceptions of personal characteristics needed to successfully complete the developmental mathematical xMOOC?

Next, I turned to post structural tenets to explore students' perceptions of characteristics needed to successfully complete a developmental mathematical xMOOC. From Derrida's deconstruction notions, I explored the absence in the data and from Spivak's ideas of marginality, I explored the data inside out; trying to bring the outside in (Jackson & Mazzei, 2011). After reading the data, I discovered all study participants were independent goal-oriented learners. I found, all study participants were motivated, proactive, and committed to their learning. They all articulated particular characteristics they deemed important, to successfully compete a developmental mathematical xMOOC. What they did not directly articulate was developmental mathematical xMOOC participants also set a schedule and kept to it, were not easily frustrated and were comfortable learning mathematics in cyber space. By rereading the silent traces in the data, I found study participants were at the forefront of today's emerging technological expansion and were helping to restructure the outdated, rigid traditional college course design and schedule. Study participants were not glued to a traditional college course design and context to increase their level of education due to real world demands and were technologically forward-thinking individuals which was implied by study participants willingness to voluntarily register for the course. I noted study participants were internally motivated as seen by their willingness to register for a course that was not a requirement for their degree. The developmental mathematical xMOOC created a flexible, free setting for study participant's opportunity to learn. Study participants could work independently with little direction and musts have good time-management skills that allows them to schedule specific times throughout a week to work on the course. Study participants did not articulate they missed the face-to-face interaction with their instructor or classmates nor the confinement of a scheduled face-to-face classroom setting. I also noted study participants were not timid or shy learners and did not give up easily. All developmental mathematical xMOOC participants had basic computer skills and access to an internet-connected computer and were comfortable learning mathematics in a virtual environment.

Synopsis of Discoveries

I created Tables 5 and 6 to summarize the findings discussed above, via constant comparative analysis and post structural tenets.

Table 5.

Findings via Constant Comparative Analysis.

Constant Comparative Analysis	Teacher Social Presence	Student Cognitive Presence	Learner Dispositional Factors	Learner situational Factors	xMOOC Characteristics
What are eight adult college students,' enrolled in a developmental mathematical xMOOC, perceptions of their learning in a xMOOC?	Lack of teacher presence	Participants were aware of level of learning engagement			Flexible, Free, Open Auto-grading, Self-paced
What reasons do these eight adult college students give for enrolling in a developmental mathematical xMOOC?			Head of Household, work full time, have dependents	Gain math confidence & knowledge, pass entrance exam, need of free flexible schedule	Free flexible course, open to anyone who has access to a computer & internet
What are eight adult college the students' ideas about how to improve the developmental mathematical xMOOCs?	The need for more teacher communication & collaboration				
What are eight adult college students' perceptions of personal characteristics needed to successfully complete a developmental mathematical xMOOC?			Determination, self-motivation, being technologically savvy, having the desire to learn, persistence, and discipline		

Table 6.

Findings via Post Structuralist Tenets.

Post Structural Tenets	**Teacher Social Presence**	**Student Cognitive Presence**	**Learner Dispositional Factors**	**Learner situational Factors**	**xMOOC Characteristics**
What are eight adult college students,' enrolled in a developmental mathematical xMOOC, perceptions of their learning in a xMOOC?			Prefer technology, enjoy virtual classroom, computer competent	Marginalized due to age, socio-economic status, math ability & confidence, and marital status & # of dependents	Easy to navigate through; must have access to computer and internet
What reasons do these eight adult college students give for enrolling in a developmental mathematical xMOOC?				Participants needed remedial course help, did not have extra money to pay for classes, participants needed class to pass the math course(s) for their intended major	Free, flexible math course

Table 6 (Continued)

What are the students' ideas about how to improve the developmental mathematical xMOOCs?	The addition of student online collaborations via online free synchronous sessions				More Mathematical discourse situations embedded in course.
What are eight adult college students' perceptions of personal characteristics needed to successfully complete a developmental mathematical xMOOC?	Did not miss face-to-face interaction with some instructor and/or classmates		Independent, goal-oriented learners, not easily frustrated, internally motivated, marginalized learners, work independently with little direction		No instructor presence, the new way to learn,

Conclusion

Many post structuralists agree, language is power, and we must no longer solely think quantitatively (Richards, 2017; Wolcott, 2009). As qualitative researchers, it is not mandatory to use mathematics to help analyze data; instead, we can use the power of words. "Interpretation (of data) is not derived from rigorous, agreed -upon, carefully specified (statistical) procedures, but from our efforts at sense making, a human activity that includes intuition, past experiences, emotion-personal attributes of human researchers that can be argued endlessly but neither proved nor disproved to the satisfaction of all" (Wolcott, 2009, p.33). The interpretation of words and stories is the process of exploring, discovering, and describing data in terms of what the *participants* see and believe (Wolcott, 2009). The data I analyzed in this study came from the lived experiences of adult students, learning developmental mathematics in an xMOOC via an open-ended questionnaire.

The participants in this study identified several positive and negative perceptions of learning developmental mathematics via an xMOOC. Unvarying with the literature on student perceptions of learning mathematics online, the convenience and flexibility of distance learning, along with the ability to choose the time, place and pace of learning were viewed as advantages of learning developmental mathematics via an xMOOC (Asburn,2004; Cercone, 2008; Cook, 2004; Jameson & Fusco, 2014; Moore & Kearsley, 1996). In addition, when learning via a developmental mathematical xMOOC, study participants had the ability to more freely choose the most suited learning approach to adjust to their particular pedagogical, situational, and dispositional needs.

I realize the categories and themes unveiled by exploring the data may have been limited due sample size. I acknowledge a larger sample size may have revealed more themes and categories on students' perceptions of learning developmental mathematics via an xMOOC. My intentions were not to identify what perceptions were most predominant but rather to understand the general perspectives and concerns of adult students learning via a developmental mathematical xMOOC.

CHAPTER FIVE: DISCUSSION

Introduction

In this descriptive exploratory case-study, I explored and described student experiences and perceptions of learning via a developmental mathematical xMOOC. Because I sought to understand adult student perceptions of their learning as they progressed through this free online developmental mathematical course, I collected information through an open-ended online questionnaire and demographic survey. After reviewing the data collected from the eight study participants, I extracted thirty categories from which I noticed patterns and five overarching themes that I labeled as follows: 1. Teacher social presence (instructor involvement, support and communication), 2. Student cognitive presence (learner engagement with content), 3. Learner characteristics (learner dispositional factors), 4. Learner needs (learner situational factors) and 5. Developmental mathematical xMOOC characteristics (the online course's key characteristics). I discovered shared commonalities and themes as well as common characteristics and learning perceptions that my study participants possessed these themes were reflected in the extant research literature. I next discuss and connect the themes discovered in my study to the existing literature.

Discussion

Question One

What are eight adult college students' enrolled in the developmental mathematical xMOOC perceptions of their learning in the xMOOC?

Constant-Comparative Analysis for Question One

I reviewed the elicited data on the questionnaire regarding college student's perceptions of learning developmental mathematics via a xMOOC and discovered the following three overarching themes also visible in the extant literature: 1. Teacher social presence 2. Student cognitive presence and 3. Developmental mathematical xMOOC characteristics. I will next discuss the commonalities.

Four of the eight study participants mentioned the lack of teacher social presence in their developmental mathematical xMOOC questionnaire as a negative attribute of the course. The extant literature echoed a similar attitude regarding teacher presence and teacher-student communication in online courses. Moore's model of online academic interaction focuses on student and teacher dialogue (Moore, 1993). He argues, distance learning requires unique pedagogies and should center on teacher-student interaction and lack of online learning discourse/communication can lead to unfavorable student learning experiences and perceptions (Moore, 1993). Other researchers agree with Moore and the importance of teacher-student online communication (Mupinga, Nora, & Yaw, 2006; Swan, 2001). Swan's (2001) research found learners with adequate instructor communication experienced both higher course satisfaction and higher levels of learning. Many agree, top priorities for distance learners are instructor feedback and communication, and most online students expect the instructor to instigate communication (Moore, 1993; Mupinga, Nora, & Yaw, 2006; Swan, 2001). This discovery indicates the value of MOOC (and any online) facilitators' understanding constant instructor interaction can ease student course anxiety and increase student course satisfaction.

The data analysis revealed study participants were cognizant of their level of learning engagement in the developmental mathematical xMOOC. Greene et al. (2015) along with Adair et al.'s (2014) also noted this theme in their research on MOOC audience and student levels of learning engagement. Greene described MOOC student characteristics as well as their learning engagement, prior experience with and self-reported commitment to completing MOOCs and discovered a connection with MOOC success and participants expected investment in the course (2015). Some researchers define MOOC levels of learning engagement as active participants, passive viewers, samplers- those only engaging in a particular module and lastly, curious bystanders who are simply looking for information about MOOCs (Adair et al., 2014; Greene et al., 2015; Nanfito, 2014). Researchers noted, individual learner reasons for enrolling in the MOOC was also a prominent theme that dictated student level of engagement and in turn predicted MOOC success (Greene et al.2015). I also found this to be true with the partakers in my study as well. Developmental mathematical xMOOC study participants set a goal and completed all or a part of the course according to that objective. For example, some participants aimed at passing the college's placement test, and thus they completed the material required for them to succeed in that endeavor.

I also found developmental mathematical xMOOC characteristics to be a prevalent theme in developmental mathematical xMOOC participants' perceptions as they studied via the xMOOC. All participants remarked on the developmental mathematical xMOOC's unique characteristics noting a flexible schedule for a free online course with helpful video tutorials, embedded auto graded tests and the ability to accept enrollment from any learner with a computer and internet access. The existing literature also recognizes these unique xMOOC characteristics. Some argue only a brick-and-mortar educational college facility can offer a true post-secondary education. "As higher education seeks to change and adapt, it is important to preserve its best aspects. The college experience should be centered in a physical place where students and faculty members feel they belong to an institution that has transmitted knowledge for generations" (Barrett, 2013, p.1). While one may agree on the value of the college experience, ninety-five percent of the population will never attend prestigious institutions and many potential students cannot attend any college or university due to the ever-growing cost of tuition. MOOCs, though, have the ability to provide multitudes of students' access to lectures, online forums, tests, and quizzes that they would normally never find easily available (MacKay, 2013). The law "requires educational institutions to provide access to educational opportunities to all students on an equal basis without regard to disability" (Nanfito, 2014, p. 67). The Rehabilitation Act (1973) and The Americans with Disabilities Act (ADA) both require colleges and universities to provide educational services, programs, and activities to disabled students (2014). MOOCs have the potential to offer students unrestricted access to education in a global context. At a much lower cost, MOOCs offer more choice, control, chances for contribution, for participation and greater student learning ownership. MOOCs also provide a free avenue for students to test their interest in a discipline (MacKay, 2013). Some debate against the educational value of teaching a course to masses of students with no or little instructor interaction, while others support MOOCs as they give more students an opportunity to learn (Barrett, 2013). It is true, a MOOC context does not offer the same learning experience as a traditional face-to-face or online course, but lower cost and customized class times, translate to a rational equivalent for many learners, (Sumell, 2013).

Question One

Post-Structuralist Tenets for Question One

Employing Derrida's post structuralist perspective of data analysis, I discovered developmental mathematical xMOOC study participants preferred utilizing technology when learning mathematics. Study participants willingness to register for a xMOOC to learn developmental mathematics implied a partiality for using technology while learning and an overall feeling of competence with their computer skills. I discovered by looking deep into the data and what was not said, none of the participants commented on difficulty with the technology embedded in the developmental mathematical xMOOC, and most in fact, most commented they found the embedded videos, auto grading quizzes and tests, “interesting and helpful.” The National Council of Teachers of Mathematics states that technology must be utilized in a way to support all students’ learning of mathematical concepts and procedures (NCTM, 2015). Many researchers, educators, and educational institutions have noted students’ frequent choice to use technology when they register for developmental math courses (Boylan, 2011; Hodara, 2013; Lovell & Elakovich, 2016). MOOCs are education’s innovative approach to improve student developmental math learning, and researchers, educators and students agree a MOOC can increase student connectivity to mathematical learning (Downes, 2012; Lovell & Elakovich, 2016). The National Council of Teachers (NCTM) position of strategic uses of technology in teaching and learning mathematics states, technology should be utilized in thoughtful way so that “…the capabilities of the technology enhance how students and educators learn, experience, communicate, and do mathematics” (NCTM, 2015, p.1). Upon studying students’ perceptions about learning developmental mathematics via a MOOC, researchers found this type of course might improve student mathematical success (Lovell & Elakovich, 2016). There is growing interest in reforming developmental mathematics education at the community college level and focusing on changing the face-to-face pedagogy that usually defines developmental mathematics (Boylan, 2011; Frame 2012; Hodara, 2013; Lovell & Elakovich, 2016; Stigler & Thompson, 2010). Learning mathematics online, eliminating costly books and using web-based materials may also help adult learners who need external motivation to learn mathematics (Hodara, 2013; Lovell & Elakovich, 2016).

Employing Spivak’s perspective of marginality in the educational system, I discovered many study participants fell in the margins of today’s academic arena due to age, socio-economic status, mathematical ability, family situational factors or a combination of these.

Three-fourths (6 out of 8) of the study participants were returning students over the age of 35, many of whom commented on their lack of mathematical confidence especially having been away from a mathematics classroom for an extended period time. According to the research literature, adult learners also tend to be non-traditional (often marginalized) learners having distinct characteristics. Some examples include returning students usually with one or more dependents, who deal with transportation issues, childcare, aging parents, and the need to earn an income. These factors can certainly interfere with the learning process (Cercone, 2008). Adult learners typically have lower mathematical self-confidence than traditional- undergraduate students who have just finished high school and the probable reason for their aversion to mathematics may be due to a combination of mathematics anxiety and low mathematical confidence (Cook, 2004; Cercone, 2008; Jameson & Fusco, 2014). This mathematical apprehension of adult learners is also associated to a limited exposure to, and low self-confidence in mathematics (Cook, 2006; Richardson & Suinn, 1972). These adult learner characteristics often leave adult math students feeling left behind and outside the norm of what typically characterizes today's college student.

All study participants mentioned enrolling due to the developmental mathematical xMOOC's unique characteristics, and stated they appreciated that it was free, flexible, self-paced, and open to anyone with internet and computer access. Most study participants older adults, head of households with dependents and full-time jobs in need of a flexible educational schedule. Single and/or working parents found free, flexible courses such as an xMOOC to be a key attribute. For those with dependents and limited funding for school, this flexibility at no financial cost was a necessity for reaching their higher educational goals. MOOCs also support NCTM's (2014) standards and position on *Access and Equity in Mathematics,* by assuring all learners, regardless of race, ethnicity, gender, or socioeconomic group, have opportunity to gain mathematical proficiency and achievement.

Researchers also agree adult students view mathematics as an unattainable concept to master (Ausburn, 2004; Cook, 1997; Jameson & Fusco, 2014). Yet, today mathematical literacy is often looked to as an important gateway through which students must pass to attain their educational and career goals (Shapka et al., 2006). Gutierrez argues, “Mathematics is viewed as so pure that it has become the discipline by which we measure other disciplines” (2017, p. 18) and because of this, many argue, mathematics should be the basis for how we view the world. My reading of the extant literature on adults and mathematics education revealed adult mathematics students perceived mathematics to be difficult and not necessary to survive in the real-world work force (Ausburn, 2004; Cook, 1997; Jameson & Fusco, 2014; Shapka et al., 2006). Regardless of the importance our society places on mathematics today, many adult students still dislike and avoid mathematics.

Question Two

What reasons do these eight adult college students give for enrolling in the developmental mathematical xMOOC?

Constant-Comparative Analysis for Question Two

After I assessed data from the developmental mathematical xMOOC questionnaire, I discovered learner situational factors, learner dispositional factors, and developmental mathematical xMOOC characteristics were the three themes necessary to understanding reasons adult college students enroll in a developmental mathematical xMOOC. I noted these three themes were also reflected in the existing literature.

Developmental mathematical xMOOC study participants articulated several learner situational factors that led them to enroll in the developmental mathematical xMOOC. Situational factors included the desire to gain mathematical confidence and knowledge, passing the college entrance exam, being an older returning student in need of a mathematics course to refresh their mathematical knowledge. Another situational factor articulated was a need for a flexible course schedule due to work and/or family commitments. Learner dispositional factors and developmental mathematical xMOOC characteristics were also key themes in understanding reasons adult college students enroll in a developmental mathematical xMOOC. Most study participants enrolled in the developmental mathematical xMOOC due to their dispositional and situational factors; they had dependents and/or needed a flexible class schedule due to work and home responsibilities. I noted an intertwining of study participants dispositional factors (being highly motivated, determined) with developmental mathematical xMOOC characteristics, and found these dispositional factors influenced study participants' decision to enroll in the course. Some course characteristics that caused study participants to enroll were its cost (free), flexible scheduling and openness to any learner with internet access and a computer. Other scholars noted similar themes in their studies regarding reasons learners enroll in MOOCs (Barrett, 2013; Frame 2012; Hodara, 2013; MacKay, 2013). Some researchers view MOOCs as a positive innovation with the potential to transform higher education's pedagogical deliveries and platforms (Adair et al., 2014, Barrett, 2013; MacKay, 2013). Many higher educational institutions view MOOCs as a sequence of self-paced online courses who aim at helping incoming students refresh their prerequisite skills and prepare for placement tests (Adair et al., 2014).

My examination of the research literature revealed while more adult students are attending community colleges, they are not equipped for college-level mathematics (Boylan, 2011; Challenges of Remedial Education, 2006; Frame 2012; Hodara, 2013; Stigler & Thompson, 2010). Developmental mathematics has become a barrier for many students trying to complete a degree. Stigler and Thompson found, after taking a community college placement test, many students are placed into a developmental mathematics course and may have to take up to four extra mathematics classes before they can register for a college-level mathematics course (Stigler & Thompson, 2010). Compared to younger students, fresh from high-school, adult students were found to have lower levels of algebra skills, had been away from mathematics longer, had completed less college preparatory classes (Meeks, 1989). Some adult students forgot their basic arithmetic skills and simply needed a mathematics refresher course for the proficiency in the mathematics required for their major. However, there were also adult students who never learned their basic mathematical skills and needed more prerequisite instruction. Because of these various barriers, developmental mathematics has become an issue for adult students when endeavoring to complete a degree (Challenges of Remedial Education, 2006). MOOCs provide educational institutions the opportunity to close the social justice inequity gap in mathematics education. NCTM's position paper, *Closing the Opportunity Gap in Mathematics Education,* states "…all students should have the opportunity to receive high-quality mathematics instruction …(and)…access to high-quality (mathematics) teachers" (p.1). Enrolling in a developmental mathematical xMOOC is one avenue in overcoming these challenges.

Question Two

Post-Structuralist Tenets for Question Two

Using the post structural ideas of Derrida and Spivak, I unearthed other reasons developmental mathematical xMOOC study participants may have enrolled in the developmental mathematical xMOOC. One incognizant reason participants may have enrolled in the xMOOC is due to their marginalization in today's post-secondary academic arena due to their situational and dispositional factors. Study participants articulated enjoying free access to a college level course that provided flexible schedules for learners with challenging life demands. Some study participants wrote they enrolled in the xMOOC because they were older returning students. Three study participants wrote they enrolled in the developmental mathematical xMOOC because they wanted to pass the placement test. What the study participants implied, was the developmental mathematical xMOOC's ability to help learners needing remedial coursework fill the gaps of their mathematical educational backgrounds and obtain more mathematical practice. I also found the study participants now had the opportunity to improve their basic mathematical skills and test into college-level courses without needing to pay or take time out of their work/family obligations for remedial mathematics courses. Many students take these placement exams with minimal preparation or after a long break from their last mathematics class. The study materials embedded in the developmental mathematical xMOOC helped study participants prepare for the placement exams that might equate to fewer needed remedial mathematical courses. According to the research literature on mathematics learning, remedial mathematical courses are often a prerequisite for adult mathematics students' continued education for their major (Boylan, 2011; Frame, 2012; Hodara, 2013; Stigler & Thompson, 2010). Students who have trouble with developmental mathematics may also face many challenges while continuing to upper division mathematical educational courses. According to Boylan (2011), community colleges attract more and more adult students; but these adult students are not ready for college-level mathematics. Many researchers agree mathematics is a barrier for adult learners attempting to complete a degree or certificate (Boylan, 2011; Frame, 2012; Stigler & Thompson, 2010).

Researchers also agree, easy access to learn mathematics is crucial in the fight for social justice (Gutierrez, 2017; Nanfito, 2014; Richards & Zenkov, 2015). Harper and Orr state, "…equity, both inside and outside of the classroom, requires… that students have access to high-quality instruction to excel in algebra…" (Richards & Zenkov, 2015, Chapter 11, p. 203). NCTM and federal laws (ADA) mandate all students access and equity in mathematics education; (Gutierrez, 2017; Nanfito, 2014; NCTM, 2014). MOOCs can provide students a free avenue to see if they are indeed interested in a discipline (MacKay, 2013). Mathematical MOOCs are meant to help high school students as well as the adult student who may have gaps in his or her mathematical knowledge (Haynie, 2015). If colleges and universities award MOOC credit, this may provide a path for non-traditional learners to earn degrees and demonstrate how diverse learners from various backgrounds can all achieve academic success.

Question Three

What are the students' ideas about how to improve the developmental mathematical xMOOC?

Constant-Comparative Analysis for Question Three

After reviewing data from the questionnaire on adult college learner's ideas about how to improve the developmental mathematical xMOOC, I discovered teacher social presence to be the major theme for improving the course. Study participants perceived the absence of instructor presence as a negative xMOOC attribute and expressed the need for more teacher-student communication and collaboration. According to Lin (2007), eight barriers exist that compromise and limit student online learning. Two of the eight barriers are lack of student to student and teacher to student social interaction and collaboration. Moore, (1993), also found lack of teacher-student interaction/communication could lead to less favorable student learning perceptions in online courses. Other researchers agree with Moore, 1993, concerning the importance of faculty-student interaction (Mupinga, Nora, & Yaw, 2006; Swan, 2001). Swan's (2001) research discovered learners who had perceived high instructor interaction levels also had elevated course satisfaction levels, and reported higher learning levels than students who thought they had less interaction with the instructor. Mupinga, Nora, and Yaw (2006) discovered, communication with the professor and instructor feedback was top priority for online learners. Some researchers add, learning mathematics online increases the challenges of distance learning since online mathematics students usually do not have the ability to ask a question and receive immediate feedback, and because not all online math classes have the same level of teacher-student engagement and one-on-one interaction with the instructor (Chiu, & Churchill, 2015).

Question Three

Post-Structuralist Tenets for Question Three

I then viewed the data considering Derrida's and Spivak's post-structural tenets and determined study participants may perceive the addition of student to student online collaborations via online free synchronous sessions (discussion chats, forums, illumination or skype sessions), with other developmental mathematical xMOOC participants and/or with other advanced mathematical students, to be another means of improving the course. Student to student virtual collaborations carry the potential to create an online mathematical community that could support frustrated, marginalized math learners. Many agree student to student mathematical discourse should be integrated in all mathematics courses as it helps learners flush out mathematical questions and concerns (Lowe et al., 2016; Lui, 2008). The establishment of student mathematical forums might also create a sense of community that journeys beyond the setting restrictions of an online course. Wikis, blogs, videography, and social media and networking, are all ways MOOC participants learn, articulate, connect, and share resources (Nanfito, 2014). The ease and design of these commonly used technologies can help ensure educational accessibility compliance with accordance to the ADA (Americans with Disabilities Act) and the Rehabilitation Act (Nanfito, 2014).

Lui (2008) states that 97% of higher educational public institutions offer at least one or more online degree programs. Liu suggests, online education can foster traditional educational pedagogy as it is viewed as having more potential and promise in "…promoting student interactions and enhancing learning outcomes by utilizing advanced computer technology" (2008, p.2). Liu's qualitative study focused on student interactions in online learning, specifically student-to-student interactions via distance courses. After researching student interactions and student perceptions of their interactions, Liu found to create effective online learning communities and encourage student online interactions, administrators, students, and faculty need to work together to increase online discourse and collaboration (2008). Lowe et al. (2016) also studied student perceptions of mathematical online tutorial sessions where they found both student and staff valued synchronous online teaching sessions. Students in this study found recording of online sessions to be helpful, liked the convenience of online tutorials, and commented the ability to interact with other participants online was positive (Lowe et al., 2016).

Question Four

What are eight adult college students' perceptions of personal characteristics needed to successfully complete the developmental mathematical xMOOC?

Constant-Comparative Analysis for Question Four

After I examined the data elicited from the study participant's questionnaire, I discovered learners' dispositional factors to be a key theme in adult college student's perceptions of characteristics needed to successfully complete a developmental mathematical xMOOC. Study participants agreed there were distinct characteristics needed to successfully complete a developmental mathematical xMOOC. Some learner dispositional factors included determination, self-motivation, being technological savvy and persistence. According to the extant research on adult mathematics learners, many researchers also agree successful online students possess certain characteristics (Cercone, 2008; Chen et al, 2015; Kim et al., 2014; Moore, 1993). Many adult students voluntarily enter college and manage their classes around work and family responsibilities (Cercone, 2008). These adult learners are usually highly motivated, task-oriented, autonomous, goal-oriented, and practical. Moore's transactional distance theory helps explain characteristics of adult distance learners (Moore, 1993). His theory suggests students' learning experiences are dependent upon distinct and diverse learner personalities. Moore (1993) states, one important personality element of a distance learner is the ability to work independently. Moore argues learner autonomy is a natural learned skill for most adults.

Kim et al.'s (2014) study attempted to understand why some mathematics distance learners succeed and some do not and what could be done to help increase online learning success. The results of their study showed motivation accounted for only 13% of student success when learning mathematics online and learner self-efficacy to be the principle predictor of learner online success (Kim et al., 2014). Chen et al. (2015) study agreed and built upon Kim et al.'s (2014) study while adding more research on student perceptions must be considered on student online motivational strategies to help effectively teach and learn mathematics online. "Students' perceptions should be considered as motivational strategies in teaching and learning… (and) for improving grades…" in online courses (Chen et al., 2015, p. 1).

Question Four

Post-Structuralist Tenets for Question Four

I also reviewed the data from the developmental mathematical xMOOC questionnaire via the lens of Derrida and Spivak's post-structural tenets. I noted participants indirectly verbalized their initiative and commitment to learning in the developmental mathematical xMOOC. I also concluded from participant responses, respondents set a schedule and kept to it, were not easily frustrated, were comfortable learning mathematics online and were internally and/or externally motivated and determined to succeed. I also discovered these same students overcame the outdated, inflexible traditional college course design and schedule by voluntarily registering for the 'flipped' online developmental mathematics course.

After I read the research literature on MOOCs and MOOC learners, I found there to be unique common characteristics many MOOC learners possess that span all types of MOOCS, regardless of the type (xMOOC or cMOOC) or the content. Participants from diverse backgrounds and with different motivational factors register for a MOOC, and completion might not be the reason the learner registered for the course (Kim et al., 2014). I found this to be true with the developmental mathematical xMOOC study participants who disclosed assorted reasons for enrolling in the xMOOC and completion of the XMOOC course was only mentioned by one participant. I also noted because of real world demands, study participants were not glued to a traditional college course design and context to increase their level of education. They were internally motivated students (marginalized due to their situational factors) and the developmental mathematical xMOOC created a flexible, free setting for study participant's opportunity to learn on their own time, around their work and family schedules. Study participants worked independently with little direction and had time-management skills that allowed them to schedule specific times throughout a week to work on the course. I also noted study participants did not articulate missing face-to-face interaction with an instructor and/or classmate, nor did they articulate missing the confinement of a scheduled face-to-face classroom setting.

The extant literature mirrors similar characteristics of student MOOC learners. Most online courses, particularly MOOCs, support both the constructivist theory and connectivist theory. The constructivist theory posits learners construct new knowledge when they are actively engaged and the connectivist theory embraces the use of technology when teaching and learning (Reiser & Dempsey 2011). A MOOC is open to anyone, uses open systems across the Web to facilitate learning and sharing. While instructors guide the MOOC, the MOOC participants are mostly responsible for their learning and sharing (Downes, 2011; Reiser & Dempsey, 2011; Siemens, 2005). Because MOOC participants are mostly responsible for their learning, scholars often use motivational theory to describe behavior and explore learners' reasons for enrolling in a MOOC. Many researchers agree studying student motivation and determination is important in understanding personal characteristics needed to successfully complete a MOOC (Beaven, Hauck, Quinn, Lewis & de los Arcos, 2014; Belanger & Thornton, 2013; Tschofen and Mackness, 2012). Researchers use motivational theory to attempt to understand why students might enroll a MOOC and what factors may drive them to complete the course(s) (Belanger & Thornton, 2013; Tschofen and Mackness, 2012). Researchers also concur learner MOOC experience can differ depending upon the learner's desire, autonomy, and cultural diversity (Tschofen and Mackness, 2012). MOOC participants determine when and how they want to engage in a MOOC. Participants who are not sufficiently motivated and do not know how to collaborate online can feel let down by their MOOC learning experience (Beaven, Hauck, Quinn, Lewis & de los Arcos, 2014; Downes, 2012).

Conclusions

The data I analyzed in this study came from the lived experiences of adult students, learning developmental mathematics in an xMOOC via an open-ended questionnaire and demographic survey. My discoveries provide knowledge about developmental mathematical xMOOC students' perceptions of their mathematics learning, experiences, and dispositional and situational factors. It is my hope an understanding of developmental mathematical student perceptions when learning via a XMOOC will lead to xMOOC design changes that will enhance the learning experience of developmental mathematical xMOOC participants. As Nanfito (2014) believes,

> For many, the value of MOOCs lies in their potential to reduce the cost of education. They hope that MOOCs will create increasingly accessible, low-cost paths for learners and reduce the overhead of developing and delivering courses (2014, p.36).

This change can then help students progress in their mathematical learning that might lead to a reduction in students' higher education costs and thus open greater educational opportunities for community college learners. MOOCS are especially important in colleges where programs, curricula, administration, and faculty must evolve to meet the non-traditional pedagogical demands of today's global learner. Through Massive Open Online Courses, learners have the chance to experience distance learning, which may help them use technology more effectively, whether it be on the job or an educational context. A significant benefit of MOOCs lies in their ability to provide learners, regardless of age, socio-economic status, and mathematical ability, with the unrestricted access and opportunity to learn. MOOCs have the ability to provide a social justice framework across curricula.

The conditions for students to obtain optimal MOOC learning success has not been fully met and future research should continue to explore and describe how, when, and why MOOC instruction is most effective and relate it to student perceptions and satisfaction with MOOC instruction. From a broader perspective, distance learning, specifically via MOOCs, represent a vital, growing trend in facilitating student learning through technology. Educational research's essential question now centers on how to develop and enhance online instructional learning platforms to maximize student-learning opportunities. I therefore encourage researchers to explore MOOC learning via other subjects and types of MOOCs. The results of this study provide clues on how to effectively implement and enhance MOOC learning to meet the learning needs of today's 21st century learners. The findings also provided practical considerations for MOOC implementation. However, this study only involves the use of MOOC learning in one setting for one subject, and one must remember there are many other ways to implement MOOC learning via multiple settings and disciplines.

Finally, research is executed to consider and help humanity (J. Richards, class notes, January 11, 2017). It was my intent to describe developmental mathematical participants' perceptions of learning via a xMOOC, using their own voices. Many post structuralists agree, language is power, and we must no longer solely think quantitatively (Richards, 2017; Wolcott, 2009). As qualitative researchers, we do not use mathematics to help us analyze data or as instruments in our research; instead we use the power of words. Wolcott, 2009, agrees with this and writes, "Interpretation (of data) is not derived from rigorous, agreed - upon, carefully specified (statistical) procedures, but from our efforts at sense making, a human activity that includes intuition, past experiences, emotion-personal attributes of human researchers can be argued endlessly but neither proved nor disproved to the satisfaction of all" (p.33). The interpretation of words and stories is the process of exploring, discovering, and describing data in terms of what the participants see and believe (2009). As qualitative researchers we must understand, once the research is complete, everything changes- data analysis, perspective, and time. Qualitative research explores the here and now thus, the data cannot be generalized but findings are potentially transferable (J. Richards, class notes, January 11, 2017). "No qualitative research report is permanent. It is merely a snap shot, a temporary holding place on route between what was thought to be true at a given moment and what it might become" (J. Richards, class notes, January 11, 2017). The findings and discoveries in this study are a snap shot in time of the true voices and perceptions of eight adult students studying and learning developmental mathematics via a xMOOC at Coastal College.

Implications for MOOC course design and facilitation

The findings from this study provide suggestions that may be useful to developmental mathematical xMOOC instructional designers and facilitators. I list these suggestions below:

1. Teacher-to-student and student-to-student communication and interaction were themes articulated by study participants. It might prove helpful if xMOOC course designers and instructors implement regular voluntary online discussion board participation to provide more

student-to-student and teacher-to-student interaction and to help alleviate adverse feelings of distance and mathematical frustrations.

2. The lack of instructor involvement and support was expressed as a negative developmental mathematical xMOOC characteristic by study participants. Implementing regular instructor support and involvement might help assuage student perceptions of isolation and mathematical frustrations, especially if instructors provide prompt feedback to student emails and weekly online synchronous forums and tutoring support. It might prove beneficial if the online synchronous forums were recorded and embedded into the course, so learners can view the forums at a time convenient to the learner. Instructor support might allow students to access to instructor knowledge and provide learning guidance for the student.

3. Study participants had different expectations in completing the course. Individual characteristics, needs, and preferences of xMOOC learners were evident throughout the developmental mathematical xMOOC questionnaire. For example, study participants had different expectations for completing the course. Some had intentions to complete the modules that suited their specific learning needs while others intended to complete the entire course. The study findings revealed the individuality of developmental mathematical xMOOC participants were characterized with a variety of dispositional and situational factors. It might prove helpful if xMOOC instructors and designers acknowledge learner differences and attempt to accommodate the domain of learner needs and situations and understand completion of the course may not be every learner's goal.

4. Although participants in this study were technologically adequate, there are critiques that debate whether the xMOOC format is appropriate for the needs of developmental mathematical students. Researchers, educators, and administrators debate if the xMOOC format meets the needs of the community college student learning developmental

mathematics. Researchers have acknowledged community college students struggle with virtual learning environments and some of the xMOOC characteristics (flexible, open with no instructor presence) can increase these challenges. Thus, restructuring the established community college xMOOC model and incorporating some in-classroom elements to create a flipped xMOOC design might prove beneficial to future MOOC learners. Appropriately restructuring the xMOOC design may help the students the educational institution ultimately serves.

5. Mathematics faculty might find it beneficial to attend professional development sessions to understand the benefits of MOOCs that surpass the ideas of learning needs of students. All Mathematics teachers need political knowledge to be successful and challenge the social injustices in education (Gutierrez, 2017, p. 19). The benefits of MOOCs are far reaching due to the politics of teachings as well as social justice considerations (i.e. 'white' math and teaching to standardized tests). Social justice education combined with political knowledge can help teachers understand the definition of equity and who benefits in our educational system. Gutierrez (2017) believes, today's teacher professional development does not help teachers understand, recognize, or negotiate the politics that they regularly face in the classroom. Teachers are expected to know mathematical content and pedagogical knowledge, but they are not expected to be fluent in political knowledge (political conocimiento). Gutierrez, defines 'political conocimiento' as "…the kind of knowledge that helps (teachers) deconstruct and negotiate the world of high stakes testing and standardization" (and) helps teachers advocate for their students (Gutierrez, 2017, p.20). Gutierrez (2017) argues, teacher education programs can develop political knowledge and should teach it. Social Justice and political conocimiento teacher professional development might help MOOC facilitators and designers as well as educators and administrators understand how politics permeates our educational system as it helps deconstruct deficits in

our educational system, so all persons involved in today's educational arena can better defend students, teachers, and public education.

Implications for Future Research

Distance education has a long history, but during the last decade there has been an exponential growth in online distance learning. This rapid advance has changed the pedagogy of post-secondary education (Lytle, 2011; Borba & Llinares, 2012) specifically; the reputation, quality and popularity of online courses have increased. Regardless of the criticisms and negative perceptions of online education as inferior to face-to-face instruction, online education enrollment exceeds face-to-face enrollment rates in many colleges and universities (Lytle, 2011). Many agree MOOCs provide learning opportunities for both teachers and students because they offer opportunity for mass student learning via unrestricted access courses that are free of charge (Masters, 2011; Perna et al, 2014; Viswanathan, 2012). Despite scholars' perspectives for or against MOOCs, many agree MOOCs, whose theoretical pedagogies are largely unchartered and still evolving, are the emerging, novel method of online teaching (Masters, 2011). Further research on students' perceptions of developmental mathematical xMOOC learning is important since rapid advances in educational technology and the changes it has brought to design and delivery of xMOOCs has altered student perceptions of their learning experience. More exploration of student perceptions of developmental mathematical xMOOC learning is necessary to improve design and delivery quality as well as enrich student-learning experience.

The study findings provide a basis for additional research related to student perceptions when learning developmental mathematics via a xMOOC. Future research on this topic may include a larger study with more participants from different disciplines. The correlation of age, gender and prior education and learning mathematics online is still strongly debated and needs further research (Adamopoulos, 2013; Breslow, 2013; Greene et al., 2015). Another Idea for future research may be exploring cultural differences within various MOOC courses and the data generated by culturally diverse MOOC participants. The social justice aspect of cultural diversity within the MOOC courses and learners who enroll in a MOOC might be an interesting research avenue.

Because many community colleges struggle with retention, particularly with online or distance courses, research exploring adult learner's perceptions with learning via mathematical developmental xMOOC, may be of interest to community college administrators and educators. There has been a recent national focus on the role of community colleges and increasing the graduation level (Obama, 2010). Obama's American Graduation Initiative called for a strengthening of community colleges with a goal of increasing 5 million additional graduates by 2020 (2010). Free, flexible, open courses such as this developmental mathematical xMOOC can be the key to increasing community college graduation rates. Thus, the call for more research on community college students' perceptions of learning developmental mathematics online and their struggles with completion will help with Obama's American Graduation Initiative and student community college student retention in general.

Many MOOC researchers have also agreed MOOCs have high dropout rates and low completion rates (Jordan, 2013; Koutropoulos, et al., 2013), yet there is sparse research on the experiences and perceptions of non-completing MOOC participants. It might be useful to understand why some MOOC participants start and complete a MOOC course while others do not.

Many researchers concur motivation is a key factor in understanding successful MOOC completion (Koutropoulos, et al., 2013; Milligan, Margaryan, & Littlejohn, 2013). Researching the possible connection between why participants enroll and take part in a MOOC, MOOC completion, and individual motivation is another research avenue. Connecting these results with various course disciplines and MOOC course structure (whether the course is 'Quality Matters' certified or if the course is an xMOOC or cMOOC) is yet another possibility for research.

Reasearchers' have found online distance courses, specifically MOOCs, require students to have high levels of self-motivational regulation, because most MOOCs do not provide a live instructor to help support the learning (Dabbagh & Kitsantas, 2004; Park & Yun, 2017). Researching the possible relationships between student motivational strategies and cognitive learning in MOOCs is another avenue for future research.

Researchers have also admitted using limited data (data posted on a formal LMS) in their qualitative analysis due to the massive amount of time it takes to analyze the volume of data a MOOC can create (Fini, 2009; Kop, 2011). Some researchers are divided between timesaving data analysis using only data found on a MOOCs formal LMS or the more time-consuming alternative of utilizing secondary external online MOOC communications and unfiltered data such as blogs, YouTube and social media (deWaard et al., 2011; Fini, 2009; Kop, 2011). MOOC researchers have also acknowledged MOOC learners often use external communications to support their learning (Kop, 2011). DeWaard et al. (2011) and Koutropoulos, et al. (2012) reported many of their study participants utilized mobile devices (phones, and tables) to access and communicate in their MOOC, as well as blogs, YouTube and other social media, even though it was not required. Limiting secondary data analysis, forces the researcher to analyze the information confined to a MOOCs formal LMS. In doing this, researchers bypass blogs, posts and other sources of external communications used in a distance course context thus possibly affecting the results of their study. A study utilizing both primary and secondary sources MOOC learner data to understand MOOC student perceptions and interactions when learning via a MOOC is another possibility for research.

Considering the large volumes of data MOOCs generate, participants may feel overwhelmed with the massive amounts of information, posts, and discussions found in a MOOC. Another research idea might be exploring strategies successful MOOC participants employ to remain up to date with discussions and class information. Milligan, Margaryan, and Littlejohn (2013) found many MOOC learners struggle to keep up with volume of information generated by a MOOC, while other participants are involved in all discussions and posts and can easily navigate the MOOC information system. Researching MOOC participants and how they approach MOOC generated information might provide insight and practical solutions in how to sift through the information overload thus helping not only future MOOC learners but also future MOOC researchers to effectively disseminate MOOC data.

Although more research focusing on MOOC learner perspective is necessary and important, even less understanding and sparse research exist on MOOC creator/facilitator perceptions and pedagogy practices, thus, leaving a substantial gap in the extant literature. Researching MOOC creator/facilitator perceptions of MOOCs, comparing, and contrasting these perceptions with student perceptions might be an interesting and worthwhile topic.

Finally, while peer-reviewed literature on MOOCs remains limited and further exploration concerning MOOCs is necessary, it is indisputable MOOCs are a vehicle of change in higher education, and as such, research to enhance the experience of both teacher and student is essential.

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Appendix A: Email Invitation to Participate

Greetings SPC math-readiness learners!

I am a doctoral candidate in Mathematics Education at the University of South Florida in Tampa, Florida. I am pursuing my doctorate by conducting research on developmental mathematical xMOOC users and their perceptions when learning mathematics via a developmental mathematical MOOC. A MOOC is a Massive Open Online Course that is free to all who wish to enroll and learn. The Math readiness class you are participating in now is considered a MOOC. Your participation is requested in this research, IRB Study #Pro00029131, involving student perceptions of mathematical xMOOCs. I would like to know what your experience has been when participating in St Petersburg College's developmental mathematical MOOC. I invite all SPC's mathematical xMOOC participants to participate in a research study and to share their perspectives through a short online questionnaire. Questionnaire responses will be completely anonymous.

To be eligible for this study you must be an adult (18 years or older) and enrolled and actively participating in St. Petersburg College's Math Readiness Course.

Participation in this study will require 15-20 minutes of your time. The questionnaires will be completed and compiled through Survey Monkey Software. There are two parts to the questionnaire. The first link is a 5-question demographic survey and the second link is a 9- question open ended questionnaire. Your questionnaire responses are completely anonymous and will be kept confidential. Your participation is also voluntary, so we appreciate you taking a moment to share your experiences with us!

By clicking the link below and participating in this study you are consenting to the IRB requirements at the University of South Florida and St Petersburg College.

USF IRB Consent form and Questionnaire Link:
29131_ver1_SB Online Consent Form (2)_files\29131_ver1_SB Online Consent Form (2).htm

If you have any questions about the questionnaire, please feel free to contact Pelagia Kilgore at pelagia@mail.usf.edu. I appreciate your thoughtful consideration of my request. Thank you for your help!

Sincerely,
Pelagia Kilgore
Doctoral Candidate
Mathematics Education
University of South Florida
4202 E. Fowler Ave
Tampa, FL 33620
pelagia@mail.usf.edu

Appendix B: Informed Consent

UNIVERSITY OF SOUTH FLORIDA

Informed Consent to Participate in Research
Information to Consider Before Taking Part in this Research Study

Pro # Pro00029131

Researchers at the University of South Florida (USF) study many topics. To do this, we need the help of people who agree to take part in a research study. This form tells you about this research study.
We are asking you to take part in a research study that is called:
College Students' Perceptions about Learning via Developmental Mathematical xMOOCs.

The person who is in charge of this research study is Pelagia Kilgore. This person is called the Principal Investigator. However, other research staff may be involved and can act on behalf of the person in charge. Pelagia Kilgore is being guided in this research by Dr. Janet Richards, Dr. Sanghoon Park and Dr. Eugenia Vomvoridi.

The research will be conducted at St. Petersburg College.

PURPOSE OF THE STUDY

Current college students are the most affected by the recent adoption of MOOCs in higher education and sparse research has been done on current college students' perceptions and experiences of developmental mathematical xMOOCs, more qualitative research on student perspective is necessary. A descriptive exploratory case study using an email survey, of college student perceptions about learning via developmental mathematical xMOOCs will help address the lack of research and has the potential to provide insights and reveal themes related to online pedagogy techniques, and methodologies, which promote student learning and successful completion of developmental mathematical xMOOCs. The purpose of this descriptive exploratory case-study is to meet the calls for qualitative research on student perspectives when learning developmental mathematics via a xMOOC.

WHY ARE YOU BEING ASKED TO TAKE PART?

We are asking you to take part in this research study because you are being asked to participate in this research because you are a current actively participating developmental mathematics MOOC student.

Study Procedures
If you take part in this study, you will be asked to: This online questionnaire should take 15-20 minutes of your time. The online email questionnaire will be comprised of nine open-ended questions about student experiences when learning via a developmental mathematical xMOOC. A brief five question demographic survey will also be included along with the developmental mathematical xMOOC questionnaire. The demographic questionnaire will be used to only describe the participants in the study and not to correlate demographics with student perceptions of MOOCs.
Alternatives / Voluntary Participation / Withdrawal
You have the alternative to choose not to participate in this research study.

You should only take part in this study if you want to volunteer; you are free to participate in this research or withdraw at any time. There will be no penalty or loss of benefits you are entitled to receive if you stop taking part in this study. Your decision to participate or not to participate will not affect your student status, course grade, recommendations, or access to future courses or training opportunities.

Benefits and Risks

You will receive no benefit(s) by participating in this research study.
This research is considered to be minimal risk.

Compensation
We will not pay you for the time you volunteer while being in this study

Privacy and Confidentiality

We must keep your study records as confidential as possible. It is possible, although unlikely, that unauthorized individuals could gain access to your responses because you are responding online.
Certain people may need to see your study records. By law, anyone who looks at your records must keep them completely confidential. The only people who will be allowed to see these records are: Pelagia Kilgore (Principal Investigator), Dr. Janet Richards, Dr. Sanghoon Park, Dr. Eugenia Vomvoridi (advising professors) and The University of South Florida Institutional Review Board (IRB).

It is possible, although unlikely, that unauthorized individuals could gain access to your responses. Confidentiality will be maintained to the degree permitted by the technology used. No guarantees can be made regarding the interception of data sent via the Internet. However, your participation in this online survey involves risks similar to a person's everyday use of the Internet. If you complete and submit an anonymous survey and later request your data be withdrawn, this may or may not be possible as the researcher may be unable to extract anonymous data from the database.
Contact Information

If you have any questions about your rights as a research participant, please contact the USF IRB at (813) 974-5638 or contact by email at RSCH-IRB@usf.edu. If you have questions regarding the research, please contact the Principal Investigator, Pelagia Kilgore at pelagia@mail.usf.edu.

We may publish what we learn from this study. If we do, we will not let anyone know your name. We will not publish anything else that would let people know who you are. You can print a copy of this consent form for your records.

I freely give my consent to take part in this study. I understand that by proceeding with this survey that I am agreeing to take part in research and I am 18 years of age or older.

Here is the link:
29131_ver1_SB Online Consent Form (2)_files\29131_ver1_SB Online Consent Form (2).htm

Appendix C: Developmental Mathematics xMOOC Syllabus

Welcome to "Get Ready for College- Math"!
To get started, watch the Introduction Video and complete/submit the User Agreement. Once you do so, the "Get Ready" and "Module 1" folders will become visible.
If you would rather see the entire course (instead of just progressing one module at a time), first complete/submit the User Agreement and then complete/submit the Release ALL Course Content survey found in the "Get Ready" folder of the course.
For a list of topics in this course, see below. Good luck!

TOPICS COVERED

Module 1
Introduction to Integers
Integer Operations
Order of Operations
Fractions, Decimals & Order of Operations
Percents, Decimals & Fractions
Linear Measurements (US/Metric Conversions)

Module 2
Evaluating and Translating Algebraic Expressions
Simplifying Algebraic Expressions
Solving Linear Equations & Literal Equations
Linear Inequalities in One Variable
Compound Inequalities

Module 3
Exponents and Order of Operations
Exponent Rules
Negative Exponents
Scientific Notation
Simplifying Rational Expressions
Multiplying and Dividing Rational Expressions
Adding and Subtracting Rational Expressions
Complex Fractions
Rational Equations

Module 4
Radicals Review
Radical Expressions and Rational Exponents
Simplifying Radical Expressions
Pythagorean Theorem
Adding, Subtracting, Multiplying and Dividing Radicals
Solving Radical Equations

Module 5
Adding and Subtracting Polynomials
Multiplying Monomials & Polynomials
Dividing Polynomials
Factoring: Greatest Common Factor/Grouping
Factoring: Trinomials with No Coefficient
Factoring: Trinomials with Coefficients
Factoring Difference of Two Squares

Special Factoring
Solving Quadratic Equations by Factoring

Module 6
Translating Word Problems
Word Problems and Problem Solving
Percents Review
Ratios and Proportions
Introduction to Geometry
Perimeter and Circumference
Area

Module 7
Graphing Review
Graphing Concepts and the Equation of a Line
Graphing Linear Inequalities in Two Variables
Systems of Linear Equations in Two Variables
Systems of Linear Inequalities

Appendix D: Developmental Mathematical xMOOC Structured Questionnaire

1. Why did you enroll in this developmental mathematical xMOOC?
2. What are your perceptions of the developmental mathematical xMOOC in which you are participating or have participated? (Please explain or elaborate).
3. What are your perceptions of the learning opportunities available in this developmental mathematical xMOOC? (Please explain or elaborate).
4. What do you like about the developmental mathematical xMOOC? Why? What do you dislike? Why?
5. How are you progressing or how did you progress in this developmental mathematical xMOOC?
6. In what ways have you benefitted, or did you benefit from this developmental mathematical xMOOC?
7. What personal characteristics do you think are needed to successfully complete a developmental mathematical xMOOC?
8. Is there anything else you would like to tell me about you as a student in this developmental mathematical xMOOC?
9. Is there anything else you would like to tell me about the developmental mathematical xMOOC in which you participate?

Appendix E: Demographic Questionnaire

1) What is your age?

2) Gender
A. Female
B. Male

3) Your ethnic and racial background
A. African-American, Black
B. Indian
C. Asian
D. White Caucasian – Non-Hispanic
E. Hispanic or Latino
F. American Indian, Alaskan Native
G. Other

4) What is your intended major?

5) Which class/level most closely describes you?
A. Freshman
B. Sophomore
C. Junior
D. Senior
E. High School Student
F. Other

Appendix F: Certificate of Completion of Education in Human Subjects Protection

Certificate of Completion

Pelagia Kilgore

Completed the Social / Behavioral Investigators and Key Personnel
Refresher Course

on Thursday, June 18, 2015

USF
UNIVERSITY OF
SOUTH FLORIDA

CITI Certificate ID#: 18834

Appendix G: University of South Florida IRB Approval

USF
UNIVERSITY OF
SOUTH FLORIDA

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-7091

2/24/2017

Pelagia Kilgore
USF Teaching and Learning
4202 East Fowler Avenue Tampa, FL 33620
RE: **Expedited Approval for Initial Review**
IRB#: Pro00029131

Title: College Students' Perceptions about Learning via Developmental Mathematical xMOOCs **Study Approval Period: 2/24/2017 to 2/24/2018**

Dear Mrs. Kilgore:

On 2/24/2017, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):

USFIRBProtocolGuidelines2.docx
Consent/Assent Document(s)*: **Online consent forms are unstamped**
Informed Consent **

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent documents are valid until the consent document is amended and approved. ****Online consent forms are unstamped.**

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. Your study qualifies for a waiver of the requirements for the documentation of informed consent for online survey as outlined in the federal regulations at 45CFR46.117(c) which states that an IRB may waive the requirement for the investigator to obtain a signed consent form for some or all

subjects if it finds either: (1) That the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern; or (2) That the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638. Sincerely,

John Schinka, Ph.D., Chairperson
USF Institutional Review Board