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An Online Statistics Course From Faculty and Students' Perspectives: A Case Study

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Walden University
2016

Abstract

An Online Statistics Course From Faculty and Students' Perspectives: A Case Study

by

Ruth Angela Best

MS, City College of New York, 2004

MBA, Pace University, 1999

BS, Concordia College, 1993

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Teacher Leadership

Walden University

April 2016

Abstract

Faculty at a private college in the northeastern United States found students lacked prerequisite mathematical skills and were unable to transfer quantitative reasoning skills to upper level business courses. Guided by Mezirow's transformative learning theory and Knowles' approach to self-directed learning, this study examined how undergraduate students learn statistics online. The purpose of this qualitative embedded case study was to examine faculty and students' perspectives about the online statistics course design and delivery while exploring possible barriers to students' learning. Data collection occurred by review of course documents and the learning management system. Archival data generated questions for semistructured interviews with 2 faculty and 4 students. Thematic analysis of data followed the inductive and interpretive approach to identify categories and 5 themes: measuring and assessing student learning, challenges learning statistics online, student readiness and preparation, online faculty roles, and recommendations for improving online statistics courses. Findings identified technical and affective barriers to learning statistics online and the need to create supportive learning environments fostering differentiated instruction, mastery learning, and complying with the Guidelines for Assessment and Instruction in Statistics Education. The resulting project was 5 professional development webinars designed to assist faculty creating student-centered online statistics courses focused on conceptual understanding. This study contributes to positive social change through implementation of course design leading to student access and online content mastery.

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Dedication

I dedicate this study to my parents, Norma and Bernard Best, who valued education highly and who made sacrifices to ensure that I accomplished my goals. Due to the socio-economic conditions within which they grew up, my parents did not get the opportunity to complete high school, but instead celebrated my successes and lived vicariously through me. Mummy, this is especially for you, because of the teacher who discouraged you from pursuing your dream of becoming a nurse. Your experience motivated me to encourage the individuals with whom I interact as an educator. Though their learning abilities may vary, my students are entitled to dream big too. Thus, I encourage them not to give up. It is possible to overcome and accomplish dreams through determination, self-advocacy, and a strong support system.

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Section 1: The Problem

Introduction

Student performance in introductory statistics courses is below established standards at colleges and universities across the United States (Aliaga et al., 2012). According to Garfield, Hogg, Schau, and Whittinghill (2002), students' characteristics along with instructors' experiences and beliefs affect the teaching and learning process for statistics courses. Many students do not understand the statistical concepts introduced in statistics courses and fail to meet the learning objectives (Chiesi & Primi, 2010; Curry, 2002). The students' prerequisite mathematical skills, coupled with beliefs and fears of failure, affect performance in statistics courses (Acee & Weinstein, 2010; Curry, 2002; Islam, Khan, Wilson, & Gooch, 2008). Limited access to technology resources also prevents some students from performing well in statistics courses (Garfield et al., 2002). Recent advances in technology and the growth of distance education have prompted a reexamination of the pedagogical approaches used in mathematics and statistics education (Moore, 1997; Tishkovskaya & Lancaster, 2012).

Despite ongoing attempts to improve course content, pedagogy, and assessment practices and integrate technology into the learning environment, academic achievement in college-level statistics courses remains unacceptable (Hassad, 2011). Students have difficulty mastering and retaining statistical concepts such as standard deviation, central limit theorem, sampling distribution, confidence intervals, hypothesis testing, correlation, and regression (Fairfield-Sonn, Kolluri, Rogers, & Singamsetti, 2009). Some researchers attributed marginal performance in statistics courses to students' aptitudes and attitudes

about math and statistics (Acee & Weinstein, 2010; Everson & Garfield, 2008; Kohli, Peng, & Mittal, 2011; Ward, 2004). Other researchers question whether college professors are using the most effective instructional strategies to promote learning (Hassad, 2011; Kreiner, 2006).

The faculty at the Barney School of Business, University of Hartford in Connecticut, conducted an experiment with a sampling of 55 students (Fairfield-Sonn et al., 2009). The purpose of the Barney School experiment was to assess students' general knowledge of statistics and determine what key statistical concepts students could retain and transfer from the introductory statistics course to the junior level Operation Management course (Fairfield-Sonn et al., 2009). Based on the findings of the 30 item multiple-choice test, the researchers inferred that at least 50% of the students were able to recall, retain, and transfer statistical concepts (Fairfield-Sonn et al., 2009). The Barney School study confirmed that the emphasis of statistics courses was on teaching students formulaic computations versus making practical applications that informed upper level business courses such as Operations Management (Chance, 1997; Dobni & Links, 2008; Fairfield-Sonn et al., 2009). The college's administrators, faculty, and students wanted to improve academic achievement in statistics courses and ensure that students understood the concepts (Kreiner, 2006).

The current study explored faculty and students' perspectives about the statistics curriculum design and online learning experience at a private college in the northeastern United States. I wanted to understand the teaching and learning process of an online statistics course. I reviewed grade distribution reports, course evaluations results, and

examined the introductory statistics course in the web-based learning management system. I also interviewed faculty and students at the study site (for the sake of this study given the pseudonym, EFG College) to identify the barriers that influenced students' performance in online statistics courses.

The Local Setting

EFG College is a privately owned college located in the northeastern United States with a student population that ranges between 1,000 and 1,500 (National Center for Educational Statistics [NCES] College Navigator, 2014). In addition to offering traditional 16-week courses on campus, the college caters to adult students enrolled in 8-week distance learning courses (NCES College Navigator, 2014). Programs of study include business administration, digital media, allied health, and information technology (NCES College Navigator, 2014). The traditional freshman students and nontraditional adult students are required to hone problem solving, analytical, and quantitative reasoning skills prior to graduation. Students registered for business courses have to complete two statistics courses-- prerequisites for upper-level finance, operations management, and other business courses.

In 2008, the academic administrators at EFG College convened a meeting to review the math curriculum (Professor A, personal communication, September 25, 2012). The overarching goal at the time was to raise the level of students' performance in the introductory and junior level statistics courses. Despite changes made to the math curriculum, the college's institutional research team reported high failure rates in the

quantitative courses, including statistics (EFG College administrator, personal communication, June, 2014).

The grade distribution report from the inaugural online statistics course at EFG College revealed that some students performed poorly on quizzes and exams. The final grade distribution of the first online statistics course resembled a bell curve with only 50% of students passing the course by the end of 9 weeks. Two students earned a score of 93% or above (A), two earned between 90 and 92% (A-), and the remaining four students received below 65% (F). The course evaluation results revealed that in addition to having difficulty understanding the content and working independently in the online course, some students had problems navigating the learning management system.

EFG College's administrators later reviewed and analyzed the results of the course evaluation surveys for hybrid and online statistics courses and found a high level of students' dissatisfaction with the statistics course content and delivery format. Perhaps some students transferred fears and anxieties from previous experiences with math, while other students performed unsatisfactorily because the statistics course appeared irrelevant to business administration coursework (Choudhury, Robinson, & Radhakrishnan, 2007; Garfield & Everson, 2009; Fairfield-Son et al., 2009; Kohli, Peng, & Mittal, 2011). Marginal student performance in online statistics courses remained an area of concern for EFG College's administrators, faculty, and students. I carried out the current qualitative research to understand faculty and students' perspectives about statistics courses and explain student performance patterns on tests and exams.

Definition of the Problem

According to Mills and Raju (2011), empirical research was sparse about teaching and learning practices for online statistics courses. One quantitative study, conducted with 92 students at Georgia Gwinnett College in 2011, found no statistical significance between students' performance in hybrid and face-to-face statistics courses (Kakish, Pollacia, Heinz, Sinclair, & Thomas, 2012). Yet, Kakish et al.'s (2012) findings showed that students taking the face-to-face course performed slightly better than the students enrolled in the hybrid course. Some school administrators and faculty remained concerned about the extent to which students actively participate and learn in the hybrid and online introductory statistics course (Allen & Seaman, 2013). Kakish et al. (2012) recommended that additional studies examine online statistics course design and analyze learning activities for effectiveness and alignment to course learning objectives. Additional research could also help to determine the most effective way to reduce anxiety, engage students in the learning process, and improve performance outcomes in statistics courses (Kreiner, 2006).

Rationale

Evidence of the Problem at the Local Level

Business and general education faculty are concerned about student performance in the math and statistics courses at EFG College. According to one faculty member, who taught college math and statistics in the 8-week online format, "The grades are not a true reflection of students' efforts" (Professor A, personal communication, September 25, 2012). Judging from the difficulty the students experienced with basic computational

operations such as rounding numbers and finding percentages, the professor felt that students were not ready for the introductory statistics course. Most of the students completed the introductory statistics course with passing grades; however, they did not develop proficiency in statistical thinking and reasoning (Professor A, personal communication, September 25, 2012). Professor A recommended either a revision of the course curriculum or remediation to address the students' deficiencies.

Professor B's midsemester course evaluation feedback also suggested possible curriculum redesign and remediation to ensure higher performance and mastery in statistics courses. At the midpoint of one introductory statistics course, some students provided feedback about the overwhelming nature of the course content and the online delivery method. The course's instructor responded by reviewing the course template and describing it as "overloaded with information that seems overwhelming and confusing for the students" (Professor B, personal communication, October 31, 2012). Professor B recommended that the instructional design team modify the course layout in the learning management system to include less readings and assignments.

One of the statistics course developers recognized that insufficient opportunities existed for students to practice the statistical concepts introduced within the learning management system (Instructional Designer 1, personal communication, November 1, 2012). The instructional design team responded by adding Khan Academy videos to the course template as supplementary resources to aid student learning. Khan Academy (2014) is a nonprofit organization that develops videos and remedial practice exercises to help students understand and master various subjects, including statistical principles.

While some adult students at EFG College required remediation to understand basic mathematical concepts, other students completed the online introductory statistics course without any additional supports. Some students attributed initial anxiety and fears about statistics courses to previous experiences with mathematics courses. For example, Student X disliked math in high school and expressed reservations about performing well in the introductory statistics course and other math-based, business courses (Student X, personal communication, December 18, 2013). Student X mastered the statistics course content and credited the instructor's teaching style for the satisfactory outcome.

Some faculty members provided multiple opportunities to self-assess and make connections between statistical concepts and everyday experiences (Student Y, personal communication, November 5, 2012). Yet, between 30% and 50% of students struggled and failed to meet the learning outcomes of online statistics courses at EFG College. Administrators and faculty wanted to know why some students performed well while other students fail statistics courses. Perhaps the gap in practice related to the curriculum, instructional design, teaching methodology, or online mode of delivery. To identify possible barriers to teaching and learning, I examined EFG College's introductory statistics course curriculum and the online faculty's instructional strategies. I also wanted to identify the specific skills students need to succeed in online statistics courses.

Evidence of the Problem from the Professional Literature

According to Tishkovshaya and Lancaster (2012), despite the growing body of research related to statistics education over the past decade, "there is still a gap between the research and practice of teaching statistics" (p. 2). A discrepancy also exists between

the concepts introduced in the statistics course and the knowledge and skills employers require for jobs in the field of business (Dobni & Links, 2008). Additional research examining course design and delivery methods can help to address the deficiencies.

Some researchers linked students' performance in statistics courses to faculty's knowledge about adult learning theory and use of differentiated instructional strategies (Aderinto, 2006; Cercone, 2007; Heiman 2008; MacGillivray & Croft, 2011; Minter, 2011; Park & Choi, 2009; Simoncelli & Hinson, 2008; Zieffler et al., 2008). Other studies examined how students' aptitude, perceptions, and attitudes affected performance in statistics courses (Bond, Perkins, & Ramirez, 2012; Bude et al., 2007; Ramirez, Schau, & Emmioglu, 2012). Significant unanswered questions and concerns remained about how students learn statistics and how instructors create learning environments that motivate students to construct meaning and succeed in statistics courses (Bude et al., 2007; Chiesi & Primi, 2010; Garfield & Ahlgren, 1988; Williams, 2010).

Bude et al. (2007) distributed questionnaires to 94 first-year students, in an introductory statistics course in the Health Science program, to measure different motivational constructs. When the researchers tested the impact of cognition, affect, and behavior on exam results for a statistics course, they found a direct correlation existed between student performance and students' attitudes (Bude et al., 2007). According to Bude et al., "students who appreciate the value and relevance of statistics...appear to study statistics more and qualitatively better and perform better on the exams" (p. 16). How students perceived the statistics course in comparison to other core subjects within

their programs of study affected academic achievement (Bond, Perkins, & Ramirez, 2012; Hood, Creed, & Neumann, 2012).

Students who perform well in College Algebra and other math courses are also more likely to complete statistics courses successfully and develop positive perceptions about statistics courses (Dempster & McCorry, 2009; Hood, Creed, & Neumann, 2012; Li, Uvah, Amin, & Okafor, 2010). Li, Avah, and Amin (2012) conducted a quantitative study to determine predictors of success by comparing students' performance in introductory statistics courses with previous performance in math courses and standardized state assessments. The study took place at the University of West Florida with 1,405 students enrolled in an introductory statistics course during the fall 2008, fall 2009, and fall 2010 semesters. Li Avah, & Amin analyzed the data using the Statistical Analysis System (SAS) to find patterns and determine causal relationship between student performance and other performance indicators, including high school grade point average (GPA), college GPA, algebra course grades, and the Scholastic Aptitude Test (SAT) or American College Testing Assessment (ACT) scores. Findings revealed a significant relationship between student performance, college GPA, College Algebra grades, and Intermediate Algebra grades. Based on the findings, Li, Avah, and Amin recommended revising the statistics course curriculum, differentiating instruction, and assessing student learning regularly to improve teaching and learning in introductory statistics courses.

In an attempt to assess student learning, Mathews and Clark (2007) interviewed eight first-year students who each received a final letter grade of A for an introductory

statistics course. The purpose of Mathews and Clark's qualitative study was to understand the cognitive process students used to conceptualize the statistical terms: mean, standard deviation, and central limit theorem. The participants represented a sample of 349 students enrolled in the statistics course at a state-supported liberal arts college. Of the 349 students, only 45 passed the statistics course with an A, of which, eight were first year students. When interviewed, the eight students who earned an A were unable to explain basic statistical concepts such as mean, standard deviation, or central limit theorem. According to Mathews and Clark, students demonstrated a low level of cognitive development. The students in the study did not have a conceptual understanding of statistics, nor were they able to articulate why statistics courses were relevant to their lives. Additional studies examining teaching and learning practices in statistics courses will help to confirm or disprove the inferences Mathews and Clark made about student performance in introductory statistics courses.

Over the last decade, statisticians and other professionals in the field have advocated to improve statistics education at the national and international levels and ensure that the statistics curriculum is relevant and meets the needs of a global business community (Garfield & Everson, 2009). As a result, there has been an increase in research relating to statistics education. Organizations such as the Consortium for the Advancement of Undergraduate Statistics (CAUSEweb.org) and the International Association of Statistical Education (IASE.web.org) have archived studies about statistics education.

In 2012, the American Statistical Association (ASA) authorized comprehensive guidelines for college level faculty to consider when planning, instructing, and assessing student work (Aliaga et al., 2012) in statistics courses. The Guidelines for Assessment and Instruction in Statistical Education (GAISE) clarified what knowledge and skills students needed to demonstrate as evidence of statistical literacy. Woodard and McGowan (2012) experienced some challenges while attempting to incorporate the GAISE when redesigning an introductory statistics course. However, the revised course was project-based, incorporated technology, and provided opportunities for students to engage with real data (McGowan, 2012). Additional research could determine how the established guidelines apply across instructional modes of delivery, such as the traditional classroom and emerging distance-learning formats.

The purpose of this qualitative project study was threefold: (a) to examine faculty's and students' perspectives about online statistics curriculum design and delivery methods at EFG College; (b) to explore the barriers to meeting learning objectives of online statistics courses at EFG College; and (c) to document the ways of creating inclusive, accessible, culturally relevant, and developmentally appropriate online learning environments. I also identified some of the challenges that adult learners faced with the content, instructional methods, and delivery modalities. This study will add to the growing body of empirical research emerging in the wake of the reform movement in statistics education.

Definitions

This section provides definitions for some of the terms referenced in this qualitative case study:

Blended learning: Blended learning is synonymous with hybrid learning. This mode of instructional delivery refers to instruction where students have an option to experience coursework in a traditional classroom setting and online via a learning management system. The percentage of on campus versus online instruction can vary dependent upon the institution. The percentage of online participation varies between 30% and 79% (Allen & Seaman, 2011).

Competency based learning: Competency based learning; also known as competency-based education (CBE) is an approach of designing teaching and learning experiences with the primary goal of having students master the content. The focus is on the outcome – what students should know and be able to do. Faculty members provide students multiple opportunities to demonstrate proficiency before moving forward to teach something new (Klein-Collins & Baylor, 2013).

Diverse learners: The term diverse learners define a group of students who differ from each other based on the following identifying factors: culture, language, age, economic and social class, and spectrum of abilities and disabilities (Freeman, Freeman, & Ramirez, 2008).

Face-to-face instruction: Face-to-face instruction takes place in a classroom on college campuses. Students access direct instruction from a faculty member, collaborate with peers, and engage in independent activities. In some cases of classroom instruction,

the professors use the learning management system to provide additional resources, reference materials, and provide a drop box for assignment submissions. The amount of content presented in the learning management system can vary from 1% to 29% (Allen & Seaman, 2011).

Online learning: Online courses are organized and presented within a learning management system, such as Blackboard, Canvas, Desire to Learn, Moodle, or Sakai. An online course is one where the professor delivers 80% or more of the content via the learning management system and there are no face-to-face classes (Allen & Seaman, 2011).

Statistical literacy: For the purposes of this study, statistical literacy signifies a student's ability to think, reason, and apply statistical concepts to make accurate business decisions (Ramirez et al., 2012).

Student readiness: According to Hauser, Paul, and Bradley (2012), student readiness denotes a student's proficiency level with instructional technology and computer literacy. Alternatively, student readiness can be determined by implementing a diagnostic assessment that provides data about each student's competency level in math, Excel, and writing (Fairfield-Sonn, et al, 2009).

Universal Design for Learning (UDL): The term, UDL, refers to scientifically valid framework for guiding educational practice. UDL provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged in the learning process. UDL also reduces barriers in instruction, provides appropriate accommodations, supports and challenges,

and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient (National Center on Universal Design, 2012, How has UDL been defined section, para. 1).

Significance

The preliminary exchange with faculty and students at EFG College indicated the need for a comprehensive review of the introductory statistics course content to identify and examine the prerequisite skills, instructional design, and online delivery methods. I wanted to determine the root cause/s of marginal student performance in the 8-week online statistics courses. This study is significant because it will inform possible revisions to the mathematics curriculum, online statistics course design, and teaching practices at EFG College. The study addressed how to reduce possible barriers to teaching and learning in the online environment and increase the level of statistical literacy and proficiency in mathematics, College Algebra, statistics, and other quantitative courses.

EFG College's mission is to ensure that graduates acquire work related skills, including problem solving and statistical reasoning (Mezirow, 1997; White, 2013). This study sought to determine whether the course developers designed online statistics courses that had a rigorous curriculum and incorporated instructional strategies that meet the academic needs of a diverse student body. In addition to examining the course assignments in the learning management system, I reviewed the syllabus to ensure that the student learning outcomes (SLO) aligned with the needs of employers.

The study's findings can lead to improvements to the college's operational processes, for example, remediation for students and on-going professional development opportunities for faculty. Some students may have the opportunity to self-advocate and take charge of their learning experiences, specifically students who are self-conscious about disclosing information about cognitive or psychological deficiencies (Higbee, Chung, & Hsu, 2008). Most importantly, diverse learners will be able to access and master the content introduced in statistics courses.

Research Question

According to Ramirez, Schau, & Emmioglu (2012), instructional approaches used in statistics education emphasize what teachers think will work, rather than "solid theory-based evidence about what does and does not work and for whom" (pp. 66-67). Extensive literature exists about the motivational factors that influence student performance in statistics courses (Chiesi & Primi, 2010; Gal et al., 1997; Hood et al., 2012). However, little empirical evidence is available to explain how to increase the level of student performance in online statistics courses. Recent literature about statistics education recommended additional research to explore how to effectively design and deliver online statistics courses (Kakish et al., 2012; Mills, 2015; Mills & Raju, 2011). The following research question (RQ) and subquestions (SQ) guided the case study:

RQ: What is the nature of teaching and learning statistics in an online format?

SQ1: What are students' and faculty's perspectives about the statistics curriculum design and online learning experience at EFG College?

SQ2: What are the barriers to learning and academic achievement in online statistics courses at EFG College?

SQ3: What prerequisite skills do students need to meet the learning outcomes of statistics courses at EFG College?

Review of the Literature

Conceptual Framework

According to Andrews (2011), distance learning “transforms the nature of learning for the contemporary learner” (p. 115). Distance learning requires discipline, organization, and self-motivation. The learner has to schedule time to complete assigned tasks within predetermined deadlines and submit them via the learning management system (Andrews, 2011). Some students have difficulty adapting to the student-centered nature of the online learning environment and perform poorly on tests and exams. Mezirow’s transformative learning theory and Knowles’ approach to self-directed learning will serve as the framework to examine teaching and learning practices in an online introductory statistics course at EFG College (Cranton, 1995; Kitchenham, 2008; Knowles, 1975; Merriam, 2004, 2008; Mezirow, 1997, 2000, 2009).

Transformative and self-directed learning theories define how adults learn, transform, and develop as learners (Cranton, 1994; Merriam, Caffarella, & Baumgartner, 2007). Learning is not merely the result of rote memorization and regurgitation, nor is it limited to the classroom; learning is the product of the learners’ ability to process, assimilate, and synthesize new information based on life experiences (Greenes, 2009; Knowles, 1975; Kumi-Yeboah, 2010). Transformation takes place when teachers and

students engage in critical self-reflection and discourse to revise perspectives about learning and change the context of a concept, situation, or experience (Cranton, 1994; Mezirow, 2009).

According to Knowles (1975), an astute and self-directed learner takes ownership of their learning. The learner is able to work independently to set learning goals, select different learning resources, study, and self-assess his or her understanding of a specific subject. Self-directed learners do not work in isolation, but consult and collaborate with peers, teachers, and other resources (Knowles, 1975). Despite the assumption that adults are self-directed, the adult learner requires clear guidance and preparation to succeed (Meyers, 2008). To perform successfully as self-directed learners, adult students may need to change their attitude and beliefs about the learning process (Keegan, 2009; Knowles, 1975; Mezirow, 2009).

Adult learners construct meaning and new frames of reference by reflecting and expanding on prior knowledge, beliefs, perspectives, value systems, personal experiences, and social interactions (Bruner, 1966; Cranton, 1995; Dewey, 1938; Kolb, 1984; Mezirow, 1997, 2009; Sweller, 2008; Tishkovskaya & Lancaster, 2012; von Glaserfeld, 1989). Adult learners, especially those who have been out of school for a while, prefer teacher led instruction (Kegan, 2009; Knowles, 1975). Some adults resist when a teacher uses transformational pedagogy to create a student-centered learning environment (Mezirow, 2009).

Changing economic conditions have forced many adult learners to pursue degrees as means of advancing their careers and increasing their earning power. The average

adult learner is female and at least 33 years old (Aslanian & Clinefelter, 2012).

Accelerated programs that run between 5 and 8 weeks meet the needs of the adult students who have to manage the demands of family, work, and school (Ausburn, 2004). The adult learners are also attracted to online and hybrid programs, which allow them the convenience and flexibility of studying from their homes.

College administrators and faculty are concerned about the adult students' ability to work autonomously and perform well in a distance-learning format (Allen & Seaman, 2010, 2013, 2014). Some studies have found that students do not perform as well because they have difficulty adapting to the online course delivery format (Xu & Jagers, 2013a). According to Xu and Jagers (2013a), older students experienced an easier transition and assimilation to online learning compared to their younger counterparts. However, the older students' overall academic performance was unsatisfactory (Xu & Jagers 2013a). Findings from other studies suggested that online students also struggle with the abstract nature of statistics courses and have difficulty contextualizing concepts such as average and mean (Garfield & Alhgren, 1988).

Colleges have offered statistics courses in an online format for over two decades, but little empirical evidence exists about how to effectively design and deliver instruction online (Kreiner, 2006). Earlier research about statistics education dealt mainly with issues related to the introductory statistics course curriculum and instructional strategies for face-to-face courses (Tishkovshaya & Lancaster, 2012). However, critical questions still exist about how students learn statistics at a distance (Mills, 2015; Mills & Raju, 2011). This study will help to explain how students function in online statistics courses.

Review of the Broader Problem

This literature review provides additional context about distance learning, perspectives about statistics education, and barriers to teaching and learning statistics at a distance. I used Walden's library databases to conduct a Boolean search using the following terms: *student performance, statistics education, statistics anxiety, student attitudes, adult learning theory, andragogy, self-regulated learning, self-directed learning, transformative learning theory, cognitive load theory, constructivist theory, experiential learning, and online learning.*

In addition, I explored the following subject specific websites including the Online Learning Consortium, formerly SLOAN Consortium; Multimedia Educational Resources for Learning and Online Teaching, and Consortium for the Advancement of Undergraduate Statistics Education (CAUSE). I found articles about distance education and the statistics education reform movement in the *Journal of Asynchronous Learning Networks, Journal of Online Learning & Teaching, Journal of Statistics Education,* and the *Statistics Education Research Journal*. The annual Babson Survey reports by Allen and Seaman (2010, 2013, 2014) also provided significant information about the status of online education in the United States.

Distance Learning

Advances in technology and reform initiatives in higher education have resulted in a rise in distance learning programs and a steady growth in student enrollment in online courses (Allen & Seaman, 2013). Over the past decade, at least 75% of colleges and universities in the United States offered online courses and about 25% of recent

college graduates have taken at least one course online (Aud et al., 2011; Parker et al., 2011). Many college administrators recognize distance learning as pivotal to long-term strategic planning (Allen & Seaman, 2013). Academic leaders have embraced online education as a social act that complements what happens in the traditional classroom (Andrews, 2011). However, some faculty still regard online learning as substandard and question whether students can learn adequately at a distance (Allen & Seaman, 2013).

The literature documented the difference in opinion about whether online and blended learning are as effective as face-to-face learning (Xu & Jagers, 2013a, 2013b; U.S. Department of Education, Office of Planning, Evaluation, & Policy Development, 2010). The big difference between online and traditional learning is the lack of physical proximity of the students and teachers (Andrews, 2011). Although student satisfaction and persistence are low in some hybrid and online courses, final exam scores in hybrid and online courses are comparable to final exam scores in face-to-face courses (Grandzol, 2004; McLaren, 2004; Utts et al., 2003; Ward, 2004).

Distance education fosters transformative learning by facilitating communication, collaboration, and the exchange of information via the World Wide Web (Meyers, 2008). The students connect and interact within a structured virtual learning community. Students interact with the instructor and colleagues in course management systems such as Blackboard, Moodle, Canvas, or Sakai. According to Meyers (2008), students are more forthcoming within discussion forums than they might be in a face-to-face classroom.

In online courses, the teacher acts as a colearner and guides students to be more self-directed and take ownership of the learning experience. The teacher assumes the role of facilitator of the learning process and acts as an agent of transformative learning (Mezirow, 2009). If instructors are to be effective in the online learning environment, they need to transform their pedagogical approach and modify how they deliver instruction and engage students in the learning process (Kegan, 2009).

Statistics Education

According to Zieffler et al. (2008), “statistics education is a new and emerging discipline ... [but] it is not recognized as a unique area of inquiry” (Introduction section, para. 2). Over the past 10 years, research on statistics education has focused mainly on curriculum design and delivery issues (Bude et al., 2007). Some studies have addressed the attitudinal factors that influenced students’ performance in statistics courses (Bond et al., 2012; Chiesi & Primi, 2010; Dempster & McCorry, 2012; Gal, Ginsburg, & Schau, 1997; Hood et al., 2012). Researchers also explored the similarities and differences between traditional face-to-face statistics courses and hybrid or online courses (Li et al., 2012; Ramirez et al., 2012). Studies found that students had similar levels of content mastery even when the instructional delivery mode was web-based versus the traditional classroom (Gal, Ginsburg, & Schau, 1997; Li et al., 2010).

The studies that examined student satisfaction and performance in online and hybrid statistics courses revealed mixed results about the learning process (Kakish et al., 2012; Suanpang, Petocz, & Kalceff, 2004; Utts et al., 2003). Some students appeared satisfied and positive about the learning experiences, but others felt that learning statistics

in an online or hybrid format required more work than in a face-to-face format (Ward, 2004). Some students felt autonomous and in charge of their learning and academic performance, even though they did not grasp the concepts and understand the course materials (Suanpang et al., 2004). When Kreiner (2006) collected data about student performance in a self-paced online statistics course, findings showed that exam scores improved. The students' level of anxiety dropped, and the self-paced mastery approach proved effective (Kreiner, 2006). Yet, some students failed to complete the course assignments due to poor self-motivation and time management skills (Kreiner, 2006).

By the end of an introductory statistics course, students should be statistically literate: demonstrating problem solving, critical thinking, and reasoning skills that transfer to other courses and the workplace (Doehler, Taylor, & Smith, 2013; Gomez, 2013; Hood et al., 2012; Lancaster, 2012; Lockwood, Ng, & Pinto, 2007). To demonstrate proficiency, students need to understand the why, how, and when to apply and analyze statistical data (Bond et al., 2012; Ramirez, Schau, & Emmioglu, 2012). According to Bude et al. (2007), if students engage in experiential learning experiences by collecting and analyzing real data, the students will develop an appreciation for statistics and discover its relevance. Rather than cursory exposure, rote memorization, and regurgitation, students need to learn statistical concepts that will transfer across disciplines and apply to real life experiences (Brown-Jeffy & Cooper, 2011; Ladson-Billings, 1995).

According to Illeris (2009), it is important to understand how students learn; how learning relates to the social, societal, cultural, and material environment; and the feelings

and motivations associated with the learning process. Instructors have to transform their beliefs and understanding about how students process and learn statistical concepts to stimulate the learning process (Lovett & Greenhouse, 2000; Steiner & Hyman, 2010; Zieffler et al., 2012). Instructors have to modify their teaching practice and methods of instructional design and delivery (Tishkovskaya & Lancaster, 2012).

In 2005, the ASA produced the GAISE College Report outlining guidelines to provide some uniformity to the curriculum design and delivery for statistics courses (Zieffler et al., 2012). The guidelines recommended shifting the instructional focus from formulaic procedures to developing conceptual understanding and statistical literacy (Aliaga et al., 2012). To develop statistical thinking, faculty will need to foster active learning experiences, engage students with authentic learning activities with real world applications, and create assessments that aligned to course goals (Zieffler et al., 2012).

In the wake of the statistics education reform movement of the last decade, research studies have emerged to explore faculty perceptions about student readiness and performance in introductory courses (Doehler, Taylor, & Smith, 2013; Hassad, 2011; Zieffler et al., 2012). The Teacher of Introductory Statistics Scale (TISS) and the Statistics Teaching Inventory (STI) generate data about the quality of teaching and learning in introductory statistics courses (Hassad, 2011; Zieffler et al., 2012). Doehler et al., (2013) created the inventory instrument and surveyed over 747 faculty members, across a wide range of academic disciplines, at seven different universities. The study validated the recommendations made in the GAISE College Report. The faculty members who took the survey agreed that introductory statistics courses should focus on statistical

thinking and reasoning and serve the purpose of preparing students for more advanced statistical applications (Doehler et al., 2013). The faculty members recognized that a second statistics course would allow students to make more discipline-specific connections (Doehler et al., 2013).

Barriers to Learning and Academic Achievement in Statistics Courses

Student performance in college-level statistics courses was substandard and may have been the result of math anxiety, negative attitudes, and limited prerequisite skills (Chiesi & Primi, 2010; Dempster & McCorry, 2009; Hood et al., 2012; Li et al., 2012). Prior unsuccessful experiences with math cause students to express ambivalence and resistance that result in further nonlearning (Illeris, 2009). To compound the issue of marginal academic performance, some faculty have difficulty disseminating the statistics curriculum because they are not trained statisticians (Doehler et al. 2013).

According to Lockwood, Ng, and Pinto (2007), students enrolled in the introductory statistics course in business programs because it was a requirement. The students memorized formulae, solved equations, and learned enough to pass midterm and final exams. However, the students found the course material irrelevant to their business studies and had difficulty retaining and applying the statistical concepts to upper level courses (Lockwood et al.). The degree to which the students mastered the statistical concepts is unknown and additional research would help to understand how students learn and demonstrate proficiency in statistics courses.

Although there appeared to be an invariable relationship between student attitudes and achievement in mathematics, more research would validate whether there is a set

relationship between statistics courses and students' attitudes (Ramirez, Schau, & Emmioglu, 2012). When students do not understand statistical concepts, regardless of their efforts on assessments, the results will be unsatisfactory. If students continually fail statistics exams, they develop a dislike for the course, find statistical concepts irrelevant, and perform poorly on exams (Bude et al., 2007). Williams (2010) suggested remediation to increase students' prerequisite skills and enhanced learning environments where students can feel comfortable discussing statistical concepts.

Chiesi and Primi (2012) recommended that teachers encourage students to attempt practice exercises to experience a sense of accomplishment, mastery, and confidence (self-efficacy). Faculty should also provide positive reinforcement by offering immediate feedback and make text-to-real world connections thereby establishing the relevance of the subject matter, such as media connections and work related connections to other courses (Chiesi & Primi, 2012). As a result, students would recognize how valuable learning statistics is to accomplishing future academic and professional goals. The transformation in attitude should have a positive impact on students' overall performance in statistics courses (Hood et. al., 2012). Faculty need to continue to explore ways to stimulate student involvement in the online environment and activate the learning process because motivated students are less likely to drop out (Kim & Frick, 2011).

Instructors should review the course design periodically to ensure that the design is accessible and easy to navigate. Faculty need be aware of the barriers students face in learning. For example, when a student experiences technical difficulties navigating a cumbersome learning management system, such difficulties become distractions to

comprehending the content (de Jong, 2010). According to de Jong (2010) and Sweller (2008), course materials should align with students' prior knowledge or intrinsic load. Faculty can promote higher order thinking or germane load by designing courses that avoid nonessential, confusing information, or extraneous load.

In order to reduce barriers to learning and ensure that students understand and apply statistical concepts, instructors have to understand how students construct meaning (Garfield, 1995). Teachers also have to understand how culture (ideology, religion, politics, class, race, gender) affects the learning process (Mezirow, 2009). To meet the needs of a diverse group of students, teachers need to know how to create inclusive, culturally relevant, and developmentally appropriate learning environments (Elkind, 1989; Gay, 2002; Grabinger et al., 2008; Gradel & Edson, 2009; Higbee, 2003; MacGillivray & Croft, 2011; Orr & Hamming, 2009).

The existing literature provided little information about how to differentiate instruction to meet the needs of diverse learners in online statistics courses. As a result, some adult students with disabilities expressed dissatisfaction with the level of academic support and assistance available within the online learning environment (Heiman, 2008; Keeler & Horney, 2007; Park & Choi, 2009). Additional research could expand the knowledge base about how to ensure that online courses are accessible for students with learning disabilities, students with limited language proficiency, and students of varying racial and ethnic backgrounds (Brown-Jeffy & Cooper, 2011; Maguire & Scott, 2006).

College administrators need to commit to continuous improvement by periodically reviewing the core curriculum and redesigning the curriculum to align with

innovations in technology and educational reforms. Students need to be assessed and appropriately placed during the freshman years. Li et al. (2012) made the following recommendations: (a) establish criteria for placing students in introductory statistics courses, (b) provide multiple means of accessing the content and demonstrating mastery, (c) provide a number of formative assessments, and (d) reteach to ensure for mastery learning (p. 883). My research study explored online statistics curriculum design and delivery methods and the ensuing impact on student learning experiences.

Implications

Zieffler et al. (2008) posited that the purpose of statistics education research is to improve teaching practice and student learning. This study sought to understand students' and faculty perspectives about teaching and learning practices of an online statistics course. One possible outcome was a redesign of the mathematics and statistics curriculum at EFG College. I could also make recommendations to improve online course development to reduce barriers to teaching and learning. However, the culminating project comprised of professional development initiatives for faculty who teach online courses at EFG College.

Summary

Section 1 of this doctoral study introduced the problem statement, rationale for the study, research questions, conceptual framework, and literature review. Despite the expanding research about statistics education and the ensuing reform movement, meager literature existed about the effectiveness of online statistics courses. The purpose of the study was to examine faculty and students' experiences to identify possible barriers to

teaching and learning statistics at EFG College. The study's findings confirmed the GAISE report recommendations for improving teaching and learning in online statistics courses.

In Section 2, I provided details about the participants, data collection methods, data analysis procedures, and findings of the study. Section 3 addresses the rationale and description of the proposed project and the related literature review. The study concludes in Section 4 with reflections, lessons learned, recommendations, and implications for future research.

Section 2: The Methodology

Introduction

Students were not performing well in online statistics courses at postsecondary schools and limited empirical evidence was available about teaching and learning practices for online statistics courses (Mills, 2015; Mills & Raju, 2011; Sebastianelli & Tamimi, 2011). The purpose of this qualitative embedded case study was to understand faculty and students' experiences and highlight possible barriers to teaching and learning statistics in the online business program at EFG College. I interviewed a purposive sampling of students and faculty who provided first-hand knowledge about the online introductory statistics courses. In addition to conducting interviews, I examined and analyzed course syllabi, end of semester evaluation reports, and the 2014 statistics course shell in the learning management system. I wanted to determine whether EFG College's introductory statistics curriculum and online course design were appropriate to stimulate student learning.

Research Design

The Qualitative Tradition

The research study followed the qualitative tradition because I wanted to learn more about the nature of teaching and learning statistics in EFG College's online business program. I examined the online statistics course curriculum and learning experience through an "*emic* or insider's perspective" (Hancock & Algozzine, 2011, p. 9). I asked EFG College's faculty and students to share their views about the statistics course curriculum and the online learning experience (see Appendix B). I considered

quantitative and mixed methods approaches; however, I chose neither because the study's emphasis was not experimental or correlational, but descriptive in nature. The goal was to understand the phenomenon versus investigating and testing the cause and effect of specific variables.

According to Mathews and Clark (2007), "there has been a shift in research methodologies away from statistical studies involving control versus treatment groups toward more qualitative methods" over the past 10 years (Research Methodology section, para. 1). The qualitative research design is an emergent and inductive process because the variables evolve during the data analysis process (Merriam, 2009). The researcher examines a phenomenon through the lens of the people affected by it. Qualitative research seeks to understand how the participants interpret and make meaning from their lived experiences (Marshall & Rossman, 2011; Merriam, 2009; Yin, 2014). The researcher spends a lot of time in the field interacting with the participants to collect, analyze, and produce some richly descriptive information about the phenomenon (Miles, Huberman & Saldana, 2014).

Qualitative data is collected primarily using an inquiry-based model with the researcher facilitating in-depth interviews (Marshall & Rossman, 2011; Yin, 2014). The interviews can be semistructured with the researcher using an interview protocol with scripted questions to spark the dialog. In addition to verbal narratives (Wiersma & Jurs, 2013), other forms of qualitative data collection, such as observations and documents, may be used to triangulate the findings and provide alternate sources of evidence to increase the construct validity of the study (Yin, 2014).

Dependent upon the context of the study, a qualitative study can be experimental, quasi-experimental, ethnographic, historical, or assume a case study model (Maxwell, 2013; Wiersma & Jurs, 2009). If the goal is to examine the effect of manipulating a variable, a researcher may want to consider the experimental or quasi-experimental approach (Wiersma & Jurs, 2009). Alternatively, a researcher uses the historical approach to study past events or situations, while the ethnographic approach examines issues of a cultural or anthropological nature (Wiersma & Jurs, 2009). The case study method is chosen when a researcher wants to examine a real world situation, a contemporary event, a specific organization, or system within a given context (Marshall & Rossman, 2011; Miles et al., 2014; Wiersma & Jurs, 2009; Yin, 2014).

Justification for Case Study Approach

According to Merriam (2009), when researchers want to discover, interpret, and gain insight about a phenomenon, they can select the qualitative case study design. I used a single case study approach embedded with two units of analysis to examine elements of online statistics courses through the viewpoints of faculty and students. The context of my study was the 3-year-old online business program at EFG College, a private college located in the northeastern United States.

Of the five qualitative research methods, the case study approach is more exploratory and explanatory in nature (Hancock & Algozzine, 2011; Yin, 2014). The case study's goal is not to prove/disprove a hypothesis or reach statistical significance based on a big sample of participant responses, as with quantitative studies, but to gain a deeper understanding of a phenomenon (Yin, 2014). I used the embedded case study approach to

understand why students perform marginally in online statistics courses and explain how teachers facilitated instruction in the distance-learning format at EFG College.

Participants

Criteria for Selection of Participants

According to Merriam (2009), researchers select a participant sample to reflect the elements of the phenomenon. Therefore, I selected a purposive sample of participants who could share relevant information about teaching and learning experiences in online statistics course (Yin, 2014). I selected participants from the roster of 72 students enrolled in online introductory statistics courses at EFG College between 2011 and 2014. I also invited the 10 EFG College faculty members who taught statistics in a hybrid or online format to participate in the study. I excluded faculty members who delivered statistics instruction solely in the face-to-face classroom.

The student participants reflected varying levels of achievement based on the letter grade (A, B, C, D, F, or W) they earned for the introductory statistics course. I wanted to understand why some students performed poorly while others performed satisfactorily in an online statistics course. The students who earned grades of A, B, or C were able to share information about the factors that contributed to passing the course. On the other hand, the students who earned grades of D, failed, or withdrew from the online statistics course could share information about the factors that impeded their performance. I asked all participants to identify possible challenges and barriers to learning statistics online.

Justification for the Number of Participants

According to Merriam (2009), the number of participants should be determined based on the research questions and purpose statement. Alternately, Marshall and Rossman (2011) recommended that the researcher justify the sample by first identifying the possible population and its variability and select the number of participants based on the variables. Miles et al. (2014) acknowledged that sample sizes for qualitative studies are typically small, nested in a specific context, and studied in depth.

My research study examined students' and faculty perspectives about the curriculum and online learning experiences at EFG College. Interviews with one currently enrolled online student and three recent graduates produced ample descriptive data to understand how students learned statistics in an online format. In addition to students, the purposive sample included two faculty members who taught statistics courses in online and hybrid formats during the 2011 to 2014 academic school years.

Procedures for Gaining Access to Participants

I secured a signed letter of cooperation (see Appendix C) and data use agreement (see Appendix D) from a member of EFG College's executive team that granted me permission to conduct the research study at the college. When I received Walden University's Institution Review Board (IRB # 01-05-15-0040942) approval to begin the study, I contacted EFG College's administrator who was in charge of the online program and was the gatekeeper of the college's archival records. The purpose of the initial communication was to provide an overview of the proposed study and outline the data collection procedures. I discussed the selection criteria for identifying prospective

participants and reviewed the informed consent document. To comply with the guidelines of the Family Educational Rights and Privacy Act, an EFG College staff member made the initial contact with prospective participants. The purpose of the initial written correspondence was to provide information and notify prospective participants about the follow-up procedures regarding participating in the research study.

Methods of Establishing Researcher-Participant Working Relationship

To establish a working relationship with student and faculty participants prior to the interviews, I provided an overview of the study, gained informed consent, and solicited their voluntary participation (Seidman, 2013; Yin, 2014). I was transparent by sharing information about data collection procedures and other pertinent elements of the study with all participants. Participants could opt out of the study if they wanted to at any time.

Ethical Protection of Participants

I asked participants to review and acknowledge receipt of the informed consent form that clarified the voluntary nature of the study, the risks and benefits of participating in the study, and the safeguards protecting their privacy. The faculty and students had the option to participate via in-person interviews in a secured space on the college's campus or via telephone interviews. I used pseudonym codes (Student #1, Student #2, Student #3, Student t #4, Faculty #1, and Faculty #2) to disguise the participants' identities. I also stored all electronic data in a password-protected computer and secured hard copy documents in a locked file cabinet in my home.

Data Collection

This qualitative case study took place in three phases and included multiple sources of evidence such as documents, artifacts, and interviews. I was able to conduct comparative data analysis across the three different sources of data collection. According to Yin (2014), the purpose of using multiple sources of data collection is to address the research questions from different vantage points, while safeguarding for triangulation and construct validity.

Phase 1: Documents and Archived Data

After securing Walden University's IRB approval, I began the data collection process by obtaining, examining, and analyzing some of EFG's archival records, specifically the institutionally generated course evaluations and grade distribution reports for the statistics courses offered between 2011 and 2014. The course evaluation responses provided some details about students' perspective about the curriculum, course design, faculty, and online learning experience. The grade distribution reports provided evidence about student performance in EFG College's online statistics courses as reflected by final grades. I used analytic memos to document noticeable performance trends and emerging themes from the student's comments.

Phase 2: Artifacts from the Learning Management System

The next data source helped to understand how the students navigated within the learning management system or virtual classroom. I reviewed the Statistics 1 syllabus, learning activities, assignments, assessments, and multimedia resources to ensure that the course template was accessible and the content aligned with the learning objectives. The

review of the online course in the LMS was almost equivalent to an observation of a face-to-face class. I explored how the technology and curriculum interplayed to impact student learning (Yin, 2014). I jotted down notes about possible barriers to students accessing the statistics curriculum in the online learning environment.

After collecting and analyzing the preliminary data from the documents, archival records, artifacts, and field notes, I documented reflections in my researcher journal. I also made a note of questions that emerged during the document mining and analysis phase of the study for consideration. I posed some of the questions as follow-up interview questions.

Phase 3: Interviews

Six semistructured interviews took place via phone conference to accommodate the participants' preferences and availability (see Appendix G). Participants had the option to meet in-person in a secured room on campus, but they all opted for phone interviews. I used a digital voice recorder and telephone microphone to document each interview, which lasted between 60 to 90 minutes. My goal was to pose open-ended questions with the purpose of generating rich descriptive data to answer the research questions.

Role of the Researcher

Because of my role as a former faculty member at EFG College, I had to bracket any preconceptions, opinions, and assumptions during the interview process (Miles et al., 2014). I wanted to learn about the faculty members' and students' perspectives and experiences with teaching and learning in the online statistics course. Therefore, I used

interview protocols to pose open-ended questions to the student and faculty participants (see Appendix B). Then, I asked the participants to review the interview transcripts to ensure that I captured and interpreted their responses accurately. My goal was to produce an authentic description of the participants' experiences.

Participant's Rights

As the primary instrument of data collection (Maxwell, 2013; Miles et al., 2014; Yin, 2014), I had to maintain ethical and trusting participant-researcher relationships. During the initial phase of each interview, I gave participants the opportunity to pose clarifying questions about the planned study. According to Hatch (2002), mutual respect, active listening, and open communication put participants at ease and allowed them to pose questions and concerns about the study.

The informed consent form outlined the participants' rights (see Appendix D). Participation in the study was voluntary and participants were not obligated to continue with the interview process. I secured all interview recordings, transcripts, field notes, and other data on a password-protected computer. Participants had the opportunity to review and provide feedback about the interview transcripts as well as the study's findings.

Data Analysis

The study followed a concurrent data collection and data analysis process (Hatch, 2002; Maxwell, 2013; Merriam, 2009; Miles et al., 2014; Wiersma & Jurs, 2009). First, I collected data from documents and the learning management system. Next, I analyzed the archival data and generated follow-up questions to pose to participants during the

individual interviews. Then I used the inductive and interpretive analysis approaches to code and categorize the raw data from interviews, documents, researcher journal, analytic memos, and field notes. Yin (2014) suggested organizing the data in a case study database and I used the Nvivo software package to compile and store all the data collected. Then I was able to query the multiple sources of data to generate the findings.

When I finished interviewing the first student candidate, I prepared the transcript, printed a copy, and began the open code process by using colored highlighters. I maintained a sense of neutrality and refrained from projecting preliminary interpretations from one interview to another (Seidman, 2013). I noted key terms, phrases, and themes in the margin of the document (Merriam, 2009). I jotted down observations, reflections, and preliminary patterns in my researcher journal. I repeated the process for each participant making a conscious effort to ensure that a reasonable balance existed between the time committed to data collection and data analysis (Merriam, 2009). The entire data collection and data analysis process spanned over a 4-month period.

After interviewing the four student participants and engaging in some preliminary data analysis, I interviewed the two faculty participants following a similar procedure as done with the student participants. I also uploaded copies of the transcripts, notes, course evaluations, grading distribution reports, and analytic memos to the Nvivo program and generated word queries as part of the coding process. Since Nvivo was incapable of making meaning and drawing conclusions, I read and re-read all the transcripts, analytic memos, and field notes multiple times. I adopted an inductive and interpretive coding

approach (Hatch, 2002) to categorize themes, make inferences, and make connections to the research questions, theoretical framework, and relevant literature on the topic.

Evidence of Quality

To triangulate the data and reduce possible validity threats, I collected data using document mining, course review, and interviews. I also collected data from two different viewpoints--from interviews with faculty and students. After I transcribed the data, I used member checks to make sure that I accurately captured the participants' responses (Maxwell, 2013; Miles et al., 2014). I also shared a summary of the findings with the participants to safeguard against any misrepresentation or misinterpretation of the information presented. To maintain the integrity of the study and reduce researcher bias, I did not impose my beliefs about student performance in online statistics courses or share my opinions during the data collection, analysis, and interpretation phases.

Procedures for Dealing with Discrepant Data

According to Miles et al. (2014), discrepancies can surface during the data analysis phase of a research study. The information collected via multiple sources including interviews, documents, artifacts, and archival records can be "disparate, incompatible ... [and] contradictory" (Merriam, 2009, p. 203). As a result, researchers can find it difficult to make inferences about the data. The researcher needs to devote the time to examine the discrepant evidence--a means of testing the validity of qualitative research that can lead to modified findings (Maxwell, 2013).

When analyzing the data, I acknowledged biases and assumptions that may have influenced how I interpreted and drew conclusions about the data. I accounted for

discrepant data or deviant cases by highlighting contradictions and differences of opinion among the course evaluation comments, faculty interviews, student interviews, and other archival data (Hatch, 2002). As Maxwell (2013) recommended, I validated my findings by asking the participants to clarify and verify information.

Findings

This qualitative embedded case study examined faculty and students' perspectives about introductory statistics course design and explored possible barriers to learning statistics at a distance. The study examined the problem of marginal performance in online statistics courses at EFG College and addressed the following research question and subquestions:

RQ: What is the nature of teaching and learning statistics in an online format?

SQ1: What are students' and faculty perspectives about the statistics curriculum design and online learning experience at EFG College?

SQ2: What are the barriers to learning and academic achievement in online statistics courses at EFG College?

SQ3: What prerequisite skills do students need to meet the learning outcomes of statistics courses at EFG College?

Nature of Teaching and Learning Statistics in an Online Format

The nature of teaching and learning statistics in an online format varies based on the stakeholders' perspectives, mindsets, and skills. The interview and course evaluation data showed that students at EFG College classified Statistics 1 as a challenging course. However, the interpretation of challenge differed from student to student. The online

course appeared fast paced and did not allow students with limited prerequisite skills enough time to master the content. Some students viewed Statistics 1 as a difficult form of math, which they abhorred, while others appeared intrigued and found the course material applicable to their daily lives. Students who had positive experiences with high school math and algebra found Statistics 1 manageable; one student described it as one of the easier courses in the business program (Student #3).

Student #3 attributed success in the online Statistics 1 course to “prior math experience, so it was a bit easier for me to grasp the new concepts and get more done in a timely manner.” Other students “didn’t have the level of math history” and appeared overwhelmed by the “new assignments and new concepts [they had] to learn almost every week” (Student #3). Student #1 described the online statistics course as “intense” and “time consuming” and thought it were better suited for face-to-face delivery where the instructor was a constant presence. Alternatively, Student #2 preferred to work independently “to process and learn” at her own pace over the allotted week’s timeframe. The students’ views about the nature of the online statistics course varied according to their learning preference and comfort level with math.

Faculty and Student Perspectives

EFG faculty considered statistics as an analytical course where “you have to practice on your own and experience it on your own in order to do it” whether it is presented in a face-to-face, hybrid, or online format (Faculty #1). Moreover, some faculty perceived exams as the primary means of assessing learning in the online statistics course. From students’ perspectives, learning in the online statistics courses

happened through dialogue with peers and the instructor. Therefore, it may be possible to assess the degree of students' conceptual understanding by examining student-to-student and student-to-instructor dialogue during synchronous (instant messaging, audio/video conferencing) and asynchronous learning activities (discussion forums). Yet some EFG College faculty did not see the value of discussion forums within the online statistics course. Consequently, some students were not as engaged in the learning experience as possible.

Teaching statistics online required EFG College faculty to explore different ways of presenting the required content so that students developed and demonstrated conceptual understanding and statistical reasoning skills. While instructors recognized that online "teaching can all be delivered via video and interactive reading materials" (Faculty #1), they were uncertain about the nature of the online teaching and learning process. One of the faculty participants wondered, "How are the students getting the concepts and how are we conveying information back and forth about, you know, what their understanding is and my understanding of their understanding" (Faculty #2). The faculty member later resolved, "it's a question of the depth to which they are getting it. And some clearly get it and others move through it more of a surface level, can calculate stuff you know, but it is not clear whether they can really explain what they are doing or offer those conclusions we look for" (Faculty #2).

The data indicated that while EFG College faculty had the subject matter expertise and performed well in the traditional face-to-face classroom, they lacked the necessary pedagogical and technological skills required for online teaching. The faculty

did not know how to utilize different types of technology to differentiate instruction for their diverse learners. Furthermore, the instructors' beliefs and philosophies about math, statistics, and distance learning influenced how they taught and how their students learned in the online statistics courses.

EFG College faculty expected their students to be self-motivated and self-directed; however, most students entered the online statistics course feeling inadequate, fearful, and anxious. Yet, in some instances, with open communication and adequate peer and faculty support, the students' level of confidence increased and they were able to overcome phobias and insecurities by the end of the introductory statistics course.

Barriers to Teaching and Learning Statistics in an Online Format

As with earlier studies (Lockwood et al., 2007; Ramirez, Schau, & Emmioglou, 2012), performance in statistics courses at EFG College was affected by students' attitudes, aptitude, and affect. Yet, the students were motivated to pass the introductory statistics despite various challenges. Barriers to students' learning in the online statistics courses at EFG College included:

1. Math phobia
2. Fixed mindsets
3. Limited prerequisite skills
4. Poor time management
5. Ineffective teaching practice

While some students passed the introductory statistics course, they lacked the conceptual understanding and experienced difficulty retaining and applying the content to real situations (Lockwood et al., 2007).

Student #4 admitted to “memorizing [statistical concepts] for the moment because once I passed it I am done... I am really not understanding it... it’s just too much to cover, to digest in this particular class.” Faculty #2 also recognized that a passing grade did not equate to a student meeting the learning outcomes for the online statistics course and wondered:

What does passing mean...in this course? Does that mean they have gotten all of the learning objectives, all of, some, and if they are one or two that they haven’t met, does that mean that they haven’t earn the passing grade by definition?

(Faculty #2)

Faculty #1 and #2 realized that if students are to meet the learning outcomes in the online statistics course, students have to move beyond memorizing formulae and procedures to demonstrating a conceptual understanding of statistics. Nevertheless, the faculty members experienced barriers when delivering instruction in an online format.

The limitations that faculty faced when teaching statistics online at EFG College included:

1. Individual philosophies about teaching and learning
2. Limited pedagogical and technological skills
3. Course design

Faculty #1 and #2 acknowledged that limited experience as online instructors affected how they taught and how students learned online. The faculty questioned “the depth of learning” that was possible considering the prescribed structure of the online course design (Faculty #1; Faculty #2). Unlike the face-to-face classroom, where instructors sometimes took the time to re-teach difficult concepts, “how much the instructor can do, spontaneously or adhoc, outside of how the course is structured” remained unknown (Faculty #2). Furthermore, instructors felt ill-equipped to create differentiated and developmentally appropriate learning environments.

Prerequisite Skills

Success in Statistics 1 at EFG College was dependent on students mastering foundational math operations and basic algebraic concepts. Students had to understand how to add, subtract, multiply, and divide. Other necessary basic math concepts included decimals, fractions, ratios, and proportions. Students also needed basic reading skills in order to comprehend the text and critical thinking skills to analyze, interpret, and solve problems.

Statistics 1 Learning Objectives

According to EFG College’s Statistic 1 syllabus, “the primary objective of the course was to introduce the statistical methodologies used for sampling and analyzing data and discuss their validity to measure various socio-economic components that arise in the business environment.” The students were exposed to topics such as sampling procedures, measures of central tendency (mean, median, mode), measures of dispersion (standard deviation and variance), data displays (frequency tables, histograms), and

probability. A review of the schedule of the learning activities as laid out in the syllabus confirmed that students had multiple opportunities to demonstrate conceptual understanding of the statistics course content. In addition to the assigned textbook, there were also supplemental readings and videos listed in the syllabus and presented in the learning management system.

Table 1 outlines the different methods used to assess student learning, for example, practice exercises, assignments, quizzes, exams, and case study projects. In addition, students had to actively participate in weekly discussion forums and make connections to the real world applications in the field of business. Yet, when interviewed, faculty questioned the extent to which students met the learning objectives, and demonstrated the course's core competencies - critical thinking and problem solving.

Table 1

Statistics 1 Learning Objectives and Assessment Criteria

Learning Objective	Assessment Instrument	Criterion for Evaluating
Recall valid sampling procedures.	Discussion/ Practice Exercises	Participation and feedback during discussion boards
Make accurate statistical computations.	Assignments/Quizzes/ Exams	Students receive a grade of C or better
Analyze and create graphs of statistical data	Exercises/Assignments/ Projects/Case Analysis	Students successfully complete projects, case analysis, and/or assignments with a grade of C or better

Note. Adapted from Statistics 1-OL Syllabus by EFG College. Copyright 2011 – 2013.

Participant Demographics

The two faculty members who participated in the study had an employment history at EFG College spanning over 5 years and taught a cross-section of face-to-face, hybrid, and fully online courses. The four female students juggled work, school, and motherhood. They had all completed 2-year Associates degrees in accounting, business administration, criminal justice, and health care administration. Three of the four students chose to enroll in EFG College's online Bachelor's degree program, while the other student was a campus-based student, who received permission to complete Statistics 1 in an online format. Table 2 provides additional information about the student participants.

Table 2

Summary of Participants - Students

Student	Gender	Enrollment Year	Program of Study	Final Grade Statistics 1	Final Grade Statistics 2
#1	Female	2012	Management	B	C
#2	Female	2011	Accounting	A-	A
#3	Female	2011	Accounting	A-	B
#4	Female	2012	Management	D	A

Themes

Five overarching thematic categories emerged during the data analysis phase:

1. Measuring and assessing student learning online
2. Challenges of learning statistics online
3. Student readiness and preparation
4. The role of faculty in the online learning process

5. Recommendations for improving online statistics courses

Theme 1: Measuring and Assessing Student Learning

EFG College faculty members measure and assess students' learning outcomes by using the final grade. However, in this era of competency education, students' ability to apply and transfer what they have learned to different situations may be a better measurement of learning. Based on conversations with student and faculty participants, I can conclude that the passing grades earned in the online statistics course did not equate to a high level of conceptual understanding and retention of information. However, at least two of the student participants believed that a review of the textbook and course notes would help them to recall the concepts introduced in the online statistics course.

Student participants found it easier to recall statistical concepts that related to their avocation and daily lives. For instance, Student #2 and Student #3 worked in the accounting field and used descriptive statistics to present data in the business reports they prepared for upper management. They both had no difficulty identifying and explaining how to find the measures of central tendency and variation – mean, median, mode, and standard deviation. Student #2 also remembered some information about normal distribution, but described probability as a difficult concept for which she needed to “get serious help.” Student #3 recollected the principles of “probability because [she] use[d] it at work when working in Excel on cash projections.” The student participants remembered basic concepts that they applied to situations beyond the online statistics course.

Since 3 or 4 years had elapsed after the student participants enrolled in the introductory statistics course, it is understandable that they were unable to recall all of the concepts introduced in the online statistics course. However, some students, including Student #1 and Student #4, struggled to master the content delivered in the statistics course and had a harder time recalling key concepts. Student #1 shared the following:

I know mean, mode, and median because you learned those in primary school, but it takes time to get it click back in my brain, but I can't lie to you about a thing about statistics, because I just passed that course and said I am done with that course. (Student #1)

Student #4 “didn't retain much ... [but promised to] go back and review” the concepts in the textbook. Despite her colleagues' struggles mastering and retaining statistical concepts, Student # 3 believed that, “regardless of when you learned something, if you fully understood it you should be able to apply that concept at any time in your life whether it is a month, or a year away.” However, the philosophy did not prove true for the students who enrolled in EFG's online statistics courses between 2011 and 2014.

Sub Theme 1a: Student Performance in Online Statistics Courses

Student performance in the online introductory statistics course at EFG College fluctuated between 2011 and 2014. As noted in a related study about student performance in an introductory business statistics course conducted in 2013 at Suffolk University in Boston, the distribution of grades in EFG College's statistics courses had a tendency to be disparate and bimodal (Haughton & Kelly, 2015). In 2011, three of the eight students (38%) enrolled in the inaugural online class at EFG College failed the introductory

statistics course. By 2012, the number of failures increased by seven percentage points, with 9 out of 20 students (45%) failing the course. In 2013, students performed much better than previous years with 73% of the 26 students passing the course. By 2014, three out of 14 students performed unsuccessfully and the failure rate dropped year over year by six percentage points to 21%.

Performance in online statistics courses lagged behind hybrid courses with an average pass rate of 72% compared to 90%. Table 3 displays the grade distribution data for the online Statistics 1 courses offered between 2011 and 2014, while Table 4 provides comparative data for the hybrid courses offered between 2013 and 2014. As consistent with Haughton and Kelly's (2015) findings, hybrid courses may aid in improving student performance in introductory business statistics courses, because learners get to engage with the instructor and peers in a face-to-face setting for part of the time.

Table 3

Statistics 1 – Online Aggregate Grade Distribution (2011 – 2014)

Year	Letter Grades Earned								
	A	B	C	D	F	UF	WD	DP	Total
2011	4	0	0	1	3	0	0	1	9
2012	1	3	5	2	9	0	0	2	22
2013	4	11	3	0	7	1	1	0	27
2014	2	8	1	0	0	3	2	3	19
Total	11	22	9	3	19	4	3	6	77

Note: UF – unofficial failure; WD – Withdrew, DP – dropped the course

Student performance in the hybrid introductory statistics course exceeded that of the fully online course, with an aggregate failure rate between 2013 and 2014 of 10% (14) for hybrid courses compared to 24% (11) for online courses; implying that hybrid

courses were a more effective way to learn statistics. However, the difference in terms of the actual number of students was three. Both instructional delivery models spanned over an 8-week period with a standardized curriculum design, therefore the course content and layout in the learning management system was similar. The major difference was that the students enrolled in hybrid courses received instruction on campus in face-to-face sessions for 70% of the time and worked online for the remaining 30% of the time. As a result, the students who opted for the hybrid program had the opportunity to meet weekly with peers and faculty.

Table 4

Statistics 1 – Hybrid Aggregate Grade Distribution (2013 – 2014)

Year	Letter Grades Earned								
	A	B	C	D	F	UF	W D	DP	Total
2013	30	16	5	2	6	1	1	2	63
2014	19	24	10	8	7	0	4	3	75
Total	49	40	15	10	13	1	5	5	138

Note: UF – unofficial failure; WD – Withdrew, DP – dropped the course

The faculty participants were concerned that the grades earned were not a true reflection of what students knew and were able to do. The faculty questioned the depth of students' conceptual understanding of basic statistical concepts. Faculty #2 resolved that "some [students] clearly get it and others move through it more of a surface level." EFG College faculty members discovered that students understood how to compute statistical operations such as the mean and standard deviation. However, students had difficulty explaining the problem solving process, making inferences, and drawing conclusions about a given data set. Furthermore, some students struggled due to possible learning

deficiencies; they had difficulty understanding the statistical content, even after tutoring and academic support.

When asked to describe the level of student performance in the online statistics course, Faculty #2 shared the following:

There were certain students who seemed to grasp things, move through pretty seamlessly, you know, didn't require a whole lot of...they required support, but they certainly didn't sort of display any level of confusion about things. As we went, they grasped it and I see that in the classroom too, they are processing things as they go and they are getting it. They are showing that by how they talk about the information and the concepts and how they are able to calculate, you know, the statistics.

Faculty #1 speculated that some students were “not necessarily doing the class to get stellar grades, but just to pass it.” According to Faculty #1, “out of 12 students, five of them failed. Five failed, two in B range, and other five in C range” (Faculty #1). Judging from the actual results presented on the grade distribution report, it was evident that there was some disparity and student performance in online statistics courses appeared problematic. Contrary to Faculty #1's account, four (38%) students earned the letter grade of C, 1 (8%) earned a letter grade of D, five (42%) failed and the remaining two (17%) students earned a letter grade of B. Faculty #1 believed that marginal performance in statistics courses lied solely with the student, resulting from a negative mindset and lack of motivation. However, while Dweck (2006) discussed the relationship between mindset and the learning process, in this case, drawing a conclusion would require further

examination of other variables, including the level of student readiness, prior learning, and barriers to learning statistics online.

Theme 2: Challenges of Learning Statistics Online

The students' responses on EFG's end-of-semester course evaluations, for the introductory statistics courses offered between 2011 and 2014, highlighted different perspectives about the teaching and learning process. Although the average 51% response rate was below the 70% rate Rumsey (2003) recommended for validating survey results, the students' comments were valuable to understanding the learning experience in the online statistics course. For example, one student stated, "I think this course is a bit challenging for an online class. The online forums were very helpful but I would recommend a hybrid class for a course like statistics." Table 5 displays a sampling of the survey prompts and the students' corresponding responses on a 5-point Likert scale:

Of the 35 students who completed the course evaluations for the online statistics courses, 34 (97%) described the online statistics course as challenging. However, some students welcomed the challenge, because they were able to develop critical thinking and statistical literacy skills, as evidenced by the following survey comment: "This course was very challenging. I guess I can say I liked the challenge. It forced me to think, but it stressed me out quite a bit because I really want to do well." Another student stated:

Since I always enjoyed working with numbers and statistics involves a lot of numerical equations, I enjoyed the challenges to see how well I understood statistics. Also the fact that now when I read an article with statistical measures I

can relate it to what I have learned throughout this course and look at articles in a whole new light.

Other students described the online statistics course as difficult and overwhelming, and they anticipated that they would earn poor grades.

Table 5

Statistics 1 Course Evaluation Survey Aggregate Results (2011 – 2014)

Survey questions	Likert Scale					N/A
	Strongly disagree	Disagree	Somewhat Agree	Agree	Strongly Agree	
1. This course challenged me.			1	7	27	
2. I found the textbook to be useful.		4	8	10	13	
3. The professor was knowledgeable about the course content			5	11	8	1
4. The professor gave clear direction for the assignments.		3	2	17	13	
5. The professor made appropriate use of Moodle as a teaching tool.		2	2	11	19	1
6. Tutoring and other learning support services were available for this course.	1		7	7	18	2

Perspectives differed based on the students' ability level, skillset, cultural heritage, and comfort level with the content of the statistics course. Students #2 and #3 had prerequisite math, communication, and technical skills to succeed online and felt comfortable learning statistics in a virtual setting. For example, Student # 3 took AP Math, AP Calculus, and AP Statistics in high school and felt well prepared for the college level introductory statistics course. Student #2 credits her formative education in the Caribbean for her strong math background because "teaching there was more advanced." She described the high expectations and rigor of her schooling and pointed out that the math concepts introduced in 6th grade in the Caribbean were taught in 9th grade in schools in the United States. As a result, Student #2 wondered whether her instructors saw a "big difference in the classroom... with learning" among students and across cultural or ethnic boundaries.

The data collected from students during the individual interviews complemented EFG College's course evaluation results. One possible conclusion is that the students' assessment of the online statistics course was negative. According to course evaluation results, students found the statistics course challenging, but some of them welcomed the challenges of the online learning experience. For example, Student # 2 appreciated having "seven days to get the work done... [because] online gives you more time." Student #3 did not find the introductory statistics course "a challenge at all" and described it as "one of my easiest classes." When comparing experiences in the Statistics 1 and 2 courses, Student #3 shared the following: "One thing about me and learning is if something is challenging I am just that more interested in it." However, Student #3

seemed to experience some cognitive dissonance in the advanced Statistics 2 course, especially when asked to make inferences about data sets.

Sub Theme 2a: Fear and Anxiety

While some students enjoyed the flexibility and convenience of the online environment, others had difficulty understanding and processing the statistics content. Some students felt anxious and overwhelmed and shared their feelings via comments on the course evaluation survey. One student found the introductory statistics course difficult and attributed marginal performance in the course to a dislike for numbers and formulas. The student was “beyond overwhelmed” by the amount of required readings and general course workload.

The level of initial fear and anxiety that some students experienced at the beginning of their introductory statistics courses abated over time. To quote one student’s course evaluation response, “Statistics scared me at first but now that I have taken it, it’s proven to be not as scary as I thought it would be.” Another student echoed a similar sentiment in the course evaluations:

I have always struggled in math so when I started taking statistics I thought the worse, but [while] in the course, I realized statistics is more than just numbers. It was a lot of work in terms of assignments and quizzes but it helped to better prepare me for my midterm and final.

During the individual interviews, I asked students whether they would take an online statistics course again. Student #1 identified the following conditions under which she would take another online statistics course:

I would take again if I have the proper break down and a good teacher who can teach you it and take out the scare, the fear out of it... Yes take out the fear, because statistics is fearful... when you don't know something, then you have a teacher that isn't good, it brings that anxiety. (Student #1)

Student #1 experienced a level of fear and anxiety that students faced when contemplating a statistics course, especially when the content was unfamiliar and difficult to read and process. Therefore, instructors need to create learning environments that are conducive to learning, where students feel comfortable asking questions.

Student #1 had a math phobia and was “terrified” of the statistics course. To be successful, Student #1 needed to devote “full attention” to the course. She described her experience taking the course as stressful, yet she preferred the virtual learning environment because she was easily bored when sitting in the traditional classroom. Student #1 viewed online learning as the modality through which she learned best. While classifying herself as a “slow learner,” Student #1 explained that she did “not get things the first time you say it ... It depends, but [when] it comes to more complex information, I have to do it a second time to really get it.” Student #1 commended her colleagues whose “brain cells” functioned differently from hers. Student #1 doubted her ability to succeed and relied heavily on her instructor for direct instruction and extra assistance in the statistics course.

Student #2 provided a different perspective and additional context about the online learning experience. At the beginning of the course, statistics appeared difficult and she anticipated failing the course. However, she was able to collaborate with her

peers and instructor to discuss and review assignments. By the end of the course, Student #2 was among the top five performers, earning a grade of A- and shared the following:

We were able to express where we were struggling; what was wrong and it was broken down, and the professor telling you what you need to do, the classmates telling you. It just made everything easier; it became a flow, and we even had to work with our classmates, our peers outside of those forums you know, we had projects that we had to work together on; it all became easier so that changed the whole mentality at the beginning so it made it easier.

Whereas Student #2 overcame initial fears and anxieties and performed well in the course, other students struggled for varying reasons and failed the course.

Sub Theme 2b: Workload and Time Management

Some students found the online courses intense and overwhelming because of the required weekly readings and learning activities. One of the respondents to the course evaluation survey commented:

I think that the course was too short to learn so much. There was an overload of work expected for this class in such a short period of time. There was not enough time to complete all of the reading assignments, quizzes, forums, learning activities, journal entries, and etcetera. It did not feel like an online class. It felt more like a statistics boot camp where you were constantly bombarded with work to do. I think too much was squeezed into such a short period of time and the book was not easy to understand.

While some students found the textbook difficult to read and comprehend, others thought it was adequate and provided ample examples and tips to aid the learning process.

Some students questioned the amount of work expected within a given week. The students described how they had to schedule time, oftentimes late at night to finish the learning activities and assignments within stated deadlines. The students wanted more time to read, process, and produce evidence of learning. For example, Student #4 declared, “I couldn’t read three chapters and then be expected to know three chapters in three weeks, doing this online... that was overwhelming.” Student #4 and her colleagues found it easier to work on the weekends; however, the weekly sessions began on Mondays and ended on Sundays. The students had to be very organized because they had to interact with peers in the discussions throughout the week. For example, as Student #4 shared, “you have to post on a Wednesday, sometimes on a Tuesday or a Thursday,” however, some students were not prepared to participate before the weekend because they were still reading.

The students with strong math skills found the workload in the online statistics course reasonable and manageable. To complete the course satisfactorily, the students had to commit time daily to complete assigned tasks. In addition, they had the option to participate in video or phone conferences and Live chats with their instructor and peers. However, as Student #3 mentioned, the scheduling of the optional synchronous session sometimes conflicted with other work or family obligations. Student #3 attributed her success to having “prior math experience, so it was a bit easier to grasp new concepts and get more done in a timely manner.” She empathized with her colleagues who did not have

the same level of math skills and “thinking from their point of view and things they said... [shared that] they felt like it was a bit much.”

The course evaluation results reflected time management as one of the barriers to learning statistics at a distance. Following is a student’s comment about the struggle to stay abreast of the workload and deadlines:

For working parents, too much time is required to be online. It’s almost impossible to keep up with reading, research, and number of exercise required.

Taking online course is more stressful and time consuming than taking the course on campus.

Student #1 justified the importance of planning time around work and family to focus on schoolwork, oftentimes late at night and early in the morning. After putting her children to bed at about 8:30pm, she would relax and “let [her] brain come back together and then by 11pm or 12am, [she was] up fully doing what [she] need[ed] to do” for her courses.

Student #1 found it better to work at night, but was sometimes “on the computer one, four, five, in the morning.” Student #2 also managed to balance working multiple jobs while maintaining a family life and completing coursework for two courses each term.

She found it “very difficult working two jobs 7 days a week...[in addition to being] a mom, a wife, so [she] spent a lot of time late at night doing schoolwork and [during her] lunchtime at work.” Amidst juggling various responsibilities, the students recognized the importance of taking time out for social activities as well.

Student #3 devised a system to allow some time on the weekends to devote to fun activities with her family and friends:

I make sure all the assignments are done and submitted by Thursday, between 11pm and 2am at the most because I remember I would stay up that late to make sure that each class I gave 100% in the assignments for each class. And that would be Monday and Tuesday for one class and Tuesday and Wednesday was for another class and come Thursday, I might make sure that both classes are done completely. Friday I don't look at it all. Saturday morning it is time you know, to look at what the instructor said about whatever I handed in if I need to correct anything and time to start that whole process all over again for the next week.

(Student #3)

From the data collected, I concluded that the online student has to exhibit discipline and set aside enough time to devote to coursework.

Sub Theme 2c: Course Design and Academic Rigor

EFG College's online faculty faced technological and pedagogical learning curve issues, similar to the reported experiences of faculty in other studies (Freeman, 2015; Reilly, Vandehouten, & Gallagher-Lepak, 2012). While reflecting on the online teaching experience, Faculty #2 highlighted some difficulties that online instructors faced, especially faculty who had recently transitioned from teaching in the traditional face-to-face classroom to the virtual classroom. EFG College faculty appeared to have difficulty delivering instruction and activating and assessing learning in the online statistics course. They did not have access to e-tools similar to the chalkboard, for example the interactive whiteboard that would help "to demonstrate calculations in a way that students you can see either in real time or asynchronously." In addition, the faculty had difficulty

differentiating instruction considering students' varying learning styles. Other than scores on tests and assignments, faculty had limited methods of measuring and assessing students' understanding. Faculty #2 queried:

Exactly how are the students getting the concepts, and how are we conveying information back and forth about, you know - What their understanding is and my understanding of their understanding. The challenge for me is on the front end in terms of sharing the content with them and figuring out multiple ways to do that so... that they can grab that; something as simple as learning styles, but also, how to make it understandable for them. We can gauge that in a classroom; it is a little bit harder online, but ... I'm thinking about multiple kinds of questioning techniques so that I can really get a sense of how they understand.

EFG College faculty members could not read body language and without students' questions, it was impossible to see whether a student was puzzled or needed clarification.

Furthermore, the asynchronous nature and 8-week structure of the virtual environment provided limited opportunities for teachable moments and spontaneity. Faculty # 2 acknowledged the limitations of working with a predesigned course template, especially being unable to reteach or "circle back," to revisit concepts where students had difficulty. Faculty also had difficulty trying to inject new information or make changes to the course content or requirements, without possibly dissatisfying students (Faculty #2).

The learning outcomes and core competencies in the online, hybrid, and face-to-face statistics courses were the same as stated in the syllabus. However, whereas face-to-face courses lasted for 16 weeks, online and hybrid courses spanned over an 8-week

period. Some participants believed that students could meet the courses' learning objectives by committing time daily to complete the assigned learning activities:

The online class gives you more time versus you had to go to school two nights a week. So the online course you basically have 7 days to get the work done. You have to report yes maybe for a chat or a forum for at a certain time, but I feel like online give you more time and so that that makes the professor more leisure able for you, that could be a difference I think. (Student #2)

Online students had the opportunity to engage in coursework daily compared to their peers who met in person on two different days for three hours. Faculty #1 agreed that if online students committed time daily to their coursework, they could satisfactorily meet the weekly learning objectives.

While some faculty explored different ways to activate student learning, others acknowledged the difficulties students experienced while trying to navigate the online statistics course:

A lot of students complained ... that in different modules there were so many different delivery methods, it was confusing because sometimes students have an article to read, sometimes they had a video to watch, sometimes they had to just read part of the book, sometimes they had to do this interactive exercise; it was too much. (Faculty #1)

When asked how they differentiated instruction for diverse learners, the two faculty participants acknowledged their inexperience in addressing and accommodating the needs of English language learners, students with disabilities, and gifted students.

Faculty #1's experience in one face-to-face class highlighted the instructors' limited knowledge about how to address the needs of a student with disabilities:

I did have a student, I remember, in my statistics class who ... use to ask a lot of questions in class which I couldn't understand because I had just gone over the material and one minute later, here he is asking questions about what I just said and when I talk to him after class, he actually came to my office hours quite frequently trying to do his best...., I said I understand that I have to give you time an half and a quiet place to work, so do you mind taking the exam in the testing center and you are welcomed to take whatever time, and he said, that is not my disability. He said "the time and a half and the quiet place to work doesn't really help me," you know and he is like, I have more things going on than that. He left it at that, I didn't really pursue it... So I think that dealing with disabilities is a thing, because I don't know the disability that the student have; it is not revealed to me. All I know is ... what I need to provide for accommodations and I completed provide that so it is ... an area I do think I can add any value.

EFG College instructors recognized that their adult learners have different ability levels and learning preferences, but were unsure about how to address all the students' needs. Judging from Faculty #1's account, EFG College faculty may be ill-equipped to address the needs of diverse learners.

As Faculty #2 concluded, instructors "need to get better at ... some ways to make sure that the [online statistics] course is accessible all the way it is supposed to be. So that is another whole other design, development question." Faculty training and development

workshops that focus on how to differentiate instruction within the online course may be the answer to improving the online learning experience at EFG College.

EFG College's faculty may need to explore different ways to motivate and incentivize students in the online statistics course. Faculty #1 pointed out that:

It is very hard to do that online motivation situation because it is all fine and good to send smiley faces and emoticons, which by the way I don't do. I tend to encourage by words. Somehow, reading words in black in white is kind of, it does not have just the same impact; it is not personal; it seems very impersonal.

Additional professional development may be the remedy to making EFG College faculty better prepared to motivate students, implement differentiated learning strategies, and accommodate the needs of diverse learners in online courses. However, Freeman's (2015) findings showed that it could take up to three iterations of teaching an online course for faculty to overcome the pedagogical learning curve.

Theme 3: Student Readiness and Preparation

Understanding the nature of online learning and being mentally prepared to commit the time and effort needed to succeed are important characteristics for distance learners. Judging from comments on EFG College's course evaluation surveys and interview responses, some students were technically and academically ill-prepared for the online statistics course. Student #3 realized that "if you are not tech savvy and if you don't use computers often, you will find statistics online to be difficult." Success in the online statistics course may be directly linked to students' attitude, affect, technical, and academic skills.

Faculty #1 shared a different perspective about marginal performance in online statistics courses, attributing it to “under preparedness” and lack of motivation. While “technology was something for some of them... the other students... didn’t take notes and they didn’t learn” because they were unmotivated and ill-prepared. Faculty #1 also believed that success in the online statistics course was dependent on students having “the proper mindset ... that mindset of motivation.” However, some students, including Student #1 and Student #4, felt that they would have been more successful if they had taken the statistics course in a face-to-face environment.

After engaging in critical dialogue and reflection, three years after completing the online statistics course, Student #4 realized how her level of unpreparedness might have negatively affected her overall performance in one of her first online courses. Yet she believed that if she were to revisit her notes and textbook, she would have a better understanding of the concepts introduced in the online Statistics 1 course:

I think that I have settled down in my *anxiety* [emphasis added] ... I still believe that taking statistics was the wrong class for me to start out with. So when I did, *mentally, I wasn’t prepared*, [emphasis added] ...I was hesitant, because I don’t have time and I don’t know that this is the right time, so I think that I went ahead ... just logged on so that I could check in and then, you know, it started. So I rushed into that not prepared. (Student #4)

Student #4 may have been too hasty in making the decision to enroll into an online course. Furthermore, it appeared as if she could have benefitted from a longer orientation to become familiar with the learning management system.

Sub Theme 3a: Prerequisite Skills

In addition to students being ill-prepared, mentally and technologically, to succeed in online statistics courses, some of them lacked the pre-requisite computational, comprehension, and critical thinking skills:

They need to learn how to look at [symbolic] notation and understand what it means... the idea that sigma means to sum up the following – and seeing that notation over and over again with different variables after the sigma sign and knowing what to do... Secondly, I feel like they lack in calculations in terms of understanding order of operations because some of the statistical formulas have different kinds of operations occurring but the order in which the operations need to occur to reach the final result has to be precise and based on mathematical rules of operations. Something that was learned in basics of math, they cannot follow on the calculator [pause]. Three they need to actually read the text. Oh, the other thing about statistics is that there are several processes that occur to get a final answer. And I think that procedural fluency is something that these students lack. For instance if there is a process with 8 steps, that get you from raw data to a frequency table, to relative frequency, to a histogram, they tend, even if the steps have been told in absolute clear terms and gone over and over again in examples, when the students then go to do problems on their own, they cannot follow the steps one by one all the way to step 8 to get the final answer. (Faculty #)

Some students lacked the “innate confidence” and struggled with basic math operations (Student #4). They were unfamiliar with important mathematical and statistical terminology and had difficulty following simple directions when solving problems.

According to Faculty #2, the students at EFG College needed to demonstrate “a comfort level with calculations, numbers, and math in general.” When asked to specify the necessary prerequisite skills, Faculty #2 responded in the following way:

They need to know the four math operations, because we don't want to take that for granted, and then working with the whole idea of converting, that whole idea of converting among decimals, fractions, and percents. And having a sense of what those things, a little deeper understanding of what fractions are, how fractions and decimals values are essentials and percents are essentially three different ways of expressing the same value... ratios and proportions. Then, you know it is not pre-requisite, but very early we want them to understand what the symbols are, how formulas work so to speak. Ah, things like squares and square roots, all of those kinds of things.

Proficiency in basic math is a critical element to successfully completing the online statistics course.

In addition to the basic math skills, all of the student participants thought that Algebra could also help in their understanding statistical concepts. While reflecting on her formative education and her “love of math,” Student #3 provided the following account that can support the rationale for including algebra as a pre-requisite course for introductory statistics:

Ah definitely algebra, algebra from I believe elementary school or middle school. That is where I discovered that I loved math. Because I remember the class and the year, but my algebra teacher in elementary school was the one who taught us, mean, median and mode for the first time and averages. And all these things, and the whole looking for x in a math problem and n and blank plus blank equals n , find n and why is n that number. (Student #3)

Students #1, #2, and #4 agreed that algebra as a pre-requisite “makes some sense because you have the x and the y in statistics” and it can help with understanding the formulaic equations in statistics (Student #2). Upon learning about the students’ beliefs, Faculty #2 agreed that algebra could help students develop relevant academic language and abstract thinking needed for the statistics course

Faculty #1 did not view algebra as a necessary pre-requisite course for introductory statistics, but provided the following justification as to why students and other faculty might believe differently:

Algebra introduces students to the idea of a variable, where the variable can take on any value. The idea of substituting a number for the variable to see the results of that equation, but beyond that, I don’t think algebra is actually necessary for the statistics that we are teaching, because ah you are not actually solving any specific equations for a variable, in one or two variables or simultaneous equations.

In light of the faculty members and students' identification of areas of deficiencies in terms of the basic math skills, some remediation may be necessary to ensure that students succeed in the introduction to statistics course.

Sub Theme 3b: Remediation

Some of the students enrolled in the online statistics course at EFG College needed to improve mathematical skills while concurrently trying to master the content in the Statistics 1 course. The review of the 2014 course template and faculty interviews confirmed that remediation in the online statistics course took place using Khan Academy videos and Brainfuse--an e-tutoring program. However, faculty and students found that face-to-face tutoring sessions and phone conferences proved more helpful to develop students' prerequisite skills. Some students contacted the instructor when they had difficulty with a concept, whereas, others collaborated with peers. For example, Student #4 decided to consult with a friend after she was unable to reach her instructor.

The students had to take ownership of their own learning. According to Student #3, "to be successful you have to be proactive and you have to be very good at managing your time." Students also need to know how to take advantage of the available academic support. Judging from the results on the course evaluation surveys (Table 1), students were aware of the online tutoring services, but the extent to which they utilized the services is unknown. Both Student #1 and Student #4 were dissatisfied with the quality of the online tutoring services and preferred to seek assistance from faculty and peers. As a result, faculty proved critical to aiding the learning process.

Theme 4: The Role of Faculty in the Online Learning Process

The data collected depicted EFG College faculty as well versed in statistics subject matter. Most of them were available and worked with the students beyond the virtual classroom to ensure success in the introductory statistics course. As Student #4 shared below, the students wanted constructive feedback about how to complete practice exercises, assignments, quizzes, and exams to improve performance moving forward:

So it sounds like I was doing what I was supposed to do, but because I had no one validating what I was doing, I felt like I didn't. I just never felt like [my instructor] would grade something and then it would just be wrong, but didn't tell me what I did wrong. Or telling me how to fix so that I wouldn't make that mistake twice; that's what I mean *presence*, [emphasis added] so when you just give out a grade ... If you don't say what the issue is I don't know so I can determine if ... it's wrong, but if you are not figuring out or explaining what was wrong. If I don't follow-up to find out what is wrong I blame you as much as I blame myself. I blame myself too then. What I will typically do is go to someone else. (Student #4)

The students identified instructor presence and validation as critical factors to overcoming some of the barriers to learning, motivation, and success in online statistics courses at EFG College.

The students wanted instructors to interact with them in the discussion forums. Student #4 explained how beneficial instructor participation was to reducing her feeling distracted, disconnected, or isolated in the online learning environment. For example,

“when students say something, then the teacher adds... ‘Look at it this way or think about...’ those kinds of comments... help tremendously” to make the online experience meaningful (Student #4). Student #4 welcomed the instructor’s comments, probing questions and feedback, especially when faculty prompted her and her classmates to take a different perspective.

Instructors need to be “knowledgeable and passionate ... someone who knows and understands what they are doing” (Student #4). When asked to provide some characteristics of effective online faculty, Student #2 stated:

The online faculty member has to have some kind of understanding that there are going to be struggles, based on not enough time set aside for certain topics, or understand maybe that the online learning is new for some people, and to have a little patience. See, my professor was not, didn’t make it like they wanted me to fail, you know, it was, ‘you are having trouble here, well I am going to come on at 9 o’clock and we are going to have this conversation and we are going to talk.’

The professor was available for you to have questions...so you have to have a professor who cares and understands that there [are] going to be barriers in the way and so, that, I think makes an online professor good.

Student #4 believed that her online statistics course experience might have been better if the teacher had been present in the virtual classroom.

Although Students #1 and #4 had the same instructor, their learning experiences were different. Student #1 interacted with the instructor and benefitted from one-on-one conferences, whereas, Student #4 described the faculty member as an “absentee

professor.” One student was proactive and reached out to the instructor, while the other expected the instructor to be more visible and reach out to the students who were faltering. It is possible that the teacher in this case was oblivious to the students’ diverse needs and therefore was unable to accommodate them. As a result, it is important to explore and understand the role that faculty play in online courses.

The teacher’s role is to facilitate the online learning process, but the student constructs meaning and demonstrates his or her understanding while working independently or collaboratively with peers:

The instructor is there to help guide you through, but they have 10% to do with your success rate... It is not the instructor at all. They are just there to guide you through it, and give you the materials, help you understand it, make sure you understand it. But the retention part, the application part, that is all the student and the application leads to the success of that class. Because if the student is unable to apply what the instructor has drilled into their heads, yeah why are we here?

The instructors are the mode ..., the instructors are there to get the students to where they need to be, but it is the students that need to take that leap, not the instructors... everything about self-directed learning has to be done by the individuals themselves. For instance, an instructor cannot tell an adult learner how to structure their lives to get assignments done because the instructor is not living that individual’s life. (Student #3)

Student #3 recognized that teachers are critical to the online learning process. Yet, she acknowledged that learning occurred in the online statistics course when students were self-directed and demonstrated conceptual understanding through application.

Students need to take ownership of their own learning experience, recognizing that learning in a distance format requires them to be self-directed. Faculty facilitate the learning experience in an asynchronous environment by participating within discussion forums, providing feedback, and sharing relevant resources. Although some faculty may continue to provide direct instruction during synchronous sessions, as Faculty #1 posited below, a faculty member's level of commitment to teaching is driven by their motivation and teaching philosophy. Furthermore, the learning happens when students actively participate in the course and work with the instructor. Faculty #1 also described the frustrations that faculty deal with when students fail to engage and complete online course activities:

There is only so much that we as instructors can do... I think it really depends on the motivation of the instructor involved... Yeah I think an instructor has to put a lot of personal judgement aside. Because, when I see a student who is not doing work and I am spending a lot of time ... I am kind of fed up and frustrated too. I have to sort of put my – 'this guy is never going to do this or do that; he is going to fail the class.' I have to put all that personal judgement aside and just keep pushing... [however] I can only push so far. If this other person doesn't engage, the whole saying you can lead the horse to water, but you can't make the horse drink the water, so I think so you as an instructor, I can only push so far, it is still

up to the person, it is *always* [emphasis added] up to the person. Always no matter what I do or say, it is up to the person if they are going to let me in to help or not. That's the way we are as human beings as well, teacher relationship and all. Someone wants to help me and I don't want it, I am not going to take it. That is not a student to teacher relationship that is a human relationship. Yeah, so I mean there is nothing that I think that an instructor can do, you know unless we have some powerful mind control tricks. (Laughing) I don't. (Faculty #1)

Although the instructor may use different instructional strategies to motivate and engage students in learning, there is no guarantee that learning will take place. EFG College's faculty shared anecdotes about students who struggled with the statistics course content and did not successfully complete the course, even after receiving academic supports.

Sub Theme 4a: Presence and Visibility

The instructor's availability and presence were very important to student success in the online statistics course at EFG College. When instructors developed student centered learning communities, students participated in "a climate of high-level dialogue and critical thinking" (Lehman & Conceicao, 2010, p. 4). Furthermore, as Student #4 indicated below, the teacher's presence helped to reduce the sense of isolation and disconnect that students experience in the online learning environment:

Just to know that your professor maybe every day or every other day or every... if you say 'I am always checking on Tuesdays if you need me just shoot me an email here or leave me a voicemail here'... But what happens if you don't have a professor that is out there? You feel disconnected, you know, like you were

always out there. So even when I wasn't looking for a question from [the instructor], what always was helpful was that [the instructors] were responding to other people. So what helped teach the class was the discussions. Then you could see the comparisons with the students and sometimes the students would go off on separate chats and kind of discussed the lesson ... All of those things just enhanced the online experience ... I am this type of person who needs to know that I am not sitting behind this computer all alone. (Student #4)

Student #2 and Student #3 were more fortunate than their peers were, because they had instructors who actively participated in online statistics course discussions. Their instructors provided constant feedback and were very responsive to emails and requests for clarification. However, as Student #3 outlined, due to the asynchronous nature of the course, responses from instructors and peers were not always immediate and students sometimes had to wait a day or more for answers to queries:

If I had questions, if I got stumped or if I could not figure it on my own, I did not have the instructor there readily to help me with the problem. I had to wait until [they were] available or sent a question via email, or wait until the next time; we had regular chats online and ah things like that. So I would have to wait until I could speak to the instructor to get that problem solved which obviously ah cannot always work if I am working on, you know, on convenience, especially if I am learning at my own pace. At times that are only convenient for me, now I have to think about the whole class or the instructors schedule and wait for that time or

inconvenience myself to join the online chat meeting in order to get that problem solved. (Student #3)

As other students commented in the course evaluation surveys, “[the instructor] could have more a presence online” to reduce students’ feeling as if the online statistics course was an “independent study.”

The faculty also discussed the time commitment of teaching online versus on campus, specifically the misconceived expectation of being available to field questions and interact with students all hours of the day. Faculty #1 recognized the importance of maintaining a regular presence in the online course especially for students in need of remediation:

If you’ve got underprepared students taking online classes, then I, as an instructor, have to do a lot of explanations. And so I have a lot of typing to do because sometimes when students have questions about how to do a specific procedure, if they haven’t read the material or [are] not interested ... they generally post a question to the instructor. That becomes cumbersome and tedious for an instructor because if you are sitting in a face-to-face environment it’s very easy to talk things through and have a piece of paper and just write things and have that absolute present connection. (Faculty #1)

EFG College faculty had difficulty establishing and maintaining a social and teaching presence in the online statistics course. Furthermore, the perceived absence of the instructor negatively influenced some students’ participation and overall performance in the course. Since creating a community of inquiry is important to online student success,

EFG College faculty may benefit from additional training about how to provide constructive feedback and academic support while establishing and maintaining a teaching presence at a distance (Guasch, Alvarez, & Espasa, 2010; Harrell, 2008; Kozuh et al., 2015).

Sub Theme 4b: Feedback and support

Feedback and academic support are important to student success in online courses at EFG College. The student participants highlighted different types of faculty feedback and support forms. Student #1 thought highly of instructors' "getting back to you and making time to call you to go over any problems or situations you had, when you really don't know what is going on. They were there to fill in information" (Student #1).

Student #4 appreciated instructors who provided "some type of dialogue, feedback on the papers or during the conference calls or ... discussion boards." She found the feedback helpful because it provided a different perspective about the topic. She "knew how [the instructor] felt about the topic, and [whether the instructor] disagreed or didn't" (Student #4).

The students wanted instructors to provide clear directions and detailed feedback. Following are two related comments from the course evaluation surveys.

1. I would have like for [the instructor] to provide feedback and/or direction on what I was doing that could and should have been done better. Just grading the work with feedback didn't help me resolve any issues especially since I was uncomfortable with the subject. I also ask[ed] if I could switch to campus to take this course because I needed to hear and get live feedback and hear

strategies that would be beneficial. I think I could have done much better on campus.

2. I think more of an explanation maybe through video from the professor may have been helpful. I felt as if we were given a book and a computer and we were sent on our way to learn these concepts on our own.

Theme 5: Recommendations for Improving Online Statistics Courses

EFG College's course evaluation and interview data showed that students and faculty recognized the need to improve the online statistics course. Recommendations made were mainly about the course design, structure, and delivery of the online course. The students wanted the content chunked and "broken down" with "step by step" directions and explanations for word problems. Student #2 wanted "it detailed enough where you could understand every single step; the problems from start to finish, what you need to do, [and] how to get that step." Faculty #2 thought that additional e-tools would help to activate learning in the online statistics course. Then, faculty would be able to convey concepts, assess understanding and "teach in a step by step fashion and students [would be able] to display what they know in a step by step fashion." The instructional designer would therefore need to sequence the content and build in the necessary scaffolds to support the learning process.

Sub Theme 5a: Learning Activities and Assessments

The layout of EFG College's online statistics course content was not organized in a manageable way. Faculty and students questioned the amount of content presented in the online course shell. According to Faculty #1, there were "so many things that the

student has to do in a week's module, it gets overwhelming" (Faculty #1). Students were expected to read assigned text, watch videos, participate in discussion forums, and complete multiple learning activities including practice exercises, journals, formative (quizzes) and summative assessments (exams).

Whereas Faculty #2 and the student participants saw the value of discussions in the online statistics course, Faculty #1 questioned their usefulness to understanding statistical concepts and applications. Based on the interview data, the discussions helped the students to demonstrate their understanding about the concepts. The students had a better understanding when reading articles from the business media that included statistical information. Furthermore, discussions provided the students with opportunities to interact with each other and the instructor. My review of the 2014 online course template showed that weekly discussions also prompted the students to reflect on their problem solving process.

The students thought that case studies and projects were effective assessments to measure learning in the online statistics course. However, Faculty #1 shared a differing opinion, about the best way to assess learning in the statistics course:

I don't know if project based assignments, makes sense for something like an analytical course like statistics. I think for statistics, you have to practice on your own and experience it on your own in order to do it. I think an exam may be the best way to assess learning.

Despite the faculty's views about project-based learning, some students credited their passing the statistics course, to having opportunities to collaborate with a peer on a culminating project.

Sub Theme 5b: Design and Delivery

Another area of improvement was what Student #3 identified as the “weekly unraveling of new assignments.” The online statistics course structure allowed for the introduction of new content weekly. It appeared as if the focus was covering content within set deadlines rather than conceptual understanding and mastery learning:

It felt like as long as the instructor can say they covered 19 of the 20 chapters in the book then they have done their work. That is not a very good way to learn, because if the students barely made it through 7 chapters, but they can tell you what they learned 20 years from now, I think it is better than if the student learns 19 chapters and the instant they drop their pen on the final exam, they are done with that class and cannot tell you one thing from that class... I just think if you are trying to teach a student to understand something, make sure that they really understand it before you jam something else down their throat. (Student #3)

Student #3 recommended scaffolding the content to aid the learning process. Rather than covering chapters in a sequential fashion, she suggested introducing related topics at the same time. For example, one student stated, “if I need to know what do in Chapter 2 to be able to solve Chapter 9, then teach me Chapters 2 and 9 at the same time” (Student #3)

Conclusion

Determining the root cause of marginal student performance at EFG College required a closer examination and analysis of the institutionally generated reports. The course evaluation results along with the faculty and students' interview data highlighted the following barriers to teaching and learning statistics in a distance format: (a) students' math phobia, (b) fixed mindsets, (c) limited pre-requisite skills, (d) poor time management, and (e) ineffective teaching practice. A major finding, which complemented other studies about online learning, was that instructor feedback and support were critical to students' performing well in the online statistics course (Hosler & Arend, 2012; Shotwell & Apigian, 2015).

While some EFG College's faculty members demonstrated patience and flexibility while facilitating the online statistics course, others were not as responsive to addressing students' needs. Student #1 expressed "that is frustrating because there are certain teachers [who] are not engaging the students; they take forever, they don't want to break stuff down." Student #4 expressed a similar experience and attributed the lack of teaching presence to her marginal performance in the introductory statistics course. EFG College's students recognized the asynchronous and self-directed nature of online learning environments and respected their instructors' time, but they wanted immediate access to the instructor when there was a problem.

EFG College's students wanted knowledgeable and experienced faculty who could establish presence and build a learning community in the virtual classroom. The instructor had to be able to create an online environment conducive to student learning. In

addition to serving as the subject matter expert, online faculty had to facilitate learning activities, share additional resources, assess student work, and provide constructive feedback within the learning management system. The students wanted their online faculty to be empathetic and accommodating of their varying needs. The students expected instructors to exhibit patience, good communication skills (verbal and written), and resourcefulness. They expected faculty to find time to provide “other means of help and resources, like the Khan Academy website or YouTube videos” (Student #3).

Student and faculty feedback ignited the need to explore whether students’ marginal performance in statistics courses stemmed from the curriculum, the mode of instructional delivery, the students’ aptitude, attitude, affect, or the instructors’ teaching style. Based on my study’s findings, in addition to fear, anxiety, and math phobia, some students also felt a sense of isolation and disconnect and described the online statistics course as stressful and confusing. A related comment on the course evaluation surveys read as follows, “I was constantly confused in this class and it was a lot for me to try to catch up.” The confusion, disconnect, fears, and anxieties had a negative effect on the students’ overall academic performance. Ensuring student success and acceptable performance in online statistics courses require faculty who are well versed in online course design and delivery methods.

Project Implications

In light of the study’s findings and the participants’ recommendations, faculty members at EFG College can benefit from additional training to ensure that students access and master the content in the online statistics courses. Therefore, I designed a

professional development project to explore ways in which instructors can reduce their pedagogical learning curve and increase social presence in the online learning environment (Freeman, 2015; Horzum, 2013; Kozuh, et al., 2015; Picciano, 2002; Pollard, Minor, & Swanson, 2014; Tyrell, n.d.). EFG College faculty can learn how to differentiate instruction for diverse learners in online statistics courses (Lombardi, Murray, & Gerdes, 2011; Mills, 2015). They also have an opportunity to review and become familiar with the American Statistical Association's Guidelines for Assessment and Instruction in Statistics Education (Aliaga et al., 2012). The long-term goal of the professional development initiative is to improve curriculum design, teaching practice, and academic performance in online statistics courses at EFG College.

Summary

The purpose of this qualitative case study was threefold: (a) to examine faculty's and students' perspectives about online statistics curriculum design and delivery methods at EFG College; (b) explore the barriers to meeting learning objectives of online statistics courses at EFG College; and (c) document the ways of creating inclusive, accessible, culturally relevant, and developmentally appropriate online learning environments. Following IRB approval, I collected, analyzed, and interpreted data from multiple sources, including archival documents, artifacts from the learning management system, and interviews with four students and two faculty members. All electronic data have been stored in a password-protected computer to protect the rights of the participants and maintain the research site's confidentiality. A sampling of the interview transcripts and researcher notes are included in the Appendices.

In addition to triangulating the data, I used member checking to reduce the possibility of validity threats. An inductive and interpretive coding approach led to the emergence of the following five thematic categories: (a) measuring and assessing student learning online, (b) challenges of learning statistics online, (c) student readiness and preparation, (d) the role of faculty in the online learning process, and (e) recommendations for improving online statistics courses. The study's findings prompted the professional development project described in Section 3. In Section 4, I share my reflections, lessons learned, recommendations, and implications for future research.

Section 3: The Project

Introduction

Quality online courses are possible when faculty have adequate knowledge and skills in pedagogy, course design, content presentation, and technology to enhance the students' learning process (Reilly et al., 2012). The purpose of this qualitative project study was threefold: (a) to examine faculty's and students' perspectives about online statistics curriculum design and delivery methods at EFG College; (b) to explore the barriers to meeting learning objectives of online statistics courses at EFG College; and (c) to document the ways of creating inclusive, accessible, culturally relevant, and developmentally appropriate online learning environments. The findings validated the faculty's concerns about marginal performance in the online statistics course and highlighted a gap in teaching practice.

The data collected from end of semester course evaluations and interviews with students and faculty highlighted some of the barriers to teaching and learning statistics at a distance. The grade distribution data confirmed that academic performance in online statistics courses was unstable between 2011 and 2014 with a failure rate fluctuating between 21% and 45%. Yet, of the 128 students who completed the hybrid Statistic 1 course between 2013 and 2014, 10% of students failed, in comparison to 24% of the 46 students in the online Statistics 1 course for the corresponding period (See Table 3 and Table 4).

A common premise across the course evaluations, interviews, and course review data was the importance of faculty-student relationship in the online learning process.

The students wanted faculty to be knowledgeable about the course content and available to provide clarity about the concepts. Students wanted clear, sequential directions and accessible course materials. Furthermore, to reduce the sense of isolation and disconnect that is sometimes prevalent in virtual classrooms, they wanted faculty with whom they could connect and consult when needed. However, the two faculty members who participated in my research study felt ill-equipped to address their learners' academic needs, specifically students with language deficiencies and students of varying ability levels.

Based on the performance indicators and feedback presented, EFG College students could benefit from a differentiated learning approach and an accessible learning environment. Students should be able to access the online course content in different ways, for example, text, audio, and video. Furthermore, they should have different opportunities to demonstrate conceptual understanding, for example, discussions and project-based assignments. Instructors at EFG College need to create learning environments that are conducive to meeting the needs of a diverse student body. To accommodate different ability levels, language differences, and learning styles, faculty have to be flexible when facilitating learning experiences. If the instructors adopt a universal approach to teaching and learning, they can provide students with equal access to instruction through multiple means of representation, multiple means of action and expression, and multiple means of engagement (Meyer, Rose, & Gordon, 2014).

To affect change in teaching practice and improve student performance in the online statistics course, instructors at EFG College need additional pedagogical and

technological training. If they learn how to use a variety of e-tools and apply differentiated instructional strategies, they may be able to enhance their students' learning experience. Therefore, I recommend professional development in the form of a series of webinars geared (a) to promote critical reflection, meaningful discourse, and collegial learning among statistics educators, (b) to address the barriers to teaching and learning statistics at a distance, and (c) to encourage the use of effective pedagogical practices to activate student learning.

Following is a professional development plan supported by relevant literature to justify my recommendation of a webinar series as the culminating project of my research study. I provide a description, rationale, and expected outcomes of my planned approach. I present the project's implementation strategy that highlights the required resources, supports, timetable, anticipated challenges, means of evaluation, and implications for social change.

Description and Goals

Professional development opportunities are prevalent in this age of educational reform and school administrators, policy makers, and researchers are exploring professional development as a means of improving the quality of instruction and student learning (Koellner & Jacobs, 2015; McQuiggan, 2012). Recent research shows that high-quality professional development stimulates reflection, active participation, and collaboration (Amundsen & Wilson, 2012; Cox, 2011; Fredrick, 2011; Grant, 2009; Macdonald & Ponistowska, 2011; National Research Center for Career and Technical Education, 2010; Reilly et al., 2012; Zoumenou et al., 2015). The planned professional

development will give faculty opportunities to reflect and engage in meaningful discourse about teaching statistics in an online learning environment. I plan to facilitate a series of five interconnected webinars to provide online faculty at EFG College with additional tools and strategies that may help to improve academic performance in online statistics courses.

The content of the webinar is grounded in Mezirow's (2009) theory of transformative learning and Knowles's (1975) approach to adult learning. The expected outcome is that faculty will make modifications to their teaching practice with a long-term goal of improving students' performance in the online introductory statistics course. The webinar series will highlight the following topics: (a) a synopsis of the study's findings, (b) the GAISE, (c) strategies to address diverse learning needs in the virtual classroom, (d) techniques to establish presence and improve faculty-student relationships, and (e) approaches to designing culturally and developmentally appropriate learning environments (see Appendix A).

Webinar 1: Statistics Education: The Standards

Amundsen and Wilson (2012) posited that curriculum design and instructional methods are informed by "in depth knowledge of [the] discipline" of study (p. 105). Therefore, prior to sharing my research findings and recommendations with faculty at EFG College, I want to ensure they are aware of the status of reform initiatives in statistics education. They will learn about the history and evolution of the introductory statistics course, which was initially intended "to help students to learn the basic elements of statistical thinking" (Aliaga et al., 2012, p. 8). I also plan to share the recent progress

report from the ASA workgroup, commissioned in 2014 to revise the GAISE report and make it “applicable to modern-day teachers of introductory statistics courses” (CAUSE, personal communication, June 29, 2015).

The webinar attendees will review, discuss, and critically analyze EFG College’s Statistics 1 curriculum. They will determine whether the course objectives, learning activities, assessment, and teaching methodology align to the six recommendations outlined in *The College Report: Guidelines for Instruction and Assessment in Statistics Education* (Aliaga et al., 2012). As a follow-up activity after the webinar, EFG College faculty will examine the online course activities, assignments, and assessments in the learning management system to determine how the students’ work would reflect statistical thinking. To prepare for the second webinar in the series, the statistics course instructors will read the complete *GAISE College Report* and jot down questions for further discussion.

Webinar 2: The Case Study

Armed with the knowledge about the statistics reform movement and an understanding about the ASA standards for introductory statistics courses, EFG College faculty will have a new frame of reference through which to examine my study’s findings. The second webinar will assume a reflection focus because “transformation in thinking or in conceptions of teaching and learning is a necessary pre or corequisite step to changes in teaching practice” (Amundsen & Wilson, 2012). Prior to sharing my study’s findings, I will ask the online instructors to review and reflect on individual course evaluation data from their most recent online statistics courses. I expect instructors

to work collaboratively to interpret and draw conclusions about the level of their students' performance in the introductory statistics course. The instructors will use personal reflective journals to document their observations and views about teaching and learning experiences and make comparisons between their teaching experience and that of their peers. The webinar attendees will also have an opportunity to review and make comparisons to the aggregate grade distribution and outcomes assessment data.

Webinar 3: The “Underprepared” Student

In addition to learning about performance indicators in online statistics courses in Webinar 2, the faculty will identify barriers to teaching and learning in the online statistics course. In preparation for Webinar 3, instructors will find and read articles about adult learning theory, creating developmentally appropriate teaching environments, creating accessible learning environments, creating a community of practice, and establishing presence in online courses. After reviewing the demographic makeup of the student body of distance learners at EFG College, the webinar attendees will learn to identify characteristics of emergent bilinguals, students with disabilities, gifted students, and adult learners. Furthermore, the online faculty will learn about strategies and techniques to overcome barriers to teaching and learning at a distance. I will demonstrate how to differentiate instruction and address cultural and developmental differences within the online classroom.

Webinar 4: The Faculty-Student Relationship

By Webinar 4, EFG College faculty should have a contextual framework upon which to begin improving the teaching and learning experience in the online statistics

course. The webinar attendees will learn how to build a professional learning community and establish presence within the virtual classroom. Based on the findings of my study and prior studies, immediacy and faculty presence promoted students' affective learning, cognition, and motivation (Baker, 2010; Picciano, 2002; Ward, Peters, & Shelly, 2010). Therefore, after sharing some anecdotes about students' experiences in online statistics courses at EFG College, I will ask those in attendance to reflect on past online teaching experiences and identify how they maintain visibility within the virtual classroom. Then I will introduce the community of inquiry model and discuss ways that faculty can establish social, cognitive, and teaching presence within the online statistics course (Garrison, Anderson, & Archer, 2000). Faculty at EFG College will get an opportunity to practice using e-tools to establish online presence, to support learners, and to provide quick and effective feedback.

Webinar 5: The Online Curriculum Design: Statistics I

By Webinar 5, the attendees should be well prepared to revisit the online course design and explore methods to improve the teaching and learning experience. The final webinar in the series will assume a method focus (Amundsen & Wilson, 2012) and introduce instructors at the research site to the federal regulations governing the accessibility requirements for distance teaching and learning. The faculty attendees will review and discuss the Quality Matters Rubric, the three UDL principles, and the nine principles of universal design for instruction. Additionally, faculty will have an opportunity to determine whether the course materials, media, learning activities, assignments, and assessments align to the learning objectives in the online statistics

course. EFG faculty can share the data they collected with the school's academic administrators and make recommendations to improve the online statistics course. Moving forward, they can also collaborate with the college's instructional designers to make the necessary improvements to the course templates in the learning management system.

Rationale

Training that is research based and practical will allow EFG College faculty to examine and transform their philosophical beliefs about the teaching and learning process (McQuiggan, 2007, 2012). Faculty will have the opportunity to reflect, collaborate, and discuss challenges they experienced while facilitating the online statistics course. Before EFG College's faculty can evaluate and make changes to the curriculum, online course design, and their teaching practice, they have to know more about national statistics education standards and expected outcomes. Understanding the adult learning process and exploring opportunities to address varying learning needs could create inclusive learning communities where students do not feel isolated. An inclusive environment can promote self-direction, while allowing learners to feel the faculty's presence and support. Faculty at EFG College also needs to understand the approaches students use to solve word problems in statistics courses (Kenti, 2014; Mills, 2015).

The current study's findings showed that marginal performance in online statistics course is due to a number of different factors related to student affect, attitudes, and student readiness to learn. Students often have doubts about their abilities to learn statistics and faculty need to know how to reduce students' anxieties, fears, and other

barriers to learning statistics at a distance (Gundlach, 2015). However, as in the case with two of the student participants, if the faculty members are unavailable and fail to establish a social, cognitive, and teaching presence in the online course, academic performance suffers.

When interviewed, the faculty participants admitted to experiencing a learning curve while transitioning from face-to-face teaching to online facilitation. In addition to learning more about e-tools to present the content and solve word problems in the statistics course, the faculty wanted to explore teaching strategies that would allow them reach diverse learners. The study's participants admitted to knowing little about how to address the learning needs of students with disabilities and English language learners.

The participants wanted to learn how to scaffold or chunk content and differentiate instruction (Baghdadi, 2011). Faculty who teach the online statistics course at EFG College have pedagogical deficits that can be addressed through their participation in a well-designed professional development program (Kennedy, 2014). An adaptive model of faculty development can equip instructors with strategies and skills to deliver instruction that has the potential to foster student learning (Elliott, Rhoades, Jackson, & Mandernach, 2015; Marra et al., 2011).

Kenti (2014) recommended professional development that follows the purposeful pedagogy instructional model. Faculty should have the opportunity to collaborate and plan instruction based on students' computational thinking and the approaches students use to solve problems in math and statistics (Czerkowski & Lyman, 2015). The goal is to

teach for understanding as prescribed by the common core standards, the GAISE, & ASA curriculum guidelines (Kenti, 2014).

Reilly et al. (2012) described different methods of presenting professional development, including workshops, seminar series, short courses, and webinars. Since most of faculty members who teach the statistics course online at EFG College are part time adjuncts, web-based professional development workshops would be a feasible way to disseminate important information. The planned webinar series could be a cost effective and creative means of allowing faculty time to interact virtually with each other as they explore different approaches to improve students' performance in online statistics courses (Baghadadi, 2011; Gregory & Salmon, 2013; Tyrell, n.d.). A webinar series would accommodate adjunct faculty who may be unable to attend trainings on a given day and time because they will be able to access the recording at a more convenient time.

Review of the Literature

The project literature review provided additional context about approaches to faculty development and perspectives about teaching and learning statistics at a distance. I used Google Scholar and Walden's library databases to conduct a Boolean search of the following terms: *communities of practice*, *community of inquiry*, *collegial learning*, *faculty development*, *professional development*, *professional learning communities*, *social presence*, *statistics education*, *online learning*, and *webinar*. In addition, I explored the International Association of Statistical Education website for recent literature on statistics education. I found articles about faculty development, online teaching and learning, and statistics education in the *Journal of Asynchronous Learning Networks*,

Journal of Online Learning & Teaching, Journal of Statistics Education, The Online Journal of Distance Learning Administration, and the Statistics Education Research Journal.

Effective professional development in education requires faculty to engage in authentic project-based activities that relate to their discipline and teaching modality (Koellner & Jacobs, 2015). For instance, the continual focus on improving students' capabilities in science, technology, engineering, and mathematics (STEM) education has resulted in more opportunities for professional development for teachers (Marra et al., 2011). Unlike the typical facilitator centered workshops and seminars, professional development should be innovative, engaging, relevant, practical, and learner centered (Cook & Steinert, 2013; Dabner, Davis, & Zaka, 2012; Kenti 2014). Furthermore, increasing technological innovations have resulted in more online and blended approaches to teaching and professional development, such as web conferences or webinars (Dabner et al., 2012).

Professional development can no longer focus solely on teaching theory or emerging technologies, but must relate to the teachers' context, especially if they teach online (Dabner et al., 2012; Gregory & Salmon, 2013). Despite the varying foci and structures of professional development for educators, the long-term goal is the same. Faculty development should enhance teacher knowledge, improve instructional practices, and increase student knowledge (Koellner & Jacobs, 2015).

The influx of online programs in postsecondary institutions necessitates a shift from teacher-directed to self-directed learning experiences. In higher education, the

instructors are content experts in their respective disciplines, who oftentimes lack formal teacher training. Therefore, they tend to model their teaching practice after teachers from their high school and/or college experiences (McQuiggan, 2012). Consequently, they need to learn new ways of engaging students in the learning process. Based on the faculty interviews, most of the instructors who teach statistics in an online or hybrid format at EFG College fall into the above-mentioned category. Therefore, authentic, pedagogically focused training and development, grounded in adult learning theory can be beneficial to their professional growth.

Characteristics of Professional Development

Researchers characterize and evaluate professional development in different ways. Marra et al. (2011) classified professional development orientations as activity driven, content-driven, curriculum materials-driven, needs driven, and needs pedagogy-driven. The different professional development orientations and characteristics represent frameworks upon which to design and implement professional development. For example, faculty training can emphasize hands-on activities, discipline specific content, model instructional strategies, unit and lesson planning, or teacher networking (Marra et al., 2011). Alternatively, Koellner and Jacobs (2015) prescribed that professional development focus on content (instructional practices to provoke students' thinking and learning), process (collaboration and active participation), and structure (professional learning communities). Elliott et al. (2015) categorized the different types of professional development under two themes: format (mode of presentation) and focus (content of presentation).

Professional development designs can be also theoretical, applied, or institutional in nature (Elliott et al., 2015). Effective professional development is a balance between theory and practice, allowing faculty members to explore trends in education, understand how students learn, and understand how to create developmentally appropriate and culturally relevant learning experiences (Marra et al., 2011; Meyer & Murrell, 2014). Professional development has to be ongoing and geared to fill the gaps left by the typical “one size fits all” approach to online faculty orientation, where training typically focus on technology and course design than on pedagogy and course delivery (Baran & Correia, 2011; McQuiggan, 2012). In addition to learning how to deliver instruction online, instructors also need to understand why certain strategies may be effective in the virtual learning environment compared to the face-to-face classroom. Furthermore, administrators and faculty developers should differentiate and customize professional development to target and address the diverse needs and learning styles of online faculty (Baran & Correia, 2011; Elliott et al., 2015).

McQuiggan (2012) recommended a model of professional development informed by Mezirow’s (1997) transformative learning theory and adult learning theory (Cranton, 1994; Knowles, 1975; Merriam et al., 2007). The overarching goal of McQuiggan’s model of professional development was to shift instructors’ perspectives about the online teaching and learning process. Recognizing faculty as adult learners with diverse needs is an important consideration when designing transformational professional development (McQuiggan, 2012; Meyer & Murrell, 2014). While accounting for instructors’ prior knowledge, experiences, and uniqueness, the training should include opportunities for

faculty to engage in critical reflection and discourse (Gallego, 2014; Mills, 2015).

Additionally, opportunities should exist for faculty to discuss successes and challenges experienced while teaching. Collaborating with colleagues as part of a community of practice allows valuable time for faculty to interact, explore different perspectives, and question assumptions and beliefs about online education, as well as receive support and constructive feedback (Earley & Porritt, 2014; Fulton & Britton, 2011; Kennedy, 2014).

Alternatively, Amundsen and Wilson (2012) developed a broader framework of professional development with an emphasis on outcomes and processes. They posited that following training, faculty should be able to apply new skills and techniques to their teaching practice as evident by improved student performance. Moreover, if given the opportunity to reflect, collaborate, and engage in discussion, action research, or inquiry, faculty should experience a paradigm shift in their thinking about the teaching and learning process (Baran & Correia, 2013).

Research showed that adaptive models of mathematics professional development increased teachers' knowledge and classroom practice, especially when the design is relevant to the participants' teaching practice (Koellner & Jacobs, 2015). For example, teachers who participated in a problem-solving cycle model of professional development appeared more knowledgeable about how to teach math and were able to improve their practice and (Koellner & Jacobs, 2015). Following training, the instructors took more time to listen to their students and were able to make modifications to math instruction and support the students' learning process. The training involved a series of related workshops that allowed teachers to work together to solve math problems. The teachers

reflected on their understanding of the problems and the strategies used to develop students' analytical and critical thinking skills (Koellner & Jacobs, 2015).

Despite the varying models, faculty development for online educators typically focuses on technology, pedagogy, or course content with the long-term goal of increasing students' academic performance (McQuiggan, 2007). The assumption is that faculty development results in effective teaching, which leads to student learning as reflected by high grades and academic performance. However, there is no guarantee that a balanced and cohesive designed professional development workshop will improve teaching practice and student learning (Amundsen & Wilson, 2012). Additional empirical evidence can help researchers assess and draw valid conclusions about the relationship between faculty development and increased student achievement (Koellner & Jacobs, 2015; Rutz, Condon, Iverson, Manduca, & Willett, 2012).

The Webinar Approach

During this era of educational reform and technological advances, recruiting and training competent faculty is a fundamental strategy to foster student learning and sustain distance education programs (Al-Salman, 2011; McQuiggan, 2007; Reilly et al., 2012). Accordingly, higher education professionals have to seek out professional development opportunities, for example, they can subscribe to discipline specific journals, attend and present at conferences on statistics education, and participate in professional learning communities. Other faculty development modalities include seminar series, short-courses, workshops, and webinars (Cook & Steinert, 2013; Cox, 2011; Reilly, 2012). I

opted to design a webinar series to share my findings and provide additional pedagogical training for faculty who teach statistics online at EFG College.

When interviewed, faculty participants admitted to holding face-to-face tutoring and remediation sessions with online students. Conversely, they wanted to learn more about virtual meeting software, specifically digital tools such as the whiteboard feature that could allow them to demonstrate problem-solving techniques. Students wanted faculty who would provide examples and detailed directions about how to solve statistical problems. Students wanted faculty to “break down” the concepts and provide examples of the steps taken to solve statistical problems (Kapp & Wingate, 2012; Student #1). More importantly, students wanted faculty to engage with them within the online learning environment in real time. However, the learning management system only allowed for instant messaging, which was better suited for sending quick messages.

The growth in distance educational programs has prompted institutions such as EFG College to adopt conferencing and webinar software. However, instructors are not all versed on how to utilize the different tools to connect with students synchronously. To participate in virtual training, instructors need video and audio conferencing tools that would allow them to connect with students, field questions, complete worked examples, and increase social and teaching presence in their online statistics courses (Garrison et al., 2000; Horzum, 2013; Kapp & Wingate, 2012; Mills, 2015; Zoumenou et al., 2015). Although the college leaders use digital software for virtual meetings, faculty developers have yet to use the e-tools to deliver faculty development webinars.

Webinars are online workshops or web conferences with the capability of reaching a wide audience in real time using Internet software and sometimes a telephone connection (Frederick, 2011; Kapp & Wingate, 2012; Zoumenou et al., 2015). Webinars present convenient and affordable opportunities to communicate, share, discuss, and simulate face-to-face classroom experiences, for example, using the chalkboard to display calculations in math and statistics (Frederick, 2011). Webinar software such as Google Hangouts, Zoom Video Conferencing, Blackboard Collaborate, and Adobe Connect typically feature two-way audio, video, whiteboards, breakout groups, polling, instant messaging functionalities, and methods of sharing files. The webinar software allows administrators, faculty, and students to use digital tools to interact, write, draw, share spreadsheets, documents, presentations, and other applications.

Implementation

Potential Resources and Existing Supports

Planning and implementing professional development, specifically a series of webinars, involves substantial human capital and technological resources (Reilly et al., 2012). Therefore, when I complete the project study, I will schedule a meeting with EFG College's academic administration to discuss my findings and proposed professional development plan. Given that the target audience are a combination of adjunct and fulltime faculty who teach Statistics 1 and 2 in an online or hybrid format, my implementation timeline has to complement the college's orientation and faculty training schedule. EFG College schedules 3 – 4 hour long face-to-face faculty workshops each month. I will discuss the possibility of hosting a webinar as a break out session during

one of the workshops for faculty who teach math, algebra, and statistics. I have a tentative launch date of February 2016 pending administrator approval, and I plan to facilitate a series of five webinars consecutively through June 2016. This timeframe should allow ample time for faculty to apply and incorporate what they are learning within their teaching practice.

After I secure permission from EFG administration to facilitate the webinar series, I have to consult with the school's technology personnel because their support will be critical to a smooth implementation process. I plan to utilize EFG College's media lab to design, deliver, and record the webinars. The school's learning management system and faculty development course are possible focal points to advertise the upcoming webinar series. However, it is possible that a designee from the faculty development team can act as a liaison to communicate to faculty via email too. I will send reminder emails and calendar invitations at least two weeks ahead of the scheduled dates. The communication will include information about the webinar, the access link, login information, PowerPoint presentation, and other handout materials

I am considering either Zoom Video Conferencing or Google Hangouts as the platforms upon which to host the webinar. The college has educational accounts and their technology personnel will be able to support anyone who experiences technical issues. I plan to archive the training sessions in a proprietary location at the college for future access by the school's faculty and staff. Since the webinar attendees will probably join from different remote locations, I have to ensure that they are aware of the browser and other technology requirements. I will collaborate with the technology personnel to draft

guidelines for accessing the training and troubleshooting issues. In terms of planning, I will encourage faculty to test their computer systems and log in at least 30 minutes prior to the start of each webinar.

Potential Barriers

Technological advances in education have prompted learners to adjust to the virtual classroom and a different way of accessing and processing information. As a result, instructors at all levels have had to learn new ways of engaging students in the learning process. The challenge, however, has been creating experiential training experiences that simulate the virtual classroom experience and allow faculty to understand how students learn at a distance (Merrill & Murrell, 2014). Furthermore, some faculty members resisted learning in a format other than the typical face-to-face workshop where participants are passive receptors of information (McQuiggan, 2012; Stewart, 2014).

Other possible barriers to facilitating the webinar series are conflicting schedules, technical issues, and participants' level of engagement (Zoumenou et al., 2015). For example, if faculty members experience Internet browser issues, they can miss critical parts of the webinar presentation. In addition, the live webinar training may occur at a time when some adjuncts have work obligations and are unable to attend a synchronous session. In terms of engagement and interaction, while some faculty may find the proposed webinar topics interesting, others may question the focus on learning theory and research about diverse learners (Meyer & Murrell, 2014). Yet others may feel

uncomfortable collaborating on activities and sharing their reflections thus, creating barriers to active participation and engagement (McQuiggan, 2012).

The proposed professional development spans over a 5-month period, and the activities require faculty to engage in critical reflection and discourse about each of the five webinar topics (see Appendix A). However, some faculty may lose interest or forget to attend all of the webinars. Hence, they would forego occasions to reflect on their teaching, collaborate with peers, and practice using instructional strategies that could improve their students' learning experiences. Transformative teaching and learning can occur, but only if EFG College's faculty members find the webinar training valuable and applicable to their teaching practice.

Proposal for Implementation and Timetable

The webinar series is tentatively scheduled to launch during the Spring 2016 semester, pending approval from EFG College's academic administrators (see Appendix A). I plan to facilitate the first 2-hour webinar on Faculty Development Day, February 15, 2016. I will record the webinar to accommodate adjunct faculty whose scheduling conflicts prevent them from attending a synchronous session. I plan to present the remaining four webinars on the third Monday of each month to correspond with the college's professional development calendar. Between February 2016 and June 2016, the faculty will have an opportunity to implement and practice using instructional techniques presented during the webinars. At the beginning of each webinar, the faculty will have an opportunity to reconnect and share about their experiences.

Roles and Responsibilities of Student and Others

During the set up phase of the project's implementation process, I will consult and collaborate with the school's academic administrators, faculty development team, and instructional technology (IT) team. The IT team will assist me with the logistics of uploading the presentation to the webinar platform and testing to ensure all technology including the browser, audio, and camera are adequately set up and working properly. An IT designee will be available to support faculty with any technical issues they experience for the duration of each webinar. The faculty will sign up for webinars upon notification from the faculty development or academic administration team. On the scheduled days, they will access the webinars using a hyperlink that will be included in reminder communications. I will act as the primary facilitator for the five faculty development webinars, but may invite the instructional designer and instructional technologist to cofacilitate and moderate some of the learning activities about digital tools and course design.

Project Evaluation

Despite the current focus on accountability in education today, research about the processes used to evaluate professional development is limited (Rutz, Condon, Iverson, Manduca, & Willett, 2012). Whereas Earley and Porritt (2014) reported that school leaders, practitioners, and policy-makers used simplistic measures and anecdotal methods to assess professional development effectiveness, Reilly et al. (2012) ascribed self-reflection as a common means of evaluation. Yet, social science researchers typically use formative or summative methods to evaluate or assess programs and projects (Trochim &

Donnelly, 2007). I plan to use the process evaluation formative method to monitor faculty's level of engagement and interest by asking them to reflect and provide feedback at the end of each webinar (see Appendix A).

The formative approaches seek to examine and improve the project before and during its implementation and can include needs assessment, structured conceptualization, implementation evaluation, and process evaluation. Summative evaluations examine the results of the project and may consist of goal-based evaluations, outcomes evaluations, impact evaluations, cost-effectiveness and cost-benefit analyses, secondary analyses, and meta-analyses (Trochim & Donnelly, 2007). Evaluating the webinar's outcomes is important to understand the participants' perspective about the format of delivery, content, and hands on activities. Faculty developers can use the data collected to improve future webinars (Kapp & Wingate, 2012).

Based on faculty feedback during and after each webinar, I plan to modify the presentation style or content to promote learner centeredness (Reilly et al., 2012). At the end of the webinar series, I will draft a goals based assessment report for the academic administrators. The report will include my reflections about the training experience and attempts made to meet the following goals: (a) Critical reflection and discourse, (b) increased social, cognitive, and teaching presence in the online and hybrid learning environments, (c) formation of a professional learning community, and (d) improved student performance in Statistics 1 and other quantitative based courses. I will also meet with academic administrators and members of the faculty development team to share pertinent feedback that can inform upcoming faculty development initiatives.

I will recommend that the college's academic administrators follow-up with an impact evaluation at the end of Summer 2016 to determine whether teaching presence is evident in online statistics courses. When administrators review and observe courses throughout the semester, they can monitor how and whether instructors incorporate the new learning into teaching practice. Additionally, the administrators should analyze relevant course evaluation data and review grade distribution data to determine the training's effects on its major stakeholders – faculty and students. Alternatively, the college's leaders can convene a focus group to hear faculty's perspectives about the professional development's effectiveness in improving teaching practice and student learning.

Implications Including Social Change

Local Community

As teaching evolves in this age of technology, instructors who teach online have to expand their skillset to facilitate effective learning experiences (Bigatel, Ragan, Kennon, May, & Redmon, 2012). The continuing growth of online programs requires flexible learning environments where all faculty members are knowledgeable and well trained to deliver quality instruction (Allen & Seaman, 2014; Bailie, 2014). Frederick (2011) predicted that the webinar approach of professional development would increase in popularity as trainers and faculty explore innovative and transformative ways to interact and collaborate online.

The proposed webinar series will address some of the concerns faculty and students expressed during the interview process. Following the training, college

administrators will look for evidence of digital tools and differentiated learning strategies in the online statistics courses. With transformed mindsets and attitudinal changes, faculty should be able to enhance their teaching practice and improve student learning (Mahoney, 2009). The training experience should prompt a community of practice among statistics instructors where they reflect on their teaching, analyze student work, collaborate on continuous improvement initiatives, and support each other. The training can inform hiring and performance management practices at EFG College.

The majority of faculty who teach online and hybrid courses at EFG College are adjuncts, who are subject matter experts in their respective disciplines. With no formal training in education, they tend to base their educational philosophies and approaches on those of their former teachers (McQuiggan, 2007). Furthermore, while most adjunct faculty members have experience teaching in the face-to-face classroom, when teaching in the hybrid or online format, they require additional support, coaching, and training (Allen & Seaman, 2011; Bedford & Miller, 2013; Mandernach, Register, & O'Donnell, 2015; Terantino & Agbehonou, 2012). By participating in the webinar professional development training, adjuncts will learn more about adult learning theory and instructional strategies that will allow them to meet diverse student needs.

Instructors are major stakeholders and a crucial component of student success in the online learning environment (Al-Salman, 2011; Bedford & Miller, 2013). According to the faculty interviewed, that success in online statistics courses required self-motivation and self-reliance. The faculty believed that some students were underprepared and unmotivated, while others lacked the prerequisite academic and technical skills to

succeed in the virtual online statistics course. Yet, the two students who earned grades of A- in the online Statistics 1 course attributed their success to self-determination and discipline. The students also mentioned tapping prior knowledge from high school math and statistics courses along with having positive interactions with college faculty.

The students who received lower grades blamed their marginal performance on ineffective teaching practices and claimed that their instructors did not participate within discussion forums, provide assistance or constructive feedback on assignments, neither did they maintain timely, open lines of communication (Bailie, 2014). When asked to identify the characteristics of effective online instructors, the students used the following terms: understanding, patient, supportive, available, responsive, and supportive. Students wanted “well-designed courses with quality materials, clearly defined expectations, relevant assignments, and assessments aligned to learning objectives and appropriate use of media” (Reilly et al., 2012, p. 102). Webinars 3 and 4 will explore how faculty can establish a sense of presence in the virtual classroom, differentiate instruction, support students, and improve the student-to-teacher relationship.

Differing opinions exist in the literature about the relationship between instructional strategies and student achievement (O’Dwyer, Wang, & Shields, 2015). However, to maintain a high quality of instruction, EFG College’s fulltime and adjunct instructors need to learn more about strategies and tools that can enhance the online teaching and learning experience (Baghadadi, 2011; Macdonald & Poniatowska, 2011). They also need to increase awareness about the GAISE and the ASA Undergraduate Guidelines for Statistical Science.

To prevent a shortage of global citizens who have adequate problem solving and analytical skills, faculty will have to create learning experiences where students can practice using the scientific method to solve real-world statistical problems (American Statistical Association Undergraduate Guidelines Workgroup [ASAUGW], 2014). EFG College's faculty will have multiple opportunities to reflect, examine, and rethink their beliefs and teaching approaches. As the focus in statistics education shifts from computation and procedural fluency to conceptual understanding and statistical reasoning, faculty have to change their mindsets about how to teach statistics at a distance (O'Dwyer et al., 2015).

Contrary to my study's findings, Windquist & Carlson (2014) posited that students' marginal performance on exams and inability to understand or retain information in statistics courses relate less to prerequisite skills and more so to poor course designs. Therefore, in thinking ahead 5 to 10 years, faculty need to consider that as a result of Common Core State Standards, and Advanced Placement courses, more students will be introduced to statistical concepts in high school (ASAUGW, 2014). Therefore, faculty and instructional designers at EFG College may need to collaborate to revise the curriculum of the introductory statistics course to make it more rigorous and relevant.

Far-Reaching

Research shows faculty at the postsecondary level tends to be content experts but they lack the skills needed to deliver instruction that results in student learning (McQuiggan, 2007). As my findings showed, the barriers to teaching and learning in the

online environment have not changed since Berge's (1998) study. Faculty and students still may have difficulty getting access to resources and people. The planned training can produce high quality teaching, student learning, and academic achievement.

Implementing differentiated learning practices and community of inquiry principles is important to improving the online learning experience across all disciplines. Webinars 3, 4, and 5 are applicable to other online courses, because they present information about how faculty can meet their students diverse needs; establish cognitive, social, and teaching presence within the learning management system; and design accessible, inclusive, culturally relevant online courses. Improved student performance in the introductory statistics may have a ripple effect and result in increased student performance in Statistics 2, Finance, and other related upper level courses for which Statistics 1 is a prerequisite.

Conclusion

Ensuring student success and academic achievement in online statistics courses will require well-trained faculty who understand adult learning theory, statistics education training, and appropriate online course design and delivery methods. Since creating a community of inquiry is important to online student success, EFG College faculty may benefit from additional training about how to provide constructive feedback and academic support while establishing and maintaining a teaching presence at a distance.

Faculty should learn more about the following topics: GAISE, differentiated learning strategies, universal design for instruction, and the community of inquiry

principles – cognitive, social, and teaching presence. Additional training will provide opportunities for critical reflection and meaningful discourse among faculty within a professional learning community. Faculty will have multiple opportunities to examine and analyze their teaching practice, identify areas for improvement, and implement changes that can increase student learning. The proposed faculty development webinars can result in faculty applying differentiated learning strategies to accommodate the needs of diverse learners in online courses.

Section 3 provided details about planning and implementing the professional development project, which evolved from the study's findings. I reviewed literature from the last 5 years to provide a contextual basis about the relevance of professional development to improving teaching practice and student performance in online statistics courses. I also described the project's implementation and evaluation processes and highlighted implications for social change at the local level and beyond. In Section 4, I will present reflections about the project's strengths and limitations and share details about how I have grown as a scholar, practitioner, and a project developer. I will conclude the study by making recommendations for future research.

Section 4: Reflections and Conclusions

Introduction

Researchers use the qualitative case study design to understand how the participants interpret and make meaning of their experience (Merriam, 2009; Yin 2014). My single case study approach embedded with two units of analysis examined elements of online statistics courses through the viewpoints of faculty and students. My goal was to determine why student performance was substandard in the online statistics courses at EFG College. I wanted to identify possible barriers to teaching and learning statistics in the 3-year-old online program. Therefore, I interviewed a purposive sampling of students and faculty, examined course syllabi, analyzed end of semester evaluation reports, and reviewed the 2014 Statistics 1 course shell in the learning management system. In this section, I will highlight the project study's strengths and limitations and share reflections about my growth as a scholar, practitioner, and project developer.

Project Strengths

To facilitate the faculty's transition from face-to-face to distance learning, Beach (2012) argued for professional development formats that would correspond with the changing learning environment. Beach believed that the advent of social networking and digitalization provided opportunities for faculty to collaborate, plan, and learn from others. The possibility of accessing training opportunities remotely by using a learning management system or webinar software meant that faculty could save on commuting time and expenses (Gregory & Salmon, 2013). Another benefit was that faculty could practice using digital tools prior to integrating them within their virtual classrooms.

I designed five professional development webinars with EFG College faculty and student beneficiaries in mind. The webinar approach allowed me to create a flexible and convenient learning environment to accommodate for the time constraints that sometimes prevented adjunct faculty from participating in faculty development initiatives. The adjunct faculty could access the webinar from a remote location as long as they had a computer with audio and video capability and an Internet connection. Webinars “allow for more immediacy and accessibility” and remove “barriers to participation in professional development” especially for faculty with conflicting schedules (Zoumenou et al., 2015, p. 63). EFG faculty could view and listen to recorded webinars at a more convenient location and time.

EFG faculty would have opportunities to experience web conferencing tools first hand and learn different techniques to apply to their online courses. I designed the proposed webinar to allow faculty members time to explore and discuss teaching practice while collaborating within a virtual professional learning community. I wanted faculty to learn more about theories and instructional approaches that could aid in increasing learning outcomes in the online statistics course. Since the online faculty who participated in the study appeared unacquainted with the statistical education standards, I designed the first webinar to introduce instructors to the GAISE and ASA guidelines of undergraduate curriculum. With new context and frames of reference, faculty will be prepared to reexamine EFG College’s curriculum design for the Statistics 1 and Statistics 2 courses.

EFG College faculty will have opportunities to review and discuss the barriers of learning statistics online as well as revisit the prerequisites for online statistics courses. They have to understand how to meet the needs of diverse learners, including gifted students, students with disabilities, and English language learners. Therefore, after faculty members learn more about adult learning theory, Universal Design principles, and differentiated learning strategies, I expect instructors to be better equipped to meet the needs of learners. The ultimate goal of this study was to improve student learning as evident by a positively skewed grade distribution in future online statistics courses.

Based on the information that Faculty#2 and Student #4 shared, the interview process prompted participants to experience modicum shifts in their thinking and feelings about online education. Faculty and students acknowledged challenges with the online statistics course, but realized that most difficulties stemmed from either limited student or faculty preparation for the online learning environment. Faculty #2 recognized a learning curve existed due to different instructors' comfort level and online teaching experiences. Students shared multiple challenges relating to the course design and delivery of the online statistics course. Student #4 described her experiences with the "absentee" instructor and recommended that faculty establish more of a presence within the online course.

The qualitative case study approach allowed for the collection of rich data about student performance and the nature of teaching and learning statistics online from those who had firsthand knowledge. The faculty and students had an opportunity to reflect and share information about their experiences with online statistics courses. The data

collected from course evaluations, faculty interviews, student interviews, and the Statistics 1 online course template validated the anecdotes about marginal student performance in online statistics courses. The data also revealed a number of imparities in pedagogical practice that also affected student performance in online statistics courses. This led to, my decision to design professional development aimed at bridging the gaps.

Recommendations for Remediation of Limitations

My study was limited to the faculty and students at a private college in the northeastern United States; however, there is potential to replicate it to examine the nature of teaching and learning statistics in an online format at other institutions. I selected two faculty members and four students at EFG College who provided rich data about the nature of teaching and learning statistics in an online format. However, a limitation of the selection process was that none of students who responded to the invitation to participate in the study had enrolled in online courses delivered in 2013 and 2014. As a result, the student interview data focused mainly on experiences about courses offered during 2011 and 2012.

The two faculty participants were able to provide information about the online statistics course design and delivery methods based on their experiences for the 3-year period. Whereas, the faculty communicated about changes made to the online statistics course template in 2014, the only source of data about the students' perspectives came from the 2014 course evaluations. Although I was able to triangulate the data, interviews with students enrolled in the recent online statistics courses would have allowed for

comparative analysis and helped to explain the fluctuations in student performance, as reflected in the grade distribution data between 2011 and 2014.

In retrospect, I should have considered interviewing or surveying instructional designers at EFG College, since they typically worked with faculty to design the online courses. Instructional designers and technologists are critical to the teaching and learning process and can inform administrators about professional development needs of online faculty. The two faculty members who participated in the study admitted that they had no input in designing or revising the online Statistics 1 course. Faculty #2 wondered whether the instructional designers even took students' input from course evaluations into account when they designed online courses.

Interviews with the instructional designers would have provided additional perspective and rationale about the nature, structure, and organization of online statistics courses. The instructional designers could address questions about alignment and accessibility. They could explain how the online course design addresses and accommodates the needs of all students, especially those with learning and language differences. Further research examining the nature of teaching and learning in online courses should include commentary from instructional designers and instructional technologists. Consulting with the technology support staff may help to reframe the problem, which I initially identified as marginal academic performance.

Scholarship

Traditional interpretations of scholarship related more to theory than practice and scholars were usually college professors whose primary responsibility was to conduct

research and publish their findings. Boyer (1990) described scholars as researchers whose role was to produce multiple publications and conference papers. The primary method of acquiring knowledge in a given field was through research rather than practice. However, views about scholarship have evolved over time and today, scholars are recognized for research, practical applications, synthesis, and teaching. Teachers in K-12 education have joined their counterparts in higher education in an attempt to transform and improve the teaching and learning experience (Hutchings, Huber, & Ciccone, 2011).

The approach that schools of higher education use to define scholarship has changed over the years from a single focus on research to include what Boyer (1990) characterized as “scholarship of discovery, of integration, of application, and of teaching” (p. 25). To be considered a scholar, a researcher has to be knowledgeable and stay current about a particular field of study. The researcher can spearhead a research project, review discipline specific literature, write journal articles, present at conferences, contribute innovative practices to the field, or deliver professional development within a specific area of study (Boyer, 1990; Glassick, Huber, Maeroff, & Boyer, 1997; Hutchings et al., 2011; Trigwell, Martin, Benjamin, & Prosser, 2000).

My doctoral project study is evidence of the scholarship of teaching and learning because my goal was to improve student learning in online statistics courses. I followed the prescribed protocols and engaged in the iterative process of academic writing to complete a qualitative case study (Yin, 2014). I identified a problem in teaching practice at EFG College, reviewed and synthesized relevant literature, followed the qualitative research design to collect and analyze data, communicated my results, and provided

recommendations for designing a professional development webinar series (Glassick et al., 1997; Trigwell et al., 2000).

While reviewing the literature on statistics and distance education, I discovered a number of quantitative studies that focused on the difference between face-to-face and online or hybrid courses (Li et al., 2012; Ramirez et al., 2012). Other studies examined students' attitudes towards statistics as measured by different survey instruments (Bond et al., 2012; Chiesi & Primi, 2010; Dempster & McCorry, 2012; Gal, Ginsburg, & Schau, 1997; Hood et al., 2012). However, limited research existed about students' perspectives about online statistics courses. Therefore, my study will add to the growing body of qualitative research in statistics education and distance education.

In March 2015, I had the opportunity to participate in a (CAUSE sponsored webinar to revisit the *GAISE College Report* (2012) and discuss a draft of the updated GAISE, earmarked for publication in 2016. After my doctoral research study is completed, I plan to continue demonstrating scholarship by facilitating professional development workshops, writing articles, presenting papers, and leading discussion groups at conferences, such as CAUSE's Electronic Conference on Teaching Statistics (eCOTS) and the University of Wisconsin's Annual Conference on Distance Teaching and Learning.

Project Development and Evaluation

I considered other project genres such as a policy paper, an evaluation report, and a curriculum plan. I opted for professional development because the goals of this qualitative case study were to examine faculty and students' perspectives about the

curriculum and course design, identify the barriers to teaching and learning statistics online, and explore ways to improve the experience for faculty and students. A faculty development webinar was a better approach to address the gaps in pedagogical practice that emerged as major barriers to students' meeting the learning outcomes in the introductory online course.

Based on the study's findings, I realized that effective professional development would allow EFG College's faculty members time to reflect, share-out, and interact with each other to explore different techniques to improve student-learning experiences. I discovered that traditional forms of professional development for educators typically followed the seminar style or classroom embedded workshop models, and the content was usually irrelevant and impractical (Dabner et al., 2012; Kenti, 2014). Therefore, to effect change, professional development models considered had to be innovative, adaptable, and specific to "the goals, resources, and circumstances of the local PD context" (Koellner & Jacobs, 2015, p. 51). In addition, professional development models had to span beyond the 1-day workshop model to transform teaching practice (Jaquith, Mindich, Wei, & Darling-Hammond, 2011). While designing the webinars, I considered my intended audience and discovered that eight of the 10 instructors assigned to teach in the online and hybrid programs worked part-time as adjunct instructors. Therefore, I selected the webinar series model to allow instructors the flexibility of attending training remotely at a convenient time and place.

The webinar approach to faculty development was a practical approach for faculty to learn about technology that could result in increased teaching presence in the virtual

classroom and ultimately, improve student learning experiences. Students wanted faculty to provide detailed procedures and use visual cues to demonstrate problem-solving techniques. However, instructors were unfamiliar with conferencing technologies such as Blackboard Collaborate and Zoom Video Conferencing, which featured interactive whiteboards. My facilitating a webinar using video conferencing technology provided faculty with a demonstration of how to engage online learners while establishing a presence in the virtual learning environment.

The five-webinar series incorporated practice exercises and activities to allow faculty to acquire new knowledge and skills, while collaborating with peers to discuss new instructional approaches and techniques. I wanted to create a learning environment that resembled a community of practice and community of inquiry aimed at sparking faculty interest in continuous professional development and ongoing action research (Kennedy, 2014). Since the webinars spanned over 5 months, faculty had time to experiment with strategies and tools, engage in action research, and report the results of implementing new instructional techniques on student achievement. Additionally, by shadowing and observing faculty in the online classroom, academic administrators could find evidence to measure the training's effectiveness in improving student learning.

Leadership and Change

During this age of educational reform, more teachers have assumed the roles of collaborative leaders and change agents (Lumpkin, Claxton, & Wilson 2014; Morgan & Lock, 2014; Nappi, 2014; Sears, 2015; Trybus, 2011; Zrike & Connolly, 2015). The teacher leader is an empowered visionary and risk taker who embodies the following

characteristics and competencies: interpersonal skills, organizational and planning skills, knowledge of curriculum and instructional innovations, mentoring, training and coaching, facilitating groups, technological acumen, change agency, leading reflective inquiry, and addressing diversity (Gordon, Jacobs, & Solis, 2014; Morgan & Lock, 2014). As I reflect and assess how I measure up as a teacher-leader, I recognize how much I have grown over the past 10 years.

My participating in the doctoral research process facilitated my professional growth and development as a teacher leader and scholar. As I reflect on my work experiences as a corporate trainer, special education teacher, mentor, faculty developer, college professor, and administrator, I realized the interconnection between my craft and scholarship. My teaching philosophy has new meaning as I discover how much my training as a special educator and mentor informs how I design learning experiences.

As a faculty developer, I attempt to create inclusive learning environments that meet the needs of diverse learners. I am always looking for innovative ways to differentiate instruction and create student centered learning experiences. My overarching goal in designing a series of five webinars was to spark transformation by engaging faculty in critical reflection and meaningful discourse (Mezirow, 2009). I wanted the statistics educators at EFG College to recognize deficiencies in their curriculum, online course design, and teaching approaches. Furthermore, by exposing the faculty to current trends and innovations in the fields of distance education and statistics education, I wanted them to recognize their role as advocates for change to improve student performance in online statistics courses.

Analysis of Self as Scholar

As a researcher and scholar, I have learned how to identify a discipline specific problem, present a conceptual framework, and construct a case study. I reviewed the literature, analyzed archival data, coded, categorized, and interpreted interview data to find answers for the research questions and a resolution to the research problem. I enjoyed facilitating the interview process because in addition to hearing first-hand accounts about the phenomenon, I observed my participants' growth and transformation as they reflected and reframed their thinking about different experiences. In addition, I learned how to transcribe data from a digital recorder, a task that took longer than I anticipated. However, I appreciated the opportunity to listen to the recordings more than once while capturing my interviewees' actual words. The coded data evolved into my findings and suggestions for a webinar aimed at educating faculty about how to improve student performance in online statistics courses.

Although I had previously created presentations for conferences and collaborated as a mentor teacher to design and provide workshops, creating a webinar was a new experience. I revisited my findings, explored the literature about professional development, and thought about possible outcomes for the stakeholders (students and faculty). I developed a training experience that will be valuable to improving teaching practice and student performance at EFG College.

Analysis of Self as Practitioner

As I reflect on my study's findings, I ask myself, "How am I establishing visibility within my online Masters level courses?" In thinking back to feedback I have gotten from course evaluation surveys, I am realizing that some of my adult learners may misunderstand my attempts to establish presence in the online course. Whereas, some of the adult learners in the research study felt they had an "absentee" instructor, sometimes I feel that I hover too much and students may perceive me as a "helicopter" instructor. However, while conducting research for my study, I have learned some additional strategies about how I can establish presence without dominating the online course.

Analysis of Self as Project Developer

The culminating professional development project grew out of the findings from interview and archival data. During the interview process, student and faculty participants had the opportunity to engage in critical reflections and meaningful discourse about their experiences in online statistics courses. I explored the literature about webinar design and created opportunities for faculty to learn about current trends and practices in statistics and distance education, complete reflective journals, and collaborate with peers to share and make connections to their practice (Gallego, 2014; Zoumenou, 2015). I provided enough details and resources to ensure faculty members were well prepared to create inclusive and accessible learning environment. My biggest take away as a project developer is observing how the conceptual framework grounded the research study and professional development project. Mezirow's (2009) transformational learning theory and Knowles's (1975) approach to self-directed learning undergirded the entire project study.

The Project's Potential Impact on Social Change

Accomplishing social change calls for a paradigm shift in the focus of introductory statistics courses at the local and national levels. For too long, statistics courses have focused on procedural knowledge and computation. However, in the age of Common Core Standards and GAISE, students need to demonstrate conceptual understanding of statistics (ASA, 2014). This research study revealed that the existing barriers to learning statistics at a distance relate mainly to limitations in pedagogical practice. However, with adequate training and support in online course design and delivery, faculty should be able to teach any course online, including quantitative-based courses such as statistics. The proposed professional development should foster continued collaboration among faculty and administrators. In addition to forming a professional learning community (PLC), statistics educators should participate in professional learning networks (PLN) such as CAUSE and the International Association for Statistics Education. To remain current about trends in statistics education, faculty can subscribe to the *Journal of Statistics Education*.

Changing teaching practice and improving students' performance in online statistics courses are dependent on teachers' knowledge, beliefs, and attitudes. Faculty buy-in is critical to improving the teaching and learning process. If cognitive dissonance exists between the teachers' existing frames of reference and the strategies introduced via professional development workshops, the teachers will be less likely to try new approaches (Barlow, Frick, Barker, & Phelps, 2014). Therefore, I chose to adopt a flexible and adaptive professional development design where faculty members can

receive the necessary tools and resources to own future process improvements (Marra et al., 2011). Likewise, if faculty members continue to collaborate in online PLCs and PLNs they can develop their technological savviness and online social personas (Beach, 2012; Owen, 2014).

Participation in PLCs and PLNs allow opportunities for faculty to practice using digital tools such as learning management systems and social networking software as they share resources and interact with colleagues. Faculty can then apply the knowledge and skills acquired to engage their own students in the learning process. PLCs have the potential to influence the quality of teaching and learning if faculty members participate consistently on a regular basis over an extended period (Fulton & Britton, 2011; Stewart, 2014). The focus of PLCs and PLNs is for faculty to reflect, share resources, and engage in practical, inquiry-based activities; all aimed at improving students learning experiences (Owen, 2014). Teachers have a forum within which they can brainstorm and gain different perspectives about instructional strategies, assessment practices, and student work (Beach, 2012; Stewart, 2014).

Effective professional development in education should increase awareness about current trends in the field and allow faculty to engage in critical reflection and discourse about teaching practice (Baran & Correia, 2013; Gallego, 2014; Jaquith et al., 2014). Adaptive professional development webinars allow faculty to reflect, write, and talk about their experiences (Marra et al., 2011). For example, EFG College's instructors will have the opportunity to work collaboratively to assess whether the statistics course content follows the standards laid out by the ASA (2014). By participating in a PLC, the

faculty can continue to discuss current trends and issues in online and statistics education. They can share best practices and resources.

Following each webinar, EFG College faculty can apply the new learning to their virtual learning environments. They can work collaboratively with instructional designers and academic administrators to ensure that course design and delivery methods follow the community of inquiry and universal design models. Academic administrators can expect to find evidence of appropriate remediation, accommodation, differentiation, and facilitation within online courses. If instructors establish social, cognitive, and teaching presence within the virtual classroom, differentiate instruction to accommodate for learning differences, and engage students in the learning process, students should perform better in the online statistics course at the local level.

To evaluate the impact of the training and PLC engagement, faculty can self-assess by collecting and analyzing student work over time. To measure teaching effectiveness, the teachers will need to monitor changes in student work and seek out feedback from peers (Beach, 2012). The goal is to improve the students' learning experience by making online statistics courses accessible and inclusive for all learners.

Implications, Applications, and Directions for Future Research

Maintaining satisfactory academic performance in online statistics courses is contingent on continuous improvement to correspond with trends in statistics education and distance education. While providing discipline specific training and technological tools was the way I chose to address the problem at EFG College, I could have considered a curriculum redesign. After examining the syllabus and course content in the

learning management system, I could have conducted an assessment to determine the extent to which EFG College's introductory statistics course aligned to GAISE. However, after the faculty completes Webinar 1 and becomes more knowledgeable about GAISE and other statistics education standards, I anticipate their conducting additional research and making recommendations for course revisions to the department heads and curriculum design team.

Another possibility for further research at the local level is a follow-up study with faculty after the webinar series ends. The expectation is that faculty would describe how they applied the new learning to improve their teaching practice and student experience. Furthermore, faculty may lead future professional development workshops to demonstrate how they are using technology to improve student learning. Additional research can also include action research where faculty examine the extent to which statistics courses align to GAISE and the recommendations made for possible course revisions. Consequently, academic administrators may want to learn about student and faculty experiences with future iterations of the online statistics course. Future researchers can also examine and measure the level of accessibility, student engagement, and content relevance in comparison to the early versions of the course template.

Further examination of the performance indicators in hybrid and online courses to determine causal differences can explain the findings that students performed better in hybrid than online courses. Some students failed to complete the introductory statistics course and earned UF or WD grades (see Tables 3 and Table 4). Without further research, I can only assume that students' dropping the course experienced one or more

of the challenges uncovered in the study: fears and anxiety, workload and time commitment, and limited prerequisite, technological, or mathematical skills. Follow-up individual or focus group interviews with students, enrolled in online statistics courses at EFG College between 2012 and present, can provide additional context and perspective about the student experience in online statistics courses.

Considering the current focus on enrollment management initiatives at institutions of higher education, EFG College's administrators may be interested in learning more about possible effects of low levels of performance in online courses on enrollment and attrition rates. Consequently, future researchers may want to conduct a quantitative study to determine the correlation between performance and attrition. I recommend that faculty, instructional designers, and administrators collaborate on future research projects.

Conclusion

Continuous improvement of distance learning programs necessitates further research across disciplines and subject areas. My curiosity about the nature of teaching and learning statistics in an online format prompted the qualitative case study involving two faculty and four students at a private college in the northeastern United States. I wanted to explore possible barriers to meeting learning objectives of online statistics courses. After analyzing grade distribution reports and course evaluation data, reviewing the online course template, and interviewing faculty and students, I discovered the following five impediments to students' learning in the online introductory statistics course: (a) math phobia, (b) fixed mindsets, (c) limited pre-requisite skills, (d) poor time management, and (e) ineffective teaching practice.

As a teacher leader, I welcomed the opportunity to address the deficiencies in pedagogical practice through a series of five webinars. Because of this project study, EFG College's fulltime and adjunct faculty received firsthand exposure to digital software tools applicable to their teaching environments. In addition to learning about instructional strategies, trends, and innovations in online education, the faculty got an introduction to the ASA standards governing their work in statistics education. They also learned how to differentiate instruction to create developmentally appropriate, accessible, and culturally relevant learning environments.

Armed with knowledge about the GAISE, new technologies and instructional strategies, I expect faculty to continue to engage in reflexive praxis, conduct lesson studies or action research projects, seek out professional development, and participate in collegial learning activities. The long-term goal is that faculty at the local level and beyond will work as a collective body to initiate change and improvements that can result in student success, engagement, and retention.

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Appendix A: The Project

The Project

Online Statistics Course from Faculty & Students'
Perspectives: A Case Study

Ruth Best
Walden University

Overarching Goals

- To provide professional development for faculty that will result in:
 - Critical reflection and discourse
 - Increased social, cognitive, and teaching presence in the online and hybrid learning environments
 - Improved student performance in Statistics 1 and other quantitative based courses
 - A professional learning community

Webinar Series

- **Webinar #1:** Statistics Education: The Standards
- **Webinar #2:** The Case Study
- **Webinar #3:** The "Underprepared" Student
- **Webinar #4:** The Faculty-Student Relationship
- **Webinar #5:** The Online Curriculum Design: Statistics I

Webinar Series Objectives

- Discuss Guidelines for Assessment and Instruction in Statistics Education (GAISE)
- Examine and evaluate EFG College's online statistics curriculum design for quality assurance
- Identify strategies to overcome barriers to teaching and learning statistics at a distance.
- Establish social, cognitive, and teaching presence in the virtual learning environment.
- Support and provide adequate feedback to meet varying students needs.

Logistics

- **Web Host:** Google Hangouts & YouTube Channel
- **Target Audience:** College faculty
- **Timeline:** Feb. 2016 – June 2016
- **Resources:** Internet, PPT, Institutional data, LMS, Pandora
- **Implementation:** Collaboration with research site personnel
- **Evaluation Plan:** End of Webinar Feedback

Webinar #1

Statistics Education: The Standards

Guidelines for Instruction and Assessment in Statistics Education

Agenda

- Welcome/Introductions 10 – 15 mins.
- Brainstorming Activity 10 – 15 mins.
- The GAISE College Report 10 – 15 mins.
- Proposed Changes to GAISE 10 – 15 mins.
- Syllabus Review Activity 20 – 30 mins.
- Questions & Answers 10 – 15 mins.
- Wrap Up & Next Steps 10 – 15 mins.

Brainstorming Activity

- What do we mean by statistical literacy?
- What is evidence of statistical literacy in student work?
- How do we measure and assess statistical literacy?
- What is the difference between statistical literacy and statistical thinking?

Guidelines for Assessment and Instruction for Statistics Education (GAISE)

Six Recommendations for Teaching the Introductory Statistics Course:

- Emphasize statistical literacy and develop statistical thinking
- Use real data
- Stress conceptual understanding, rather than mere knowledge of procedures
- Foster active learning in the classroom
- Use technology for developing conceptual understanding and analyzing data
- Use assessments to improve and evaluate student learning

Source: Briggs, M., Cobb, G., Coff, C., Garfield, J., Gould, S., Lock, R., Moore, T., Rossman, A., Stepienkowski, B., Utts, J., Velleman, P., Wehrer, J. (2012). College Report: Guidelines for assessment and instruction in statistics education. Alexandria, VA: American Statistical Association.

Activity

- Review Statistics 1 Syllabus – description, objectives, competencies, topics, assessments
- How does the Statistics 1 course measure up to GAISE?
- What recommendations do you have for improving the course with GAISE in mind?

Qualifications for teaching an Introductory Statistics Course

- Two statistical methods courses including content knowledge of data collection methods, study design and statistical inference.
- Experience with data analysis beyond material taught in the introductory class.

Source: ASA/MAA Joint Committee

Definition of Statistical Literacy

Statistical literacy signifies a student's ability to think, reason, and apply statistical concepts to make accurate business decisions (Ramirez et al., 2012).

American Statistics Association Proposed Changes to GAISE

- Emphasize statistical literacy and develop statistical thinking
- Use real data **with a context and a purpose**
- Focus on conceptual understanding, rather than **application** of procedures
- Foster active learning
- Use technology for developing conceptual understanding and **for** analyzing data
- Use assessments to improve **as well as to** evaluate student learning.

Source: American Statistical Association webinar entitled *Updating the Guidelines for Assessment and Instruction in Statistics Education (GAISE) College Report* by Michelle Everson & Megan Moxley.

Statistics I Purpose

The purpose of the course is to introduce the statistical methodologies used for sampling and analyzing data and discuss their validity to measure various socio-economic components that arise in the business environment.

Statistics I Core Competencies

- Problem Solving
- Critical Thinking
 - Logic and reasoning
 - Transfer and application

Home Work

- Write your personal reflections about today's webinar.
 - What were key takeaways?
 - What do you still have questions about?
- Review the Statistics Course Template in LMS.
- Evaluate the template through the lens of GAISE.
- Identify evidence of activities that result in conceptual understanding and statistical literacy.
- Provide at least 2 recommendations for improving the course materials, media, assessments, online template in general.

Webinar #1 Q&A



Webinar #2

The Case Study
Online Statistics Course from Faculty & Students'
Perspectives: A Case Study

Student Learning Outcomes

*The student will learn how to **collect** data; **display** data using frequency tables, histograms and stem-and-leaf displays; and to **compute and analyze** the most commonly used measures of central tendency and variation of a data set. The course will also introduce the basic concepts and methodologies used in probability theory. The student will learn how to **compute probabilities** for simple events, conditional probabilities, and probabilities for compound events.*

Planning Ahead

To prepare for next time:

- Read the GAISE College Report
- Read about Common Core standards
- Jot down some questions to discuss further
- Review course evaluation data for Statistics I
- Review outcomes assessment data for Statistics I

Evaluation

- 3 2 1 Feedback form

Identify

- three things you learned
- two questions you still have
- One thing that you can apply to your practice

Agenda

- | | |
|------------------------|--------------|
| ■ Welcome | 10 - 15 mins |
| ■ Ice Breaker Activity | 15 - 20 mins |
| ■ Self Assessment | 10 - 15 mins |
| ■ The Problem | 20 - 30 mins |
| ■ Reflections | 10 - 15 mins |
| ■ Barriers to learning | 15 - 30 mins |
| ■ Questions & Answers | 10 - 15 mins |
| ■ Wrap Up & Next Steps | 10 - 15 mins |

Barriers to teaching and learning statistics at a distance

- Overwhelming course design (layout)
- Cognitive overload (delivery)
- Technical issues
- Content Relevancy
- Ineffective teaching practice
- Limited pre-requisite skills
- Poor time management
- Fixed mindset

Pre-requisite skills

- Technical (computer)
- Computational (basic math)
- Procedural fluency
- Communication (reading, writing and oral)
- Critical thinking & analytical

Home Work

- Find and read articles about:
 - Adult Learning Theory
 - Creating developmentally appropriate learning environment
 - Scaffolding instruction
 - Differentiating instruction
 - Creating accessible learning environments
 - Creating a community of practice
 - Establishing presence in online courses

Evaluation

- Webinar Exit Slip
 - What was helpful from today's session?
 - What is something you are wondering?
 - What do you want to explore further during the next session
 - What is one thing that you will explore further as a result of today's session?

Teaching statistics for conceptual understanding

- Feedback & Support (Tutoring)
- Surface knowledge v. depth of knowledge
- Differentiated instruction (incorporating Brainfuse)
- Scaffolding and chunking content
- Project based learning – case studies (experiential learning; competency based learning)

Recommendations

- Establishing a community of inquiry
 - Social Presence
 - Cognitive Presence
 - Teaching Presence
- Curriculum evaluation & redesign
 - Project based assessments
- Faculty development and training

Webinar #2 Q&A



Webinar #3

The "Underprepared" Student
Dealing with diversity in the virtual classroom

Agenda

- Welcome 10 – 15 mins
- Ice Breaker Activity 10 – 15 mins
- Adult Learning Theory 10 – 15 mins
- The diverse learners 10 – 15 mins
- Differentiated Learning Discussion Activity 20 – 30 mins
- Teaching Statistics for Conceptual Understanding 10 – 15 mins
- Questions & Answers 10 – 15 mins
- Wrap Up & Next Steps 10 – 15 mins

Ice Breaker

- What did you learn about:
 - Adult Learning Theory
 - Creating developmentally appropriate learning environments
 - Creating accessible learning environments
 - Creating a community of practice
 - Establishing presence in online courses

Adult Learning Theory

- Malcolm Knowles
 - Andragogy
 - Self Directed Learning
- Jack Mezirow
 - Transformational Learning
 - Critical Reflection
 - Rational Discourse

Student Demographics

- | | |
|--|--|
| Age
60% ≤ 24 years
40% ≥ 24 years | Ethnicity <ul style="list-style-type: none"> ■ 44% Hispanic/Latino ■ 35% Black or African American ■ 15% Caucasian ■ 2% Mixed Race ■ 2% Asian ■ 2% Race Unknown |
| Gender
60% Female
40% Male | |

Source: National Center for Educational Statistics (NCES) College Navigator, 2013

The English Language Learner (ELL)

- Emergent Bilingual
- Language Deficiencies
 - Academic Reading & Writing
- Accommodations
 - Written notes
 - Buddy system
 - Peer tutor

The Student with Disabilities

- Learning Disabilities
- Emotional Disabilities
- Autism
- Other Health Impairments
 - Anxiety disorders
 - Post Traumatic Stress Disorder (PTSD)
 - Traumatic Brain injury (TBI)

The Gifted Student

- Characteristics**
- Learn at faster pace
 - Finish assignments quickly
 - Crave challenging/rigorous assignments
- Tips to engage the gifted students**
- Get to know the intellectually gifted student(s)
 - Conduct informal assessments
 - Utilize outside resources
 - Design learning activities with Bloom's Taxonomy in mind (creating & evaluating)
 - Ask intellectually stimulating questions

The "Underprepared" student

*Taking statistics was the wrong class for me to start out with. So when I did, **mentally, I wasn't prepared**, ...I was hesitant, because I don't have time and I don't know that this is the right time, so I think that I went ahead ... just logged on so that I could check in and then, you know, it started. So I rushed into that **not prepared**.*

Remediating the 'underprepared' student

- Remediating the "underprepared" student (Basic Math skills)
 - How to reduce statistics phobia?
 - Growth Mindset
 - Multiple means of presentation/representation/assessment
 - Differentiated instruction
 - Tutoring
 - How to reduce isolation and disconnect?
 - Orientation
 - Feedback & Support
 - Instructor visibility

Addressing cultural differences

- Get to know your students well
- Create real world examples that help students connect to the curriculum.
- Create a learning community where students feel valued and accountable to each other.
- Hold high academic standards and expectations for all students
- Treat all students as competent and developing
- Foster a *growth mindset*
- Examine your own cultural identity
- Design lessons with all your students in mind.

Source: [The National Equity Project](#)

Reflective Write (Critical Incident)

Critical Incident Reflection Framework

Think about the students in the last statistics course you taught.

- How would you describe the students as learners? (**What**)
- Were you able to address their differing learning needs? Why/Why not? (**So What**)
- With you new learning, how will you address and meet the needs of diverse learners? (**Now What**)

Feedback (Evaluation)

- How did this webinar relate to your job and in what ways has it caused you to reflect about your role as an online/hybrid/face to face faculty?
- What new ideas have you gained and how do you plan to implement these new ideas in your course?
- What information was of the greatest value to you?
- What specific suggestions do you have to improve the training webinars?
- Additional comments

Academic Supports

- Remediation for online students
 - Brainfuse
 - Khan Academy
 - Tutoring & Conferencing
- Strategies to differentiate instruction in the online classroom
 - Scaffolding
 - Chunking

Differentiated Instruction (Discussion Activity)

- What is differentiated instruction?
- Why is differentiation important?
- How can you differentiate in the online course?
- What does differentiation look like online?
- When do you differentiate instruction?
- Who benefits from differentiated instruction?

Webinar #3 Q&A



Webinar #4

The Faculty-Student Relationship
How to build a learning community and establish presence in the virtual classroom

Agenda

- Welcome 10 – 15 mins
- Ice Breaker Activity 10 – 15 mins
- Student Expectations 10 – 15 mins
- Community of Practice 10 – 15 mins
- Feedback & Support 10 – 15 mins
- Questions & Answers 10 – 15 mins
- Wrap Up & Next Steps 10 – 15 mins

Ice Breaker

Revisiting the Critical Incidence Exercise

- Diverse Learners
 - What
 - So what
 - Now what

Student Experience

I had no one validating what I was doing... I just never felt like [my instructor] would grade something and then it would just be wrong, but didn't tell me what I did wrong. Or telling me how to fix so that I wouldn't make that mistake twice; that's what I mean *presence*, [emphasis added] so when you just give out a grade ... If you don't say what the issue is I don't know so I can determine if ... it's wrong, but if you are not figuring out or explaining what was wrong.

What do students want?

I would have like for [the instructor] to provide feedback and/or direction on what I was doing that could and should have been done better. Just grading the work with feedback didn't help me resolve any issues especially since I was uncomfortable with the subject... I needed to hear and get live feedback and hear strategies that would be beneficial..

Community of Inquiry

- Social Presence
- Cognitive Presence
- Teaching Presence

Using e-tools to establish presence and provide effective feedback (COI model)

- Kaltura (mini lessons; feedback)
- Zoom (scheduling synchronous sessions)
- Blackboard Collaborate
- Google Hangouts
- Voicethread (feedback)

Feedback and Support

- Providing adequate feedback and support
 - Video (Zoom, Kaltura, ScreenCastomatic)
 - Phone Conference
 - Instructor Notes
- Orientation Course (Mandatory)
- Collaboration with Advising team – one voice

Activity

- Reflect on your past online teaching experience and identify instances where you established social, cognitive, and teaching presence.
 - What could you have done differently
 - How do you plan moving forward to establish a sense of presence
- What method will you use to establish presence in your online statistics course?

Webinar 4 Q&A



Agenda

- | | |
|--------------------------|--------------|
| ■ Welcome | 10 – 15 mins |
| ■ Ice Breaker Discussion | 10 – 15 mins |
| ■ Course Design | 20 – 30 mins |
| ■ Universal Design | 10 – 15 mins |
| ■ Questions & Answers | 10 – 15 mins |
| ■ Wrap Up & Next Steps | 10 – 15 mins |

Alignment

- Learning Objectives
- Course Materials
- Learning Activities
- Assignments
- Assessments

Federal Legislation



Source: Bart, R. (2012). Universal Design for Learning: Creating an Inclusive Virtual Learning Environment. 20th Annual Distance Teaching & Learning Conference Proceedings. Retrieved from http://www.edulibted.com/conferences/resources_20thannual0212_2012.pdf

Webinar #5

The Online Curriculum Design: Statistics I
Designing a culturally and developmentally appropriate learning environment

Discussing Cognitive Load

There were "so many things that the student has to do in a week's module, it gets overwhelming."

Accessibility

- [Quality Matters Rubric - Standard 8](#)
- [OLC Quality scorecard](#)
- [EASI](#)
- [AHEAD](#)
- [DO-IT](#)

Universal Design



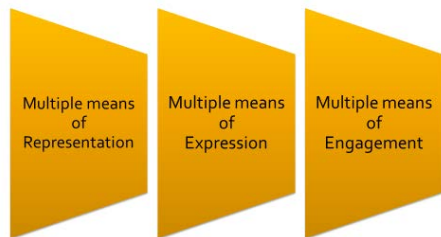
Source: Bart, R. (2012). Universal Design for Learning: Creating an Inclusive Virtual Learning Environment. 20th Annual Distance Teaching & Learning Conference Proceedings. Retrieved from http://www.edulibted.com/conferences/resources_20thannual0212_2012.pdf

Defining Universal Design for Learning (UDL)



Source: Bart, R. (2012). Universal Design for Learning: Creating an Inclusive Virtual Learning Environment. 38th Annual Distance Teaching & Learning Conference Proceedings. Retrieved from http://www.uvex.edu/sites/default/files/2012/01/udl_2012.pdf

The Three UDL Principles



Source: Bart, R. (2012). Universal Design for Learning: Creating an Inclusive Virtual Learning Environment. 38th Annual Distance Teaching & Learning Conference Proceedings. Retrieved from http://www.uvex.edu/sites/default/files/2012/01/udl_2012.pdf

Characteristics of UID in the learning management system (Moodle)

Perceptible Information	Flexible Use
Screen preferences, font size, masking, colors	Links to additional information
Screen document readers	Choice of topics/assignments
Text-to-speech	Conferencing tools
Screen/cursor magnifiers	Audio/video presentation tools
Transcription	Mind maps/diagram displays
Captions	
Technical and physical support	Simple & Intuitive Use
Voice recognition	Searchable forums
Word prediction	Searchable content
Built-in assistive technologies	Easy-to-navigate menus
Limited use of external links	Simple interface
Embedded multimedia/assistive technologies	Direct link to new post
Browser capability checker	Offline resources
	Mobile interface

Source: Elias, T. (2010) Universal Instructional Design Principles for Moodle

Home Work

Using the Quality Matters Rubric, reference the Statistics 1 syllabus and the online course template to determine the following:

1. Course objectives are specific, observable and measurable?
2. Evidence to show that course materials, media, learning activities, assignments, and assessments are aligned to the learning objectives?
3. Accessibility of course content as presented in Moodle

HEOA's Official Definition of UDL

The term Universal Design for Learning means a scientifically valid framework for guiding educational practice that:

- A. Provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged.
- B. Reduces barriers in instruction, provides appropriate accommodations, supports and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient.

Source: HEOA, 2008, 122 STAT 3088

The Nine Principles of Universal Design for Instruction

Equitable use	Instruction is designed to be useful to and accessible by people with diverse abilities. Provide the same means of use for all students, identical whenever possible, equivalent when not.
Flexibility in use	Instruction is designed to accommodate a wide range of individual abilities. Provide choice in methods of use.
Simple and intuitive	Instruction is designed in a straightforward and predictable manner, regardless of the student's experience, knowledge, language skills, or current concentration level. Eliminate unnecessary complexity.
Perceptible information	Instruction is designed so that necessary information is communicated effectively to the student, regardless of ambient conditions or the student's sensory abilities.
Tolerance for error	Instruction anticipates variation in individual student learning pace and prerequisite skills.
Low physical effort	Instruction is designed to minimize nonessential physical effort in order to allow maximum attention to learning. Note: This principle does not apply when physical effort is integral to essential requirements of a course.
Size and space for approach and use	Instruction is designed with consideration for appropriate size and space for approach, reach, manipulation, and use regardless of a student's body size, posture, mobility, and communication needs.
A community of learners	The instructional environment promotes interaction and communication among students and between students and faculty.
Instructional climate	Instruction is designed to be welcoming and inclusive. High expectations are espoused for all students.

Characteristics of UID in the learning management system (Moodle)

Tolerance for Error
Ability to edit after posting
Confirmation before sending assignments
Warnings when leaving course site
Learner Community and Support
Study Group
Links to support services
Instructional Climate
Involvement in discussion forums
Regular email contact with students
Availability for one-on-one consultation

Source: Elias, T. (2010) Universal Instructional Design Principles for Moodle

Webinar Debrief (Evaluation)

Webinar Series Feedback Form	
What Worked Well?	What still needs improvement?
Additional Professional Development Needs	Immediate Applications to practice and implications for further Professional Development

Webinar #5 Q&A



References

- Alago, M., Cobb, G., Cuff, C., Garfield, J., Gould, R., Lock, R., Moore, T., Rossman, A., Stephenson, B., Uets, J., Velleman, P., Wilmer, J. (2012). *College Report: Guidelines for assessment and instruction in*
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Agenda - Webinar Series

Webinar #1: Statistics Education: The Standards - *Guidelines for Instruction and Assessment in Statistics Education*

Tentative Date & Time: February 15, 2016, 6pm to 8pm
Recording available on February 16, 2016

- Welcome/Introductions 10 – 15 mins.
- Brainstorming Activity 10 – 15 mins.
- The GAISE College Report 10 – 15 mins.
- Proposed Changes to GAISE 10 – 15 mins.
- Syllabus Review Activity 20 – 30mins.
- Questions & Answers 10 – 15 mins.
- Wrap Up & Next Steps 10 – 15 mins

Webinar #2: *Online Statistics Course from Faculty & Students' Perspectives: A Case Study*

Tentative Date & Time: March 21, 2016, 6pm to 8pm
Recording available on March 22, 2016

- Welcome 10 - 15 mins
- Ice Breaker Activity 15 – 20 mins
- Self-Assessment 10 – 15 mins
- The Problem 20 – 30 mins
- Reflections 10 – 15 mins
- Barriers to learning 15 – 30 mins
- Questions & Answers 10 – 15 mins
- Wrap Up & Next Steps 10 – 15 mins

Webinar #3: The “Underprepared” Student: *Dealing with Diversity in the Virtual Classroom*

Tentative Date & Time: April 18, 2016, 6pm to 8pm
Recording available on April 19, 2016

- Welcome 10 – 15 mins
- Ice Breaker Activity 10 – 15 mins
- Adult Learning Theory 10 – 15 mins
- The diverse learners 10 – 15 mins
- Differentiated Learning Discussion Activity 20 – 30 mins
- Teaching Statistics for Conceptual Understanding 10 – 15 mins
- Questions & Answers 10 – 15 mins
- Wrap Up & Next Steps 10 – 15 mins

Webinar #4: The Faculty-Student Relationship - *How to Build a Learning Community and Establish Presence in the Virtual Classroom*

Tentative Date & Time: May 23, 2016, 6pm to 8pm
Recording available on May 24, 2016

- Welcome 10 – 15 mins
- Ice Breaker Activity 10 – 15 mins
- Student Expectations 10 – 15 mins
- Community of Practice 10 – 15 mins
- Feedback & Support 10 – 15 mins
- Questions & Answers 10 – 15 mins
- Wrap Up & Next Steps 10 – 15 mins

Webinar #5: The Online Curriculum Design: Statistics I - *Designing a Culturally and Developmentally Appropriate Learning Environment*

Tentative Date & Time: June 20, 2016, 6pm to 8pm
Recording available on June 21, 2016

- Welcome 10 – 15 mins
- Ice Breaker Discussion 10 – 15 mins
- Course Design 20 – 30 mins
- Universal Design 10 – 15 mins
- Questions & Answers 10 – 15 mins
- Wrap Up & Next Steps 10 – 15 mins

Evaluation Example: Webinar #3

- How did this webinar relate to your job and in what ways has it caused you to reflect about your role as an online/hybrid/face-to-face faculty?
- What new ideas have you gained and how do you plan to implement these new ideas in your course?
- What information was of the greatest value to you?
- What specific suggestions do you have to improve the training webinars?
- Additional comments

Example of Application of Concepts: Webinar #1 Home Work

1. Write your personal reflections about today's webinar.
2. What were key takeaways?
3. About what do you still have questions?
4. Review the Statistics Course Template in LMS.
5. Evaluate the template through the lens of GAISE.
6. Identify evidence of activities that result in conceptual understanding and statistical literacy.
7. Provide at least two recommendations for improving the course materials, media, assessments, online template in general.

Appendix B: Interview Protocols

Students

1. What are the pros and cons of learning statistics in an online format?
2. What did you learn in the online statistics course?
3. How did instructors facilitate learning in the online statistics course?
4. How have you applied the concepts presented in the online statistics course?
5. Which college courses prepared you for the introductory statistics course?
6. What were some of the challenges you faced in your online statistics course?
7. What is your opinion about the design and layout of the online statistics course?
8. What do you think about the assignments in the online statistics course?
9. What would you change about the online introductory statistics course?

Faculty

1. What are the pros and cons of teaching statistics courses in an online format?
2. How are students performing in your online statistics courses?
3. How do you activate learning in online statistics courses?
4. What barriers to learning do students experience in online statistics course?
5. What challenges do instructors face when delivering online statistics courses?
6. How do instructors differentiate instruction to meet diverse student needs?
7. What pre-requisite skills do students need to succeed in online statistics courses?
8. What changes would you make to the online course template?
9. What are the learning outcomes of the online statistics course?
10. What role do instructors play in designing the online statistics template?

Appendix C: Letter of Cooperation

Background Information

The threefold purpose of the proposed doctoral study is to examine faculty and students' perspectives about the curriculum design and delivery of introductory statistics courses; explore possible barriers to meeting learning objectives in online statistics courses; and document ways to create accessible, culturally relevant, and developmentally appropriate online learning environments.

Permission to conduct study

Based on my understanding of the above mentioned purpose of the proposed research study and the attached Data Use Agreement, I give permission for you to conduct the study entitled Online Statistics course from faculty and students' perspectives: A case study within the **EFG College** (pseudonym). As part of this study, I authorize you to review student opinion survey reports (online statistics courses), the introductory statistics course template, and related syllabi. I also authorize you to interview interested faculty and students and follow-up with them to validate the interview transcripts and study's findings. Individuals' participation will be voluntary and at their own discretion.

We understand that our organization's responsibilities include: initial contact with eligible prospective participants to distribute the researcher's letter of informed consent; provide guest access to the learning management system; and provide a space for conducting face-to-face interviews. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University Institutional Review Board (IRB).

Sincerely,

Authorization Official
Contact Information

Appendix D: Data Use Agreement

This Data Use Agreement (“Agreement”), effective as of June 21, 2014 is entered into by and between Ruth Best (“Data Recipient”) and EFG College (“Pseudonym for Data Provider”). The purpose of this Agreement is to provide Data Recipient with access to a Limited Data Set (“LDS”) for use in research in accord with the HIPAA and FERPA Regulations.

Definitions. Unless otherwise specified in this Agreement, all capitalized terms used in this Agreement not otherwise defined have the meaning established for purposes of the “HIPAA Regulations” codified at Title 45 parts 160 through 164 of the United States Code of Federal Regulations, as amended from time to time.

Preparation of the LDS. Data Provider shall prepare and furnish to Data Recipient a LDS in accord with any applicable HIPAA or FERPA Regulations

Data Fields in the LDS. No direct identifiers such as names may be included in the Limited Data Set (LDS). In preparing the LDS, Data Provider shall include the **data fields specified as follows**, which are the minimum necessary to accomplish the research (list all data to be provided): Math, Algebra, & Statistics course syllabi; Statistics course content (learning management system); grade distribution data across online, hybrid, and campus based statistics courses; student opinion survey/course evaluation/feedback data for statistics courses.

Responsibilities of Data Recipient. Data Recipient agrees to:

Use or disclose the LDS only as permitted by this Agreement or as required by law;

Use appropriate safeguards to prevent use or disclosure of the LDS other than as permitted by this Agreement or required by law;

Report to Data Provider any use or disclosure of the LDS of which it becomes aware that is not permitted by this Agreement or required by law;

Require any of its subcontractors or agents that receive or have access to the LDS to agree to the same restrictions and conditions on the use and/or disclosure of the LDS that apply to Data Recipient under this Agreement; and

Not use the information in the LDS to identify or contact the individuals who are data subjects.

Permitted Uses and Disclosures of the LDS. Data Recipient may use and/or disclose the LDS for its Research activities only.

Term and Termination.

Term. The term of this Agreement shall commence as of the Effective Date and shall continue for so long as Data Recipient retains the LDS, unless sooner terminated as set forth in this Agreement.

Termination by Data Recipient. Data Recipient may terminate this agreement at any time by notifying the Data Provider and returning or destroying the LDS.

Termination by Data Provider. Data Provider may terminate this agreement at any time by providing thirty (30) days prior written notice to Data Recipient.

For Breach. Data Provider shall provide written notice to Data Recipient within ten (10) days of any determination that Data Recipient has breached a material term of this Agreement. Data Provider shall afford Data Recipient an opportunity to cure said alleged material breach upon mutually agreeable terms. Failure to agree on mutually agreeable terms for cure within thirty (30) days shall be grounds for the immediate termination of this Agreement by Data Provider.

Effect of Termination. Sections 1, 4, 5, 6(e) and 7 of this Agreement shall survive any termination of this Agreement under subsections c or d.

Miscellaneous.

Change in Law. The parties agree to negotiate in good faith to amend this Agreement to comport with changes in federal law that materially alter either or both parties' obligations under this Agreement. Provided however, that if the parties are unable to agree to mutually acceptable amendment(s) by the compliance date of the change in applicable law or regulations, either Party may terminate this Agreement as provided in section 6.

Construction of Terms. The terms of this Agreement shall be construed to give effect to applicable federal interpretative guidance regarding the HIPAA Regulations.

No Third Party Beneficiaries. Nothing in this Agreement shall confer upon any person other than the parties and their respective successors or assigns, any rights, remedies, obligations, or liabilities whatsoever.

Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument.

Headings. The headings and other captions in this Agreement are for convenience and reference only and shall not be used in interpreting, construing, or enforcing any of the provisions of this Agreement.

IN WITNESS WHEREOF, each of the undersigned has caused this Agreement to be duly executed in its name and on its behalf.

DATA PROVIDER

DATA RECIPIENT

Signed: _____

Signed: _____

Print Name: _____

Print Name: _____

Print Title: _____

Print Title: _____

Appendix E: Introductory Letter

Dear Colleague,

Over the past two decades, there has been a reform movement in statistics education and a number of studies have addressed student performance issues in face-to-face classrooms. However, little empirical research exists about teaching and learning practices in online statistics courses. I am conducting a research study to explore faculty and student perspectives about the curriculum design and delivery of online statistics courses. A goal of this study is to capture and chronicle your experiences by conducting an individual interview with you over the next few weeks.

I am interested in hearing about what you consider as the pros and cons of learning statistics at a distance. My long-term objective is to discover ways to make improvements to the online statistics curriculum design to ensure the learning environment is inclusive, accessible, culturally relevant, and developmentally appropriate.

If you are interested in participating in the research study, please contact me directly using the email address below. Your participation in this project is voluntary and the information you share will be kept confidential. Do not hesitate to contact me if you have any questions or concerns regarding this research study.

Sincerely,

Ruth Best

Appendix F: Sample Transcript

To provide context and set the stage let me verify some demographic information from you.

When did you start your bachelors program? What year?

Ah 2012

Oh ok! [Slight pause] So, when you were taking the statistics course online, that was part of your associates?

That was a part of ...No that was a part of my Bachelors but I had, I needed one more class in order to become fulltime so they went ahead and started me in my Bachelors program while I had one leg in the Associates finishing up.

So was that the only online course that you took - the Statistics 1 course?

No that was not the only one online course I took. I think it had something to do with media, it was an elective, and it had a lot to do, and, I don't remember the exact name, it had a lot to do with current events and a lot of forums postings and ahm, just responding to peers, there were no exams or anything else.

So, just to clarify you were not a fully online student, you were an adult student; part of the evening program?

Yes I wasn't a fully online student.

OK! And it's interesting because you started out in [with a different program of study]?

Yes 2010 to 2012

Oh! Ok, and what prompted you to come into the business?

Well I landed a fulltime job as an accounts payable clerk, and the company I was working for, ah, had the program where they would reimburse you if you went to school; and my manager kept pushing me, you should try; and I have always loved math and accounting so I realized that the school had it and ... so I said I was going to get some help.

So your highest degree to date is your Bachelor's. Any plans to pursue a Masters?

Yes I plan on pursuing my Masters in Finance, but I am currently studying for the CMA exam, the Certified Managerial Accountant's exam.

That is excellent! [with emphasis].

Yes, Thank You

So wait, your bachelors is in business administration with a concentration in accounting or ...?

Business management with a concentration in accounting.

Ok! So now that we collected all the demographic information...Now that I have gotten all that, I want you to take a moment and reflect back on your experience as a student enrolled in the online statistics course. [OK] Ah and you know, be honest, you know, tell me how you felt.

I really want to know because we are not going to be able to make improvements, obviously, unless we get the feedback from candidates and as you know the purpose, you know, from reading the informed consent, the purpose of this study is to examine the faculty's and students' perspectives about curriculum design and delivery methods; to explore possible barriers to meeting learning objectives in online statistics courses; and to possibly document ways of creating inclusive, accessible, culturally relevant, and developmentally appropriate online learning environments.

For this, I will be interviewing a number of faculty and students, and our interview will run between 60-90 minutes. You will have an opportunity to review the interview transcripts and study findings to verify that I have captured the information accurately.

Any information you provide will be kept confidential. I will not use your personal information for any purposes outside of this research project. And I will not include your name or anything else that could identify you in the study reports, so you can be as frank as possible. Data will be kept secure by safeguarding all interview recordings, transcripts, field notes, and other data on a password-protected computer. Data will be kept for a period of at least 5 years, as required by Walden University.

I will be taking notes and you know I am recording, ah, so feel free to stop me if you need additional clarity on a question. Ah, do you have any questions before we move on with the interview protocol?

I am ready

Awrighty, you are ready, Ok! So, first question, what are the pros and cons of learning statistics in an online format?

Well I think the pros, some pros of learning statistics online is, ahm, have to do with the time frame. When I say that I mean, you are given a little more time online than face-to-

face, with the professor to figure or try to understand what it is that you need to know, or learn, or get from the problem that is being given to you. Rather than if you were in the classroom, the professor is right in your face, your classmates are right there and some people like myself aren't as comfortable with not being comfortable with the unknown versus me being behind my computer and I have my own space; my own time to process and learn.

Ahm, a con that I can think of, ahm, well learning statistics online is the fact that you can right away ask a question that pops up, but, a pro about that, if I answer my own question, is that you can simply, with the experience I've had is that you can simply send a message, because there were a lot of times when the professor was available to answer your question.

Ahm, another pro of learning statistics online is that you have computer access and if there is something that you don't know you can browse the web quickly. You can switch over to Google and, you know, find out what this means if you forgot; even the simple terms I'm referring to. Ahm, I was very comfortable with learning statistics online. It was not as detailed as other accounting courses that needed one to one attention face to face. I am comfortable being able to communicate, being able to understand what other classmates were going through from their writing; not every time a face to face interaction has to be there. More people can express themselves in writing like myself, in order to get to a point that we are trying to achieve.

Good, good. Ok you raised a lot of key things. You talked about feeling comfortable expressing yourself in writing. Do you get the sense that a lot of your classmates felt the same way?

I, yeah, I think so. I met a few friends who I still have today, in the course, and they felt the same exact way, they were better at writing than actually speaking their way out of a question.

Umm, you also talked about learning style and the discomfort you felt in a face-to-face class. Can you speak a little more about that? Do you think that is related to you personally or is it something about adult learning styles?

I think from experience, it has a lot to do with the adult learning styles, because you can be in a classroom with people younger than you, older than you, and it is not very comfortable to say be one of the oldest and not knowing; it is just emotional feelings, which is just human. It's normal, so not being comfortable in the classroom versus being behind your computer and having your teacher there, your classmates there, they are seeing your face, they are not seeing your gestures, they are not realizing that you are a little shy or uncomfortable. That helps a lot, but I think it has a lot to do with the adult learning. Younger people are probably don't care and they would have the mentality or

the feeling well, we are learning, but adults have more pride and feel like they've experienced more so there is a little timid emotion that you're gonna have when you really don't know.

Ah, you talked about being comfortable online as well. What do you think was the attributing factor to your comfort level working in; doing, actually working in a statistics course online?

Well, when I started that course, I said I was going to fail upfront; well this is statistics has a lot to do with collecting data. I just thought that statistics was going to be difficult and the first few classes, I was struggling, but then when you have a professor whose who is there to answer questions, who made themselves available for you, who made it open for your classmates to throw their questions out, and you know it wasn't enclosed, where you would feel like you were the only one having this issue. You were open and because we had that the ability to hear back from classmates and hear back from the professor, the availability of everyone, that made it easier for me.

So what I thought I heard you said is that the availability was key and the fact that there was kind of like a community of learners, you guys felt comfortable with each other, that you could communicate and share, and even share your struggles with each other, if I am understanding you correctly.

Yes, you know, we became very close and we all felt the same exact way and when we brought up problems to the class and to the professor then it was explained. We were able to express ourselves, understand where the struggles were. We had this session where we were able to express where we were struggling, what was wrong and it was broken down, and the professor telling you what you need to do, the classmates telling you; it just made everything easier; it became a flow, and we even had to work with our classmates, our peers outside of those forums you know, we had projects that we had to work together on; it all became easier so that changed the whole mentality at the beginning so it made it easier.

You said something that, that triggered a question; you said things were broken down; can you speak a little more to that, when you say broken down what does that mean to you?

When I speak about things being broken down, I am referring to broken down, details of every problem that we had, it was explained word for word, step by step. It is amazing the way that it was taught to us. It's like there was no need for in class presentation, because it was detailed enough where you could understand every single step; the problems from start to finish what you need to do, how to get that step; was very well explained.

So was that the way the course was presented in the learning management system? Was it the way it was broken down in Moodle? Or was it a combination of interactions with your peers, the instructor and your readings?

Yes it wasn't broken down that way in Moodle, because as I said I was a little afraid at first when I saw what the assignments, what the text said. It was a combination of the discussions, it was a combination.... We even had the opportunity to have a mic and hear each other. You going near each other and a combination you going to the professor and getting extra help and talking to the classmates, like I said we had conferences outside of the classes. It was a combination of everything that just came together like a family and made it work; easier to understand.

Right! Now you mentioned something about fear. Was it fear of what you saw in terms of the content? I know you mentioned at first you thought you would fail because of... what was it exactly? Was it the content? Was it the fact that you saw all this work in Moodle? Was it the layout of the course? What caused that fear?

Well a combination of things made it fearful. Well, you hear that online classes are more work and, am, the extra work, it's less that you are in class or, yes the assignments were there in Moodle week by week but that was explained so that did not make it fearful... only what you hear you know that online is going to be difficult, it is hard. It was more giving it a try first, that was my fear, that is why I wasn't afraid because the other class I took was after. Statistics was the first course. Yes, it is a lot more work, but the breakdown of it made it easier for you, you know, you had this number of assignments due each week by that date and you needed to get it done. So, I do not think it is too much work for the short timeframe, I think the timeframe was good, the amount of work was good. Your surroundings what you hear people say, that is why I was afraid.

You answered my next question before I even asked it, because I was going to ask you what you thought about the workload, because, you know, like you said, oftentimes people say oh my goodness, online is more work than, than, ahm being face to face, but do you think that people have that perception because you are doing more on your own?

Yes, I think so and that also have to do with personality or maybe your commitment or dedication. I mean going to school is a commitment that you are making and you have to know that you are going to be doing work. It is not going to be a piece of cake every time. I was never one to complain about the workload. I expect to have work and so I did, I never thought the online courses were too much work, because you are given the assignments ahead of time, you have a lot of time to do it and get it done, so again that is what people say or personalities about how people handle the work is why you hear those issues.

Right! How did you balance to do your readings, your assignments, interact with your colleagues? How did you balance your time?

I, that was very difficult because I have been working two jobs since 2010, I work 7 days a week, I went to school, I was a mom, a wife and so I spent a lot of my time late at night doing school work and at my lunch time at work, so during the day at lunchtime, I would be able to communicate with classmates; I would do my part late at night and by the time they would be up, my part would be done, during the day we would communicate via email and that's how I balanced it.

Ok! So tell me what you can remember from Statistics, [laughing]. What did you learn?

Well I learned a lot. Ahm I learned that the key or that the first thing you have to do is collect data. You need to collect data in order to have some form of statistics, so that was, I think that was the most, ahm, thing that stuck with me because from the online course and the second statistics course I took was all about: Where are you *going to* collect the data? What you *going to* do with the data that is you statistic and... that the thing, thing stuck with me in statistics.

Do you remember any of the concepts?

Ah not off the top of my head. All I can remember is the loop with what you call the chart that goes up and down and the peak, I am thinking. I can remember more of the last class versus the online, but let me try and think about the problem that I was having and had to get serious help for. Ohh we had to do a lot of things in Excel.

Uh huh

Yeah the project we had to do was in Excel and ahm off the top of my head...

So tell me what was so; what do you remember from the second course, since that is fresher

Oh the second course was [laughing], that was funny, ahm, I can remember the drawings that the teacher put on the board with the shading and the areas, of ah, you know, you have the line...

Ah I think I know what you are talking about – the bell curve?

Yeah - - the bell curve yeah [laughing], I can remember that and where it meets and you shade in that area and...

The z scores and probability?

Yeah, z scores and yes probability was always my worst; I was never comfortable with probability. Yes, that was my struggle with the online course – probability!

Why? What was it? The topic – where did you struggle most?

Well the understanding how. I remember how the instructor broke it down, if you roll the dice five times what is the probability of me getting a one and repeating the process and that whole thing I never grasped it. It always, it is still a struggle for me today, but I don't use it, so I don't remember it.

That is a good segue, but before we segue into my question about how you use what you've learned, I just want to let you know that probability is one of the areas that even face-to-face students struggle with [yeah]. When I taught statistics in the face to face program, students struggled with probability. That was something that we had to spend a couple weeks going over, and in the hybrid program in the evening it was the same thing. But the thing with the online, the way it is laid out, I don't know how much time was allotted to work on probability...it is an area that people struggle a lot with.

Yeah that could probably be it, you know, the amount of time that certain aspects of the course was spent on, but probability was just a struggle and you are probably right, I don't think we had enough time working on that, but the teacher did explain it in detail that I got it, in order to take my exam and I got it right, but if I was to explain it today, I can't [ok], it is something that I would have to learn again.

Ok awrighty. What is your typical learning style? How would you classify your learning style?

I am a good listener and I like to put it into practice, so I don't have to be face to face, but once I hear something, I like to write a lot, so I am writing a lot of what we are talking about right now. I like to write a lot and once I listen then I put it to practice. That's how I like to learn.

So if we were to put that into... it's probably auditory/tactile, because you said you like to listen, which is the auditory, and you like to write, which is the tactile/kinesthetic probably, you know?

Yes, um hmm that sounds like me.

Yes awrighty, and you mentioned something that I will probably come back too, you know, learning something just enough to pass the test. Ah, would you say that about a lot of concepts either in the Statistics 1 or II course. You got things right; you got a good grade but really and truly you would have to go back and revisit it to really fully understand?

Yes I would have to say that for a lot of the Accounting courses as well as the statistics courses that I took. Basic Math was probably one of the only courses that you use that you see every day like my daughter, now she is going and she is learning multiplication, but for something that you don't use very often, you will forget it and especially like the probability I struggled with. I would definitely be reminded of the concepts. Maybe it will be easier this time. Because it was taught to me years ago and now. The Statistics 1 online and in the classroom and I probably have to be reminded about the key steps in order to accomplish or answer the problem.

So ahm you told me, you started talking about math. One of my questions is which college courses do you think would prepare you for the introductory statistics course? What would be some of the prerequisites for if you were to give advice to a student coming in online or even a face to face introductory statistics course? What would be the courses that they should have? What kind of experience and knowledge should they have coming into the course?

Well I think if they have taken basic math then they have, you are getting the gist of statistics... it more word problems; it is not just physical, regular math line by line math. It is more reading the word problem and answering it, so maybe some kind of mathematical concepts – there is a course like that. But it is definitely Statistics 1 and 2. It gets harder as you go along, but if you have basic math concepts, you should be ok.

I've seen other studies that say that college algebra is key.

Oh yeah, algebra

Yeah! Because of the ,you know, algebra is a lot of equations and a lot of that stuff, I think that's where the thinking is, probably if you have an understand of algebra, you will be able to do better in statistics.

But you are saying basic math. So what are some of basic math concepts that inform statistics?

Multiplication [ok], so that as well as the word problems like I said where you have to read then understand then collect your data and figure out the solutions.

What about basic concepts like percentages and fractions and ratios?

Ratios yes. So that is why I think the basic math would be more of a prerequisite because you do those in basic math, the fractions and the ratios [yes] and proportions [proportions yes] so yeah. I mean now that you said algebra that makes some sense because you have the x and the y and I remember some of that in statistics, a little bit the letters, but ahm I think if you have basic math, college algebra, mathematical concepts for sure, I am saying that because from learning math in the Caribbean, mathematical

concepts was a course and that was where I was learning ratio and proportion and I remember I use to go outside and cry because I couldn't get it at the beginning ratio and proportion because I wouldn't get it for nothing no matter what my teacher did. She would follow me outside and try to talk me out of crying because I wouldn't understand.. the fractions I was a genius

Oh wow!

I love fractions to this day; I am a genius at fractions.

To be successful in fractions, divisions and all those things and ratios, you have to really know multiplication. People don't realize the correlation. [yes] Now you mentioned, you mentioned ah your formative education being in [the Caribbean] and that is like a little, you know I mentioned cultural relevance and cultural connections before [um hmm]. What was the difference, even you would have been younger at the time, what differences did would you see the learning, the way information is presented, the instructional strategies that the instructors used in the Caribbean versus your experiences in the US?

Well it's very, very, very different. Ah the math, the teaching there is more advanced. Why I say that, because I started learning at the middle school level, the high school level here, seventh grade and when I left [the Caribbean], I completed grade six, I skipped one grade and what I was learning in grade six in [the Caribbean], they were teaching it in ninth grade in high school.

Wow!

Yes so I was already ahead and I was more comfortable and I understood it better. Some of the teachings were similar, the same teaching for fractions and algebra, and it wasn't that it was different; it was just that I had already learned it.

Right

So we were more ahead you know, I guess we were, a lot was being taught to us, like we are in school longer hours in [the Caribbean] you know we were just ahead, so when I went to ninth, so I left [the island] seventh grade, I didn't go to eighth grade and I went straight to high school after taking an exam, so what I was learning in ninth grade, I already did all of that in [the Caribbean].

Wow, you know I am wondering, you know, thinking of our classes, our adult program, oftentimes we have a lot of students who are immigrants who are coming from the Caribbean and other parts of the world, I am wondering, you know, how they feel being in the classroom with students from other, you know, who may like you maybe you maybe advanced as a student coming from the Caribbean. But how

does that play out in the classroom? I am just talking out loud. I just thought about that as you were speaking, you know, from our perspectives in the college level.

Right, it was very evident in our classes, some of the classes I had where students from the Caribbean versus students from elsewhere, you know, there was a big difference, we not to say we were smarter, but the few I had a few other Jamaican classmates with myself ahm two other guys and our writing, the way we presented was totally different was from how the other students presented, but like I said it's from our experiences, experiences we had, you were, it was thrown in our faces to present from grade one. Yes, so I saw the big difference in the classroom. I don't know if the teacher sees it. Some teachers did see it because they made it clear that this was a, that was b and some teachers just didn't realize that we were all from the Caribbean or not, but I see the big the difference with the learning with what we know versus what others knew.

Yeah wow! You raised a good point, how do we as teachers do we recognize it and then how do we respond to it? You mentioned that some teachers said *a* and *b*, did they do it to you individually or did they recognize your advanced level in the whole class?

A few of them did, individually and in the whole class, because, you know, at the time it was assignments that she had, he/she had to make it all well we only had one A. Even in statistics I think, I remember now, there was only one A on the final and a B, and the A and the B were two [islanders]. [laughing]

Wow! Is this was the second course or the first one?

That was the second course. That was the second course. [Wow]. There was one A, one B, and the rest were Cs and B-s. I think and [the instructor] came in and we were like oh wow.

Were you the A by any chance?

I was, I was actually [laughing]. Thank god for the project, the project made the A for me, it did [oh good, good].

Now before I move to my next question, you mentioned previously that some of your classmates did not seem to have, you know, they did not come to that second course with the concepts, the conceptual understanding, like you took from the course. I remember you even mentioning you wished you had taken the second course online as well. You appeared frustrated that your classmates didn't seem to have a grasp of the basic [oh yes] concepts of statistics.

They were not taught half the things that we were taught online and thank god that I kept all my notes and all my papers. What they were taught in the first statistics course did not

help them in any way, shape, or form for the second course. They were lost. The poor teacher didn't know what else to do. Instead of teaching the second course there were times that we were going back to what we should've already known, so that is probably, that also helped me to get my A because I knew more.[laughing] I knew more.

And you know the irony, yeah but the irony is that most of your colleagues had face to face classes where was the argument that you know where a lot of students say I would do better if it was face to face, yet your classmates had face to face classes, but yet they didn't walk away with the concepts, which brings me to another point ahm. What was the timeframe in between when you took the first course to when you took the second course? Was it right after?

No, it was over a year.

Wow!

It was over a year, yeah, and all of them took the statistics course face to face. I remember that they were very much against, "oh my god you took statistics online, oh wow," and I am like 'yes and obviously I learned a lot more than you did' [laughing].

That's interesting, but you know you raise another point about learning theory because remember in the beginning you said that you're working on your own, you are trying to get the information, if you don't understand, you ask a question of your peers or you instructor, so you, a lot of the learning is really on you, versus when you are in a face to face classroom, it is very easy to check out, you know [right] the teacher is talking and you may not necessarily be paying full, you may not be paying full attention. So that happens sometimes in the face to face, so it probably is a different style of learning and it sounds to me based on just talking to you, for a student to be successful in the online course be it statistics or anything, they need to be able to to ah be independent would you say? And ah they have to be willing to commit, that was the word you used. [yeah] You talked about the commitment. Anything else that you would think that you would think would be a characteristic for a student to be successful online?

Ahm, well it's like I said, have a lot to do with your individual personality, your character. Are you going to school to better yourself or are you going to school because my mom made me go to college? Or you know it has a lot to do with that, but learning online for someone who has a life like me, it's great, it's fantastic; you get the opportunity to learn and earn credit the same way as if you were in the classroom, so it is great overall. It has nothing to do with where you can't learn or you can't do, you're not going to learn enough, it's nonsense, because when I was learning statistics in the classroom, there were more things in the classroom to distract me than there was when there was when I was sitting on my computer at home with my headphones on, my mic

on, communicating on my assigned nights of the weeks. I know this was statistics and I knew what time it was, but there was so many different things to distract you in the classroom.

Interesting!

So I am all for online learning and I think it is just great, especially for adults; it gives you more leisure, more time to do things, and an adult is not going to waste time to focus on learning and this is why I am doing this course for; to better myself, to better my life, my family, and it will be just fine.

Yeah, I .. when you were talking about the personality and stuff, I jot down a note to myself; intrinsic motivation. It sounds like what I am hearing you say is that adults have that intrinsic motivation, you are doing it for a purpose like you said. It is not because mom wants me to do this, you have got goals that are yours and there is a reason why you are doing it.

Yes,

So it sounds like you had a good experience, but I am sure that they were some challenges, some of which you alluded to some of the content, but any other challenges? Navigating the course was fine in Moodle, did you have a learning curve in in navigating the learning management system at all?

Well, Moodle was no problem for me and it could because it wasn't my first time using it. Ahm, the online tool (?) was the first time using it, but it was quite simple. It was ahm, it was very detailed and that had a lot to do with your professor and how they present, you know, the assignments ahm, the, what you call it there, I forgot, what is the thing the professor give you before you, when you join the course?

What is that, the syllabus quiz, the diagnostic?

The syllabus, yes, the syllabus [laughing]; it breaks everything down for you, so now you know what's to come and Moodle allowed the professor for you to, ahm, have week by week assignments and it also didn't open up until a certain time so it wouldn't be too overwhelming, so that was a good thing. No versus seeing the whole three months of work that you have to do, when it is time, the new week would drop down and you would be able to see it. Although sometimes I was hoping for the weeks to open so that I could be ahead because there were some weeks where I would be done with the work earlier, so ahm, maybe I would suggest opening up two weeks at a time instead of just one, for students who are more ahead. Ahm, but it was very easy to navigate, well explained, the fact that we could talk at the same time you know at a certain time; you say log in at 8 o'clock, we are going to have a chat; those were very helpful, those were good and for Moodle to have that, you know, that feature, that was good [ok] also the mike.

So ahm, you talked about Live Chats, did your course have videos as well or was it just text-based?

Ah text based. I don't remember any videos. [ok]

Ok, Awrighty! And you, ahm, yeah you mentioned the layout, the syllabus. What did you think about the pre-assessment? Do you remember how well you did in the pre-assessment before you started the course, and do you remember taking a diagnostic before?

I took one yes, but I don't think I did that well, I don't remember. I don't think I did that well.

So what do you think about the assignments. I know we talked about probability, we talked about. Do you remember like there was, I can refresh your memory in terms of the concepts that were introduced in the first course. It was the mean, median, and mode that was the, the focus, ahm [yes], standard deviation, graphing, the bell curve that you mentioned before, so you talked about having a project, but what about the discussion forums in the course?

Oh those were great, those were very helpful, ahm, that was pretty much after you've done your assigned readings, reading these chapters, going through the concepts, you are able to discuss them, write what you thought and reading what other people, although a lot of them were the same, a lot of thoughts were the same, you know, I thought the forums were great.

Now one of the things that I know they tried to do in those forums was to make connections to real life experiences and, ahm, make connections to what was happening at the time in terms of news. What are your thoughts about that as part of your course? Was it relevant or should it... [Interrupted]?

Yes [go ahead]. I think that was very relevant. I've had many courses, not online, but regularly and that is something that I realize that a lot of professors do and that I think is good. It doesn't make things boring; it gives you the chance to relate to what's going on to make you aware of stuff. Some people don't even have time read or look into the newspaper or check out the news but if the class gives you the assignment then you become more aware, you are able to relate to others and you are able put what you are learning to real life immediately to prepare you for what you are working towards; preparing you for the real world. So I think that should always stay in the curriculum.

Which takes me to my next question; How have you applied the concepts to future, you know, later courses that you've taken because you've graduated, as well as your work life?

I use these concepts all the time at work. Mean, median, mode, standard deviation. It may not be the exact thing, way that, I have had to write them on paper for class, but working in accounting, you know, you have to run reports and prepare projects for the managers and upper management and so you know you want to know what is the mean... that is average and you know it is related to my daily life every day. And then I get to work with my daughter with her math and you know I can relate to that as well. So I use that, that's the basics of statistics that you would never forget.

In addition to your work life, now thinking back to some of the other courses that you took, you, did you, you took primarily accounting courses, but were you required also to take, ahm, what was that course called, intermediate finance? Was that a part of the accounting program or no?

Yes, yes, it was.

So do you think that some of what you learned in the statistics course informed that course as well?

[Background noise] Yes, yes, ahm, the statistics and intermediate finance, I mean it had, it had the... I can't think about the exact concepts that we used.

You know in finance, there's a lot of, to help refresh your memory, ahm you said standard deviation you are using on your job. But in finance they talk about spread, which is really the standard deviation as well, so I am sure when you had intermediate finance, the terms, the terminology, like you were talking about earlier, differed, but it was the same concept.

Yes and then sometimes we don't even realize until it is broken down for us, [right] oh that's what that is. Oh but I remembered ah slightly a little bit about that.

Yeah and you talked about word problems earlier. What would you say in terms of skills you have developed as a result? You talked about the focus, everything is about data collection. What skills would you say in addition to learning how to figure out certain things, what skills would a course like statistics, what can you develop?

Well it definitely helps with your math skills with average, finding the mean and mode and the basics, but it you learn the basic math, multiplication, subtraction, the PEMDAS from day one and that goes with you just make you, it help you put the pieces of the puzzle together.

That is the computational skills, but any other skills?

Ahm, any other skills with statistics, I mean like I said, gathering the data and solving word problems which at times that work that is something you have to do when you asked sometimes you have to do, it's not in equation form.

The reason why I ask you that is because each of the, if you were to go back and look at your syllabi and it probably would make sense now. Each of the syllabi have general education core competencies and the Statistics 1 course, there were two core competencies; problem solving and critical thinking. So how do you think that course developed those two skills?

How do I think the statistics course help with these two skills?

Yes, Oh well that is all the statistics course is about, well not all, other than the computations and the equations, but I remember from statistics a lot of thinking a lot of problems with words and questions and I don't remember a lot of math numbers being thrown at you; you have to read and actually go out and do a survey and gather data, then put numbers together to make sense. So those courses are big in helping you prepare for a statistics course.

I am glad to hear you said that because there is a, are some guidelines that actually came out within the last five to ten years on what should be the focus of statistics courses and a lot of times the focus is on number crunching, but what I am hearing you say is that in your experience it was more about analysis and critical thinking and problem solving. You were given a situation or you were... collected some data and then you had to analyze it and come up with ah an outcome or some findings, so that's good to hear that your experience was not basically number crunching.

Right

What would you change other than you mentioned briefly something earlier about probably spending more time on certain concepts. But what else would you change if you were to change anything about the online statistics course?

I [pause] let's think what would I change, ahm

What recommendations if you can't think about changes, what recommendations would you make to improve it?

Ahm, well other than having a great professor, I mean, I can't think about any bad areas. The experience I had when taking the course, but I could say ahm [pause] I am trying to think about where I had any struggles, was just trying to understand one concept and I mean, we have ways of contacting the professor, if we had questions we were able to communicate with our classmates. Ahmm

So you struggled mainly with probability that was the only area where you struggled?

Yeah that is the only area I had trouble with; the other stuff was pretty simple.

OK, you mentioned that those Live Chats were very helpful, because you know, you know... 9 o'clock, 10 o'clock and people were still going, even though you guys had to work the next day [yeah].

Oh yeah we were committed to getting it. [laughing]

Now you mentioned that a key is having a great professor and I have heard this from, ahm, people who have had great professors and people who have not had great professors, so my question is what would you identify as the characteristics for an online faculty member to be effective?

Well first the online faculty member has to have some kind of understanding that there are going to be struggles, based on not enough time, set aside for certain topics, or understand maybe that the online learning is new for some people and to have a little patience. See, my professor was not, didn't make it like he/she wanted me to fail, you know, it was you are having trouble here, well I am going to come on at 9 o'clock and we are gonna have this conversation and we are going to talk and the professor was available for you to have questions before it was time for class start, so you have to have a professor who cares and understands that there is gonna be barriers in the way and so that I think ahm makes an online professor good.

So you... the barriers that you, you would identify if I heard you correctly, time management is one of the barriers, you would say, as well as the online learning experience itself was difficult, any other barriers to learning?

Ahm no, no not that I can think of.

So to recap to what I heard you say in terms of characteristics, which is so ironic because I heard these same, same ahm, characteristics before and I've seen it also in the literature: understanding, patience, availability, caring, and I didn't get the other, but I will listen to the tape. But the patience and the understanding is something that is in the literature a lot and flexibility is also a big one. [yes]. Even you said availability, you the instructor would obviously would have to be flexible to commit time later in the day, when the students would be available.

Right and, you know, once you have a professor that is understanding, who makes you feel like you know well you are not alone, I understand, you have a life, you are an adult, you have children, you have. That helps a lot. You have some professors who don't care that you have another life outside, you know school yes it is gonna help you in the future

but it is time that you are setting aside then. You have to have that kind of support and comfort in order to do well.

Right! Now and that is really what I am hearing in terms of how your instructors facilitated the learning. What was the difference between how your online course was facilitated versus how that second face to face course was facilitated? Were there any similarities and differences?

Ahm, there were, there were some similarities, I mean some face to face professors were understanding; they themselves were working two jobs; they had a job in the day and were coming at night to spend two hours go home, you know they were understanding, they were relatable. Then, there were students themselves, as well as being adults and then you had some who were well “you come to school, you are here to learn and you have no time to waste and if you miss this and miss that it is a problem. And they made it uncomfortable, they made you uneasy, and they made it seem as if you were not trying you were not doing enough. So, ahm, that is where I am for the online course cause sometimes it is hard for you to get in to the actual classroom versus I get at home I can do some much, before it is time for me to log on. Or the online class gives you more time versus you had to go to school two nights a week. So the online course you basically have 7 days to get the work done. You have to report yes maybe for a chat or a forum for at a certain time, but I feel like online give you more time and so that that, ahm, makes the professor ah more leisure able for you, that could be a difference I think.

Now you mentioned earlier how in your second statistics course, the instructor did a lot of, I guess she used a lot of, ahm, she did a lot of demonstrations on the board. What else did she do to facilitate the learning experience for you and your other classmates?

Not enough, I think she stuck in the book too much, tried to do the book by book and that was not good at all. It didn't help my other classmates who obviously didn't learn the basics who were lacking the understanding. It didn't help them at all. You just can't stick to the book. You have to show, be more accountable with your teaching and show that you know you are talking about. You don't have to go by what John Smith, the author said.

Speaking of the book, what did you think about the book you had for the Statistics...? [Interrupted]

I didn't like it

The first course?

Ah! We didn't like either book

You didn't like the books. Why?

I think, I don't think it taught us. What [the teachers] were teaching us, I think [the teacher] made copies of something and post it for me actually with the probability issues that I was having.

So extra resources was helpful?

Ok! Awrighty, oh wow! You have really really really shared some good good stuff! Ah you actually took me into some of the theoretical concepts, one of which is about learning theory and how adults learn differently; how it differs from how other younger students learn. Ahm, would you say that online is more self-directed than face to face?

Yes

And when you hear the term self-directed, what does that mean to you?

Well I take that as you learning at your own pace, you learning at your own ability with off course guidance, rules, some restrictions some constrictions, but self-directed is you taking what is being presented to you into your own direction. And for someone who is putting themselves in a position where they can better themselves, they are not going to direct themselves in the wrong way.

So then would you say that adults tend to be more self-directed learners?

Yes

Ah hah

I would hope so [laughing]

It is interesting that you say that you would hope so because that is the belief, but there are those who obviously dispute whether they are directed learners or not. Do you have any questions for me?

I don't I think I have talked your ear off enough.

No, you have given me a lot of, ahm, of good information, ahm, about your experience and some recommendations that obviously can help improve, ahm, one of the things that you pointed out that I've seen a lot in the literature is that students learn the, the content but if it is not being used or if they are not using it day to day they may tend to forget it... you gave me a lot of good information. So at this point, since you have no questions and not that I think we have covered, but I know we have covered all the questions that I had and more, because as we were talking more questions popped up. I will stop the recording at this time.

Appendix G: Sample Researcher Log Notes

Reflections on interview with Student #1:

I was saddened that she does not remember key concepts from the introductory statistics course i.e. standard deviation. Yet she recognized connections between statistics and finance but could not specify concepts.

She admitted to focusing more on passing course versus learning the content for recall and application.

She kept alluding to the role the instructor plays in student success in online courses,

She recognizes how important statistics is to business, especially her career in finance.

She wants more structure, i.e. step-by-step instructions, **break down**, highlight main points, teacher notes versus reading the textbook (not easy to read)

She alluded to differences between how adult learn versus teenagers

In response to follow-up question, she admitted to being a slow to medium learner if content is not presented visually.

Reflections after interview with Student #2

It doesn't matter format of statistics course. It is all about a student's drive and determination - commitment and workload. Self-motivation?

- The teacher has to 1. breakdown material and 2. build community
- Both S#1 and S#2 identified the following characteristics of online faculty:
 - understanding
 - patience
 - availability
- Adult learners have more of a purpose
- Students have to be able to be comfortable with expressing themselves in writing.
- Recalling statistics is correlated to whether students use the concepts in daily life
- Attitude towards school and commitment to learning are linked
- Student #2's learning style => good listener, writer, and note taker
- Accounting and statistics courses => not using very often; maybe easier =>ZPD
- Statistics = word problems

Observations/takeaways from interview and interviewee

Very articulate

To accommodate advanced students we need to open the modules earlier
Curriculum should include (references) connections to real world experiences

What are the barriers to learning statistics online?

The teacher *breaking down*/ providing extra resources.

Interview with Student #2 flowed much better => Time went by. I felt like I was asking more probing questions in interview with Student #1.

I found I asked many follow-up questions when I spoke with Student #2, probably because I read about the importance and how to ask follow-up questions prior to the interview.

Reflections on interview with Faculty #1

Faculty #1 using a more affective approach to teaching stats/to promote learning = 1:1 meetings, pep talks

Content focus = computational

1. Students can succeed in OL stats courses if they are self-motivated, well-prepared to work independently -> students expect online to be easy -> they may not expect to exert the effort.

Follow-up Question: What would you do differently if you had to teach stats online?

Questions evoked to ask Faculty #2

- a. Hybrid v. online which is better?
- b. Formulas +> How did students do?
- c. What about stats thinking and reasoning?
- d. How important are discussions to understanding stats content in OL course?
- e. What is the difference between old and new templates?

Need to start exploring resources to update Lit. Review - 2011 - 2015 references

2. How prepared are faculty to address the needs of students with disabilities and English Language Learners?

How accessible are OL course for students with disabilities?

Under prepared => How do we them up to the level of self-motivation?

How does our course compare to others at other schools?

How is content presented in the learning management system?

- Chunked? broken down
- Sequential? Step by Step
- Procedural fluency?
- Statistical reasoning and thinking

Perspective about new environment

Barriers to learning.