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A Qualitative Assessment: Adult Perceptions of Collaboration as Mitigation for Statistics Anxiety

Karl James Kinkead
Walden University

Walden University

COLLEGE OF EDUCATION

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Karl Kinkead

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Dr. Heather Miller, Committee Chairperson, Education Faculty
Dr. Richard Hammett, Committee Member, Education Faculty
Dr. Bonita Wilcox, University Reviewer, Education Faculty

Chief Academic Officer

Eric Riedel, Ph.D.

Walden University
2015

Abstract

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Karl J. Kinkead

Ph.D., Oxford Graduate School, 2010

MS, Auburn University, 1973

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Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Math anxiety, defined as feelings of apprehension and fear of courses involving mathematics, often interferes with student learning in a variety of college-level courses. A related phenomenon, statistics anxiety, affects the performance of many students in statistics courses. Researchers have found evidence that including collaborative problem solving as an instructional methodology is effective at reducing the negative effects of statistics anxiety. The purpose of this qualitative case study was to explore adult perceptions of collaborative problem solving as an instructional methodology focused on improving the learning environment in a business statistics course. Behaviorist, constructivist, and adult learning theories provided the foundation for this study that gathered narrative interview data from 14 adult students. The narratives were analyzed by first coding responses to questions into 7 frames of reference. Further refining of the data was accomplished by grouping responses in each frame of reference into common realms of response. Findings indicated that the adult participants perceived collaboration to be effective at reducing stress levels and improving course performance. Additionally, the participants identified weekly learning tasks, collaborative partner selection methods, and student resource materials that could benefit from redesigning. The project that stemmed from this research involved restructuring the instructional methodologies, learning tasks, and student resources to better align with adult learning preferences identified by the participants. The benefits to positive social change resulting from this project study included improving the course learning environment for adults and identifying adult preferences for implementing collaboration as a learning methodology.

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Dedication

I dedicate this work to my students, both past and present, for without their angst there would be no purpose in initiating a study on the subject of *statistics anxiety*. It is for my past students' palpable fears, tangible apprehensions, and entrenched forebodings that I am driven to metaphorically sit in their chairs in order to understand how and why many barely suffer through one of my favorite subjects: statistics. It is for my future students' benefit that I remained committed to understanding the absurdity of how I can so delight in anticipation of meeting my new students, while they concurrently fear entering my classroom. My hope for this research study was that I could discover instructional methods with the potential to help my future students overcome some or most of their anxieties and learn the true meaning of making a "statistically significant difference" in their workplaces.

Acknowledgments

I would like to acknowledge those who both guided and prodded me along on this 4½-year journey. The first person I wish to acknowledge is Dr. Heather Miller, my committee chair, without whose guidance I would still be working on a mixed methodology project. Next, I wish to acknowledge Drs. Richard Hammett and Bonita Wilcox for their diligent editing and insightful comments regarding the final project and abstract. Next, I wish to acknowledge Dr. Marsha Harwell, without whose help I would still be up to my eyes in a quagmire of APA formatting rules. Finally, I would like to express my appreciation to Walden University for allowing me to participate in the HEAL Ed.D. program: a program worthy of respect for its rigor, high quality instructors and administrators, and exemplary program integrity. I thank you all for persevering with me through this endeavor.

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Section 1: The Problem

A local private, liberal arts college introduced the business statistics course introduced into the curriculum in January 2012 provided the context for this qualitative project study. The instructional methodology for the course was the first in the adult program to introduce a collaborative problem solving lab as a core instructional methodology. Collaboration was included in an effort to allow students to build team-based problem-solving skills and to reduce the negative effects of student anxieties, specifically statistics anxiety (Bell, 2008; Onwuegbuzie & Wilson, 2003). Collaboration received considerable attention from educational researchers during the past 15 years as an intervention for reducing anxiety levels among students attending a variety of statistics courses (Bell, 2008; Brindley, Walti, & Blaschke, 2009; Davis, 2003; Delucchi, 2006; Dykeman, 2011; Pan & Tang, 2004). Since initiating the business statistics course in January 2012, instructors found anecdotal evidence in student survey comments, project assignment grades, final exam scores, and course final grades that many adult students considered collaborative problem solving helpful. However, evidence also existed that not all students benefited from some combination of course content, learning tasks, and/or instructional methodologies.

Since initiating the statistics course in January 2012, approximately 25% of all students completing the course exhibited high levels of anxiety at the prospect of working on a collaborative team as evidenced by (a) interpersonal challenges during the lab sessions, (b) incomplete in-class project assignments, and (c) low grades on the final exams. One factor that researchers indicated may contribute to student challenges is the

phenomenon of statistics anxiety (Dykeman, 2011; Pan & Tang, 2004; Zeidner, 1991). The objective of this research was to gain insight into student perceptions of a course methodology that includes collaborative learning as an instructional initiative and into an adult's perceptions of and challenges with statistics anxiety.

In Section 1, I will address statistics anxiety along with a description of the problems encountered with collaboration as an instructional method. I included an overview of the rationale behind and significance of the study, the guiding research question, and a discussion of the implications of the study. This section also includes descriptions of key constructs of importance to the study. Important constructs include statistics anxiety, collaboration, and the application of scenario-based problem solving as mitigation for statistics anxiety.

Definition of the Problem

The business statistics course that served as context for this study was a math-based elective offered during the final semester of a degree completion program. The program was established by a private, liberal arts college located in the Southeastern United Sates. The program provides adults with some previous college experience the opportunity to complete bachelor of science degrees in business management, organizational management, healthcare management, human resource management, or applied psychology (Bryan College, 2013). The college historically scheduled the statistics course six to eight times per year to meet 1 night per week for 5 weeks. Each weekly class session typically lasted approximately 4 hours and, typically, included a 1-

hour lecture, immediately followed by a laboratory-style 3-hour collaborative problem-solving session.

In this project study, I evaluated collaborative problem solving as a core methodology in the business statistics course: a methodology focused on lowering student anxiety levels, a phenomenon labeled *statistics anxiety* by Onwuegbuzie, DaRos, and Ryan (1997). Onwuegbuzie et al. defined statistics anxiety as a debilitating apprehension that typically occurs when students confront any form of statistics or statistical analysis in any form. According to Onwuegbuzie and Wilson (2003), student anxiety levels in a statistics course, or statistics anxiety, is a pervasive phenomenon affecting as high as 75% of all undergraduate and graduate students taking any college-level statistics course. In addition to research identifying statistics anxiety as a factor affecting a variety of student demographics, educational researchers also focused on instructional interventions for improving the statistics class environment, one of which was the application of collaborative, or team-based, problem solving (Bell, 2008; Onwuegbuzie & Seaman, 1995; Pan & Tang, 2004; Quinn, 2006; Schacht & Stewart, 1990).

Educational researchers interested in the phenomenon of statistics anxiety found evidence that allowing students to work in small teams applying statistical principles to recognized scenarios, problems, and case studies has been of some help in reducing student anxiety levels and improving learning (Bell, 2008; Dykeman, 2011; Galli, Ciancaleoni, Chiesi, & Primi, 2008; Pan & Tang, 2004, 2005). Pan and Tang (2004, 2005) concluded that anxiety levels significantly decreased when students worked in

collaborative teams applying statistical concepts to real-world case studies. Dykeman (2011), concurring with Pan and Tang, proposed that socially active business statistics classrooms that encouraged learning through the application of statistical concepts to familiar business settings had recognized success at significantly reduced student anxiety levels. Connecting Dykeman's advice for a relevancy to the lessons learned from Knowles (1978) principles of andragogy, informs instructors of the need for adults to both participate and recognize purpose in any learning endeavor. It is not overreaching the conclusions drawn by Dykeman and Knowles to conclude that adult learners appreciate a socially active classroom where they are allowed to collaborate with fellow students. Additionally, educational researchers have provided strong evidence that adults connect with course assignments and tasks that incorporate real-life scenarios and case studies with which they easily identify.

Since initiation of the business statistics course, end-of-course survey comments have generally been positive regarding the application of collaborative problem solving as a core instructional methodology in the business statistics course. According to lab project, final exam, and overall course grades, 75% of the students met the learning objectives for the course. However, some combination of course content, learning tasks, and instructional methodology was challenging to an estimated 25% of all students completing the course. Statistics anxiety obviously affected a percentage of students as evidenced by comments, made during the course and on end-of-course surveys. For these reasons, the phenomenon of statistics anxiety is an important element in this project study.

The purpose of this study was to understand adult student perceptions of collaborative problem solving as both a core instructional methodology for reducing statistics anxiety and as a factor affecting performance on assignments in a business statistics course. I proposed that an investigation of student perceptions into statistics anxiety could provide insight into why a percentage of students were challenged by some combination of course content and instructional methodologies employed in the adult-oriented business statistics course.

Rationale

Evidence of the Problem at the Local Level

The purpose of this study was to gain insight from past students of a business statistics course as to what combination of course content, learning tasks, and/or instructional methodologies was a challenge to some students. The population for this study included past students of a face-to-face applied business statistics course that was offered six to eight times per year as a math-based elective. Adults attending the program were required to possess a minimum of 45 credit hours from an accredited college and a minimum of 2 years of work experience relative to the degree program they chose. Students attending the program attend class 4 hours per night, 1 night per week, over a 5-week period. Each weekly class includes a 1-hour lecture and 3-hour lab period. Prior to each face-to-face class, students are required to complete reading, homework, and Internet research assignments requiring 15 to 20 hours of preparation. The learning tasks focused on developing a student's ability to analyze a variety of marketing, sales, financial, and demographic data. Skills covered in the course include data sampling and

gathering methods, descriptive statistics development and reporting, hypotheses testing with both parametric and nonparametric test protocols, correlation and regression analysis, findings interpretation, and developing and reporting accurate conclusions.

The instructional methodology employed in the business statistics course commenced with a 1-hour lecture. The purpose of the lecture was to (a) introduce the analytical methods to be applied during the subsequent lab period, (b) provide direction for using the statistical software package elements, and (c) provide students an opportunity to discuss and interact with the lab assignments that followed the lecture period. During the final 3 hours of each week's class, collaborative teams of two to three students analyze a scenario-based case study in order to answer specific questions regarding the company or organization in their scenario. By the end of each week's lab period, each team of students submits an executive summary of their findings, conclusions, and recommendations. Each student subsequently received a common grade on each weekly lab assignment.

From the initial launch of the business statistics course in January 2012, student surveys and end-of-course round-table comments were generally positive regarding the course content, instructional methodologies, and learning tasks. Since the courses was initiated in January 2012, students voiced an appreciation for the opportunity to work with a collaborative partner, with several students commenting that they could not have completed the course without their partner. However, there was also anecdotal evidence that collaborative problem solving may not have benefited all students equally, as approximately 25% of all students completing the course had difficulties working as a

partner on a collaborative team, submitted incomplete scenario projects, and/or performed poorly on the course final assessment. Although I am unable to directly correlate the low performance of this percentage of students with statistics anxiety, the professional literature had numerous research efforts indicating that statistics anxiety was most likely a factor (Dykeman, 2011; Onwuegbuzie & Wilson, 2003; Pan & Tang, 2004; Zeidner, 1991). It was therefor unknown to what extent statistics anxiety was a dynamic among students who had difficulty successfully completing collaborative learning assignments and end-of-course assessments.

The rationale for this project study was the need to investigate student perceptions of collaboration as a learning methodology initiated to reduce the effects of a statistics anxiety on student performance. Of particular interest were the challenges that a percentage of students faced with the weekly collaborative scenario-based projects and collaborative final assessment, and their perceptions as what were the underpinnings of their challenges with the course methodology. I focused this study on evolving past student perceptions of the use of collaborative learning projects and their perceptions as to the effect the methodology had on their personal anxieties at completing a business statistics course.

Evidence of the Problem from the Professional Literature

Collaborative problem solving. Allowing students to work collaboratively on assignments can be an effective methodology for reducing stress levels in students within a multitude of contexts, courses, and degree programs (Drago-Severson, Cuban, & Daloz, 2009; Mesh, 2010; Scherling, 2011; Smith, 2011; Swartz & Triscari, 2011; Taylor, Abasi,

& Pinsent-Johnson, 2007). According to a number of researchers, course designers and instructors need to make time during class for students to interact and collaborate on assignments (Brindley, Walti, & Blaschke, 2009; Chen, Gonyea, & Kuh, 2008; Delucchi, 2006, 2007; Drago-Severson et al., 2009; Harrington & Schibik, 2004; Helmericks, 1993; Macheski, Lowney, Buhrmann, & Bush, 2008; Potthast, 1999). Researchers investigating interactive, participative classroom environments found evidence of improved performance among a variety of students in difficult courses (Delucchi, 2006, 2007; Harrington & Schibik, 2004; Helmericks, 1993; Macheski et al., 2008). Then evidence of improved learning through the application of a socially active classroom provides considerable impetus for instructors to incorporate instructional strategies that include a socially active classroom.

Collaboration has the potential to help statistics students in specific to work out their conflict with statistics materials, alleviate the negative performance effects of excessive stress due to statistics anxiety, reduce the effects of course-content fears, and interact fellow students (Delucchi, 2007; Harrington & Schibik; Helmericks, 1993; Macheski et al., 2008). Although each of these researchers found benefits in creating a collaborative environment in the statistics classroom, they also urged caution with the methodology, suggesting that not all students benefited equally from a collaborative classroom environment. Keeler and Steinhorst (1995) found that even though a high percentage of students benefited from a collaborative environment, some students had difficulty with working on collaborative teams. Giraud (1997), Hansen (2006), and

Johnson, Johnson, Nagy, and Pruett (2008) all provided evidence that collaborative learning was effective, but had limitations.

Although collaboration on both in-class and take-home assignments may benefit a proportion of students, some students are may not benefit from or prefer to participate in collaborative assignments. One example I have repeatedly among the adults attending my statistics classes is the preference for working independently to protect a coveted high grade point average. These students, frequently one or two individuals in each class, often voice that they are fearful of a collaborative partner pulling down a carefully nurthered high GPA. A second category of student that generally prefers to work alone on assignment encompasses individuals intimidated by working in small groups due to learning challenges or skills deficiencies. These students generally will "hide in the background" of a collaborative team and will often contribute considerably less than their partner on collaborative assignments. Although collaboration is an effective methodology for instructors to use to teach team-based skills, it must be recognized that flexibility in application may be appropriate to accommodate the variety of learning styles and learning preferences in adults.

Working on problem-solving teams is an proven method for teaching business students how to collaborate on problems. Hansen (2006) conducted surveyed research on the application of team-based problem solving in business schools and concluded that most students found working on team projects to be both helpful and enjoyable. However, Hansen also reported that a percentage of students involved in his research had difficulty with collaboration due to several factors inherent with individual students.

These factors included instructors forcing students to work on predetermined teams, team-members participating uneaqually, students with irreconcilable personal differences in work ethic, individuals on a team with little to no interest in the subject matter, and skill deficits that hampered productivity on assignments and course assessments. Johnson et al. (2008) surveyed students from several courses where collaborative learning was a core instructional methodology and found that students disliked two aspects of working on teams, with the leading complaints being instructors choosing the teams and team members not carrying their weight on assignments. Giraud (1997) completed a study on collaboration among college students and reported that not all students benefited from the collaborative intervention equally, with some students challenged by a team-based structure, while others felt constrained or burdened with collaboration. Comments such as those revealed in Giraud (1997), Hansen (2006), and Johnson et al. (2008) provided evidence that although collaboration may be effective as an instructional methodology for some, if not a majority of, students, team-based problem-solving methods may be a challenge for others.

It is important for instructors who employ collaboration as an instructional methodology recognize two aspects of team-based learning: not all students learn at the same pace, and not all students learn in the same manner. This admonition necessitates that the socially active classroom must also allow for an adult's individual needs, interests, and preferences for learning. Some students of the course were marginalized by the instructors not allowing any flexibility in requiring students to work on a

collaborative team. Students who voiced an interest in working independently were asked to choose a collaborative partner regardless of their preference.

Statistics anxiety defined. The construct of statistics anxiety evolved out of a number of studies on anxiety, student attitudes, and previous math experiences among traditional college students (Dykeman, 2011). Of interest to the phenomenon is the fact that several researchers propose direct ties between math anxiety and statistics anxiety (Baloglu, 2004; Bell, 2008; Cherney & Cooney, 2005; Dykeman, 2011; Quinn, 2006). However, Baloglu (2004), suggested that statistics anxiety was a somewhat different phenomenon, and may only be related to math anxiety. Baloglu concluded that math and statistics anxiety were different phenomena, possibly due, at least in part, to statistics requiring higher-order verbal reasoning skills, analogous to learning a second language. Regardless of any similarities or dissimilarities between learning a new language and learning statistics, researchers found that college-level statistics courses are some of the most challenging that an undergraduate or graduate student must face in their curricula (Onwuegbuzie & Wilson, 2003).

In addition to the reasoning and analytic skill challenges many students face in statistics courses, researchers have also identified psychological challenges that affect a student's ability to learn data analysis methods and procedures (Baloglu, 2004; Bell, 2008; Collins & Onwuegbuzie, 2007; Pan & Tang, 2005). A high percentage of college students perceive statistics as one of the most stressful, feared, least enjoyed, least understood courses in their curricula (Baloglu, 2004; Bell, 2008; Collins & Onwuegbuzie, 2007; Druggeri et al., 2008; Dykeman, 2011; Keeley, Zayac, & Correia,

2008; Lalonde & Gardner, 1993; Onwuegbuzie & Wilson, 2003; Pan & Tang, 2005). To this point, Collins and Onwuegbuzie (2007) suggested, "many students report higher levels of anxiety and stress in statistics courses than in any other course in their degree program" (p. 118), indicating a widespread emotional reaction to the subject of statistics. Onwuegbuzie and Wilson (2003) quantified the breadth of statistics anxiety as affecting as high as 75% of all students taking statistics courses, while Dykeman (2011) reported that students rated statistics "the least desirable of all courses required for their academic major" (p. 441). Onwuegbuzie et al. (1997) revealed students with elevated levels of statistics anxiety exhibited psychological symptoms of frustration, worry, panic, and depression along with physiological manifestations of the phenomenon, including headaches, muscle tension, perspiration, and feeling sick. In addition to several educational researchers having documented the existence and effects of statistics anxiety, I identified several research efforts that identified the phenomenon's antecedents (Bessant, 1995; Blalock, 1987; Lalonde & Gardner, 1993; Schacht & Stewart, 1990; Trimarco, 1998; Zeidner, 1991).

Factors contributing to student anxiety. As early as the 1980s, educational researchers identified a range of both affective and cognitive antecedents for the phenomenon of statistics anxiety. The antecedents mentioned included a student's previous experiences with math and statistics courses, poor study skills, weak reading skills, challenges with math, and elevated test-taking anxiety levels (Bessant, 1995; Blalock, 1987; Lalonde & Gardner, 1993; Schacht & Stewart, 1990, Trimarco, 1998; Zeidner, 1991). Lalonde and Gardner (1993) suggested that the anxiety with which many

statistics students battle emanates from each individual's self-perception of his or her ability to learn mathematics and mathematics related subjects such as statistics. According to Bessant (1995), Blalock (1987) and Trimarco (1998) math anxiety, test-taking anxiety, poor computational skills, and poor reading skills were factors that tended to exacerbate a student's anxiety. As important as student cognitive and affective factors are as contributors to student anxiety levels, Schacht and Stewart (1990) proposed that the learning environment might be of equal importance to all other individual factors. Schacht and Stewart proposed that instructional methodologies, learning tasks, use of classroom time, and instructor knowledge and experience in teaching the subject might have as much to do with a student's anxiety levels as any personal factors the student may bring into the classroom.

Many factors affect a adult student's anxiety over the prospects of successfully completing a challenging course such as statistics. Whether it is a fear of math, test-taking anxiety, or computer skill deficiencies, the statistics instructor should recognize that not all instructional methodologies and learning tasks are effective for all adults. The value of business statistics analysis to future business managers warrants instructors to continuously search for and experiment with a variety of instructional methodologies: especially methodologies that reduce fear, minimize student marginalization, and moderate the learning environment.

Summary. Researchers investigating methods for mitigating anxiety in the statistics classroom reported finding benefits from coupling collaborative learning initiatives with authentic scenario-based projects. Evidence exists that student course

assignment and assessment quality were higher in classrooms where students were allowed to collaborate. Additionally, collaborative classroom environments were less stressful, more enjoyable, and more conducive to learning an anxiety-producing subject such as math or statistics. However, a collaborative learning environment has not been shown in research to universally benefited all students. Researchers have provided evidence that working in teams is a challenge to a percentage of students. Of importance to this study was a scarcity of research regarding the challenges faced by adults in a college-level statistics course. For many reasons, adult learning in general and adult higher education in specific has received far less attention than traditional education. A combination of the growing number of adults returning to college and the dearth of research identifying adult preferences in the classroom provides an opportunity for educational researchers to work.

Definitions

The following are definitions of key terms used in this study:

Adult student: Defined by the college's minimum age for entrance into the adult-oriented degree completion of 21.

Anxiety*:* The American Psychological association (2013) defined anxiety as "an emotion characterized by feelings of tension, worried thoughts, and physical changes like increased blood pressure" (p. 1). The National Institute of Mental Health (2013) characterized anxiety as feelings that fill an individual with unwarranted and frequently unfounded fearfulness and uncertainty that emanates from events perceived to be stressful.

Authentic learning*:* According to Lombardi (2007), authentic learning was defined as learning that focused on "real-world, complex problems and their solutions, using role-playing exercises, problem-based activities, case studies, and participation" (p. 2). One tenet of authentic learning is that academic success may be enhanced through the shared experience of students working together in order to complete learning tasks. Of importance to this research study were the suggestions by Oblinger (2007) that authentic learning within the context of higher education typically

- includes real-world tasks that emulate professionals in the field of study;
- incorporates challenges that are complex and multifaceted;
- encourages reflection and self-assessment;
- holds students accountable for achieving milestones that practitioners were required to meet under genuine working conditions; and
- tasks students to work in teams that require members to draw upon their own experiences, skills, and knowledge while negotiating a scenario based problem, opportunity, or situation. (p. 2)

Collaborative learning*:* Barkley, Cross, and Major (2005) proposed that collaborative learning is learning "through group work rather than learning by working alone" (p. 4). For purposes of this research, the terms cooperative learning and collaborative learning were considered interchangeable, both referring to an instructional methodology that tasks small groups of students to complete in-class statistical analysis assignments, receiving a common grade for all submissions.

Cooperative learning*:* For the purpose of this study, cooperative learning and collaborative learning was considered to be interchangeable terms that encompass an instructional method that allows students to "work together on a common task, sharing information and supporting one another" (Barkley et al., 2005, p. 5).

Degree completion program: A college-level program offered to working adult students with some previous college. Students completing the program can earn bachelor's degrees in business management, organizational management, healthcare management, human resource management, and applied psychology (Bryan College, 2013). Students entering the program must be over the age of 21, possess a minimum of 45 credits, and have a minimum of 2 years of work experience within their chosen field of study. The program offers students the option to take courses either online or at various off-campus onground locations.

Executive summary: For purposes of this study, a statistical accounting of all findings and conclusions regarding questions and data posed regarding a real-world business scenario.

Mathematics anxiety*:* Ashcraft and Moore (2009) characterized mathematics anxiety as "a person's negative affective reaction to situations involving numbers, math, and mathematics calculations" (p. 197). Ashcraft and Moore define math anxiety as resulting in tension and anxiety that hampers a student when he or she is required to manipulate numbers or solve math problems in a variety of ordinary life and academic situations.

Real-world scenario*:* A form of scenario-based learning (SBL) that use scenario-based case studies as the basis for learning tasks that cement learning in real-world situations. SBL typically emulates real-world contexts, problems, and situations that challenge the student to apply learning outside of the classroom context. Mariappan, Shih, and Schrader (2004) defined SBL as an instructional methodology, that uses an "authentic context" (p. 2) to connect the learner with learning. Mariappan et al. proposed that instructors could enhance the learning experience by placing the learner within a real-world scenario where decisions regarding recognizable businesses guide the learning process. Real-world scenarios applied in the business statistics course emulate recognizable local and national for-profit and not-for-profit local businesses with which students possess some knowledge. The scenarios used within the business statistics course include regional trucking firms, regional and national retail chains, local consulting agencies, and faith-based not-for-profit organizations.

Statistics anxiety*:* According to Zeidner (1991), statistics anxiety is a situation-specific construct that affects students learning or applying statistics principles, methods, manipulations, or formulas. Onwuegbuzie et al. (1997) described statistics anxiety as the apprehension that occurs when individuals encounter statistics in any form and at any level.

Significance

The significance of this study resided in discovering adult student perceptions of collaborative problem solving initiated as an instructional methodology focused on reducing statistics anxiety and improving course performance. Several realities regarding

the subject of collaboration were evident from the professional literature and, subsequently, informed the trajectory of this project study. Educational researchers identified data collection, analysis, and interpretation skills as invaluable tools for students to master (Ruggeri, Dempster, & Hanna, 2011; Smith, & Martinez-Moyano, 2012). Smith and Martinez-Moyano (2012) contended that, since the 1950s, the skills to collect, analyze, and use data have increased in importance. However, researchers provided evidence that statistics courses are some of the most feared, intimidating, and least enjoyable in a student's curriculum (Onwuegbuzie & Wilson, 2003; Xu, Meyer, & Morgan, 2008).

An inverse correlation exists between a student's level of statistics anxiety and his or her performance in a statistics course (Ali & Iqbal, 2012; Galli et al., 2008; Zeidner, 1991). Ali and Iqbal (2012) found "that statistics anxiety was significantly correlated with examination marks" (p. 116), while Galli et al. (2008) found evidence those students who failed statistics courses had consistently exhibited higher levels of statistics anxiety. The well-documented existence of statistics anxiety and the phenomenon's negative correlation with performance in a variety of statistics courses led researchers to identify instructional methods with the potential to reduce anxiety levels and improve the learning experience. Among the treatments found to provide some relief to highly anxious students is the application of collaborative problem solving as a core instructional methodology.

Considerable research exists supporting the use of collaboration, collaborative problem solving, and socially active learning environments as being more effective than

traditional instructor-focused, passive, lecture-intensive classrooms (Drago-Severson et al., 2009; Mesh, 2010; Scherling, 2011; Smith, 2011; Swartz & Triscari, 2011; Taylor et al, 2007). Researchers also suggested that collaborative problem solving within the context of a college-level statistics course was of considerable help to some students in reducing the phenomenon of statistics anxiety (Bell, 2008; Onwuegbuzie & Seaman, 1995; Pan & Tang, 2004; Quinn, 2006; Schacht & Stewart, 1990). However, the use of collaborative problem solving in the business statistics course that provides context for this project study has not been entirely successful in reducing student fears and anxieties.

The purpose of this study was to examine why approximately 25% of students who attended the business statistics course were challenged by some combination of course content, learning tasks, and collaborative learning. It is unknown why a percentage of students do not perform well within the confines of a mandated lab session that requires a team-based approach to assignments that amount to 35% of a student's grade. Furthermore, it is unknown what student perceptions are of the effectiveness of collaboration as a means to reduce adult student anxiety levels in a business statistics course.

This study added to the base of knowledge regarding collaborative learning methodologies within the contexts of adult business students, statistics anxiety, and statistics education. There is a paucity of research conducted on the subject of collaborative learning as an instructional methodology for reducing the effects of statistics anxiety among adult students in statistics courses in general, and business statistics courses. Baharun and Porter (2009) commented that although considerable

thought has gone into defining the construct of statistics anxiety, "only a few studies have been conducted investigating ways or techniques to reduce student anxiety levels" (p. 254). In this project, I focused on (a) understanding student perceptions of collaborative problem solving as a core instructional methodology, (b) emerging student perceptions of any benefits that collaboration has on reducing statistics anxiety, and (c) emerging student recommendations for modifications to the instructional methodology that would improve the learning experience.

The importance of this study resides in an interest regarding student perceptions of adult students regarding (a) the anxieties they face when taking a business statistics course, (b) the use of mandatory collaboration as an in-class instructional methodology, and (c) the benefits of collaborative problem solving as a means to reduce statistics anxiety. There is an appreciation for team-based projects as collaboration appears to reduce fear and allows students to flourish within complicated subjects such as statistics. Alternately, some students prefer to work independently and not be dependent on anyone but himself or herself for a grade in the course. I designed this project study to define the range of student perceptions of collaboration as a portion of the instructional methodology focused on improving learning through reducing the anxiety levels of adult students. The intent of this study was to gather student perceptions of a mandatory collaborative problems-solving lab in an effort to both reevaluate the effectiveness of and look for alternatives to mandatory collaboration as a core instructional methodology. The advantages of this research to the greater college setting would be a greater understanding of adult perceptions of collaborative learning as an instructional methodology.

Guiding Research Question

In this qualitative case study, I addressed the following research question regarding adult students participating in a business statistics course:

> What perceptions do adult students have of collaboration as an instructional methodology, the phenomenon of statistics anxiety, and the effectiveness of collaboration at reducing the effects of statistics anxiety on course performance?

The business statistics course that provides context for this research used collaborative problem solving as a core instructional methodology since its inception in January 2012. In addition to allowing students to practice team-based problem solving, collaboration was included in the course methodology in an effort to improve the learning environment for students with high statistics anxiety levels. Many students provided input in both the end-of-course roundtable sessions and through the online survey instrument that indicate approval, even enjoyment of the collaborative process. However, some combination of course content, learning tasks, and/or instructional methods has been a challenge for a percentage of students.

Since initiation of the business statistics course January 2012, approximately 25% of the students completing the course performed poorly on the weekly collaborative lab projects and/or the collaborative final exam. It appeared that students who performed poorly fell into three general categories or groups. One group included students who voiced that they were highly stressed over taking a statistics course. A second group included individuals who expressed challenges with any form of math. The third and significantly smaller group included students who questioned the importance of statistics

in general and, subsequently, had a low motivation levels for learning the materials. Of primary interest to me as a statistics instructor and educational researcher conducting this project study were the roles that math-efficacy and anxiety played in an adult's ability to learn statistics.

Review of the Literature

The literature review for this project study began with the establishment of a theoretical framework followed by a section that includes seminal and current peer-reviewed journal articles regarding two subjects of importance to this research. The first subject of importance regards the phenomenon of statistics anxiety and the effects the phenomenon has on student performance in a college-level statistics course. The second important focus of this review regarded research in socially active instructional methodologies such as collaborative problem solving. In addition to these two primary subjects, I also explored research regarding the similarities and difference between statistics anxiety and math anxiety and the antecedents to anxieties among college students.

The sources for this literature review included ERIC, SAGE, EBSCO, Google Scholar, and Internet websites dedicated to statistics, statistics anxiety, and instructional interventions. The majority of this literature review included peer-reviewed, full-text, journal articles from seminal and current (<5 years) research studies. A variety of key search terms and phrases guided a review of the professional literature, including *student anxiety*, *math anxiety*, *test anxiety*, *statistics anxiety*, *statistics instruction*, *statistics course design*, *statistics anxiety intervention*, *collaborative instruction*, *collaborative*

learning, and *collaborative problem solving*. Two local public libraries and my own personal library provided additional resources for this literature study.

Theoretical Framework

The theoretical framework for this research included elements of behaviorist, constructivist, and adult learning theories. According to behaviorist theory, the results of effective learning inevitably involve changes in observable behavior as opposed to changes in the cognitive process. Moving adult students past their fears, anxieties, and worries regarding the subject of statistics as a course of study must involve some change in behavior brought about through the process of education. Merriam, Caffarella, and Baumgartner (2007) proposed three assumptions regarding learning within the behaviorist framework. The second assumption regarding behaviorist theory was that the learning environment plays a role in student learning behavior (Skinner, 1971, 1974). A third assumption proposed by Merriam et al. regarding behaviorist theory regards the concept of reinforcement as a factor in learning. Reinforcement maintains that instructors can strengthen the learning experience through a combination of use, application, and repetition of knowledge in order to build skills. In this study, I looked to discover barriers and challenges to learning that were behavioral in nature in an effort to help students adversely affected by the phenomenon of statistics anxiety.

Constructivist theorists is important to this research effort in that it incorporates the concept of a student creating personal meaning as learning interacts with the student's storehouse of knowledge, experiences, and skills (Creswell, 2012; Merriam et al., 2007). The process of learning, or constructing meaning, is often viewed as a highly

individualistic endeavor and may be, dependent on the "individual's previous and current knowledge structure" (Merriam et al., p. 291). Within the framework of constructionist theory, and directly informing the design of this project study, was the social constructivist view to educational theory proposed by Bruner (1960). Bruner proposed that within the framework of an educational setting, students develop or make meaning through social intercourse with their peers, the instructor, and the instruction materials. This perspective directly informed the design of the interview questions I used to gather data as I probed student perceptions of working within a collaborative environment on a subject perceived by many students as difficult, challenging, and frightening. Acknowledging the social constructivist approach, I paid attention to developing the interview questions in order to elicit adult feelings, perspectives, attitudes, and emotional dispositions towards the phenomenon of statistics anxiety and the application of collaboration as mitigation.

As important as the tenets of behaviorism and social constructivism were to this project study, the principles of andragogy, or adult learning, were equally important. Knowles and Associates (1984) and, later, Knowles, Holton, and Swanson (2011) proposed a different theoretical framework for understanding how adults learn. Knowles et al. proposed five assumptions that form the basis of adult learning theory, three of which informed the use of collaborative problem solving as a learning initiative. One of Knowles' key assumptions is that adults are capable of self-direction and, subsequently, appreciate the opportunity to participate in and during the learning experience. Specific to this research, it was unknown whether an adult's need to be involved in the learning

experience extended to participating in a collaborative problem solving environment. Adults bring a wealth of experience to the learning environment that can benefit the learning experience. An adult's experiences inform the need for educators to take into account the application of "techniques to tap into the experience of the learner, such as group discussions, simulation exercises, problem-solving activities, case methods, and laboratory methods" (Knowles et al., 1984, p. 64). It was also unknown whether a collaborative problem-solving environment encouraged adult students to engage their personal knowledge and experiences in learning the subject of statistics, even though collaboration is in line with Knowles and Associates (1984) principles of andragogy. Also of importance to the theoretical framework for this study was Knowles's admonition that adults learn in order to solve problems, effect change, and/or acquire useful and applicable skills. Learning how to analyze and draw conclusions from business data is a useful and applicable skill. Knowles and Associates proposed that educators must find a way to connect their students to the subjects through acknowledging the need for adult students to socially connect, have their goals and aspirations addressed, and have learning connected to real-life situations with which they are familiar.

Behaviorist, constructivist, and adult learning theory all informed the design of this study that elicited adult perceptions of collaborative problem solving as an instructional intervention in a business statistics course. The professional literature had scant information in it regarding adult students in general, and adult student perceptions regarding statistics, statistics anxiety, and collaboration as mitigation for statistics

anxiety. This project was proposed to close a gap in knowledge as to the challenges that an adult students encounters when faced with learning the subject of statistics.

Socially Active Learning Environments

Technology and social media are altering how learners prefer to access information, assimilate knowledge and skills, and interact during the learning process (Brindley et al., 2009; Chen et al., 2008; Drago-Severson et al., 2009; Siemens, 2008). Siemens (2008) proposed that students now have "expectations of education as participative, engaging, and active" (p. 6), expecting their classrooms to be adaptive, active, and sensitive to students' needs for social interaction. According to Siemens, the social pressures brought by students into the halls of higher learning have pressured educators to rethink the three basic theories of learning; behaviorism, cognitivism, and constructivism. Siemens suggested that that these time-tested learning theories are flawed as they do not account for the influence of technology on the learning environment and focus learning on the individual, leaving little room for socially constructed learning. Connectivists conceptualize that knowledge making is relational instead of individualistic, contextual as opposed to universal, and systemic rather than segmented (Siemens, 2005). The basic tenets of connectivism proposed that learning must include nurturing and maintaining connections between learners, creating a socially active learning environment where students share and cocreate knowledge, and, finally, interacting student personal experiences with new learning.

Social learning theory influenced educators to redesign college-college-level courses to be more responsive to the expectations of the socially active college student

(Brindley et al., 2009; Chen et al., 2008; Drago-Severson et al., 2009; Oludipe & Awokoy, 2010; Ruey, 2010). Brindley et al. (2009) proposed that course designers consider the classroom as a community of learners, suggesting that a socially active learning environment has the additional benefits of helping students to achieve deeper learning, building student confidence, increasing student satisfaction with the college experience, and improving student retention rates. Drago-Severson et al. (2009) supported this contention in research applying collaborative methods in English for speakers of other languages (ESOL) courses. Drago-Severson et al. produced definitive evidence indicating that when English instructors attending the course were encouraged to collaborate on in-class assignments and assessments, perspectives expanded, with the result of collaboration being a significantly deeper learning experience.

The need to develop methods that improve learning retention is one of the objectives of course designers in general and to statistics course designers. Ruey (2010) produced evidence that a socially active learning environment is statistically more effective in helping adult students retain information than a passive, lecture-focused, format. Ruey concluded from her research that learning improved when students were involved in an active, participative, collaborative learning environment that allowed students to interact and work together on in-class assignments.

The benefits students attain from a socially active learning environment appear to go beyond the retention of information to reducing the many anxieties faced by students while taking college-level social science, technology and math-based courses (Chen et al., 2008; DeVaney, 2010; Ioannou, Artino, & Anthony, 2010; Oludipe & Awokoy,

2010). In research conducted on students in a college-level chemistry course, Oludipe and Awokoy (2010) concluded that cooperative learning methods dramatically reduced the anxiety levels of a majority of their students (p. 1). Ioannou et al. (2010) came to the same conclusion regarding psychology students and reported that test scores indicated retention of course content was significantly improved, student anxiety levels significantly reduced, and students found the course more enjoyable. In research conducted on college-level education courses, Dallmer (2004) provided evidence that test anxiety reduced dramatically, test scores increased, and student attitudes towards the course dramatically improved when students were allowed to work collaboratively on assignments. Dallmer found evidence that students who initially reported high test taking anxiety at the beginning of a course, reported that anxiety levels reduced when allowed to complete the final exam collaboratively. In another study of 206 first-semester students taking English composition, public speaking, and political science courses, Stefanou and Salisbury-Glennon (2002) evaluated student perceptions of learning communities, collaborative learning, and other socially active learning initiatives applied across a variety of courses and curricula. Findings from this survey research indicated that there were gains in student motivations and improved attitudes towards coursework among students in the collaborative groups.

In addition to these studies, researchers found some evidence that collaborative learning methods applied as an instructional methodology in college-level statistics courses are effective in mitigating statistics anxiety among some students (Buhrmann & Bush, 2008; Delucchi, 2006, 2007; DeVaney, 2010; Harrington & Schibik, 2004;

Helmericks, 1993; Keeler & Steinhorst, 1995; Macheski, Lowney, Buhrmann, & Bush, 2008; Smith, 2011; Steinhorst & Keeler, 1995). Within the statistics classroom, evidence exists that a socially active classroom can improve student performance by lowering anxiety levels (Delucchi, 2007; Harrington & Schibik, 2004; Macheski et al., 2008). Harrington and Schibik (2004) discovered that team-based problem-solving assignments made statistics for many students more interesting and considerably less stressful. Delucchi (2007) conducted research with 270 college-level statistics course students who had completed a social science statistics course that incorporated collaboration on both in- and out-of-class assignments and assessments. Delucchi reported that survey scores from the students in courses that allowed collaborative groups to complete assignments "exceeded the overall campus average" (p. 457). Delucchi added that his students added comments to the survey that the course was both less stressful and more enjoyable than anticipated. Macheski et al. (2008) reported on an American Sociological Association (ASA) workshop conducted with 40 college-level instructors. The purpose of the workshop was to investigate innovative teaching practices for difficult and diverse subjects such as research statistics, and sociological theory. According to Macheski et al. (2008), the key elements needed in teaching more difficult, abstract, and theoretical courses such as statistics included

- creating an active and engaging instructional methodology,
- fostering a socially interactive classroom,
- engendering a sense of community among students and faculty,
- constructing an emotionally safe classroom environment, and

- insuring that student emotional wellbeing is acknowledged and accommodated. (pp. 44-46)

Macheski et al. concluded that instructors of more difficult courses must develop strategies for turning classrooms into workshop-like atmospheres that lower stress and anxiety levels. Also proposed are instructional strategies that create a learning community that feels safe for all students to learn demanding, difficult, and stressful courses such as statistics.

Researchers found evidence that statistics courses are some of the most difficult, least liked, and most stressful that a college student may take (Galli et al. 2008; Onwuegbuzie, 2004; Onwuegbuzie, Leech, Murtonen, & Tahtinen, 2010; Onwuegbuzie & Wilson, 2003; Pan & Tang, 2005). Findings from these researchers indicated that statistics anxiety is a factor contributing to the reputation of statistics courses being difficult, complex, and filled with higher-level math. I proposed in this study proposed to investigate for any possible link that may exist between students challenged by collaborative learning as an instructional methodology in a business statistics course and the phenomenon of statistics anxiety.

Anxieties Among Higher Education Students

General anxiety. Research identified stress, worry, anxiety, and fear as a factor affecting the performance of a percentage of college students across a multitude of disciplines (Ali & Iqbal, 2012; Ashcraft & Moore, 2009; Drum and Baron, 1998; Galli et al., 2008; Geist, 2010; Haiyan, LihShing, Wei, & Frey, 2009; Liu, Onwuegbuzie, &

Meng, 2011; Onwuegbuzie & Wilson, 2003). The pressures of college produced a variety of student anxieties, including

- GPA anxiety (Mounsey, Vandehey, & Diekhoff, 2013),
- language anxiety (Hui-Ju, 2011),
- test anxiety (Yildirim, 2008; Hsieh, Sullivan, Sass, & Guerra, 2012; Zeidner, 1998, 2007),
- math anxiety (Ertikin, Bulent, & Yazici, 2009; Geist, 2010; Haiyan et al., 2009),
- statistics anxiety (Ashcraft & More, 2009; Bell, 2008; Bolliger & Halupa, 2011; Buui & Alfaro, 2011; Dykeman, 2011; Keeley et al., 2008; Perepiczka, Chandler, & Becerra, 2011),
- study anxiety (Vitasari et al., 2010),
- technical (computer) anxiety (Bolliger & Halupa, 2011; Chen et al., 2008; DeVaney, 2010),
- communication anxiety (Cowden, 2010; Liu et al., 2011),
- science anxiety (Dilevko, 2000; Oludipe & Awokoy, 2010),
- asking-for-help anxiety (Vigil-Colet, Lorenzo-Seva, & Condon, 2008), and
- interpretation anxiety (Vigil-Colet et al., 2008).

When students are able to keep these stresses under control, the results can be energizing (Cowden, 2010; Shipman & Shipman, 1985). However, left unchecked, these same anxieties can become debilitative, resulting in feelings of panic, an inability to cope, and

feelings of desperation that can affect course performance (Cowden, 2010; Onwuegbuzie et al., 2010; Vitasari et al., 2010).

The inability of a student to cope with stresses can also lead to a myriad of emotional, physiological, and academic difficulties (Brackney & Karabenick, 1995; Cowden, 2010; Onwuegbuzie et al., 2010; Vitasari et al., (2010). In early research into statistics anxiety among university students, Brackney and Karabenick (1995) discovered evidence that uncontrolled anxieties all too often reduced a student's coping skills to a point where they were unable to meet college-level academic standards. More recently, Onwuegbuzie et al. (2010) found that unchecked out-of-control anxiety in a college student's life often left the student unable to cope with all college-level work. Cowden (2010) broadened the contentions made by Onwuegbuzie et al., claiming that when student anxieties resulted in uncontrollable worry, the stress they engender can become debilitating to every aspect of a student's academic, personal, and social life. Vitasari et al. (2010) evaluated another vector for student anxiety, proposing that the problem for many anxiety-prone students was an excessive, uncontrolled anxiety that disrupts concentration, lowers memory function, and, inevitably, seriously handicaps success.

Frequently, student anxieties, fears, and worry go beyond a feared instructor, the deadline for an important paper, or an upcoming final exam: Some anxiety stems from a deep-seated fear of a subject or course. Educational researchers into instructional methods applied to statistics courses indicated that the prospect of taking a college-level statistics course all too leads to debilitating levels of a phenomenon labeled as statistics anxiety among a proportion of students (Lalonde & Gardner, 1993; McCarthy, Fauladi,

Junker, & Matheny, 2006; Onwuegbuzie & Wilson, 2003; Williams, 2010; Xu et al., 2008).

Statistics anxiety. The fear that manifests in students required to take a college-level statistics course is one example of a situation specific anxiety with considerable potential for causing performance problems (Lalonde & Gardner, 1993; Onwuegbuzie & Wilson, 2003). Lalonde and Gardner (1993) suggested that many, if not most, statistics instructors will "attest to the significant number of students experiencing apprehension with regard to their ability to perform well in the [statistics] course" (p. 109). Supporting this contention, research conducted by Pan and Tang (2005) proposed that student anxieties may be the single largest challenge that statistics instructors face. From the standpoint of the student, Onwuegbuzie and Wilson (2003) proposed that statistics anxiety negatively effects course performance in as high as 75% of all undergraduate and graduate college students. One of the many negative effects of statistics anxiety is the emotional toll that the phenomenon has on students deeply affected by the phenomenon.

Research has indicated that the phenomenon of statistics anxiety has emotional consequences (Bui & Alfaro, 2011; Dykeman, 2011; Williams, 2010). Williams (2010) addressed the emotional consequences of statistics anxiety in original research conducted on 76 students enrolled in an introductory statistics course. Williams concluded that he found strong evidence that statistics anxiety generated "feelings of inadequacy and low self-efficacy" (p. 1) in a proportion of students, and that these emotional factors deeply affect student performance in the statistics course. Also addressing the emotional upheaval to students, Bui and Alfaro (2011) surveyed statistics anxiety levels among 104

undergraduate science students and found a strong correlation between student anxiety levels and student attitudes towards science classes requiring statistical analysis and student performance in a science course that required statistical analysis. Researchers have documented not only the emotional toll that statistics anxiety takes on students, but how widespread the phenomenon is across almost every student demographic (Ali & Iqbal, 2012; Bui & Alfaro, 2011; Davis, 2003; Dykeman, 2011; Galli et al., 2008; Murtonen, Olkinuora, Tynjala, & Lehtinen, 2008; Ruggeri et al., 2008).

There are findings regarding the pervasiveness effects of statistics anxiety on student performance across a large variety of demographic boundaries, including

- gender and age groups (Bui & Alfaro, 2011; Davis, 2003; DeCesare, 2007; Onwuegbuzie & Wilson, 2003; Ruggeri et al., 2011);
- international, linguistic, and cultural groups (Liu & Onwuegbuzie, 2011; Liu, Onwuegbuzie, & Ment, 2011; Murtonen et al., 2008; Ruggeri et al., 2008);
- ethnic groups (Collins & Onwuegbuzie, 2007; Davis, 2003; Onwuegbuzie, 1998); and
- educational fields and course majors (Ali & Iqbal, 2012; Dykeman, 2011; Galli et al., 2008; Murtonen et al., 2008; Oludipe & Awokoy, 2010; Perepiczka et al., 2011; Pierce & Jameson, 2008;).

Although evidence exists that some student demographics are affected more than others (Onwuegbuzie, 1998; Collins & Onwuegbuzie), the phenomenon of statistics anxiety appears to affect a wide variety of demographics, fields of study, and personality types.

In addition to the ubiquitous nature of statistics anxiety, researchers provided evidence that excessive, unmanaged levels of statistics anxiety resulted in a variety of behavioral challenges in college students. Behavioral challenges that researchers found evidence of among college statistics students included reduced class attendance; procrastination on assignments; disruptive classroom behavior; and low scores on assignments, projects, and examinations; and changing study majors (Ali & Iqbal, 2012; Bell, 2003; Galli et al., 2008; Lalonde & Gardner, 1993; Onwuegbuzie, 2004; Onwuegbuzie & Wilson, 2003; Pan & Tang, 2005). Researchers found evidence that the most pervasive behavioral challenge that students face is on student performance on statistical analysis on projects, homework assignments, quizzes, and final exams (Bell, 2008; Lalonde & Gardner, 1993; Onwuegbuzie & Wilson, 2003). Lalonde and Gardner (1993) produced definitive findings indicating that statistics anxiety "correlated significantly negatively with exam performance" (p. 117). Although Lalonde and Gardner would not claim a causal relationship between statistics anxiety and course performance, they indicated that the phenomenon has an "indirect impact on performance because of its effect on attitudes and motivations" (p. 121). More recently, Onwuegbuzie and Wilson (2003) proposed a strong "causal link between statistics anxiety and course achievement has been established" (p. 199). Research completed at a large university in Spain by Vigil-Collet et al. (2008) at a large university provided evidence that a close relationship existed between statistics course performance and statistics anxiety was evident among psychology students.

The considerable attention paid to the construct of statistics anxiety and its toll on student performance prompted follow-on research into instructional methodologies that may improve learning among highly stress college students. Educational researchers interested in exploring interventions for reducing student statistics anxiety levels recently turned their attention to instructional methodologies that invigorated and enlivened the learning environment by focusing learning on application in an effort to reduce anxiety levels (Bell, 2008; Davis, 2003; Dykeman, 2011; Onwuegbuzie & Wilson, 2003; Pan & Tang, 2005, Pierce & Jameson, 2008; Quinn, 2006; Vaughn, 2009). Pierce and Jameson (2008) summarized findings from their survey research across 128 education and technology majors with a recommendation that statistics instructors rethink instructional methods, course learning tasks, and classroom environments in an effort to foster a more positive, open, and involved attitude towards the subject of statistics among undergraduate and graduate students. In a study complementing this recommendation, Quinn (2006) evaluated various teaching methods believed to mitigate statistics anxiety among social work majors. Quinn found evidence that infusing student-to-student interactions, such as group presentations and discussion forums, were effective in reducing statistics anxiety among some students. In addition to these proposals for a more interactive classroom environment, research by Pan and Tang (2005) and Vaughn (2009) proposed that a blended or multidimensional approach to teaching statistics courses may be beneficial in reducing statistics anxiety.

Pan and Tang (2005) conducted focus group research on social science graduate students and found evidence that a combination of "multidimensional instructional

methods" (p. 205) coupled with instructors being sensitive to student anxieties was one key to reducing student statistics course anxieties. Vaughn (2009) conducted research applying a teaching methodology that included what the researcher called a "balanced amalgamated approach" (p. 106) that included combining short lectures and active learning collaborative projects. Vaughn reported that when he incorporated collaborative project-based learning into his classroom sessions, students quickly built confidence in their abilities, markedly increased in their enjoyment of the class, and, subsequently, began to engage actively with the learning materials and tasks.

The body of research addressing methods for mitigating statistics anxiety included advice for statistics instructors to continually experiment with instructional methods (Bell, 2003; Davis, 2003; Galli et al., 2008; Pan & Tang, 2004). These researchers admonish instructors to task students through a variety of methods that encourages students to participate actively with the learning materials, the instructor, and other students. Of equal importance to the level of personal connectedness within the class are proposals that instructors provide students with opportunities to connect statistics instruction to their own work-lives. Evidence was found that students connected more deeply with statistics methods when they were challenged with assignments that included real-world (recognizable) examples, problems, case studies, and scenarios (Bell, 2003; Davis, 2003; Dykeman, 2011; Galli et al., 2008; Giraud, 1997; Macheski et al., 2008; Onwuegbuzie & Wilson, 2003, Pan & Tang, 2004). Team projects, collaborative testing, collaborative problem solving, real-world scenarios, and active classrooms are touted as part of the formula for reducing statistics anxiety among highly anxious students. A

socially active instructional environment such as collaborative problem solving is one method for reducing the debilitating effects of statistics anxiety for many students (Harrington & Schibik, 2004).

Collaborative Learning as Mitigation for Anxiety

Benefits to the classroom environment. Researchers described collaborative learning as an instructional methodology that encourages students to share in the responsibility for tasks in an effort to promote a co-dependent, co-accountable learning environment (Rahman, 2009). Findings from educational researchers provided evidence that classrooms where collaborative learning methods are applied are less stressful; the results of which is a learning environment significantly more conducive to learning than a lecture-based classroom (Brindley et al., 2009; Du, Yu, & Olinzock, 2011; Giraud, 1997; Helmericks, 1993; Macheski et al., 2008). Giraud (1997) found students who worked in collaborative groups felt freer to ask more questions, learned more quickly than students did in lecture-based classes, scored higher on mid-term and final assessments, and expressed positive attitudes towards collaboration and the course in end-of-course surveys. Another seminal researcher into the use of collaboration in teaching statistics, Helmericks (1993) discovered evidence that when he allowed students to collaborate on assignments, the environment was more open and relaxed than the standard lecture-based environments in which he normally taught. More recently, research completed by Du et al. (2011) provided evidence that when compared to individual competitive pedagogies, collaborative classrooms resulted in "better psychological connections (caring, support, and commitment), greater psychological health, social competence, and self-esteem" (p.

28). Macheski et al. (2008) conducted workshop training where a collaborative workshop atmosphere was encouraged and found that classroom activities that included interactive elements such as collaborative problem solving created an environment where students commented that they felt both emotionally safe and unthreatened by the learning tasks.

Another important element of teaching difficult subjects such as statistics was to insure that instructors paid close attention to the classroom environment, specifically by developing a sense of community where students could feel as if they were in it together (Macheski et al., 2008). Brindley et al. (2009), conducted research evaluating participation levels between traditional lecture-based statistics classrooms and cooperative problem-solving classrooms. Brindley et al. concluded that individual student participation levels in a collaborative classroom were over twice those of students in a control group that employed only individual efforts among the participants. In addition to collaboration helping to lower stress levels in the classroom, another benefit was improved student performance with course objectives, assignments, and assessments (Bell, 2008; Davis, 2003; Delucchi, 2007; Mullins, Rummel, & Spada, 2011; Potthast, 1999; Wilson, 1999).

Benefits to student performance. Evidence exists that collaboration improves student scores on both in-class and out-of-class projects (Bell, 2008; Brindley et al., 2009; Davis, 2003; Delucchi, 2007; Potthast, 1999). Potthast (1999) conducted one of the earliest studies on the benefits of collaboration and produced evidence that her students attained higher scores when allowed to collaborate on assignments and

assessments. In research conducted on graduate-level African American students, Davis (2003) found conclusive evidence that a collaborative instructional strategy is empowering, significantly reduced statistics anxiety in the classroom, and, ultimately, improved course performance (p. 154). Delucchi (2007) found similar evidence that collaborative learning techniques, when applied in an undergraduate entry-level statistics course, improved the acquisition of statistical skills. Bell (2008) conducted similar research and concluded that dividing students into project groups was useful in helping highly anxious students learn complex statistical procedures. In a joint study between two universities in Germany and the United States, Brindley et al. (2009) gathered data over a 3-year period and found that participation in a collaborative team not only developed teamwork skills and increased a sense of community, but also fostered a significantly deeper learning experience for the students.

Mullins et al. (2011) conducted similar research, but included only female students participating in a math class where students completed all homework and in-class assignments working in collaborative teams. Mullins et al. made two observations regarding the effectiveness of collaboration as an instructional methodology. First, collaborative learning methods applied to "procedural instructional materials" (p. 438) did not have a positive effect on student learning. This research showed that some students simply "took turns in solving the problems" (p. 438), resulting in neither student learning all of the steps. The second observation drawn from the research conducted by Mullins et al. indicated that when pairs of students were dealing with conceptual problems, "collaboration yielded a reduced number of errors [on exams] . . . as compared

to individual learning" (p. 437). This research pointed to one important fact regarding collaboration; there are applications where collaboration benefits student learning, and other applications where collaboration may be a hindrance to the learning process.

Socially active classrooms should not be considered a universal cure for the stresses that students face. Additionally, Capdeferro and Romero (2012) found evidence that not all students find working in a small problem-solving team to their liking. Capdeferro and Romero explored the frustrations students felt when involved in a collaborative learning experience and found unequal levels of commitment, responsibility, and involvement within a team were the most numerous complaints brought forth by students. The second and third most frequent complaints were unshared goals and difficulties in communications due to reticence, disinterest, and/or poor negotiation skills. Students frustrated with the collaborative process often reported that being put off by students who did not fulfill their obligations, had a poor work ethic, were satisfied with poor quality work, and/or who contributed minimally on assignments. Hansen (2006) also reported that students often found that unequal participation, goals, and interest in the learning materials detracted from the collaborative experience. Johnson et al. (2008) found that the leading complaints in their collaborative classrooms emanated from instructors choosing the collaborative teams, and team members not accepting equal responsibility for assignments. Likewise, Giraud (1997) found that not all students benefited from a collaborative methodology, and, in fact, found that some may not have benefited at all, due to the challenges of working on a team. Giraud

proposed that stress, anxiety, fear, and self-doubt might be factors in students challenged by the collaborative process.

Summary of Literature Review Findings

Socially active learning environments are an academic phenomenon that answers the adult student's expectations for a more participative, engaging, and active style of learning. These expectations have resulted in pressure on college-level course designers, instructors, and administrators to rethink instructional methodologies, learning tasks, and classroom organizations. An adult student's need for a more participative classroom has resulted in course designers and instructors having to rethink the value of the lecture-based pedagogies that have been historically pervasive in higher education. As a result, educators are evaluating more active, open, collaborative atmospheres for their classrooms. In addition to providing a more socially active classroom, educational researchers found evidence of three additional benefits for the collaborative classroom. The benefits of collaboration on in-class assignments included (a) accommodating of a variety of learning styles, (b) an improved likely hood of engaging the student with complicated learning tasks, and (c) lowering student anxiety levels when faced with unfamiliar or challenging subjects. Although stress and anxiety are pervasive elements that affect the performance of a high percentage of college students, when managed these psychological factors can energize a student to finish a paper or study a little longer for that difficult final exam. However, left uncontrolled excessive levels of stress interfere with the student's ability to concentrate on their studies, rendering them ineffective in their learning efforts.

Educational researchers labeled the pervasive fear that affects a proportion of college students enrolled in statistics classes as statistics anxiety, a debilitating psychological factor that can have deep performance and psychological effects on students. Researchers reported correlations between anxiety levels and (a) exam performance, (a) course achievement levels, and, at times, (c) overall academic performance. The substantial toll that anxiety has taken on a majority of students engaged in learning the subject of statistics provided the impetus for researchers to evaluate a variety of instructional methodologies to lower the stress levels in the classroom.

In recent years, educators have turned to addressing the issue of statistics anxiety in the classroom through the application of more participative classroom environments with the potential to connect students to statistical procedures through a collaborative, active, problem-based learning environment. Active, participative, more socially involved statistics classrooms have subsequently provided considerable evidence of lowering student stress levels and creating a more relaxed open environment for a high percentage of students. However, collaboration cannot be considered as a universal remedy for all highly stressed statistics students. Educational researchers found evidence that collaboration may be a frustration to a proportion of students, and a serious challenge to learning among some. Some adults challenged by the collaborative classroom complained that their performance suffered due to team members being confused over the assignment; having a poor work ethic or uncooperative attitude; not participating equally; or having different expectations, goals, or objectives for the learning experience.

Regardless of the reasons given by students, collaboration appears to be an effective method for an only a percentage of students.

Two distinct gaps in knowledge within the educational research base appear to exist. First, there was scant research regarding the challenges that adults face when participating on collaboratively assignments. Second, no scholarly, peer-reviewed research was found regarding statistics anxiety among adult students in general, and, more specifically, among adults participating in a statistics courses. The research conducted in this project study has the potential to close a gap in knowledge regarding student perceptions of collaboration, the phenomenon of statistics anxiety, and the effectiveness of collaboration as mitigation for statistics anxiety. The expectations for this study were that student perceptions may provide insight into methodological changes with the potential to reduce statistics anxiety levels, improve the learning environment in statistics classrooms, and, ultimately, improve the learning of valuable statistical skills.

Implications

The local, national, and international implications for this study include the need for statistics instructors to incorporate instructional methods in their courses that help students work past the fear of statistics. Opening statements from the author of a leading business statistics textbook admonished business students that "As a business professional you will constantly be dealing with statistical measures of performance and success, as well as with employers who expect you to be able to utilize the latest statistical techniques" (Weiers, 2008, p. xiii). The ability to gather, analyze, interpret, and draw logical conclusions from business data was no longer a proficiency that

businesses hope to find in their managers, these abilities become requisite skills. Unfortunately, many business students look upon any statistics course as being one of the most rigorous, demanding, difficult, least liked, anxiety producing courses in their curriculum (Onwuegbuzie & Wilson, 2003). As such, DeCesare (2007) proposed that helping students to overcome their statistics anxieties has become an important factor in course design and instruction in most, if not all, curriculums (DeCesare, 2007).

A question educational researchers, course developers, and instructors have been asking regards which instructional methodologies help highly anxious statistics students cope with their stresses in the statistics classroom. At the time of this research, no learning initiatives or instructional methodologies were identified that benefited all students. However, there are methods such as collaboration that move many, if not a majority of traditional college statistics students towards a less stressful, more effective, and more enjoyable statistics course. Researchers into the phenomenon of statistics anxiety found evidence that cooperative learning helps many students in both introductory and graduate level statistics classes (Vaughn, 2009). College statistics instructors likewise reported that collaborative methodologies have helped many students overcome the effects of debilitating levels of statistics anxiety (DeCesare, 2007).

Evidence exists that not all students benefit from a collaborative instructional methodology. In fact, I have seen evidence that a percentage of students chaff at being required to work collaboratively, while a second group of students is challenged by working collaboratively with other students. The local implications of this study lie in emerging adult student perceptions of collaboration a core instructional methodology and

then using these perceptions to modify the course methodology in order to improve the learning experience for a few more students. The wider implications for this study are to add to the knowledge base regarding

- how adult students perceive collaborative problem-solving,
- what causes adult students to be anxious over taking a statistics course,
- how the phenomenon of statistics anxiety affects an adult student's performance in a collaborative environment, and
- what additional measures can be undertaken to reduce stress and improve the learning experience.

I anticipated from the beginning of this project study that findings from the qualitative research and literature search efforts would lead to one of two possible projects. The first possibility for a project would include a complete redesign of the course methods, resources, and learning tasks. The second possible project that could evolve from this research effort would be a partial overhaul of some elements of the course methodology that adults' perceived was less than effective, troublesome, or ineffective. This last option would include some modification of the learning tasks, instructional methodologies, and course resource materials. As the focus of the research was on adult student perceptions of statistics anxiety and collaboration as an instructional methodology, I anticipate that possible modifications to the existing course would include some combination of the following actions:

- modifying or eliminating collaboration as a core instructional methodology for the in-class, problem-solving, lab sessions;

- eliminating collaboration on the final exam;
- providing math-challenged students with additional tutoring or self-help resources prior to and during the course;
- replacing the existing statistical software package;
- replacing the existing textbooks;
- providing students with course specific resources to assist students with skill deficiencies in the requisite software packages (i.e. word processing, database management, and statistical);
- revising or replacing the in-class scenario projects;
- modifying the 1-hour lecture and 3-hour lab session weekly classroom schedule; and
- providing counseling assistance for students affected by statistics anxiety.

One or more students in the after-course survey raised all of these possible modifications to the course structure.

Summary

I focused this section of my project study on describing both the benefits and limitations of collaborative instructional methodologies as an intervention for reducing the anxieties that many students face in a college-level statistics course. The business statistics course that provides the context for this study incorporated collaborative problem-solving exercises into the weekly lesson plans. The purpose for including collaboration as a core instructional methodology was to both build skills in team-based problem solving and to reduce statistics anxiety. However, I found evidence that

approximately 25% of all students who completed the statistics course were challenges with some combination of course content, learning tasks, and instructional methodologies. The challenges these students faced with the business statistics course provided the overall purpose for this project study, to identify changes to the course structure, resources, and instructional methods that would improve the learning experience for a wider range of learning styles (See Appendix A).

Section 2 provides a map for the direction this qualitative case study took in gathering narrative data from previous students of the business statistics course. Also included in section 2 is a description of the proposed research design, the plan to insure the ethical treatment of all participants, the data collection and analysis procedures, the limitations and scope of the study, and the data analysis procedures.

Section 2: The Methodology

Introduction

In this section, I describe the research methodology selected to identify and understand adult student perceptions of collaborative problem solving, statistics anxiety, and collaboration as mitigation for statistics anxiety in a business statistics course. I selected a qualitative case study approach in an effort to obtain rich narrative data from a representative sample of students who had completed the statistics course since initiation in January 2012. Although I considered a quantitative methodology, I eschewed this method, because I was unsure as to what variables were meaningful to adult students and subsequently should be included in a survey instrument. I will review the research design, sample of participants, data acquisition methods, data analysis procedures, and research findings.

Qualitative Research Design

The Research Focus: Problem, Purpose, and Question

As there is little concrete evidence regarding the perceptions adults have of statistics anxiety and collaboration as mitigation for statistics anxiety (the problem), I am proposing a qualitative study that will focus on gathering perceptions from past students of the business statistics course that provides context for this project study. Within the context of educational research, Creswell (2012) defined a research problem statement as a nest for the "educational issues, controversies, or concerns that guide the need for conducting a study" (p. 59). Creswell proposed two basic types of research problems: practical- and research-based. Practical-based researchers attempt to identify,

understand, and possibly solve a problem. Alternately, in research-based methodologies scholars focus primarily on adding to the knowledge regarding some phenomenon of interest to the researcher. From the practical standpoint, the problem addressed by this project study was a lack of knowledge regarding adult student perceptions of the benefits gained from working collaboratively in a business statistics class. From a research standpoint, I attempted to address a gap in the educational literature regarding the pervasiveness of statistics anxiety among adult students and the effectiveness of collaboration at reducing anxieties in the classroom.

Another element of any research effort is a concisely framed purpose statement (Creswell, 2012). The purpose of this project study was to understand adult student perceptions of collaboration as a mitigation factor for statistics anxiety. Creswell recommended that every research project have a concise statement of the question used to guide the research effort. The research question that guided the research was:

> What perceptions do adult students have of collaboration as an instructional methodology, the phenomenon of statistics anxiety, and the effectiveness of collaboration at reducing the effects of statistics anxiety on course performance?

The Research Design: A Qualitative Case Study

Because my interest in this project was in understanding student perceptions of statistics anxiety and collaboration as an instructional methodology, I selected an interview-based qualitative approach as the overall research design. Hancock and Algozzine (2011) and Flyvbjerg (2011) who proposed that selecting a qualitative framework for a project is appropriate when the researcher wants to focus on

understanding a phenomenon from the participants' point of view. Creswell (2012) advised that a qualitative approach is appropriate when the variables affecting a phenomenon are unknown and need exploring. With the focus of this project study on understanding (unknown) adult student perceptions of collaboration and statistics anxiety, a qualitative approach was the most appropriate research methodology. Because I conducted this research on a small group of well-defined students, I decided to refine the research strategy along the lines of a case study.

Three separate resources on research strategies by Hancock and Algozzine (2011) Lodico, Spaulding, and Voegtle (2010), and Stake (2008) informed my selection of a case study as the design strategy for this project study. A case study is a research strategy appropriate to elicit meaning regarding the effects of a phenomenon from the perspective of an individual or group of individuals. Hancock and Algozzine (2011) advised that a case study is appropriate when the researcher is interested in an in-depth understanding of individuals who are in a bounded system. Stake (2008) stated that case studies are appropriate when there is a phenomenon of interest to the researcher within a well-defined, organized, contiguous unit. As my focus was on understanding the perspectives of past students of a single business statistics course, the appropriate research strategy was a case study.

The Research Limitations

As with all case studies, the choice of the bounded system added limitations to this study (Flyvbjerg, 2011). One limitation of this research effort is the sample of participants selected; I chose only adult, nontraditional students enrolled in a college-

level business management degree completion program at a Southeastern U.S. liberal arts college. A second limitation was that I selected participants from only one business statistics course with an enrollment since January 2012 of only 93 students. A third limitation of the study was the limited number of participants who volunteered for the study. Although I invited all students who had completed the course since January 2012 and had an active e-mail on file with the college ($N = 91$), only 14 participated. A fourth limitation of this study rested in two demographic factors inherent in the population and the resulting sample. First, while the gender demographics of the population of students was 55% female and 45% male, the demographics of the sample was 70% female ($n = 10$) and 30% male ($n = 4$). Second, the approximate ethnic makeup of the student population was 10% African American; while the ethnic makeup of the sample was 100% European Americans. Although I tried on two separate occasions to remedy these two demographic discrepancies between the sample and population, no additional male or African American students volunteered to participate.

As I was the original designer of this course and the only instructor since its initiation in January 2012, every participant knew me. This factor, coupled with my experience in teaching statistics, knowledge of the phenomenon of statistics anxiety, and experiences with collaboration as an instructional methodology all add to the limitation of this research project. In an effort to insure that I minimized the negative effects of these personal biases, it was necessary for me to both acknowledge and understand my own predispositions towards statistics anxiety and collaboration. Also of importance to this acknowledgment was the fact that I earned a master's degree in engineering, am a retired

senior executive business leader who used statistics extensively, and am currently an adjunct professor of statistics with a PhD in quantitative analysis. These factors led to a personal challenge I have with understanding why students find statistics courses challenging, fear inducing, and, anxiety producing. Likewise, having done considerable research regarding instructional methodologies for statistics instruction, I had a number of presuppositions regarding what did and did not work effectively in the statistics classroom. In an effort to counter these personal predispositions, prejudices, and biases, immediately prior to each interview session I reflected on these limitations in an attempt to exercise care with my questioning, offhand comments, and body language. Even with this acknowledgment, I was aware that body language and exculpatory comments might telegraph some meaning to my participant. Once recognized, this acknowledgement required that I remind myself to remain as neutral as possible during both the interview and data analysis processes.

Regardless of the limitations of this research effort, I remain convinced that the data collected from interviewing 14 adult students of the statistics course provided insight into student perceptions statistics anxiety and collaboration as an instructional methodology within the context of an adult-oriented business statistics course.

Research Participants

The Selection of Participants

I selected participants for this project study research from a population of 93 adults who had completed the business statistics course since January 2012. The sampling frame ($N = 81$), from which I selected a sample of convenience, consisted of

adults with an active e-mail address on file with the college. Creswell (2012) suggested that a sample of convenience is appropriate when the researcher is constrained to selecting participants who are "willing and able to participate" (p. 145), precisely the circumstance with this study. Creswell proposed that qualitative research typically involves the selection of a purposeful sample where the researcher selects participants who are knowledgeable of a specific phenomenon, problem, or issue of interest to the researcher. As the focus of the project study was to elicit student perceptions of collaborative problem and statistics anxiety (the phenomena of interest), there was justification for including only participants who had successfully completed the course. Therefore, the sample of students selected for this research effort included only individuals who had completed the business statistics course, maintained an active e-mail address on file with the college, and indicate a willingness to participate in the study. The administrator for the college's Adult and Graduate Studies Department provided a letter of cooperation (see Appendix B) that authorized me to contact past students of the course. Additionally, the college provided me with a list of active e-mail addresses on file with the college for all past students of the business statistics course.

The process of selecting participants for the research study began with my sending e-mail invitations (see Appendix C) to the 81 past students of the business statistics course with active e-mail addresses on file with the college. I received 18 responses from the first invitation, 12 of which were positive. I sent a second invitation to all individuals who had not responded approximately two weeks later. An additional six students responded as willing to participate. Of the 18 individuals who responded

positively, I was able to schedule and complete interviews with only 14 of the 18 volunteers: 10 females and four males. As the demographics of my sample were significantly different from the population demographics of 55% female and 45% male, I attempted a third time to solicit additional participants and received no positive responses.

The Sample of Participants

The 14 participants, 10 female and 4 male, who participated in this research fairly represented the broad range of ages and work backgrounds of the students who had completed the course since January 2012. A brief description of each participant in this study follows (all names are pseudonyms):

- Adam was a 30 to 40 year old European American male who advised that he had recently graduated and immediately been promoted to managerial position within his company. Adam is a self-proclaimed "loner" who did not "like to really rely on people." This participant voiced that he remembered being highly stressed over the prospects of taking business statistics and remained stressed throughout the course. Adam voiced repeatedly that collaboration on the in-class assignments was "really really helpful" advising that when he did not understand a procedure, his partner was able to help him.
- Barbara, a 40 to 50 year old European American female, was a stay-at-home mother with a part time job as a substitute teacher and secretary in a private Christian school. Barbara described herself as a highly self-reliant perfectionist who remembered feeling significantly stressed over the prospects

of completing the statistics course and maintaining a 4.0 GPA. Barbara felt lucky to have selected a compatible collaboration partner with similar aspirations for a high grade. Barbara claimed that after the first night of working collaboratively she was able to settle into learning the material and even enjoyed the class.

- Carl, a male in his late 20s, claimed to have no fear of any math class and no anxiety over taking a statistics class. He described himself as "OCD, very perfectionist, very detail oriented." Carl had recently graduated and been hired away from his current employer to an upper level managerial position with a company closer in Texas. Carl admitted that he did not enjoy collaborating, preferring to do the work independently. However, Carl commented that he recognized that there were benefits to team-based problem solving as an instructional methodology. Carl cited the need for business students to learn how to cooperate in analyzing problems and arriving at a consensus on solutions.
- Dorothy, an energetic, outgoing, 30 to 40 year old female was a bookkeeper for several private businesses. Dorothy was a self-professed "high achiever" who claimed to have "slight OCD tendencies." She had only recently graduated with a 4.0 GPA and was looking for a different job. Dorothy remembered some stress over taking the statistics course; she was concerned with being able to maintain 4.0 GPA. Dorothy commented several times that she very much enjoyed collaborating during the statistics due to having

chosen a partner who was compatible in both work ethic and expectations for a high grade.

- Everett, a European American male in his early 40s, was a decorated soldier during the Gulf War, had previously worked as a paramedic Life Force: a nation-wide helicopter rescue service. At the time of the interview, Everett had his own business; a medical services business. Additionally, Everett had recently advised that he had recently been accepted into a physician's assistant program and was in the process of selling his business. Everett commented that he enjoyed math and statistics, admitting that he perceived statistics as "just another math class." This participant described himself as highly computer literate, analytical, and self-sufficient.
- Fran, a European American female in her late 30s, was a stay-at-home mother who was currently looking for a managerial position. Fran was another participant who mentioned several times that she preferred to work collaboratively, seeing benefits in working with a partner who supplemented her challenges with writing. Fran said that she needed a collaborative partner who was good at writing due to her not "being able to put my thoughts down on paper." Fran remembered being "somewhat stressed" with taking a statistics course, along with feeling "overwhelmed" due to being challenged with math word problems.
- Gwen was in her early 40s, and freely admitted that she was "extremely intimidated" by any math class, including the business statistics class. Gwen

worked for her local school board as a bookkeeper and substitute teacher for kindergarten children. Gwen was a strong proponent of working on a team. She commented, "two heads are always better than one," adding that she "enjoyed [collaboration] because she never felt alone."

- Harold, an entrepreneur and computer programmer, claimed to be "very fearful of . . . anything to do with math." Harold claimed that he would not have been able to finish the statistics class without working collaboratively with someone who was knowledgeable with math. Harold commented that he enjoyed hearing other student's perspectives while collaborating on statistics assignments.
- Iris was a homemaker who had homeschooled seven children with considerable experience in teaching a broad range of primary- and secondary-level classes and courses. This participant was a straight "A" student all through college. She commented on several occasions that she felt competent with math, any computer software programs, word processing, and database management: all skills needed in the business statistics course. Iris commented that she enjoyed challenges, was a perfectionist, enjoyed attending college, and fully enjoyed the business statistics class. Iris voiced that she enjoyed collaborating because she knew her partner prior to coming to the statistics class. Iris was one of the five participants who voiced that if they had not known their partner prior to coming to the class, they would have

preferred to work independently on all assignments. She enjoys math, math puzzles, and had no fear of taking statistics.

- Jessica was a female in her late 50s who worked as a receptionist in a local retail outlet. She acknowledged being highly anxious about the business statistics class due to "math not being [her] strongpoint," and having challenges with computer-based classes such as statistics. Jessica admitted that she broke out in hives and left the classroom crying at the beginning of the first night of statistics due to being highly stressed over the prospects of "even passing the class." Jessica was one of four students who claimed they could not have completed the class without collaboration. Jessica also admitted that she "may not have been an equal contributor" to the problem-solving assignments.
- Kay was in the group of four participants who claimed no anxiety with math or statistics; however, she also advised of challenges with test anxiety. Kay, a self-avowed perfectionist with a high GPA, advised that she did not have a good experience with collaboration in the business statistics class as she felt that her partner was weak and that she "had to do most of the work." Kay advised that she always preferred to work on all assignments, voicing that she enjoyed working out problems on her own. Kay commented that she had recently enrolled in an MBA program offered at the same college where she completed her bachelor's degree.

- Laura was an accountant and bookkeeper who voiced, on several occasions, that she "never enjoyed math" and was highly stressed over taking any statistics course. At the time of the interview, Laura had finished all of her classes, but had not graduated due to needing to complete a portfolio project. Laura advised that she did not typically enjoy working in groups, but due to her high levels of math and statistics anxieties, was grateful for having a knowledgeable partner in the statistics course.
- Mary claimed to have no anxiety over either math or statistics. This participant described herself as having a "type 'A' personality" that was a high achiever with a 4.0 GPA. Mary claimed that she generally enjoyed collaboration; however, during the statistics class she found her partner was little to no help on any of the projects.
- Nancy was a 40-year-old single woman who was currently the general manager of a large restaurant. She advised that she had no fear of math, having worked in the field of accounting for 13 years. Mary was outspoken, professional, and confident of her abilities both in business and with academics. Nancy enjoyed talking about her experiences in the business statistics class, voicing that she had a "very enjoyable experience" with the course in general and especially with working collaboratively. Mary stated that she enjoyed learning statistics with a collaborative partner that she had known for years. At the time of the interview, she had completed all of her

coursework, but had not graduated due to needing to complete a portfolio of work experiences.

The 14 participants included 4 males and 10 females, and represented a broad range of opinions about, experiences with, and predispositions towards collaboration and statistics anxiety. All of the participants were open and honest regarding their feelings, concerns, and anxieties regarding collaboration, statistics anxiety, and the benefits of collaboration in reducing statistics anxiety.

The Ethical Protection Measures Employed

In preparation for conducting this project study, I completed the National Institutes of Health (NIH) training course, "Protecting Human Research Participants" (see Appendix D). Additionally, I undertook to insure the protection of all participants through the use of a formal consent form that

- explained the purpose of the research;
- described the qualitative data collection procedures and expected interview lengths;
- disclosed a participant's right to withdraw from the research at any time and for any reason;
- described how a participant's right to privacy were protected through the use of pseudonyms and securing of all narrative data, transcripts, and field notes; and
- included procedures for adhering to federally regulated institutional review board guidelines.

In addition to the above, I reviewed all of the participant rights with each interviewee at the beginning of each interview session. I secured all of the narrative data on a password-protected personal computer with limited to access and accessibility.

Data Acquisition

Data collection was accomplished via personal one-on-one interviews at a site convenient to the interviewee. I scheduled interview sessions during the months of March and April 2014 at locations, dates, and times agreeable to each individual participant. Once each interview session was scheduled, I sent the participant a copy of the Participant Consent Form (see Appendix E) for review. At the beginning of the interview session, I asked each participant if he or she had any questions regarding the consent form, answered any questions, and requested that they sign and date a copy for my files. Although offered, none of the participants requested a copy of the signed consent form.

The interview protocol followed Hatch's (2002) recommendations for a structured interview. According to Hatch, a structured interview was appropriate where the researcher conducts the interview with a preformatted list of questions addressed in a formal interview protocol (see Appendix F). The purpose behind the use of a preformatted list of questions was to "gather information from several informants that can be compared systematically" (Hatch, p. 95). In keeping with Hatch's format for a structured interview, I organized my primary and follow up questions into what I termed five areas of inquiry:

- attitudes regarding collaboration in general,

- experiences with collaboration during the business statistics course,
- collaborative partner selection,
- self-perceptions of statistics anxiety level, and
- effects of collaboration on student anxieties.

As needed, I added follow-up questions after each of the five primary questions to probe for additional input regarding each participant's experiences with and perceptions of collaborative problem solving and statistics anxiety.

All participants agreed to my recording the interview sessions, with none accepting my offer to receive a copy of the transcript. I completed all interview sessions in under 1-hour, after which I copied the digital audio file from the recorder to my personal computer. Upon confirming that I had accurately transferred the digital recordings to my computer, I erased all recordings on the digital recorder.

Data Analysis Procedures

Transcribing the Narratives

I personally transcribed each of the first four interview sessions and, subsequently, sent the remaining nine recordings to a professional transcribing service. As a quality control measure, I compared each commercially transcribed interview with the respective recording and made corrections as required. I secured all digital recordings and final transcribed interviews on my personal password-protected computer. I will keep the stored data secure and in my possession for a minimum of five years.

In order to insure participant anonymity within the transcribed files, I implemented three actions. First, I maintained a reflective log where I kept the only

reference to each participant's given name, gender, personal observations during and after the interview, and the date and time of the interview session. As a second step to insure participant anonymity, I removed all references to the participants, identities and replaced each name with a chronologically coded, gender-specific pseudonym. As an example, I gave the first interview participant, a male, the pseudonym of Adam. I referred to the second participant, a female, as Barbara, and so on. In an additional effort to insure anonymity, I coded the names of any collaborative partners or other individuals mentioned during the interview, replacing any names with a letter designation. I will maintain control of all recordings, transcriptions, and the reflective log on my personal computer or in my home-office desk; I will maintain all records for a minimum of 5 years.

Organizing the Data

Within the framework of an unfettered data-driven strategy, I commenced the coding process by employing a method described by Creswell (2012) as *analytic*. This method required me, as researcher, to divide an interview transcript into meaningful blocks or segments of narrative. To facilitate this step of the data analysis process, I used a word processing program to highlight sections of the narrative with the following color codes: (a) yellow for introductory, conclusion, and off-subject comments, (b) green for questions posed by the interviewer, and (c) blue for responses from the participant. For the second step of the data organizing process, I used the word processing program to add underlines, highlight, and, subsequently, add descriptive comments (preliminary codes) to salient portions of each narrative that directly addressed the questions I had posed. As

an example, Adam responded to my question regarding his or her experience with collaboration with "I enjoyed working on a team; it helped me get through the course." Subsequently, I distilled this comment down to a preliminary code of *Collaboration was helpful-enjoyable*. Likewise, Gwen and Harold commented that they were highly stressed with any math course, commenting that statistics was just a very difficult math course. I coded these responses as *Extreme or High Math Anxiety* and *Extreme or High Statistics Anxiety.* I continued this method until I had analyzed each participant's responses within each of the areas of inquiry.

Developing the Frames of Analysis

After organizing and coding each of the 14 interview transcripts, I grouped contextual responses from each participant into what Hatch (2002) termed "frames of analysis" (p. 163). Initially I attempted to force each participant's responses into the original five areas of inquiry, calling these my frames of analysis. However, because attempted to force each participant's responses into the five original frames, it became obvious that I needed to add two additional frames: partner compatibility and challenges with math and math-based courses.

When discussing experiences with collaboration in the business statistics course, every participant made one or more comments regarding the importance of having a compatible partner. Examples of comments made by interviewees regarding their experience with collaboration during the statistics class included the following:

- Barbara admitted that collaboration concerned her "thinking it could affect my grade." She stated that she "didn't want to be paired up with someone who may cause me to make a C."
- Iris was concerned with having a partner that was less than committed to learning the material and earning a high grade. She added, "What I don't like about working on a team is when [there are] students that are not committed . . . they don't really care about the outcome, their goal for a grade is maybe a C and my goal is an A, our goals don't match up."
- Nancy had a similar comment, "I don't know how well I would have liked [collaboration] had I been paired with somebody I didn't know or know their capabilities."

These comments, among others regarding compatibility, convinced me to craft a sixth frame of analysis that informed student perceptions regarding the collaborative process as being either burdensome or helpful to the learning process. I called this sixth frame *Important Partner Compatibility Factors*.

A seventh connected group of comments evolved when I queried participants regarding any challenges they faced with the phenomenon of statistics anxiety. After reading the description for statistics anxiety that I supplied, each participant volunteered some comment regarding his or her abilities, deficiencies, or challenges with math and math-based subjects such as basic math, algebra, geometry, trigonometry, accounting, and statistics. Examples of comments from participants included the following:

- Adam commented, “I love math. . . . I love numbers . . . . Math is not a difficult subject for me.”
- Barbara said, “I have [always] been pretty decent at math.”
- Carl said, “[Statistics] is just math, numbers are not hard for me.”
- Harold remembered commenting the first night of class “Oh, my God, this is math, more algebra and math.”
- Jessica expressed her concern with statistics when she admitted that she “had to take college algebra five times, so that should give you an idea of my anxiety [level].”

As this seventh frame of reference informed a participant’s perceptions of self-efficacy with statistics, I added a frame of reference termed *Self-perception of Math Anxiety Level*.

I conducted a final follow-up review of the 14 participant transcripts to identify the need for any additional frames of analysis. Upon completing this review, I concluded that the seven frames adequately and accurately encompassed all participant comments that could possibly inform the research question. The final seven frames of analysis are as follows:

- Attitude Regarding Collaboration in General,
- Experience with Collaboration During Class,
- Prior Experience with Partner,
- Important Partner Compatibility Factors,
- Self-perception of Statistics Anxiety (S/A) Level,
- Self-perception of Math Anxiety (M/A) Level, and

- Effects of Collaboration on Anxieties.

Finalizing the Response Domains

The second step in analyzing the narrative data was to mine the coded key phrases in each transcript for what Hatch (2002) termed *response domains*. Hatch offered the concept of condensing comments from all research participants within each frame of analysis into a system of response domains that accurately encompassed the intent of each individual's comments within each frame of analysis. I attempted to insure parsimony during this critical phase of data analysis process by developing a system of succinct response categories that represented all of the responses within each frame of reference, while also insuring that the categories were mutually exclusive. I found this step of the data analysis process to be difficult, time consuming, and complex. After several tentative starts at constructing a system of response domains for each of the seven frames of analysis, I settled on the following response categories within each of the seven frames:

- *Attitude Regarding Collaboration in General*
    - *Alone* - prefers to work alone,
    - *Qualified* - prefers to work collaboratively only if a compatible partner can be found
    - *Collaborative* - prefers to work collaboratively whenever possible
- Experience with Collaboration During Class
    - *Helpful* – collaboration was perceived as of some benefit

    - *Problematic* – either the partnership was less than effective, or the individual was unable to perform effectively as a member of a collaborative team

- *Prior Experience with the Collaborative Partner*
    - *Yes* – knew the collaborative partner prior to coming to the course
    - *No* – Chose a partner they did not know prior to the course
- Important Partner Compatibility Factors
    - *Knowledge* – having experience and/or familiarity with math, statistics, word processing, database management, or any of a number of skills needed to complete the course successfully
    - *Work Ethic* – willing to share equally in the workload
    - *GPA* - personal expectations for grade
- Self-perception of Statistics Anxiety (S/A)
    - *Extreme or High* – characterized by extreme worry or fear of being able to complete the course with a passing grade
    - *Marginal or Low* – comments included some worry or anxiety due to reputation of the course, but generally not fearful of passing
    - *None* – comments in this domain generally indicated no anxiety or fear of statistics or math
- Self-perception of Math Anxiety (M/A)
    - *Extreme or Hi*gh – comments included a fear of any course requiring any form of math

- *Marginal or Low* – comments were generally characterized by worry over higher-order math courses such as calculus, geometry, trigonometry, etc.
- *None* – comments in this domain generally were positive regarding math in any form

- Effects of Collaboration on Anxieties
  - *Helpful* – comments in this domain generally indicated that working on a collaborative team reduced the participant's fears, worry, or anxiety
  - *Minimal or Problematic* – responses classified in this response domain indicated either no opinion or collaboration was difficult for the participant

Insuring Qualitative Reliability, Transparency, and Validity

Creswell (2009) proposed that researchers could enhance the integrity or quality of qualitative findings by addressing both the qualitative validity and the qualitative reliability of a research effort. According to Creswell, the researcher can develop the validity of a qualitative study through a process of rigorously checking transcript accuracy to the digital recording. This process insures that all interpretive remarks concerning a transcript remain true to the participant's original intent. To facilitate this quality measure, I completed the following four audit steps:

1. I first reviewed each transcript for accuracy, comparing the transcript with the digital recording. This process required that I playback each digital recording while carefully reading each transcript for any differences.
2. Next, I reviewed each transcript to insure that my notes, comments, and reflections regarding the interview were accurate to the individual's intent.
3. As a third step, I carefully reviewed each transcript to insure that I had categorized correctly all key phrases (codes) within the appropriate frames of reference.
4. Finally, I performed a review of the classification of each participant's comments and my coded comment to the response domain in order to insure that the domain accurately represented the participant's comments.

The result of these verification methods insured that the Matrix of Frames of Analysis and Response Domains (see Appendix G) accurately represented the original intent of the participants' responses.

I performed one final measure for insuring transparency of the data analysis process with a reflective log that chronicled the formal audit trail from transcript through theme development. I reviewed the chronicle first with my peer/expert reviewer. Merriam (2009) addressed the importance of using a peer reviewer as an additional strategy for the researcher to promote validity and reliability of a research effort. To facilitate a peer review process, I enlisted the aid of a fellow college instructor who was familiar with qualitative methods and the subject of statistics anxiety to review my analysis and findings. The peer reviewer evaluated the appropriateness, inclusiveness,

and congruency of the frames of analysis, response domains, findings, conclusions, and recommendations for a project. I have included a copy of the signed confidentiality agreement with the peer reviewer in Appendix H. The final step of this review was to secure my committee chair's concurrence that the procedures for data analysis were appropriate.

Preparing the Data for Analysis

After a final review of the seven frames of analysis and the respective response domains, the data obtained from all 14 participants was both properly organized and accurately represented. Furthermore, the research question that inquired as to adult student perceptions of collaboration and statistics anxiety was answerable through the data collected. Data analysis commenced by methods proposed by Hatch (2002) and Yin (2009). Hatch proposed reviewing the participant responses first within each frame of analysis and, subsequently, between the seven frames. Coupled to this, Yin proposed an analytic methodology creating data displays such as tables, graphs, or charts that organize the data. Yin's recommendation that the researcher put "information into different arrays. . . . By creating data displays" (p. 129) complimented the frame and domain organization proposed by Hatch. Following this logic, I combined Hatch's matrix of frames of analysis with tabular representations of the responses as recommended by Yin during the analysis phase of this research. I discuss the findings from this analysis in the following section entitled Research Findings.

Research Findings

The process of deriving meaning from the data relative to the research question required a two-step examination of the frame of analysis and response domains. Hatch (2002) proposed the first step was for the researcher is to analyze for "complexity, richness, and depth [of meaning]" (p. 171) within each frame of reference. The process of looking for patterns of responses within each frame of reference provided insight into how adults perceived three areas of importance to this project study: (a) collaborative learning as an instructional methodology, (b) the anxiety challenges they faced with statistics, and (c) how collaboration affected the participant's anxieties.

Step 1: Intra-frame Analysis.

The data analysis process began with organizing the frames of analysis and respective response domains into a data display, as per Yin's (2009) recommendation, constructing a table of all responses within each frame of analysis (see Appendix G). I also added frequency counts to each table as recommended by Hatch. I addressed each frame of analysis separately in the following sections and included a frequency table, a discussion of the findings, and possible themes that evolved from the analysis.

Attitude regarding collaboration in general. I categorized coded responses in this frame of reference as follows: *Alone* - preferring to work alone on all assignments, *Qualified* - preferring to work collaboratively with a known partner, and *Collaborative* – prefers to work on a team whenever possible. Table 1 is a summary of responses by category.

Table 1

Participant Preferences for Collaboration

General Preference for Collaboration	Number of Participants	Percentage of Sample
Alone	4	28%
Qualified	5	36%
Collaborate	5	36%

- There was an equal distribution of coded responses between the three domains. When the added caveat that some students prefer to work collaboratively only with a known partner, the majority of participants prefer to work collaboratively (*n* = 10, 72%)
- Alone – Participants in this category (*n* = 4, 28%) generally preferred to always be responsible for their own work. Adam stated, "I'm a loner. . . I don't like to rely on people." Barbara, another participant who preferred to work alone commented that "It scared me . . . thinking [collaborating] could affect my grade."
- Qualified – Participants in this category (*n* = 5, 36%) voiced a preference to working collaboratively with a partner only if the partner was both known and compatible. Iris characterized individuals in this category of response indicating that if she did not know anyone in the class, she preferred to work alone. Laura commented that she generally did not enjoy working in groups, however in the statistics class she "gravitated towards a person that I knew

[and] had the same work ethic." This participant stated that if paired with someone less concerned with his or her grade, it would upset her greatly.

- Collaboration – Participants with comments in this response category (*n* = 5, 36%) preferred to work collaboratively whenever possible in difficult or complex courses. Fran summed the responses for this domain with "I would prefer working with someone . . . [because] two heads are better than one."

Two possible themes evolved out of these findings:

1. The majority of adult students prefer to work collaboratively on in-class assignments with one caveat – some prefer team-based work only if a known, compatible partner is available.
2. A minority of adult students prefer to work independently on all assignments.

Experience with collaboration during class. I categorized responses in this category as either *Helpful* or *Problematic*. Table 2 summarizes the participant responses in this frame of analysis.

Table 2

Participant Experience with Collaboration During the Course

Preference for Collaboration during Class	Number of Participants	Percentage of Sample
Helpful	10	71%
Problematic	4	29%

- Helpful – Participants who responded positively regarding their experience with collaboration in the business statistics class (*n* = 10, 71%) generally

categorized their experience as *helpful* or enjoyable. Harold offered several observations shared by those finding collaboration to be helpful, including: "You can share the responsibility. . . . You gain more ideas from other people [on] the team. . . . Two heads are better than one. . . . Everybody sort of benefits from each other."

- Problematic – A minority of participants (*n* = 4, 30%) categorized their experience as being *problematic*, difficult, or difficult due to being unequally yoked with his or her partner. All four of these participants voiced either some level of incompatibility with their partners or general dislike for the collaborative process. Gwen voiced, "I felt that I was carrying a lot of the weight . . . and the other person was just kind of tagging along." Likewise, Kay advised that she found collaboration to be less than productive because "We argued about our answers. . . . We didn't work well together."

Findings in this reference frame reinforced the themes developed in the previous section, where a majority of adult students finds the experience of collaborating on in-class assignments to be helpful and/or enjoyable.

Prior experience with partner. Within this frame of reference, a majority of the students (*n* = 9, 64%) had collaborative partners they had known from previous classes. The remaining participants (*n* = 5, 36%) were forced to choose a partner they had never worked with or known prior to the statistics class. This frame of reference becomes more important in the second stage of analysis, interpreting patterns of responses across the seven frames.

Important partner compatibility factors. This frame of analysis arose out of comments offered regarding my inquiry into each participant's experience with collaboration during the business statistics class. I grouped coded participant comments into three categories of response: *Knowledge, Work Ethic,* and *GPA.* Table 3 summarizes the responses for this frame of analysis:

Table 3

Important Compatibility Factors Among Participants

	Participants mentioning each factor	Percentage of participants
Knowledge	13	93%
Work Ethic	12	86%
GPA	8	57%

- Knowledgeable – The most frequently mentioned compatibility factor was a prerequisite for a collaborative partner to be *knowledgeable*, skilled, or competent (*n* = 13, 93%). Fran advised that she had difficulty putting the right words on paper, as it "takes me forever to come up with something to write," adding later in the interview that her "team member was a good one because he filled in where I [was lacking]." Jessica commented that her partner's "computer skills were a lot higher than mine. . . . She was a big help."
- Work Ethic – The second most frequently mentioned compatibility factor (*n* = 12, 86%) was for the need for a collaborative partner to be dependable. These

participants defined dependability in a partner as a willingness to share the workload equally. Jessica advised that "what I don't like about working on a team is when there are students that are not committed . . . they don't really care about the outcome." Likewise, Laura was concerned with collaborating because of past partners who had not pulled their own weight.

- Grade Point Average - The third most frequently mentioned compatibility factor (*n* = 8, 57%) was GPA or the need to find a collaborative partner who had similar learning goals for the course. Typically these individuals self-identified as high-achievers concerned with maintaining a carefully nurtured GPA. Laura's comments were typical among this category when she voiced collaborations "scared me right from the beginning. . . . I graduated with straight A's and so, [putting] me with somebody that I didn't know, it scared me thinking it could affect my grade."

Two additional themes evolved out of these findings:

3. Adults place a high priority on a collaborative partner's compatibility in the areas of knowledge, work ethic, and aspirations for the course.
4. The high frequency of a combination of knowledge and work ethic as compatibility factors was an indication of an adult's need to feel equally yoked when collaborating on assignments.

Self-perception of statistic anxiety. I categorized coded responses in this frame of analysis into three categories: *Extreme/High, Moderate/Low,* and *None*. Table 4 summarizes the response domains within this frame of analysis.

Table 4

Participant Statistics Anxiety Levels

Preference for Collaboration during Class	Number of Participants	Percentage of Sample
Extreme/High	6	42%
Moderate/Low	4	29%
None	4	29%

- A majority of students (*n* = 10, 71%) made comments indicating that they had some level of fear, angst, or stress about the subject of statistics.
- Extreme/High – Participants in this category (*n* = 6, 43%) voiced a lack of self-confidence in completing the business statistics course on their own, typically citing a general fear of formulas, word problems, analyzing and drawing conclusions from data. Adam, one of the more extreme examples of this response domain, voiced that he "had extensive worry" about taking any statistics course. Harold offered that when he learned that he had to take a statistics course his first comment was "Please, just let me get through this class. . . . Oh, my God, this is math."
- Moderate/Low – Participants in this category (*n* = 4, 29%) voiced some level of worry over being able to complete the course with a grade sufficient to maintain a high GPA. Carl commented that he was "worried initially . . . because I heard so [many] people having problems with it." Dorothy admitted that she was "on the fence" about taking the course, because she had heard so

many people say that it was scary. Comments from participants in this domain typically expressed concern for taking statistics due to the reputation from other students as one that was difficult, challenging, or complicated. The difference between participants in this domain and the Extreme/High domain was one of degree; these adults generally had more of a concern regarding the class than a fear of completing the course.

- None – Individuals in this realm (n = 4, 36%) claimed no statistics anxiety, generally commenting that they had no concerns regarding learning statistics, typically voicing the opposite – an interest in the subject. Comments from Iris are typical of the individuals claiming no statistics anxiety: "I was looking forward to statistics," and "I like logic . . . math games . . . logic puzzles." These individuals typically voiced that they found the course both enjoyable and interesting.

One possible theme evolved from these findings:

5. Statistics anxiety is a factor that affects many adults with feelings of emotional well-being, and/or concern for performance on assignments. This theme tends to validate research conducted by numerous educational researchers indicating that the learning performance of a majority of many statistics students is affected by statistics anxiety (Baloglu, 2004; Bell, 2008; Collins & Onwuegbuzie, 2007; Onwuegbuzie, et al., & Ryan, 1997; Onwuegbuzie & Wilson, 2003; Pan & Tang, 2005).

Self-perception of math anxiety. For this frame of reference, I coded participant responses similar to the previous frame, *Self-Perception of Statistics Anxiety*. Table 5 is a summary of the findings in this realm of response.

Table 5

Participant Math Anxiety levels

Math Anxiety Level	Number of Participants	Percentage of Sample
Extreme/High	4	28%
Moderate/Low	5	36%
None	5	36%

- A majority of the participants (*n* = 9, 64%) commented on having some level of math anxiety. Gwen commented that she "passed [college-level] algebra with a D . . . I just don't get [math]." Laura offered that she "never enjoyed math . . . I've never enjoyed any of that." Likewise, Katie admitted, "math is not my strong point. . . . I had to take college algebra five times."
- Conversely, a smaller percentage of the participants (*n* = 5, 36%) indicated no fear of, or anxiety over, any form of math or math-based courses. These individuals characteristically voiced some level of enjoyment for math, problem solving, or data analysis. Iris' remarks are typical of this domain with responses such as "I like logic . . . doing math games . . . completing logic quizzes . . . word puzzles." Kay had similar comments with "I've just always enjoyed math. . . . I love problems, I take it as a mystery, they give you an equation . . . and you find out where it goes."

One additional potential theme evolved from these findings:

6. A percentage of adults will experience anxiety, fear, or angst over any course that requires advanced levels of mathematics, exactly the case with any college-level statistics course.

Effects of collaboration on anxieties. Regarding responses in this realm of response**,** I classified participants by their comments as generally claiming that collaboration was *Helpful* or *Minimal/Problematic*. Table 6 summarizes the responses by domain.

Table 6

Effects of Collaboration on Participant Anxieties

	Number of Participants	%
Helpful	10	71%
Marginal/problematic	4	29%

- The majority of participants (*n* = 10, 71%) made comments that collaborating on in-class assignments was helpful to reducing anxieties either for the participant or their partner. Adam advised, "My teammate really helped me to understand and get through [the class]. Barbara admitted that her anxiety level lowered after the first night of class because she started to feel "more comfortable with collaborating."
- Four individuals, 29%, voiced that they either had no opinion regarding the benefits of collaboration on anxieties, or found collaboration was no help to

them personally. These participants typically voiced that they did not enjoy collaboration and perceived his or her partner to be less than helpful during the course.

One additional theme evolved from this frame of analysis:

7. Many adult students perceive that working collaboratively on in-class assignments helped them to cope with their anxieties.

Step 2: Intra-frame Analysis.

According to Hatch (2002), the second phase of finding meaning from narrative data involves analyzing for patterns between frames of analysis. During this phase of analysis, I looked for patterns of response between:

- *Attitude Regarding Collaboration in General* and *Experience with Collaboration During Class*
- *Experience with Collaboration During Class* and *Prior Experience with Partner*
- *Experience with Collaboration During Class, Prior Experience with Partner,* and *Effects of Collaboration on Anxieties*
- *Self-perception of Statistics Anxiety* and *Self-perception of Math Anxiety*

The process of looking for patterns of responses across these frames of analysis found additional themes regarding the effectiveness of collaboration as an instructional methodology and as mitigation for statistics anxiety.

Experience with collaboration in general and during the statistics class. In comparing participant comments within the two realms of *Attitude Regarding*

Collaboration in General and *Experience with Collaboration During Class*, the following patterns were important to the research question:

- Of the individuals attesting to a preference for working alone (n = 4), three had problematic experiences.
- Of the remaining participants (n = 10) who claimed some level of enjoyment or helpfulness with collaboration in general, eight made comments that collaboration was helpful and or enjoyable.

Findings from this analysis serve to confirm that a majority of the participants in this study found collaboration to be helpful (see theme 4).

Experience with collaboration and prior experience with partner. A pattern in the findings was revealed when I compared participant comments between the two frames labeled *Experience with Collaboration During Class* and *Prior Experience with Partner* (See Table 7).

Table 7

Participant experiences with collaboration and Prior Experience with Partner

Participants	Experience with collaboration	Prior Experience With Partner
9	Helpful	Yes
1	Helpful	No
1	Problematic	Yes
3	Problematic	No

- Of importance to the research question is the finding that nine of the ten individuals that claimed a *helpful* experience with collaboration had prior experience with their collaborative partner.
- Of the four individuals who voiced a "problematic" experience with collaboration (*n* = 4, 29%) three had no prior experience with their partner.

One additional theme advanced from these findings:

8. Prior experience with a collaborative partner plays a role in the perception adult students have of the benefits of collaborating on in-class assignments.

Statistics anxiety versus math anxiety. When I compared coded responses within the realms of *Self-perception of Statistics Anxiety* and *Self-perception of Math Anxiety*, another distinct pattern is evident (see Table 8).

Table 8

Participant perceptions of a relationship between Statistics and Math Anxiety

Number of Participants	Statistics Anxiety level	Math Anxiety level
4	Extreme/High	Extreme/High
2	Extreme/High	Moderate/Low
1	Moderate/Low	Moderate/Low
2	Moderate/Low	None
5	None	None

- A majority of the participants in the study (*n* = 9, 64%) claimed some level of statistics anxiety and math anxiety.

- All five participants claiming no statistics anxiety also claimed no math anxiety.

Another potential theme evolved from these specific findings:

9. Adults generally perceive a relationship between math and statistics anxiety.

Statistics anxiety and benefits from collaboration. I conducted an evaluation of coded responses regarding a participant's *Self-perception of Statistics Anxiety Level* and *Effects of Collaboration on Anxieties.* This analysis revealed evidence of the effectiveness of collaboration as a means to reduce statistics anxiety among many adult students (see Table 9).

Table 9

Statistics Anxiety and Effects of Collaboration on Anxieties

Number of Participants	Statistics Anxiety Level	Effects of Collaboration on Anxieties
6	Extremely/High	Helpful
3	None	Helpful
2	Marginal/Low	Helpful
2	None	Minimal
1	Marginal/Low	Minimal

- Of the 10 participants who claimed some level of statistics anxiety, eight advised that collaborating reduced their anxieties with the course.

- Also of note was the finding that all of the participants who claimed Extreme/High statistics anxiety (n = 6, 43%) also claimed that collaborating was helpful in reducing his or her statistics anxiety.
- Of interest is the finding that of the four individuals claiming no statistics anxiety, two claimed that they found evidence that collaboration helped reduce anxiety levels in his or her partner.

I identified one additional theme from these findings:

10. A majority of participants perceived some benefit from collaboration as mitigation for statistics anxiety.

Additional Important Findings

Several serendipitous findings were identified that may not directly influence the research question but are important to the project that precipitated from the research findings. The serendipitous findings included the following:

- A majority of the participants perceived the use of a computer software package to accommodate statistical testing as a plus. Research on statistical instruction is consistent in reporting that non-math students find learning a statistical software package as considerably less stress inducing as memorizing formulas and pen-and-pencil problem-solving exercises.
- The additional home reading assignments and shorter, 1-hour, lectures were mentioned by several students as an improvement over other classes where there were 4-hour weekly lectures. There were no negative comments on this methodology. The professional literature admonished statistics instructors to

vary their class instructional methodologies in an effort to accommodate the variety of learning styles among adult students.

- The weekly 3-hour lab period was a subject of considerable discussion among the participants, with no negative comments forthcoming. Several students expressed that they enjoyed the opportunity to use (practice) the statistical treatments they had learned in readings, homework assignments, and during the in-class lecture. The professional literature recommended the use of in-class practice sessions to guide students through the first time use of statistical methods.
- Comments from participants regarding the two textbooks were generally positive. Remarks indicated that both texts were accurate and understandable in their explanations of statistical terminology, methods of analysis, and interpretation of findings.
- Individuals who self-identified as being math challenged, expressed the need for some tutoring. These comments generally centered on the need for students, who had been away from formal math instruction for several years, to have someone help them to review basic math and algebra.
- Several comments indicated that students struggled with proficiency using the database and statistical software packages. Recommendations from participants included the need for tutoring on Microsoft Excel™ and a resource pamphlet on the statistical software package.

- The majority of students perceived a benefit in collaboratively completing the final exam. More than one student advised that they believed the final exam to be a "good learning experience," the exact reason a final exam is given. Earlier in this research, two studies on collaborative testing reported that collaborative testing was an effective instructional methodology for traditional students.
- Several participants commented on the four scenarios that students used during the lab portion of each week's class; indicating their preference for using real-life companies and actual real data, instead of fictitious companies and made-up data. The professional literature echoes this recommendation to include *real-life* data to connect student learning of statistical concepts to the world in which they live.

Summary of Findings

Researchers have well documented the phenomenon of statistics anxiety as both pervasive and debilitating to traditional college students, with findings indicating that statistics anxiety may affect as high as 80% of all college students. Evidence exists that a socially active classroom can reduce a student's anxiety levels. The findings from this research do not run counter to any of these pronouncements. My research indicated that statistics anxiety influences, to varying degrees, a proportion of adult students. Additionally, I found evidence that collaboration on in-class assignments was of some benefit to a majority of students in reducing their fear, angst, or stress. Although the findings from this research are not generalizable to any populations outside of this case

study, there are indications regarding collaboration and statistics anxiety. Findings indicate a proportion of adults faced with the prospects of attending a college-levels statistics course will (a) be negatively affected by statistics anxiety, (b) show a preference to work collaboratively if offered the opportunity, and (c) will express that collaboration reduces their anxiety levels.

An additional benefit identified as a result of this research study was two voids filled in the body of professional research addressing adult learning. First, I found no studies in the professional literature that addressed statistics anxiety or collaborative learning among nontraditional postsecondary or, more specifically, with adult students. This study of adult students attending a college-level business statistics course enhances the body of scholarly educational literature. Second, this research provides a unique perspective of adult student perspectives of collaboration as an instructional methodology, statistics anxiety, and collaboration as mitigation for statistics anxiety. The application of a qualitative study to elicit student perspectives of collaboration as an instructional methodology, statistics anxiety, and the benefits of collaboration in reducing statistics anxiety is, to the best of my knowledge, unprecedented.

Final Themes

An analysis of the findings from narratives collected from the 14 adult students of a business statistics course yielded themes that represent the perspectives adult students have of collaboration, statistics anxiety, and collaboration as a methodology for reducing statistics anxiety. I subsequently distilled the 10 preliminary themes down to the following four core themes that directly addressed the research question.

- *Preference for collaborative learning*
    - A majority of adult students prefer to work collaboratively on in-class assignments, expressing enjoyment of team-based learning and perceiving value from the experience.
    - A percentage of students prefer to work collaboratively only if a known, compatible partner is available.
    - A minority of adults prefer to always work independently
- *Collaborative partner compatibility factors*
    - Adult students generally prefer to work collaboratively with a partner they know and had worked with previously.
    - Partner compatibility is a factor in an adult's perception of the effectiveness and enjoyability of collaboration.
    - Adults define a compatible collaborative partner as one who is knowledgeable or skilled, has comparable work habits, and expectations for a high grade in the course.
- *Statistics anxiety and. math anxiety factors*
    - Adult students generally perceive statistics courses as being difficult, challenging, intimidating, and stressful.
    - A majority of adult students self-profess to anxiety being a factor in their learning efficacy in a statistics course.
    - Adult students perceive a strong relationship between statistics anxiety and math competency.

- *Collaboration as mitigation*
    - A majority of adult students perceive collaboration as an effective method for reducing the effects of statistics anxiety.
    - Adult students generally perceive collaboration as improving the in-class learning environment.

These four themes will provide the basis for developing a project focused on redesigning the learning experience within the business statistics class that provides context for this project study.

Section 3: The Project

Introduction

The qualitative research completed for this project gathered adult student perspectives regarding the benefits and challenges of collaboration and the phenomenon of statistics anxiety. In the following sections, I describe a project to redesign the existing business statistics course using the findings from both the qualitative data gathered from 14 past students of the business statistics course and a search of the literature regarding adult-oriented statistics instructional methods. Included in the project are three deliverables (see Appendix A). The first deliverable is a PowerPoint™ presentation detailing the research, research findings, and recommended modifications to the course. The second deliverable includes the modifications to the course syllabus that I will present to the adult and graduate studies dean for approval. The third deliverable is an implementation timeline for the project, also to be presented to the dean for approval. Present in the remaining sections are descriptions of the project goals, objectives, and rationale, along with a review of related literature and a description of the project.

Project Description and Goals

The objective for the project was to identify and incorporate into a plan for implementation alternate instructional methods, learning tasks, and learning resources that could assist future students who would possibly be otherwise marginalized by the existing business statistics course. The proposed project includes a presentation to the dean of adult and graduate studies for the college to modify the existing business statistics course. Included in the final project will be recommendations to modify the (a)

syllabus/participant guide, (b) instructional methodologies, (c) student resources, and (d) learning tasks. Justifications for recommending substantial modifications to the business statistics course resulted from two sources: findings from interviews conducted with 14 past adult students of the course and from a review of the literature regarding statistics instruction.

Project Rationale

The purpose for the research conducted in this project study was to gather adult college student perceptions of the methodologies, resources, and learning tasks in a business statistics course. I asked participants for their perspectives regarding five areas of inquiry:

- statistics and statistics courses,
- personal challenges with math,
- statistics anxiety as a factor affecting performance,
- collaboration as an instructional methodology, and
- collaboration as a mitigation strategy for statistics anxiety.

Research findings provided evidence that

- statistics courses are perceived by adults as difficult, challenging, and stressful;
- many adults are challenged by any form of math;
- statistics anxiety negatively affects the performance of a percentage of adult students;
- a majority of adults prefer to work collaboratively on in-class assignments;

- a minority of adults prefer to work independently on all assignments;
- a percentage of adults prefer to work collaboratively only when a compatible partner can be identified; and
- a majority of adults perceive that collaboration reduces statistics anxiety.

These research findings gave me insight into why a percentage of adults found the existing statistics course instructional methodologies and learning tasks challenging. The rational for this project is to use findings from the qualitative research effort along with findings from the professional literature regarding statistics instruction to develop an improved methodology for adults challenged by math, statistics anxiety, and collaborative problem solving.

Review of the Literature

I had two basic objectives for the literature review. The first objective was to validate findings from the qualitative research regarding both the effectiveness of and challenges with collaborative problem solving as mitigation for statistics anxiety. The second objective was to identify alternate instructional methods, learning tasks, and instructional resources with the potential to improve the learning environment for adult learners. I used the following four themes from the research findings to focus the literature search:

- adult attitudes regarding statistics and statistics courses;
- math anxiety, statistics anxiety, and the anxious adult student;
- instructional methods for the adult statistics classroom; and
- collaboration as an instructional methodology: pros and cons.

Adult Attitudes Regarding Statistics and Statistics Courses

Adults returning to college face challenges to learning that traditional students may not experience (Bell, 2008). The first challenges facing busy adults are time-related: In addition to attending class and completing homework assignments, the adult learner must also find time to manage work, family, and social responsibilities. Bell described a second set of hurdles with which adults must contend, such as "unrealistic goals, social-familial problems, and poor self-image" (p. 157). Of equal importance to the adult learners' personal challenges are factors relating to how colleges traditionally formulated courses. Knowles (1978) and Knowles and Associates (1984) proposed that traditional college courses and college instructors will not accommodate an adult's motives, preferences, and preferred strategies for learning.

Knowles (1978) introduced the concept of andragogy, which proposed differences between how adults and traditional younger students learned. Knowles's principles of andragogy provide instructors insight into how to reconfigure traditional college-level courses to accommodate an adult's preferences for learning. Tailoring Knowles's original five andragological principles to the adult statistics classroom suggests that adult learners need to

- understand why statistics is important to their careers and personal interests;
- receive acknowledgment and accommodation for their challenges, knowledge, and experiences;
- actively engage in learning tasks, resources, and instructional methodologies that focus on solving problems of importance to adult learners;

- participate actively in the process of learning; and
- involve their personal motivations as a driving factor for learning.

These five tenets of adult learning provided a logical starting place to search the professional literature for how, as a statistics instructor, I can better engage and accommodate an adult's attitudes towards statistics.

Enlightening the adult statistics learner. One of the more pervasive attitudes adults brings to the statistics classroom is a lack of appreciation for the subject of statistics and why it may be important to them and their careers in business. Nasser (2004) found that many students entered his classrooms with the perception that a statistics course was little more than an obstacle to their graduating on time and with a respectable GPA. This finding by Nasser directly acknowledges one of Knowles' (1978) main precepts of andragogy: adults must understand the personal benefits before they will enthusiastically engage in learning a difficult subject such as statistics. For this reason, it is incumbent on the statistics instructor to explain the benefits of learning statistics prior to delving into statistical principles, concepts, or methods of analysis. Smith and Martinez-Moyano (2012) addressed this requirement by advising statistics instructors to look for ways to help adult students understand that "the ability to employ and comprehend statistical concepts and tools is an essential skill in managerial activities" (p. 107). Chiesi and Primi (2010) discovered another facet regarding a student's need to understand the value of statistics: Students enter the statistics classroom with "great variation in expectations and perceptions regarding [the value of] statistics" (p. 19). They suggested from their research that when students became aware of the utility of statistics,

attitudes markedly improved, as did assignment grades. The statistics instructor who ignores student misgivings regarding the value of statistics may miss the opportunity to help students benefit from active engagement in learning the valuable statistical tools offered in a statistics course.

Acknowledging and accommodating the adult's challenges. In addition to the knowledge, experience, and skills that adults bring to the college classroom, many adults also bring personal challenges to learning a complex, abstract, math-related course such as statistics (Bell, 2003; Davis, 2003; Dykeman, 2011; Mvududu & Kanyongo, 2011; Onwuegbuzie & Wilson, 2003; Pan & Tang, 2005). Pan and Tang (2005) and Bui and Alfaro (2011) both independently admonished statistics instructors to acknowledge and accommodate the adult student who has been away from math long enough to have forgotten how to solve even the simplest algebraic equation. Macheski et al. (2008) proposed that the abstract nature of statistics coupled with a requirement for higher-order cognitive skills could create an overwhelmingly stress-filled classroom environment for the math-challenged adult learner. The psychological chemistry of personal anxieties, concerns with personal challenges, and challenges with math results in some adults having little motivation to put forth the effort to connect with the subject of statistics. It is incumbent on instructors to both acknowledge and accommodate an adult student's stresses and challenges with math courses by incorporating learning interventions to help students with weak math skills. Educational researchers recommended several interventions to help students with weak math skills. Baloglu (2004) proposed offering math remediation tutoring and math self-help materials. Pan and Tang (2004) added that

it is critical for instructors to make themselves available and accessible during and outside of class-time. Lalayants (2012) admonished instructors to incorporate instructional techniques that emphasize the applicability, usefulness, and practicality of statistics. Mvududu and Kanyongo (2011) stressed that abstract statistical concepts are learned more effectively when instructional methods include real-life examples that students recognize and identify. Nasser (1999), and, later, Smith and Martinez-Moyano (2012) independently proposed statistics instructors incorporate instructional methodologies and learning tasks into their courses that (a) stressed relevant-real-life applications over theory, (b) used computers instead of memorizing formulas and using paper-and-pencil to solve problems, and (c) focused class time on practicing analytical methods rather than taking lecture notes.

Connecting with an adult's goals and aspirations. Knowles (1978) proposed that a third factor affecting learning in adulthood was the need for an adult to connect course subject matter with personal goals and aspirations. Snee (1993) proposed that when statistics instructors prioritized theory over application, adult college students in practice-based curriculums such as education, psychology, and business had difficulty connecting with the instruction. While memorizing formulas, learning to use tables, and writing papers on statistical theory may be mandatory for the future actuarial student or statistics instructor, students in practice-based curricula demand to understand how statistics can benefit them and their career interests. Adult business students must understand how learning statistics connects directly their world: a world that focuses on providing customer service, producing products, analyzing marketing data, developing

quality control programs, controlling inventories, and improving profit and loss statements (Pan & Tang, 2004; Snee, 1993). To this point, educational researchers focusing on statistics instruction concluded that business statistics courses that fail to focus on business applications, business scenarios, and business data are of little practical benefit to business students (Calderwood, 2002; Peiris, 2002; Strasser & Ozgur, 1995; Zanakis & Valenzi, 1997).

Educational researchers proposed several solutions for how to connect the non-math student with the subject of statistics. These include

- increasing student participation during class-time (Calderwood, 2002);
- using real-life examples, problems, and exercises that connect with the student interests and work experiences (Smith & Martinez-Moyano, 2012; Lalayants, 2012); and
- helping students understand how new learning connects with their existing knowledge, skills, and experiences (Garfield & Ben-Zvi, 2007).

Involving and motivating the adult statistics learner. The fourth and fifth points Knowles (1978) proposed as important to adult learning regard an adult's need to be actively involved in the learning process and to have personal motivations acknowledged as a driving force for learning. Adults come into the statistics classroom with adult social skills, adult needs for interaction, and adult needs to participate actively in the learning process. The instructor must develop instructional methodologies to incorporate these adult traits into the learning environment. Additionally, numerous studies have shown that adults react far more favorably to a

socially active classroom than one in which they are required to listen to long lectures (Chiesi & Primi, 2010; Garfield & Ben-Zvi, 2007; Pan & Tang, 2004; Smith & Martinez-Moyano, 2012). To these very important points, researchers proposed that instructors should consider the following strategies to engage adults in learning statistics:

- develop instructional methodologies incorporating the use of problem-solving exercises (Pan & Tang, 2004; Smith & Martinez-Moyano, 2012);
- engender and encourage a social active classroom that allows time for adult learners to share experiences and learn from one another during class time (Chiesi & Primi, 2010; Garfield & Ben-Zvi, 2007); and
- use technological tools, learning tasks, and resources with which the adult is familiar to aid the student with visualizing and exploring data (Garfield & Ben-Zvi, 2007).

Summary of adult attitudes. Educators challenged with designing and/or teaching an adult-oriented statistics course must first acknowledge that adults perceive statistics courses as some of the most challenging in any curriculum (Onwuegbuzie & Wilson, 2003). A second attitude of many adults is that statistics courses are complicated math courses, which can be especially stressful for adults who have not studied any form of math in years. A third attitude of many adults is that studying statistics is of little value to them and their career interests. Exacerbating this attitude in adult statistics students are the methods that traditional math departments used to teach the subject of statistics, with a heavy emphasis on

theory, formulas, and pen-and-pencil problem solving. Not all adult students enter the statistics classroom with these attitudes, however, many do, and it is incumbent on statistics instructors to both acknowledge and accommodate these challenges to teaching statistics to the adult learner.

Math Anxiety, Statistics Anxiety, and the Anxious Adult Student

There are several anxieties that indiscriminately affect traditional and nontraditional college students alike (Galli et al., 2008; Liu & Onwuegbuzie, 2011; Onwuegbuzie & Wilson, 2003). Although some stress may motivate the college student to buckle down and learn a difficult or challenging subject (Keeley et al., 2008), left unchecked, severe anxieties can be detrimental to both a student's emotional well-being and to their ability to cope with the challenges of college. Research identified a variety of anxieties that plague the traditional college student, the more pervasive of which include

- GPA anxiety (Mounsey et al., 2013),
- test and class anxiety (Hsieh et al., 2012; Rana & Mahmood, 2010; Yildirim, 2008),
- study anxiety (Vitasari et al., 2010),
- math anxiety (Ertikin et al., 2009), and
- statistics anxiety (Bell, 2008; Bolliger & Halupa, 2011; Perepiczka et al., 2011; Dykeman, 2011).

Many students bring stresses such as test anxiety and GPA anxiety with them to the college classroom. Williams (2010) referred to these stresses as *trait anxieties* (p.

50), or anxieties peculiar to the student. Other stresses, such as course anxiety and instructor anxiety, are more situational in nature; Williams proposed these are *state anxieties* (p. 50): anxieties that are peculiar to the student's environment. Regardless of origin or nature of the anxieties, students identified debilitating levels of trait or state anxieties as reasons for dropping, postponing, or performing poorly in a variety of classes (Ali & Iqbal, 2012; Galli et al., 2008; Liu & Onwuegbuzie, 2011; Onwuegbuzie & Wilson, 2003; Haiyan et al., 2009). Of the anxieties that college student's face, math anxiety is one of the more pervasive challenges to student performance in a statistics course (Bekdemir, 2010; Perepiczka et al., 2011; Onwuegbuzie & Wilson, 2003).

One anxiety pervasive among adult and traditional students is math anxiety, or a general fear of applying any form of math higher than simple addition and subtraction. Richardson and Suinn (1972) defined math anxiety as feelings of tension, fear, and unsettledness regarding the application of math. Morris (1981) proposed that math anxiety is an irrational fear of math in any form, while more recently Bekdemir (2010) defined math anxiety as illogical feelings of panic or embarrassment coupled with an irrational fear of failure. Regardless of the adjectives used to define the phenomenon, research provided evidence that math anxiety is an increasingly factor among traditional and nontraditional students (Chandler et al., 2011; Dykeman, 2011; Ertikin et al., 2009; Forte, 1995; Pan & Tang, 2005; Richardson & Suinn, 1972).

Educational researchers differ in their estimation of the relationship between a student's math competency and his or her motivation to learn statistics. However, several researchers found evidence that weak math skills are a reliable predictor of a student's

attitude towards and performance in a statistics course (Chiesi & Primi, 2010; Tremblay, Gardner & Heipel, 2000; Onwuegbuzie, 1998, 2000; Pan & Tang, 2005; Sorge & Schau, 2002; Tariq & Durrani, 2012). Research generally indicated that a student's negative attitudes towards math generally are due to learning deficiencies in the subject (DaRos & Ryan, 1997; Nasser, 2004). Research conducted on traditional college students entering a statistics course with weak math skills typically had low motivation to connect with and learn statistical methods (Chiesi & Primi, 2010; Lalonde & Gardner, 1993; Nasser, 2004; Onwuegbuzie, 1998, 2000; Onwuegbuzie, DaRos, & Ryan, 1997; Pan & Tang, 2005). Lalonde and Gardner (1993) found that student attitudes towards math strongly correlated directly to a motivation to learn statistics.

In addition to math skills playing a part in a student's motivation to learn the subject of statistics, research provided evidence that weak math skills also affected a student's performance on statistics projects, assignments, and exams (Calderwood, 2012; Nasser, 2004; Chiesi & Primi, 2010). There is a correlation between math skills, motivation to learn statistics, and performance on statistics assignments: a fact that needs to be recognized and, subsequently, accommodated by statistics instructors of all students: traditional and nontraditional students. Chiesi and Primi (2010) found that math skills acquired during high school had a "direct and strong effect on [statistics] achievement" (p. 19). Rancer, Durbin, and Lin (2013) found similar evidence among 144 communication students entering an introductory statistics class. Their research indicated that math competency was directly linked to a communication major's ability to learn statistical concepts and procedures.

Also of importance were findings that nationality, language, or cultures are not factors affecting the connection between math anxiety, statistics anxiety, and learning proficiency. Nasser (2004) conducted research on Arabic-speaking, pre-service, education students and concluded that a student's math aptitude was the best predictor of achievement in an entry-level research statistics course. Likewise, Tariq and Durrani (2012) found strong evidence among UK undergraduate students that students who tested higher in math skills performed significantly better on statistics course exams.

Although research indicated a connection between math and statistics anxieties and math and statistics competencies, additional research indicated that statistics anxiety might be somewhat more complex than math anxiety (Lalayants, 2012; Lalonde & Gardner, 1993; Nasser, 2004; Onwuegbuzie & Wilson, 2000; Pan & Tang, 2005). Nasser (2004) proposed that statistics anxiety is a considerably more complicated phenomenon than math anxiety. Nasser proposed that instructors need to recognize that math and statistics anxieties are not identical due, at least in part, to the requirement for students to both manipulate numbers, and then, to make sense of the results. Nasser suggested that requiring students to enumerate findings, develop conclusions, and formulate courses of action required higher-order thinking than algebra, geometry, or trigonometry. Lalayants (2012) expanded on the concept of statistics anxiety with the notion that the phenomenon is more complex than math anxiety. Lalayants findings indicated that students with statistics anxiety exhibited a fear of math and formulas that coupled with an anxiety over having to make sense out of numbers emanating from a statistical analysis. This broader vision of statistics anxiety has grown in acceptance due to evidence that many students

who do not exhibit challenges with math exhibited challenges with drawing conclusions from a statistical analysis (Galagedera, 1998; Nasser, 1998, 1999, 2004; Rancer et al., 2013).

It is important for the statistics instructor to acknowledge the existence of math and statistics anxieties among students. It is likewise important for instructors to acknowledge that requiring students to manipulate data with statistical tools and, then, to interpret their findings requires a higher-order thinking that may be challenging to even the most math-competent students. However, Keeley et al., (2008) admonished statistics instructors that math and statistics anxieties may not always constitute "a fire that needs to be stamped out" (p. 13). Their point being, that when recognized and controlled, these anxieties help may help students to maintain focus when studying a complex, demanding, and difficult subject such as statistics. Much like coffee, statistics and math anxieties in small doses can propel a student to invest time and effort in learning the subject of statistics However, in large quantities, the effects of both coffee and anxiety may be debilitating.

Taking these considerations regarding math and statistics into account, it is incumbent on the statistics instructor to make resources available to help the math-challenged student. Resources with the potential to aid the math-challenged students included

- providing moral support to math-challenged students,
- replacing paper-and-pencil calculations with statistical software programs for data analysis,

- pairing math-challenged students with collaborative partners who are competent with math, and
- making self-help resources available online for students to access outside of class.

Instructional Methods for the Adult Statistics Classroom

Since the 1990s, college statistics instructors began to suspect that traditional math-centered teaching methods are not effective when teaching statistics to students whose interests are in practice-based fields. Education, nursing, business, engineering, and a variety of social science students often found traditional theory- and formula-based methods of teaching statistics to be disconnected from their career interests (Helmericks, 1993; Hogg, 1991; Snee, 1993; Watts, 1991). Additionally, with the proliferation of computers and statistical software packages, students outside of the math department found the traditional focus on theory, formulas, and paper-and-pencil problem-solving methods to be both cumbersome and intimidating (Bartz & Sabolik, 2001; Ciftci, Karadag, & Akdal, 2014; Smith & Martinez-Moyano, 2012). In the late 1990s, practice-based departments, such as business schools, began to assume the responsibility for teaching statistics, and, simultaneously, began building statistics course content to include specific practice-based contexts. Although these changes moved statistics closer to the students' interests, instructors and researchers found that simply moving the courses was not enough to engage fully practice-based students in learning a complicated subject such as statistics.

From this early foray into moving statistics instruction to the practice-based fields of study, researchers began to investigate and recommend a variety of innovative methods focused on connecting students with learning statistical methods (Forte, 1994; Lalayants, 2012; Neumann, Hood, & Neumann, 2013; Schacht & Aspelmeier, 2005). Forte (1995) and, later, Schacht and Aspelmeier (2005) found that stress levels declined and learning improved when instructional methods included humor, including cartoons and videos of ridiculous statements regarding statistics. Neumann, Hood, and Neumann (2013) concluded that using real-world scenarios with which students could identify was an important factor in breaking down the learning barriers many students had with learning statistics. Lalayants (2012), likewise, found similar evidence in her survey research that students preferred applying statistical methods to problems, scenarios, and issues that students readily identify with as being important to their chosen field of study. The conclusion that many researchers came to was that instructional methodologies needed to change in order to engage students more effectively with the art and science of analyzing business data.

In a Delphi survey of master's level statistics instructors, Smith and Martinez-Moyano (2012) found that instructors were reaching practitioner-oriented students by

- researching the use of statistics in current events,
- emphasizing statistical concepts over memorizing formulas and theory,
- requiring students to work in small groups on statistical problems, and
- providing opportunities to practice statistical analysis in class.

Researchers in two separate studies, Pan and Tang (2004), and, later, Lalayants (2010), proposed that instructors should incorporate multiple instructional methods into a learning environment that relied heavily on applications-oriented teaching methods. More recently, Ciftci et al., (2014) conducted research on first year nursing students enrolled in a statistics course and concluded that the use of computer software to solve complex statistical problems was a stress reducer and helped students to connect with using statistics to analyze data. Ciftci et al. proposed that the use of statistical software reduced statistics anxiety, improved course performance, and positively affected nursing students' attitudes towards statistics. The majority of research I found regarding statistics instruction in practice-based curriculums focused on traditional college students. However, findings from this body of research, when coupled with the differences in how adults learn, provide valuable insight into teaching statistics to adults.

As early as the 1970s, researchers were beginning to realize that there are a number of differences between how adults learned and how traditional students learned statistics. Although Knowles first introduced the basic principles of andragogy in 1978, it was not until the 1990s that adult educators began investigating and applying Knowles's principles of andragogy to instructional methods used in the statistics classroom. Knowles's recommendations that adults learn differently than traditional students stimulated research into using a socially active classroom for a variety of adult college-level classrooms. Researchers and instructors began to experiment with using small group cooperative learning methods to task students with working together to solve problems, complete in- and out-of-class assignments, and, even, take final exams

(Dolinsky, 2001; Forrester & Tashchian, 2010; Forte, 1995; Frankenstein, 1989; Jones, 1991).

By the 1980s, research into statistics instruction provided evidence that when students were allowed to cooperate on practical assignments, learning efficacy improved, as did learning outcomes. Frankenstein (1989) conducted research that produced findings indicating that students performed better on in-class math assignments when allowed to work collaboratively and receive a common grade. Jones (1991) reported that students in a cooperative problem-solving environment expressed more positive attitudes towards statistics than did students enduring a traditional lecture-based pedagogy. In 1995, Forte, an early researcher into statistics instruction, found that using real-world data and requiring students to work in small groups reduced student anxiety levels and significantly improved learning. In 2001, Dolinsky conducted research on first-year college students and found similar evidence. In Dolinsky's research, student learning improved with the application of practical exercise problems coupled with collaboration. Calderwood (2002) proposed that allowing students to work collaboratively on in-class assignments was an effective method to get students past their fears of math and statistics. Albers (2008) proposed that a collaborative partner could significantly enhance the learning experience by reducing the fear of having to work alone throughout the course. Albers suggested that working in a group gave collaborative partners new insights and resulted in more innovative solutions than when students worked alone. Smith and Martinez-Moyano (2012) found that sociology and psychology students reacted favorably to working in small problem-solving teams, especially when assigned

real-world applications and practical exercises. Lalayants (2012) found that student stress levels declined when using multidimensional instructional approaches such as collaborative and cooperative work-groups. Working in groups, typically small groups, appears to be part of the formula for lowering adult anxieties and fears in the statistics classroom. Researchers have provided evidence that students find comfort in working on complex projects when they can bounce ideas off each other, support and supplement each other's skills, and talk through problems with a fellow student.

Although research regarding instructional methods for adult statistics students is scant, coupling instructional methodologies found to be effective with traditional college students to Knowles' (1978) principles of andragogy provided valuable insight into how to teach statistics to adult learners. A short summary of the lessons learned regarding instructing students in statistical methods include the following:

- Traditional methods of teaching statistics that included an emphasis on paper-and-pencil problem solving are ineffective with students in non-math-oriented curriculums (business, social science, nursing, and engineering).
- Statistical software programs and personal computers have reduced the complexity of conducting statistical data collection, research, and analysis.
- Practical real-world scenarios, identified by the adult student, will significantly improve the connections students make between statistics and their chosen field of study.

- A socially active classroom that allows students to work in small collaborative groups reduces a student's sense of isolation and provides for a richer learning experience.

The use of computers and statistical software, real-world scenarios and data, and a socially active classroom all appear to be elements of an adult learning environment that instructors of statistics courses should take into consideration. The application of collaborative learning methods seems to engender much of what Knowles' (1978) proposed as important learning factors for adult students. However, there are benefits and detriments to using collaboration in both the traditional and nontraditional classrooms (Chiesi & Primi, 2010; Dolinsky, 2001; Magel, 1998; Pan & Tang, 2005; Will, 1997).

Collaboration as an Instructional Methodology: Pros and Cons

Educators often use the terms *collaborative* and *cooperative* interchangeably to describe learning methodologies that task small groups of students to work on assignments either in class or outside of class time (Will, 1997). According to Will, both cooperative and collaborative learning are "characterized by focused discussion or problem-solving activities conducted within the context of a small group" (p. 26). MacGregor (1990) had a more pragmatic view of collaborative learning; his definition proposed that team-based learning is, by nature, an effective method for socially constructing knowledge in a manner that is generally more consumable than traditional lecture-based pedagogies are to students. Will discovered another benefit another benefit from using collaboration as an instructional methodology, a recognizable shift in the

responsibility for learning from the teacher/instructor/facilitator to the student in the adult classroom. This benefit is of importance in an adult-oriented classroom, a classroom that Knowles (1978) proposed should be student centered as opposed to instructor centered.

Researchers found benefits in using collaborative methodologies when teaching difficult, challenging subjects such as statistics (Chiesi & Primi, 2010; Dolinsky, 2001; Magel, 1998; Pan & Tang, 2005). Dolinsky (2001) found that grades improved in a statistics class that included allowing students to work collaboratively on assignments. Pan and Tang (2005) found that students got past their self-imposed barriers to learning when they worked collaboratively on statistics. In Chiesi and Primi's (2010) survey research, students working collaboratively on in-class and homework statistics assignments reported significantly higher levels of self-confidence in learning statistics than when they first entered the classroom. Additionally, and of equal importance, Chiesi and Primi found survey evidence that indicated adults found statistics considerably easier to learn in the collaborative environment than what the students first perceived when entering the course. Even in the large lecture hall, Magel (1998) found strong evidence that test scores improved when students worked collaboratively on exams. Also of significance, several researchers investigating adult education practices found that knowledge retention improved and problem solutions were more creative when students worked collaboratively on assignments (Imel, 1996; Johnson, Johnson, & Smith, 1991; Kaedel & Keehner, 1994). However, the use of collaboration, cooperation, and collaborative problem solving is not without its detractors, nor did collaboration work equally at improving learning for all students.

One negative of collaborative instructional methodologies is that it can be time consuming, often taking up twice as much time as lecture-centered pedagogies (Will, 1997). Additionally, many adult learners may resist working collaboratively due to difficulties with collaborative partners in past courses, fears regarding a carefully nurtured GPA, and a lack of group skills. Will (1997) pointed out an important caveat to teaching in a collaborative environment with his admonition to instructors that, "It is an error to assume that people know how to interact effectively in a small group" (p. 36). To expand on this point, Johnson, Johnson, and Smith (1991) noted that cooperation is not a natural human trait and collaborative methodologies may not work for all instructors, all classes, and/or all students. Notwithstanding a student's group skills, the most frequent complaints regarding collaboration generally regarded partner compatibility, poor instructions from the facilitator, poorly designed learning tasks, and inadequate feedback: any of which can pull down the grade of a highly motivated student (Johnson, Johnson, and Smith, 1991; Will, 1997).

It can be difficult to develop effective collaborative sessions for adult-oriented statistics classes because adults learn different ways and at different speeds. Moreover, some adults need quiet time to assimilate new information while others learn better through discussion of an issue, problem, or topic (Will, 1997). Mesh (2010) reminds us that, due to learning style differences, adults need a combined or blended approach using several pedagogies, a complexity to using collaboration that confounds the instructor/facilitator.

Summary of the Literature Survey

Adult statistics students may not differ greatly from traditional younger learners with respect to their attitudes towards the subjects of math and/or statistics. Traditional and nontraditional students are generally (a) challenged by math, (b) fearful of taking a college-level statistics course, (c) doubtful of the worth and importance of learning math, and (d) struggle with learning statistics by lecture, paper-and-pencil problem-solving methods. Additionally, and of importance to this project study, there appears to be only minor differences in the perceptions that adult and traditional student have towards collaborative learning methodologies. However, instructors that want to teach the adult statistics student effectively must acknowledge that adults bring several differences into the classroom by way of their adulthood. Instructors to the adult statistics learner must recognize that an adult learns differently than traditional learners. The important differences included the following:

- a need to understand why statistics is important;
- acknowledgment of the skills, knowledge, and experiences they possess;
- the need to be actively involved in the learning process;
- the need to have their personal motivations engaged in learning the subject of statistics;
- the need to have statistics connected to their personal goals, aspirations, and career interests; and
- the lack of math-related courses in recent years.

If instructors are going to engage the adult learner in actively learning the subject of statistics, these differences in how an adult learns must be recognized, accounted for, and addressed in the adult statistics class.

Smith and Martinez-Moyano (2012) provided valuable insight from a Delphi Experiment conducted among college-level statistics instructors. The purpose of this research was to identify best practices for teaching the subject of statistics to adults. The following is a paraphrased summary of best practices surfaced by the research conducted by Smith and Martinez-Moyano:

- The use of topical examples and current events enhance an adult's connection between statistics instruction and their personal lives.
- Using computer software applications, as opposed to requiring the memorization of formulas and completion of paper and pencil exercises, reduces an adults stress level in the statistics classroom.
- Adult students connect better with statistics instruction that emphasizes understanding over the ability to complete statistical calculations from memory.
- Acknowledging and accommodating an adult's challenges and anxieties with any form of math will significantly reduce stress in the classroom.
- Adults react favorably when allowed to interact, help each other, and practice statistical procedures.
- Most students learn statistics more effectively when allowed to work collaboratively on in-class and out-of-class assignments.

- Adults react more favorably to socially active classroom than a lecture based, passive classroom.
- Instructors who exude passion and excitement for the subject of statistics often find that their students connect more effectively with learning the subject of statistics.

Although there are similarities in how adults and traditional college students learn, an adult's need to be involved, to know the reasons for learning a subject, and to be self-directed, adds complexities to teaching the adult student a complex subject such as statistics. To ignore the complexities of teaching adults may be the difference between an effective statistics-learning environment and one that is burdensome, difficult, and fraught with fears and anxiety. The following section describes a project to reengineer the business statistics course through acknowledging a combination of the findings from my qualitative research and a review of the literature regarding statistics instruction

The Project: Redesigning an Adult Statistics Course

Both the qualitative research and literature survey focused on understanding collaboration, statistics anxiety, and the benefits of collaboration from an adult student's perspective. Findings from the research I conducted on 14 past participants of the business statistics course and from the professional literature were consistent in a number of areas:

- Students generally perceive statistics courses as difficult, challenging, and intimidating.

- Students consistently identify a strong connection between their math competency and anxiety over taking a statistics course.
- Majorities of students self-identify as having challenges with college-level courses that require the application math, the use of formulas, or the analysis of data, or the interpretation of findings.
- A majority of adult students self-profess to math and statistics anxiety as factors affecting their aptitudes to learn statistics.
- A majority of students prefer working on an in-class problem-solving team as long as they can collaborate with a student they feel is compatible.
- Adults define a compatible collaborative partner as having traits that include: (a) knowledge or skills with math, word processing, and database management; (b) strong work habits and willingness to share equally with assignment workloads; and (c) high expectations for learning the material and earning a high grade in the course.
- A minority of adults prefer to work independently on all course assignments.
- A majority of adult students perceive collaboration as an effective method for reducing the effects of statistics anxiety.

In addition to these findings regarding statistics and collaboration, comments from participants regarding the business statistics course structure, methodologies, and resources indicated that several key aspects of the course structure were sound and worth maintaining. These include the following:

- The weekly 1-hour lecture coupled with a 3-hour lab session was both effective and enjoyable to participants in the research.
- The use of Minitab™ as the computer software package was considered a sound strategy for data analysis.
- Students generally perceived the concept of using scenario-based case studies during the lab portion as an effective learning strategy.
- The use of the existing textbooks, Microsoft Word™, and Microsoft Excel™ were satisfactory applications used in the business statistics course.
- A majority of adult participants perceived that working collaboratively on the course final exam, including receiving a common grade, was acceptable, if not beneficial, methodology.

The findings from the qualitative research provided the motivation to evaluate the professional literature for instructional methodologies, learning tasks, and student resource materials that could improve the learning experience of a higher percentage of students. Additionally, a review of recent professional literature regarding statistics instruction indicated that instructors of both traditional and nontraditional students were successfully lowering student stress levels by applying several innovative methods not employed in the existing business statistics course. The legitimate criticisms from the research participants regarding the course methodologies, when reviewed in light of findings in the literature, led to possible changes to improve the existing business statistics course. The following is an amalgamated list of changes to the business statistics course that I believe can improve the learning experiences for adult students:

- Course introduction – Due to the pervasiveness of math and statistics anxiety and the negative effects of these stresses on student performance, I will revise the course introduction letter and first-night opening comments to acknowledge the pervasiveness of math and statistics anxieties and the effects these phenomena have on adult performance in a business statistics class. The introduction letter and opening comments will also include information about tutoring and self-help resources that are available outside the weekly class sessions (see below).
- Student tutoring services – Students challenged with word processing, database management, statistical software use, and basic mathematics can access prior to the course beginning until the course ends.
- Student self-help resources – Students will receive a list of online resources for math, word processing, statistical software package, and database management.
- Voluntary collaboration – Future students will be afforded the option of choosing to work collaboratively or independently on all in-class assignments and exams.
- Extra credit options for collaborators – Students who voice a preference for working independently, but subsequently agree to work collaboratively to help a challenged student will be given the option of completing assignments for extra-credit if they believe their grade suffered due to collaborating.

- Real-world scenarios and data – Evidence existed in the professional literature regarding statistics instruction that adult students connected better with statistical concepts when the instructor employed *real-world* scenarios and actual data for students to analyze. I will revise the existing scenarios, which students utilize during the lab period of each class, to include actual data from organization recognized by adult students.

Included in Appendix A is a Powerpoint presentation and handout that completely describes all of the modifications to the course to be presented to the dean of adult and graduate studies at the college where I teach the business statistics course. Also included in this appendix is a schedule for implementation. Due to the complexity of these modifications to the instructional methodologies, I am proposing a 1-hour meeting with the dean to present the research findings and recommended changes to the program. As the designer and only instructor for the course, it will be my responsibility to author the changes to the course syllabus and participant guide. It is my plan to make any changes systematically during 2015 while simultaneously receiving comments back from students as to their recommendations regarding the changes to the instructional methodologies and materials.

Implementation

I will plan implementation of the recommended changes to commence upon approval by the dean of academic affairs for the adult and graduate studies department. Although I will plan to make changes to the syllabus and participant guide immediately upon approval, I will phase in all course modifications within the first three cohorts of

students during 2015. A seven-step process will guide the implementation of all modifications. The proposed steps, in order of implementation, are:

1. rewrite and obtain final approval of the syllabus, participant guide and all student communications within 1 month of approval to proceed with the modifications to the course;
2. obtain college certification as a tutor in math, statistics, word processing, and database management within 3 months;
3. author self-help videos and handout notes for all software applications used in the course within 6 months;
4. redesign the first case-study scenario within 1 month, to include actual data from well-known organizations and companies; and
5. redesign remaining scenarios within 6 months.

Potential Resources and Existing Supports

The majority of modifications to the instructional methods, learning tasks, and student resource materials require only time and effort on my part to complete. I can design and construct both the handouts and instructional videos to help students with word processing, database management and the statistical software without any approvals and with existing resources that I maintain on my home computer. I currently have authority to upload any resource materials to the virtual classroom without any prior approval. Additionally, I have access through the Internet to databases from nationally known companies, government organizations, and non-government organizations. I will design new scenario projects around organizations that provide data on the Internet.

Internet sources with available data include the Bureau of Labor Statistics, the U.S. Department of Education, and a variety of private corporations that publish data on the Internet. Finally, obtaining approval to become a certified math, word processing, statistics, and excel database instructor requires that I obtain references and complete a short training program provided by the college. I will begin the certification process within the coming weeks.

Potential Barriers to Project Implementation

Once approved, I foresee no barriers to completing any of these modifications to the current instructional methodology. As the original designer and only instructor in the business statistics course, I can envision no serious personal, academic, or administrative barriers to completing the changes listed above. The dean of academic affairs in the Adult and Graduate Studies Department of the college is aware of this project study and commented that he is waiting for me to present any recommended changes (personal conversation, May 2014). At this time, I foresee no impediments to effecting the changes.

Project Evaluation

It will be my responsibility as the designer of and instructor for the business statistics class to monitor and report on the effectiveness of any implemented changes. I will plan to monitor each phased step of the implementation through both my personal interaction with the students and end-of-course surveys completed by all students. Additionally, I maintain a confidential record of every student who completed the course, including grades for the lab projects, homework, final project, and final exams. At the

end of the first year after completing all changes, I will compare the grades and survey comments of students in the new classes to those from prior classes. Additionally, during the first year after making the modifications, I will choose one or two students from each class who struggled with some part of the course assignments or instructional materials and either interview or survey these volunteers for additional feedback regarding the effectiveness of the course. These evaluative activities should provide me with the necessary input to monitor and effect changes to the course methodology.

Implications Including Social Change

Local Community

The implications for positive social change at the local level are threefold. First, implementation of the revised methodologies and additional student resources should provide future students with a more relaxed, reassuring environment in which to learn business statistics. The implementation of tutoring resources for the students, along with ready access to math, word processing, and statistics software instructional videos, will be of value to students needing to brush up on skills prior to or during the course. Second, modifying the scenario project platforms to include actual data from recognizable national organizations should allow students to connect better with the learning tasks. Considerable evidence indicates that students more readily connect with statistical principles when they know they are working with actual data from a recognizable organization. Finally, allowing students the choice to collaborate or work independently on in-class assignments should accommodate the preferences of all adults for completing the lab projects.

Far-Reaching

There are two additional far-reaching benefits to the research study and proposed project. Of primary importance is giving students a greater appreciation for the power that data analysis can bring to the organizations for which they work. These "statistics enlightened" students will become improved consumers and initiators of statistical information within their respective organizations. The ability to both comprehend and generate complex statistical analysis is a skill valued by corporations and governmental organizations (Onwuegbuzie & Wilson, 2003; Pan & Tang, 2004, 2005). At the time of this study, a paucity of research existed regarding the challenges that an adult faces when returning to the college statistics classroom. Findings from this research substantially enhances the professional literature regarding learning in adulthood, perceptions of collaborative instruction methods, the effects of math and statistics anxiety on adult learners, and the effectiveness of collaboration at reducing the effects of statistics anxiety. Of importance is the paucity of research conducted that sheds light on adult learner perspectives regarding the phenomena of math and statistics anxiety, two subjects for which I found no research in the professional literature. Upon completion of this project study, my intention is to expand the knowledge base regarding adult-oriented statistics courses through publishing a journal article on the findings of this research.

Project Study Conclusion

The research conducted for this project study involved gathering qualitative narratives from 14 adult students who had previously completed a college-level business statistics course at the private college where I teach. I was able to identify themes from

the data that exemplified adult perceptions of the statistics course, the phenomena of statistics and math anxieties, and the worth of collaboration as mitigation for these anxieties. Of specific interest were the themes regarding adult student perceptions of collaborative problem solving as an instructional methodology implemented to reduce adult statistics anxiety levels in my classrooms. These themes provided insight into the benefits or challenges that adults perceived from working collaboratively on in-class problem-solving assignments. I was interested in surfacing whether adults perceived that working collaboratively reduced an adult student's math or statistics anxiety and, subsequently, improved learning. Adults in this study

- favored working collaboratively on in-class assignments;
- believed collaboration lowered their math and statistics anxieties;
- placed a high priority on collaborating with a partner that was compatible;
- perceived compatibility in a partner to include his or her knowledge of the subject, work ethic, and expectations for a high grade; and
- believed that performance was negatively affected by math and statistics anxieties.

Of significance is the finding that a majority of the adults who participated in this study voiced that the existing course instructional methods, learning tasks, and course resources were effective. However, some participants voiced that they were in some manner challenged with

- math and statistics anxieties,
- mandatory collaboration on all in-class assignments

- finding a compatible collaborative partner, and
- collaborative partners with insufficient skills in word processing, and database management.

In an effort to confirm findings from the qualitative research, I conducted a search of the professional literature in three areas. First, I searched for insight regarding methodologies, learning tasks, and resource materials preferred by adult statistics learners. This research effort provided evidence that adults need

- to understand the importance to them for learning statistics;
- a variety of instructional methodologies to accommodate varied learning styles;
- instruction methods, learning tasks, and resource materials that connect an adults interests, experiences, and skills with the learning experience;
- a socially active learning environment; and
- to have their motivations for learning engaged and, subsequently, connected to course content.

A second vector for my search of the professional literature was to understand how the phenomena of statistics and math anxieties affected adult learners. I found considerable evidence that math and statistics anxieties were pervasive among both traditional and adult students: significantly affecting attitudes, motivations to learn, and course efficacy. Additionally, recent research provided findings indicating that the number of students challenged with math and math-related subjects was increasing with every incoming freshman class. Of importance to this project study were similar findings

indicating that instructors were concerned with the adult's math skills after having been away from any math courses for several years.

Finally, I researched the educational literature for studies that proposed innovative, adult-oriented instructional methods for teaching statistics to the adult learner. Findings from the literature provided evidence that adults preferred a learning environment that

- incorporated computer-based learning applications to solve statistical problems rather than paper and pencil;
- allowed adults to choose their level of participation in collaboration and other team-based initiatives;
- provided adult learners with resources to accommodate their challenges with math, and computer software programs; and
- included an instructor who reassured students of his or her willingness to accommodate the challenges an adult faced with statistics courses.

These findings from the qualitative research coupled with the professional literature provided valuable insight into how I could modify the existing course in order to improve the learning environment for a higher percentage of adults.

Although the basic course content and learning tasks in place since 2012 will remain essentially intact, findings from the qualitative research and literature search indicated improvements that improved both the learning environment and learning experience. I identified two objectives for altering the course methodology and resources, to assist students significantly affected by math and statistics anxiety and to

accommodate student preferences for collaboration. The proposed modifications to the existing course instructional methodology include

- allowing students the choice of working on a collaborative team or independently for all in-class assignments including the final exam;
- redesigning the in-class assignments to include real-life data from recognized national and local companies and organizations;
- providing reassurance to all students that the course will include minimal math skills;
- allowing time during the first class night for students to voice concerns with, anxieties over, or challenges with statistics, math, and or the software applications used in the course;
- providing after hours office hours and tutoring aids to assist students challenged by math, word processing, data base management, and statistical software utilization;
- providing online math, and statistics aids through short video training programs that students can access asynchronously to class time; and
- initiating math, statistics, word processing, and database management tutoring.

Upon approval from the dean of adult and graduate studies, I anticipate that it will take between 6 to 9 months to complete all of the changes to the course. It will be my responsibility as the instructor for the business statistics course to monitor the changes through (a) personal observations, (b) student surveys, and (c) a regimen of student

interviews that I will personally conduct with a minimum of two students from each class.

The following section will review the project strengths, remediation of limitations, potential impact on social change, and implications for future research. Additionally, the next section will present my personal observations regarding the research I conducted. Also included in the final section are observations of myself as a scholar for change, a leader, project developer, and a qualitative researcher.

Section 4: Reflections and Conclusions

Introduction

Section 4 provides an overview of my perceptions regarding the project study conducted to investigate adult student perspectives regarding the instructional methods, resources, and learning tasks employed in a business statistics course. I conducted interviews with 14 adult students regarding perceptions of (a) the instructional methodologies employed in the course, (b) the phenomena of math and statistics anxiety, and (c) the effectiveness of collaboration as an instructional methodology. In the following sections, I will discuss the strengths and limitations of this project, implications for practice and positive social change, and possible implications for future research.

Project Strengths

I found three strengths in the project that emanated from this study. The first strength emanated from the application of a qualitative case study methodology. The majority of feedback I received from students regarding the business statistics course was complementary of the course structure, learning tasks, and instructional methodologies employed. However, when I considered anecdotal evidence, assignment grades, and final exam grades, the findings indicated that a minority of adults found some combination of learning tasks, instructional methods, or learning resources to be challenging. In order to understand better why some students were challenged with the course, I designed the research methodology to focus on interviewing past students for their perceptions of the course content. Of specific interest to me was the opportunity to identify adult student perceptions regarding math anxiety, statistics anxiety, and the effectiveness of

collaboration as mitigation for anxieties. As I was unfamiliar with all of the variables that affected an adult's attitudes regarding these factors, a survey-based quantitative methodology was a poor choice. Creswell (2012) claimed that researchers consider a qualitative approach when variables affecting a phenomenon are unknown. Hancock and Algozzine (2011) proposed that qualitative methodologies are appropriate when the researcher's primary focus is on surfacing a participant's point of view regarding some phenomenon of interest to the researcher. One of the overall strengths of this project study was the selection and application of a qualitative methodology to elicit student perceptions of the learning tasks, methods, and resources employed in the business statistics course.

The final two strengths of this project concerned the population of adult students from which I was able to select participants to interview. Since initiating the course in January 2012, the majority of the population of adults from which I could select a sample had completed the course within a 2-year period prior to the commencement of this research. As such, memories regarding the course learning tasks, methods, and student resources were recent and still strong. This strength became evident during the interview sessions and proved to be helpful in surfacing participant perceptions of the course. A strength of this project resided in all 14 participants having completed the degree program coursework prior to their respective interviews with 12 having already graduated. This strength revealed itself in the participants' level of openness with expressing their feelings, perceptions, and remembrances regarding all facets of the business statistics course.

Although there are limitations to generalizing from any qualitative research endeavor, the data collected from adult participants provided a picture of student perceptions regarding the business statistics class. The themes were consistent with findings in the majority of scholarly research studies regarding math and statistics anxieties, math competency, collaboration as an instructional methodology, and collaboration as mitigation for statistics anxiety. While the findings of this research effort may not encompass the entire breadth of adult perceptions regarding the subject of statistics, this research contributed to the body of scholarly research findings regarding adult attitudes towards statistics anxiety, math competency, math anxiety, and collaboration as an instructional methodology.

Recommendations for Remediation of Limitations

There are two limitations to the generalizability of this research:

- the choice of a qualitative case study to gather data and the subsequent selection of a bounded system that included only past students of one business statistics class at one private, liberal arts, Christian college; and
- a lack of proportionate gender and ethnic representation in the sample of adults who volunteered to participate compared to these demographics among the population.

In retrospect, I am uncertain how I could have obtained a larger or more diverse sample for this study. During March and April, I sent emails on three different occasions to past students requesting participants for the research and received responses from only 26 individuals, of which, only 14 volunteered to participate. I selected and interviewed

participants during the spring, when primary and secondary schools in the area may have been taking spring breaks. One possibility for obtaining a larger selection of participants would be to attempt the study during a time of the year when adults may be more available for interviewing.

Regarding the limitation emanating from the choice of a case study and the resulting disparity of demographics in the sample of participants, I can envision two possible opportunities for increasing the validity of the study. The first option would be to expand the study by including additional participants from classes who completed the course after the original sample selection. I could interview additional participants using the existing interview methodologies, and incorporate the findings into the existing database. This option could potentially offer an opportunity to alter the sample demographic to be more in line with the population of students who had completed the course: 55% female and 45% male, and 90% European Americans and 10% African American.

Another possible means to increase the validity or extend the generalizability of this research would be to use the themes developed in the existing research effort to develop a psychometric survey instrument. Once validated, I could offer the survey instrument to a variety of adult programs that included statistics courses.

The choice of a case study and the resultant bounded system required that I confine participants to past students of one business statistics course at one private, liberal arts college located in the Southeast United States. Although the selection of a qualitative methodology all but eliminates the generalizability, findings from this

research did provide instructors of adult statistics courses valuable insights regarding adult perceptions of statistics courses. Additionally, having surfaced important variables that affect adult student attitudes regarding the study of statistics, I see the potential to develop a reliable and valid survey instrument that I could use to explore the initial findings from this research effort.

Scholarship

I have historically understood the concept of scholarship within the contexts of classical academic pursuits, including researching, studying, learning, and teaching. I would attempt to describe my personal journey towards scholarship through three metaphorical scholarly professors to whom I would like to introduce to my reader. My first professor is a Cambridge archeologist, historian, or anthropologist. The investigative-scholar may have dedicated his or her life's work to unearthing and understanding the ancient Orkney settlements in far northern Scotland, or, possibly, the Mayan pyramids of the Yucatan peninsula. Possibly my Cambridge historian-scholar spent his or her life preserving and interpreting the Dead Sea scrolls, or, understanding the Confessions of Augustine. My anthropologist-scholar may travel annually from Cambridge to the jungles of Brazil in order to study a lost tribe of people the world of scholars never knew existed. Thus, my first scholar from Cambridge instills in me a passion for studying, a love for truth, and a quest for understanding the wonderfully colorful patchwork quilt that makes up human existence.

My second scholar is the astrophysicist, marine biologist, pharmaceutical chemist, or geneticist from MIT, Ecole Polytechnique Fédérale de Lausanne in France, or the

Moscow Institute of Technology and Science. This scientist-scholar may have dedicated his or her life's work to understanding the universe, the diversity of ocean-life, the existence of naturally occurring pharmaceuticals, or the complexity and diversity of the human genome. This scholar is an empirical existentialist with interests in origins, black holes, tubeworms from the deepest part of the ocean, and the genetic make-up of early hominids. My second vision of scholarship is the scholar-scientist who proposes theories, develops hypotheses, and worships at the altars of scientific inquiry, deductive reasoning, and observation. This professor is exacting in both his and her research efforts and writings. His or her work is widely read due and respected for clarity of thought, attention to detail, and adherence to the rigors of scientific inquiry. I garnered from this scholar the importance of valuing a reputation for integrity in my own scholarship and respect for the scholarship of my peers. Another valuable lesson learned from this scholar is the care he or she exercises when communicating in writing: always with clarity, accuracy, and readability.

The professor completing my Ménage à trois of scholars is a consummate teacher and social research-scholar studying, writing, and teaching within the social fields of philosophy, psychology, cultural anthropology, and education. He or she is dedicated to discovering and describing the human condition and affiliates with the world's preeminent research institutions: possibly Harvard, Johns Hopkins, Oxford, or Heidelberg University. This professor/scholar/researcher is skilled at interviewing, observing, investigating, and teaching. Nothing interests this scholar more than prying into every facet of human psychology. He or she is also a brilliant instructor who captivates her

students with facts, anecdotes, and, of course, incredibly tough final exams that insure her students take seriously their own personal scholarship. This scholar informs me to be relentless in my inquiry, attend to every detail, and constantly question all of my methods of instruction.

Although my three professors do not fully define the breadth of definition needed to describe scholarship, the basic tenets there: they include studying, learning, researching, questioning, and instructing. Although I have not had the opportunity to sit at the feet of a Cambridge, Heidelberg, or Johns Hopkins scholars, I have read the books and journal articles they published. Although I do not pretend to place myself on a level with a Cambridge scholar, I am learning to be a scholar in my own right: through study, research, analysis, critical thinking, and learning excellence in the arts of pedagogy, or more accurately, andragogy. My interests and my calling lie in the field of adult education. I choose to be a scholar that dedicates his remaining years to the adult who finds he or she must return to the halls of academia for more knowledge and skills. My hope is that someday, I can be an example to someone's definition of scholarship; I would become a scholar not of bones, ancient structures, or historical tomes, but of methods to help adults better appreciate and understand the art, science, and skills of analyzing data.

Project Development and Evaluation

Thirty years in business management, earning a doctorate in social research, and teaching adults the science of quantitative inquiry have all contributed to my project development skills. Some of the skills needed to develop a project are gathering data,

analyzing findings, drawing conclusions, and making recommendations for change: I honed these skills in both the business world and in the classroom for a number of years. I also have experience developing programs of study, college-level courses, business development plans, and corporate restructuring programs. Additionally, Walden University did not have to teach me how to develop or evaluate projects, plans of action, or programs. What I gained from my experience at Walden is an appreciation for how to gather narrative data, analyze it for a consensus of ideas, and develop alternatives to address the areas of consensus. The process of developing a plan of action to address findings from the qualitative research was laborious, somewhat confusing, and terribly complicated compared to gathering numerical data and running a Mann-Whitney U test. However, I could not have completed the project that emanated from gathering qualitative data with my quantitative skills; I needed additional, complementary skills. That is what I learned regarding project development, qualitative measures for obtaining input to a project, at times, can result in a better understanding of human perceptions and, subsequently, lead to a better project. This experience added considerably to my capabilities as a scholar, researcher, and project developer.

Leadership and Positive Social Change

During my previous career as a corporate executive, I learned much regarding leadership styles and "people-centered" methods to manage change in the world of international business. After 30 years in business, I had developed a hardnosed, task-oriented leadership style that served me well as I progressed up the proverbial corporate ladder. Upon retiring from business, I began studying for a doctorate in social research,

while at the same beginning a second career teaching various statistics courses to both adult undergraduate and graduate students. I quickly learned that my well-honed hardnosed, take-charge, task-oriented leadership style needed a bit of adjustment to be effective in the world of academics in general and in the adult statistics classroom.

I did eventually adjust to a style of leadership that proved effective in the adult classroom. I continue to manage transformation by leading students to think through a change in attitude regarding the utility of business, quality control, and research statistics. However, it was not until beginning my studies at Walden University that I became aware of the concept of positive-social-change-focused leadership and scholarship.

The southern university where I earned my undergraduate and master's degrees in the early 1970s was far more interested in keeping students paying tuition and out of the Vietnam War era draft, which, in fact, did contribute substantially to social change. The graduate school where I earned my first doctorate was a Christian-based organization, and, subsequently, taught a very narrowly interpreted type of social change. The liberal arts college where I currently teach promotes a Christian lifestyle; however, this school's concept of positive social change is deeply rooted in its religious beliefs. It was not until I joined the Walden School of Education that I first heard of using education to promote positive social change from a secular sense.

The books and journal articles that were part of the course readings began to explain Walden's charge; I was supposed to begin working towards improving "the human and social condition by creating and applying ideas to promote the development of individuals, communities, and organizations, as well as society as a whole" (Walden

University, 2013). I freely admit that I am still digesting this directive. I do see the importance of righting wrongs, promoting equality, engendering respect for differences, and developing tolerance for all cultures, peoples, races, orientations, and ethnicities. I also see that education can help to open eyes towards social injustices. If these are the primary tenets of promoting social change, then I am onboard with social constructivism in its broadest sense.

However, I remain somewhat conflicted, confused, and confounded with some of what I read regarding "positive social change." I propose that there are good scholarly reasons for my *three-Cs* (confliction, confusion, and confoundedness). I would first cite the educational policies of Freire (1970), who proposed that one of the purposes for adult education is to indoctrinate adults to keep a wary eye on power, privilege, class, and consumerism. Although I see benefits in teaching adults to think independently regarding these subjects, I have mixed feelings regarding my right to proselytize adults with my perspectives on these subjects. However, I do agree that I have a responsibility to present all sides of an issue and allow adults to make up their own minds. I question the veracity of scholarship from an instructor who has as a personal agenda altering his or her student's perspectives, opinions, and worldviews on religion, right-to-life, LGBT issues, and, possibly, even euthenasia. I fully agree with Freire that the learning environment should support and contribute to the integrity of all learners, regardless of race, creed, color, orientation, or political affiliation. However, I remain conflicted with Freire's hypotheses that education is invariably political in nature and all educational theories are, in fact, political theories. In my opinion, education and, hence, educators,

have a limited responsibility to offer the range of perspectives on social issues. However, I personally draw the line with attempting to promote one perspective over another. My fear for this form of social engineering resides in the history of world leaders who attempted to use their respective educational systems to promote personal agendas, indoctrinate an entire generations with a narrow point of view, or socially reprogram young adults to aberrant ways of thinking and acting. Germany, Italy, the USSR, China, and North Korea are all examples of how world leaders used the education systems to indoctrinate their respective citizens with the social agendas of the countries' respective leaders. Every one of these national efforts resulted in chaos, economic catastrophe, and social unrest.

In conclusion, if it is Walden University's view that education and educators should be proactive agents for change as defined by academia, I remain beyond conflicted, confused, and confounded: I choose not to participate. However, if Walden University is a proponent of educators teaching all sides of an issue, and, most importantly, teaching an adult how to think critically about his or her own personal views, then I am not conflicted. I hope the truth is in the latter, because have come to respect Walden University as an institution of higher learning that encourages adults to think critically about all subjects.

Analysis of Self as Scholar-Practitioner

I fit the classical definition, and proudly wear the mantle, of quantitative researcher. I earned both a bachelor's and master's degree in engineering, and after retiring from corporate business, earned a Ph.D. in social research with a specialization in

quantitative methods. For the past 10 years, I taught quantitative research, business statistics, and quality control statistics to both undergraduate and graduate students. Although my academic upbringing throughout the past 45 years taught me much about scholarship, not until my entry into Walden University did I fully comprehend what it meant to be a well-rounded scholar-practitioner. My purpose for earning a second doctorate was to push my scholarship past quantitative research and statistics in order to understand more fully the breadth of social research. It was for this purpose that I undertook a qualitative research project.

However, reflecting critically on my last 4 years at Walden University, I admit to only beginning to develop my own scholarship. As an adult educator, I begin to understand that my focus is to strive continuously towards becoming an educational scholar-practitioner. I define the focus of my scholarship to begin with a relentless search for educational methods, resources, and learning tasks that benefits adults, the organizations they work for, and the communities in which they live. My scholarship continues into the classroom where I am to be an example of a compassionate educator of adults. I believe that, as a scholar-practitioner, I am responsible to promote truth over agenda, develop skills rather than indoctrinate perspectives, and build adult student confidence free from any conflict in purpose.

As a scholar, I commit first to being a life-long learner; there is no better way to promote scholarship than from the chair of learning. I also commit to a relentless search for more effective methods to improve adult student learning. My future students deserve instructional methods, learning tasks, and course resource materials that fit their needs,

their styles of learning, and their goals and objectives. Finally, as a scholar among scholars, I will be innovative in developing, initiating, and publishing my own ideas for how to improve the adult classroom. Those ideas should be sufficient for replacing my quantitative façade, not with another mantle, but with a persona that is considerably more scholarly in practice.

Analysis of Self as Project Developer

Due to my experiences as a corporate executive and having earned a doctorate in quantitative research, I understand how to develop a project, write a new course, create a research strategy, and organize a scholarly paper. Although researching a phenomenon, problem, issue, or new instructional methodology may not be a primary function of the project developer, research is an important supporting function. I thought I knew how to be an effective researcher prior to entry into Walden University. I learned quickly that I was not as focused in my research as I needed to be. While completing this project study I found it incredibly difficult to keep my eye on the primary purpose of my research.

It took several false starts, but I learned that my tendency, when researching, was to follow rabbit trails. I love to read and enjoy finding new (to me) ideas for how to teach adults, or how a researcher applies statistical tools in a research study. I freely admit that a novel approach to analyzing pre-test post-test survey data or a new multivariate examination of an experimental procedure can derail me from my original intentions. A similar situation occurred during the project-oriented literature search when I began to investigate research findings regarding the phenomenon of statistics anxiety. I soon found that statistics anxiety was only one of the anxieties with which adults contend in

college-level statistics courses. I, subsequently, found myself deep into researching test anxiety, professor anxiety, GPA anxiety, study anxiety, and question-asking anxiety. The last of these anxieties, question-asking anxiety, was a brand new concept to me. I spent the better part of a day becoming an expert regarding why some adult students do not ask questions during class. To an adult instructor, all of these are important; however, they are off task to developing a project to help adult students with statistics anxiety. Literally, three days later, I looked up from my computer and found that I had wandered off into a morass of anxieties and written dozens of pages on the variety of these phenomena. Unfortunately, none of my wanderings addressed the core research questions I had posed for the project I was developing. I learned a lesson from this foray into adult anxieties; I learned to keep the research question in front of me at all times while researching, developing, or polishing the narrative in a program description. However, I in no way claim to be reformed completely; I still love to wander, read, search, investigate, and, yes, look for rabbits like a beagle. However, for now I remain on-task to finish this project study and move on to researching, writing, and teaching.

The Project's Potential Impact on Social Change

What I have left unsaid throughout this project study was the ulterior motive I had for selecting a qualitative project and, subsequently, for my personal future impact on positive social change. As proposed in my research question, I wanted to improve my methods for teaching statistics to adult students battling with math and statistics anxieties. Additionally, I also wanted to understand why some students perform poorly on a collaborative problem-solving team. Finally, yes, I did want to understand if adult

students perceived collaboration as an effective methodology for lowering the effects of statistics anxiety. The focus for my inquiry was not only on understanding, but on understanding in order to develop new instructional methodologies, learning tasks, and course resources that would be more effective at connecting my future students with statistics. There are considerable elements of social change in these endeavors. However, my primary interest, and where I can make the most impact on social change, emanates from another, more selfish motive: I wanted to learn the art of qualitative research.

My reason for finally bringing this ulterior motive to light is more of a self-purging than altruistic intention. I have been an instructor for social research to both undergraduate and doctoral students. However, having had no formal qualitative training, and, admittedly, very little respect for what I termed the "darker side" of social research (i.e., qualitative methods), I historically skewed my teaching towards quantitative research. Where I believe that I can make a substantial social impact resides in my newfound competency to teach the full breadth of social research in the future. Having completed only one qualitative study makes me no expert that can rival the likes of Hatch (2002), Creswell (2012), or Yin (2009). However, I do understand the basics, and I am now familiar with the qualitative experts and their writings. Additionally, I know how to get in touch with their teachings on the subject of qualitative research through their books and journal articles. I also feel confident in my ability to introduce these experts to my future students, in order that they may go forth and initiate positive social change as their personal life's work. Having completed a qualitative project study,

I feel more comfortable in my ability to help my future students understand both avenues for conducting social research: the more enlightened quantitative path and the "darker" more esoteric qualitative path. Thus, the potential for my impact on positive social change resides, not on only in teaching adults the power of quantitative research, but in teaching the subtleties of a well-grounded, well-formatted qualitative study.

Implications, Applications, and Directions for Future Research

For this qualitative project study, I obtained data in the form of narratives from 14 adult students. My investigation focused on surfacing and understanding adult perceptions of statistics in general, the phenomena of math and statistics anxieties, and the application of collaborative problem solving as a mitigation initiative for reducing statistics anxiety. The findings from this research endeavor provided valuable insight into adult students' perceptions of how I could modify an existing course methodology to improve learning and, subsequently, better connect adults with the subject of statistics. However, the generalizability of this research is limited due to my gathering data from only one business statistics course at only one college. Regardless of a limited possibility for inferring to other adult student populations, there are valuable implications for future students and scholars alike.

The implications from this research regarding adult education are two-fold. First, from a local level, I was able to obtain insight into how I could modify the existing instructional methodologies, learning tasks, and course resources to accommodate adults challenged with the existing course structure. Students provided insight into the need for collaboration to be voluntary, allowing students to work independently as an option.

Additionally, there was evidence in the professional literature provided regarding how I could reconfigure the existing collaborative, problem-solving, in-class learning tasks with more recognizable case studies and actual databases. Finally, the research confirmed my personal observations some adult students are math-challenged and, subsequently, requires additional assistance in the form of tutoring or other self-help resources.

I can envision two obvious directions for future research to identify findings that would be potentially more generalizable regarding the application of collaboration as a core instructional methodology and the challenges that adults face with statistics and math anxieties. One obvious direction for future research would be to expand this qualitative study to additional students in order to obtain both a larger sample and a more representative gender and ethnic demographic. With having interviewed only 14 students, the majority of which were European American females, I believe that I could significantly enhance the findings of this research by adding narratives from students who completed the course since this research endeavor started. If a purposeful sample of male and African American participants could be encouraged to participate, I propose that the findings of the research would be considerably more indicative of the population of students who completed the course.

Two additional methods may provide results that are more generalizable. First, to find additional colleges and alternate statistics classes where I would be allowed to contact past students in order to further this research study regarding adult perceptions of statistics anxiety, math anxiety, and collaboration as a methodology. Finally, a third, and possibly more far reaching, direction for future research would be to use the findings

from this qualitative study to develop a Likert-type survey instrument that could be used to more readily obtain a larger sample of student perceptions.

Conclusion

My journey at Walden University has taken four years out of an already full life. At age 62, I entered Walden University with the motive of learning more about adult education, scholarship, and qualitative research. At age 65, having (almost) completed the requirements for a second doctorate in adult higher education, I believe I am better prepared to accept the mantels of both scholar-practitioner and life-long learner. In addition to learning much regarding how to be an agent for social change, I expanded my horizons past being a "quant" researcher. My experience at Walden University instilled in me a more well-rounded perspective of what a researcher for positive social change can accomplish. With this knowledge, these experiences, and a new set of research skills in my scholarly quiver, I believe that I am prepared to go forward to complete the research "Holy Grail," a mixed-method research project.

In addition, thanks to the 14 students who volunteered to allow me to interview them, I considerable insight regarding how adults view the subject of statistics, their challenges with statistics and math anxieties, and their perspectives regarding the use of collaboration as an intervention to reduce anxieties. I have insight from these same participants regarding how to modify the course structure, learning tasks, and course resources to help students marginalized in some manner by the existing course structure.

Having completed this project study, I have four goals for my scholarship going forward. The four goals are to

1. implement the modifications to the business statistics course that the 14 participants indicated could improve the learning experience for a greater percentage of adult students,
2. continue to research for instructional methodologies that will enhance adult experiences with learning in my classrooms,
3. publish a journal article entitled "College-level Statistics: Perspectives from Adult Learners," and
4. complete a mixed-methods research project.

To these four, I add that my life's work is teaching adults. I look forward to whatever challenges my God has for me that puts to work my newly acquired scholarly skills.

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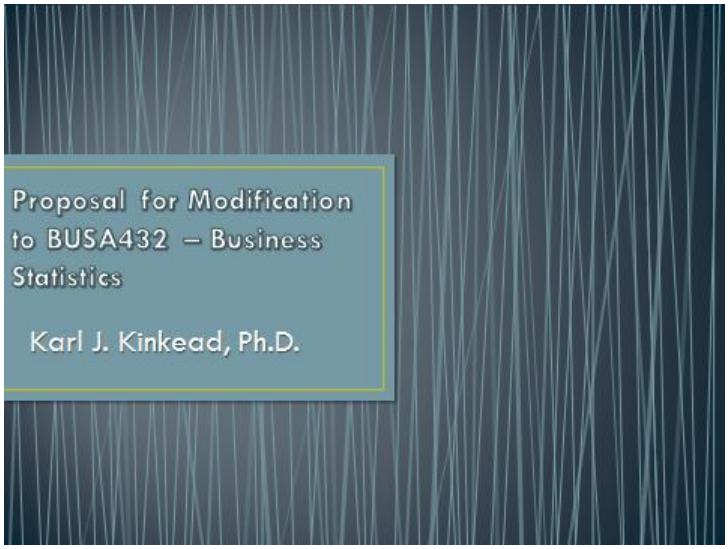
Appendix A: Presentation of Recommended changes to the Business Statistics Course

The recommended changes to the business statistics course will be presented to the dean of adult and graduate studies of the college through (a) a PowerPoint slide presentation describing the findings and recommended changes, (b) a summary of proposed syllabus changes, and (c) an implementation timeline of the recommended changes.

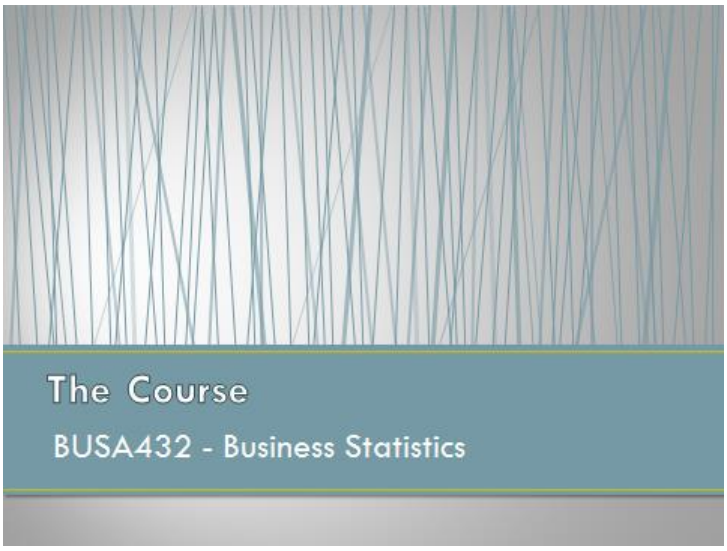
Power Point Slide Presentation

Slide 1



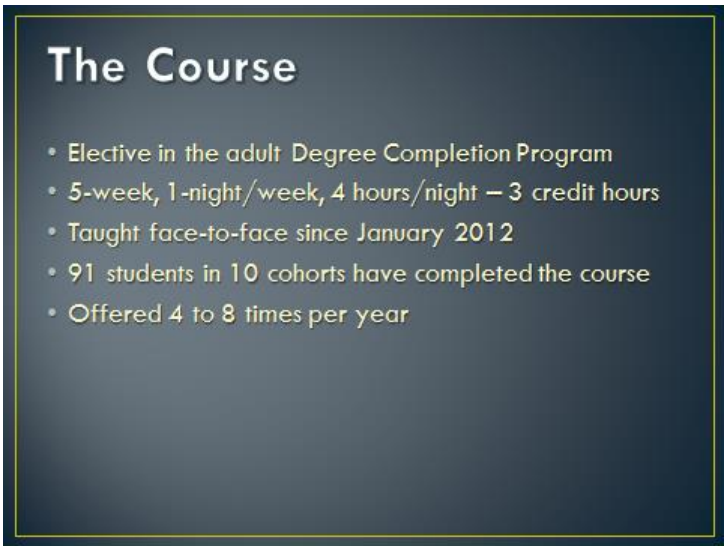
Thank you for affording me this time, I will keep this presentation to under an hour. The purpose of this meeting is to inform you of the research I conducted on the Business statistics course and recommend several changes to the course learning tasks, instructional methodologies, and student resources.

Slide 2



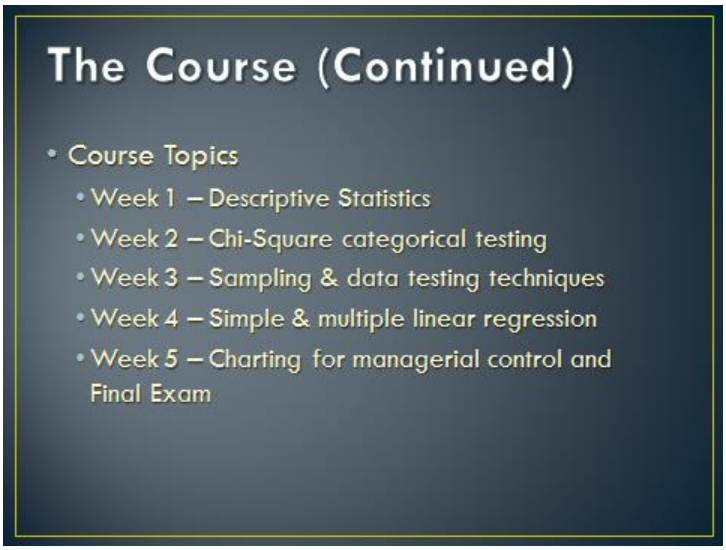
I would like to start with a brief overview of the existing course.

Slide 3



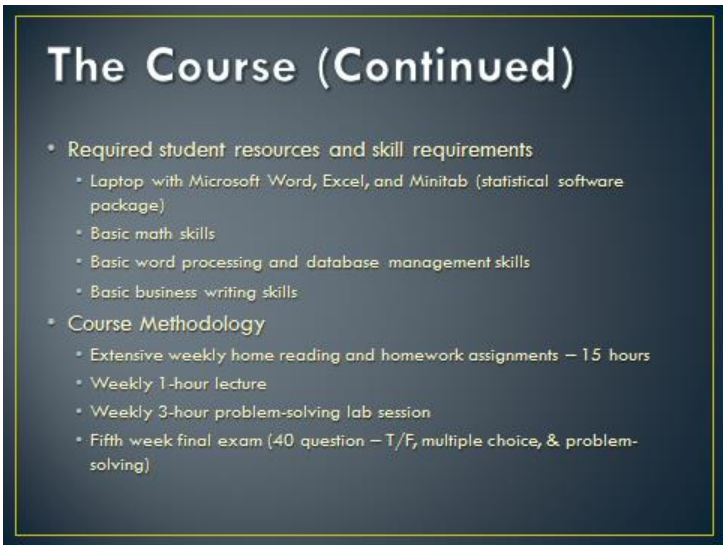
The course was taught as an elective over a 5-week period and lasts 4 hours per night. Since January 2010, when the course was first initiated, approximately 90 students have completed.

Slide 4



Each week of the course, a different subject is covered that pertains to analyzing business data. The subjects include. . .

Slide 5

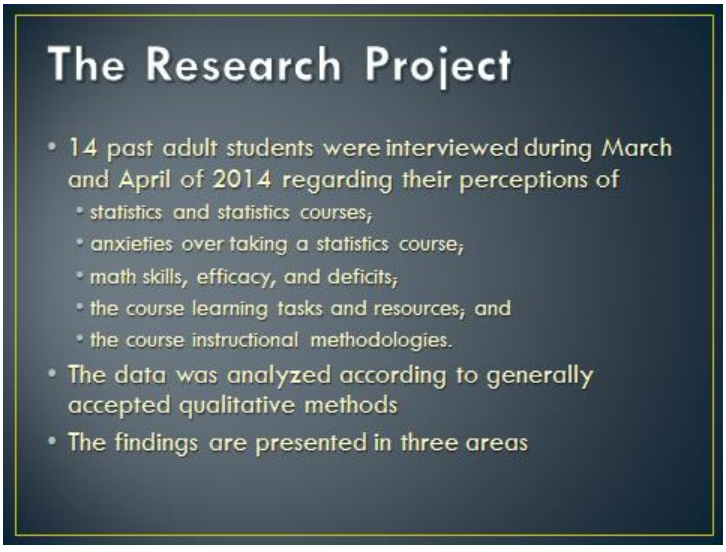


Students are required to come to class with a laptop complete with Microsoft Word, Excel, and Minitab: a statistical software package. Students are expected to have a working knowledge of these programs. The course methodology includes. . .

Slide 6

In January of 2014, as partial requirements for completing a doctoral program in adult higher education, I began a project entitled ". . . " The purpose of this project was to identify adult student perceptions regarding the course methodology and a phenomenon labeled in the literature as statistics anxiety.

Slide 7

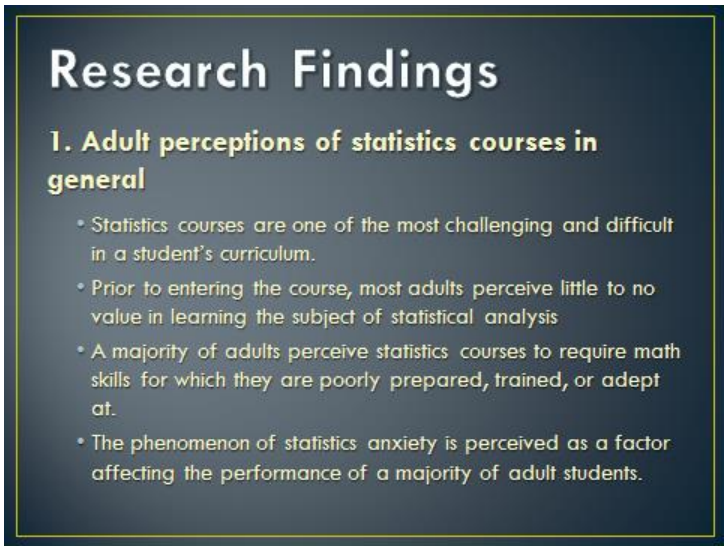


Fourteen past students interviewed and data analyzed from the transcripts provided insight into an adult's perspective… Data was analyzed according to. . .

Slide 8

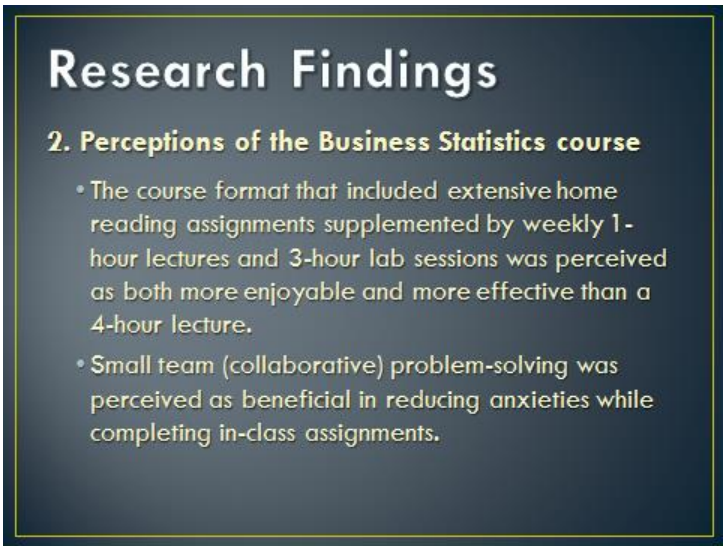
I organized the findings from the research into three categories that I would like to explain briefly.

Slide 9



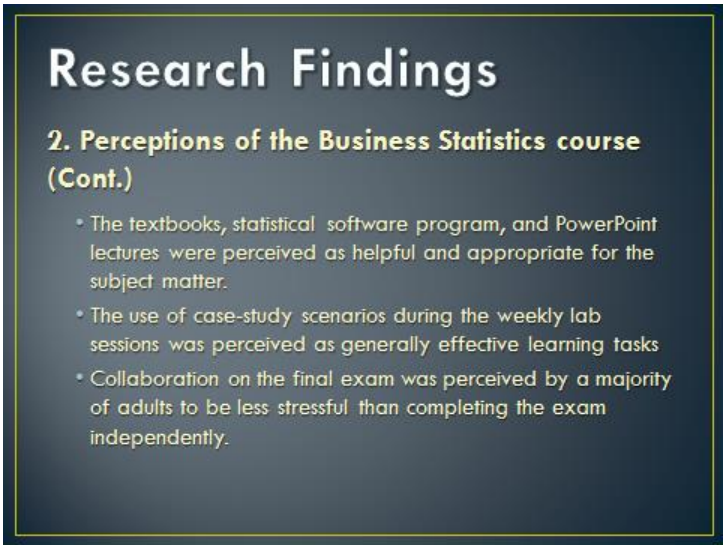
Four important findings were identified regarding statistics and statistics courses in general. These were. . . These findings were confirmed in the professional literature regarding statistics instruction, statistics anxiety, and adult student math competency

Slide 10



The second category of findings was in regard to the specific Business Statistics course. First, all of the participants unanimously voiced appreciation for not having to sit through a 4 hour lecture on statistics. Additionally – Lab session and Collaboration on in-class assignments.

Slide 11

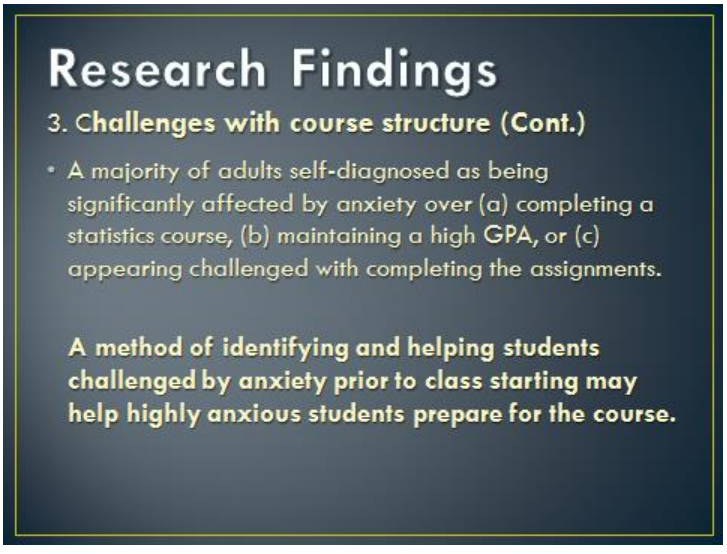


A second perception that the participants voiced regarded the textbooks, statistical software package, and Powerpoint lectures. Additionally, the majority affirmed the use of collaborative problem solving

Slide 12

The third category of findings I labeled as "challenges with . . ." First, of the fourteen participants, four, voiced that they did not enjoy working collaboratively and preferred to work independently. The course methodology required collaboration on in-class assignments, this is one area that appears to need modifying.

Slide 13

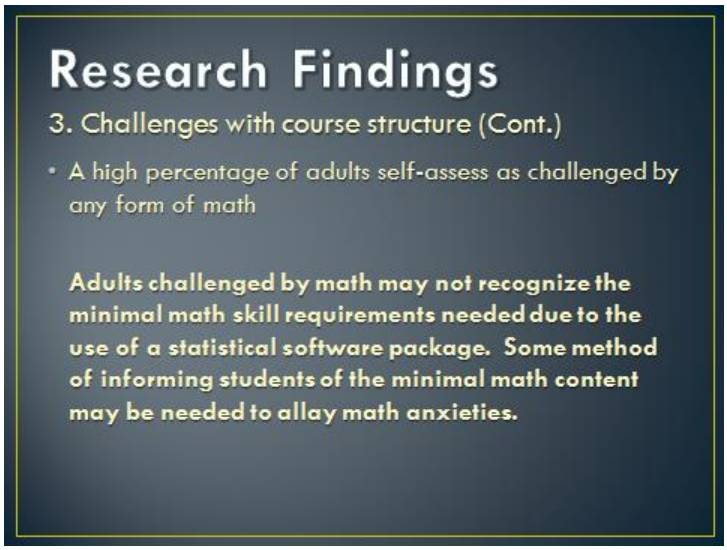


A second finding paralleled findings in the professional literature – 75% of the participants voiced being affected by some level of anxiety for three categories of reasons.. These three reasons included. . .

Slide 14

A third challenge that needs to be addressed is one that I had not found in the professional literature – partner compatibility. There were three areas of compatibility and every participant mentioned at least two of these as important to their enjoyment of working on a team.

Slide 15



A fourth challenge came as no surprise and that was that 75% of the participants self-professed to being challenged by math or math-related courses. Until now, there has been no accommodation of these challenges, no acknowledgement, no remedial help…

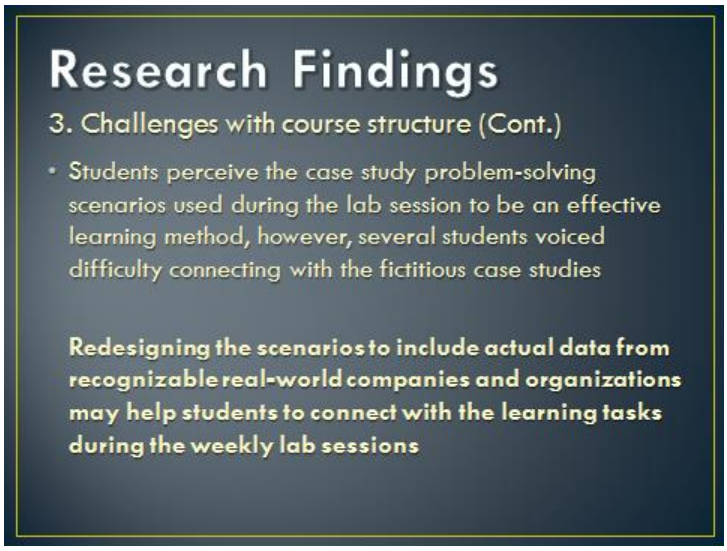
Slide 16

A fifth challenge involved the range of computer competency among students. It became apparent both in the course and from the participants that computer literacy, specifically word processing and database management were challenges to

Slide 17

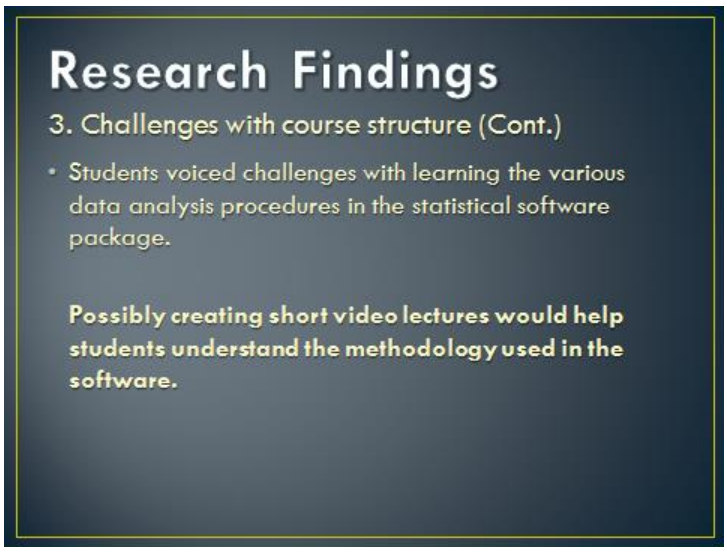
A sixth challenge was voiced by four of the students who claimed that their partners brought down their grade.

Slide 18



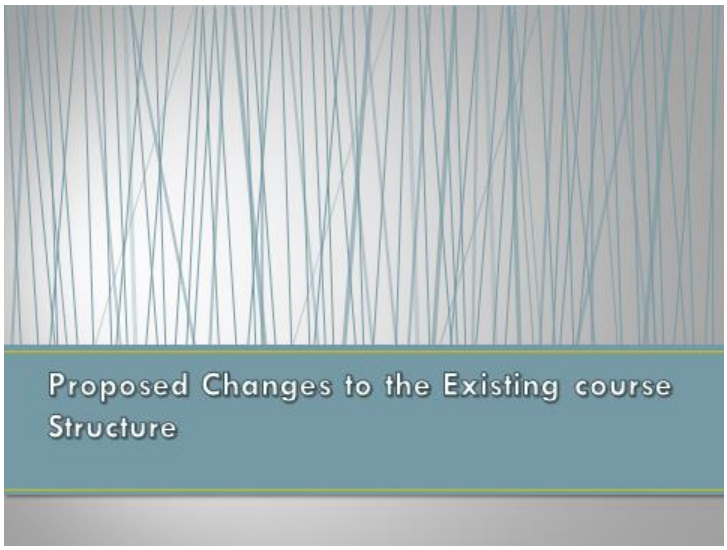
Another challenge I uncovered had to do with the case studies used in the lab portion of each week's class. I developed these to mimic businesses around the area, however, they are fictitious. Several participants voiced that they wished this were real data regarding real organizations. Recent journal articles. . .

Slide 19



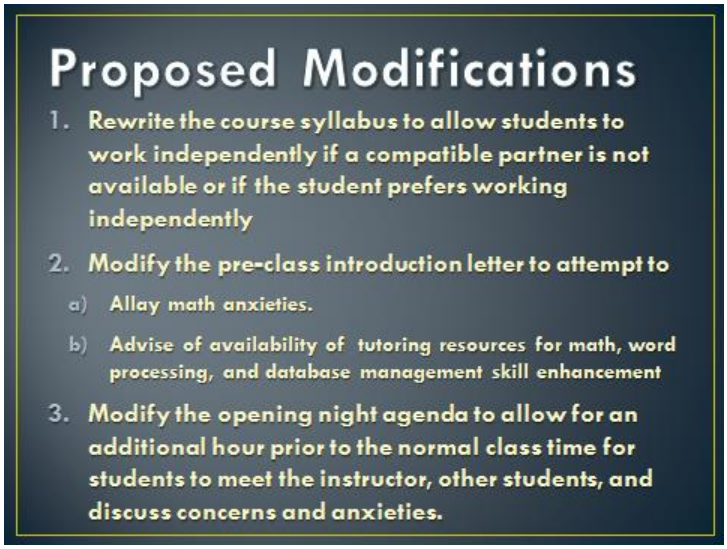
An eighth challenge dealt with the limited amount of self-help resources available to help students learn Minitab, the statistical software package.

Slide 20



These findings led me to propose several changes to the existing course instructional methodology, learning tasks, and student resources. I would like to cover, very briefly, these findings and then handout a document with the exact changes to the Syllabus that I am recommending to the syllabus/participant-guide.

Slide 21



Flexibility with collaboration, introduction letter, and opening night agenda

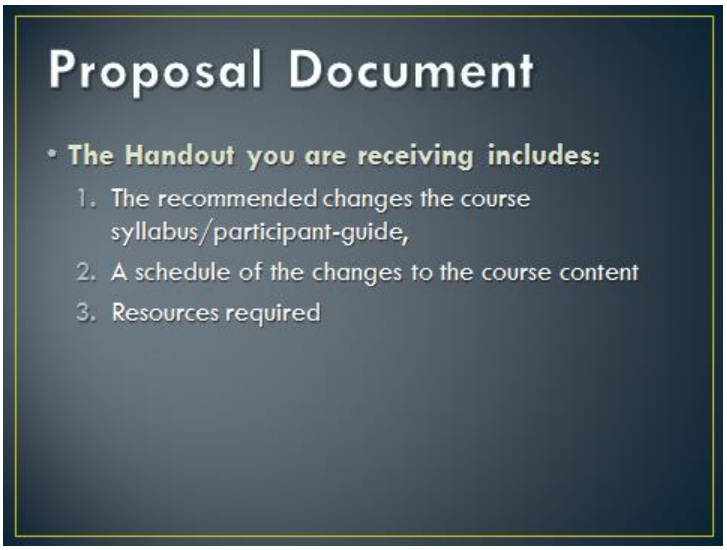
Slide 22

The next recommendation is to rewrite the four scenarios used during the lab sessions

Slide 23

Finally, I am recommending that I develop 6 Minitab videos that cover the basic data analysis procedures used in the lab sessions. These can be reviewed by the students as part of their homework assignments.

Slide 24



Allow me to handout a document I entitled "Proposed Business Statistics Course Modifications" for both your review and hopefully, approval. I also included a timeline for making changes. <briefly review the changes>

Slide 25

Are there any questions?

Proposed Syllabus Changes

The following is a list of the changes to the course syllabus. For reference purposes, the existing page number, section title, and verbiage found in the Syllabus is included, followed by the recommended changes:

- Page 3 – **Weekly Business Statistics in-class Collaborative Lab Projects:**
    - Original language - During week 1 of class, students will select a lab-project collaborative partner for the duration of the 5-week course.
    - Revised language – Students have the option of working independently or selecting a collaborative partner to complete the lab assignments and final exam. Once a collaborative partner is selected, the team will complete all lab assignments and the final exam. Each member of a collaborative team will receive a common grade.
    - Revised language – Add the following sentence to the end of the paragraph. "Students who perceive that their grade suffered due to agreeing to work collaboratively will be provided an opportunity to raise their grade through an optional extra assignment to be completed during the week following the final week of class.
- Page 3 – **Final Review Exercise:**
    - Original language – During the lab portion of the 5th week of class, each collaborative group will complete a summary review of materials covered during the course (instead of a scenario project).

- Revised language – Add a follow-on sentence that states “Students who chose to participate independently on the scenario projects in weeks one through four, must complete the final review exercise independently also.”

- Page 8 – **Class Methodology**
  - Original language - This business statistics course is designed to enhance student learning through readings, lectures, homework, collaborative group projects, a final collaborative assessment, and a project paper.
  - Revised language - This business statistics course is designed to enhance student learning through readings, lectures, homework, case study projects, a final assessment, and a project paper. It is recommended that students will complete the weekly projects and the final assessment in small 2-person teams; however, students may request to work independently if preferred. Students choosing to work independently on the weekly case study projects will be required to complete the final assessment independently also.
  - Original language - The last 3 hours of the first four class sessions will be dedicated to a small group lab project.
  - Revised language – The last 3 hours of the first four weekly class sessions will be dedicated to case-study lab projects that may be completed collaboratively or independently.
- Page 20 – **Lab Project Scenario #1**
  - Original language – The chairperson and CEO of ACME trucking. . .

  - Revised language – The commissioner of Baseball has asked you to evaluate the effectiveness of a new policy regarding player salary equalization by team and by region. As the statistician, research expert, and baseball aficionado, you have been retained by the commissioner to evaluate if the policy implemented 4 years ago has progressed the salaries of the 30 teams (2 leagues) are progressing towards parity. The commissioner provided you with the actual salaries for all 30 teams for the past 4-years and asked for a complete analysis to be conducted. Your report is due in 4 weeks.

- Page 20 – **Lab Project Scenario #2**
  - Original language – The senior pastor of your church and the church board of deacons are interested in better understanding the make-up and annual giving patterns of the church congregation. . .
  - Revised language – You work for the United States Federal Department of Education. As the chief statistician, you have been assigned to analyze the 2010 census data for any trends in adults attending higher education not-for-profit versus for-profit universities by state, region, and ethnicity. You are requested to report back directly to the Secretary of the Department of Education with any important trends you find in the data within 4 weeks.
- Page 20 & 21 – **Lab Project Scenario #3**
  - Original language – The Better Business Bureau (BBB) of Chattanooga, Tennessee asked. . .

- Revised language – The United Way of America organization hired you to evaluate giving patterns for the past 10 years. Your given the gross receipts for the past 10 years by (a) state; (b) region (Southeast, Northeast, Midwest, northwest, west, and Southwest); (c) donor classification (private, corporate, and governmental); (d) gender, and (e) whether a donation was directed or general). You have been asked to report back to the UW executive committee with any recommendations regarding marketing plans you propose.

- Page 21 – **Lab Project Scenario #4**
  - Original language – You have been asked to provide four executive summaries to the CEO of your company. . .
  - Revised language – The American Federation of Labor Organizations (AFL-CIO) hired you to evaluate the trends in union membership over the past 10 years. You have been given the data maintained by the Federal Department of Labor Statistics to evaluate the trends by (a) affiliated union; (b) state; (c) gender; (d) labor type (management, technician, hourly paid, and professional; and (e) industry sector. You have also been given the same data for Canada, Australia, and the EU. Your job is to report back in 4 weeks any trends that might provide insight into where the AFL-CIO is losing or gaining membership.

Implementation Timeline

Instructional Component	Current Methodology	Proposed Methodology	Order of Change
Computer Software	Microsoft Excel, Word, and Minitab	1) Develop Video presentations and self-help guides to be placed online 2) Word processing & database mgt. videos	1) Complete all weekly statistical treatment videos by 3/31/2015 2) Complete by 5/31/2015
Lab problem-solving Scenarios	Scenarios & databases are fictitious	Redesign to include real-world organizations and databases	Complete all databases, weekly assignments, and grading rubric by 3/31/2015
Weekly Laboratory configuration	Collaboration through 2-person teams	Offered and recommended, but not mandatory	Revise syllabus upon approval – 1-week to complete
Final Exam	Collaborative through 2-person teams	Offered and recommended, but not mandatory	Revise syllabus upon approval – 1-week to complete
Math, word processing, and/or database management aids to reduce anxiety	None in place at this time	1) Affirm in an introductory letter that the basic level of mathematics required 2) Actively inquire as to a student's level of anxiety on the first nigh to class 3) Offer asynchronous, online tutoring	1) First 2015 class 2) First 2015 class 3) Upon completion of tutoring training and certification process – approximately 6/2015
Course introduction & opening night agenda	Introductory letter	1) Revise introductory letter to acknowledge statistics and math anxiety 2) Allow time at the beginning of the first night to discuss S/A and M/A. 3) Introduce the availability of tutoring computer challenged students	1) Revise in time for first class in 2015 2) First 2015 class

Appendix B: Letter of Cooperation

[redacted]
Adult & Graduate Studies Program

Dear Karl Kinkead:

Based on both prior discussions and a review of your proposal, it is understood that you wish to contact prior students of the Statistics for Quality Management Course (BUSA432) that you have taught since January 2012. Please accept this letter as permission to contact previous students of this course for the purpose of interviewing them as to their experience within the BUSA432 course. It is understand that

- only students who have completed the course will be approached to participate in the research,
- participation in this research will be voluntary,
- students who do volunteer to participate may withdraw at any time and for any reason,
- the only data collected will be through interviewing previous students of the BUSA 432 course regarding their opinions, perceptions, and thoughts regarding the statistics course instructional methods.
- other than to obtain contact information for potential participants, no Bryan College A&GS personnel will be involved in the research unless prior approval [redacted] AGS program department supervision,
- no [redacted] facilities will be used to conduct research unless prior approval is received from AGS program department supervision,
- [redacted] personnel will not have access to any raw data in the form of interview recordings or transcripts collected from personal interviews,
- no compensation will be made to any participants for their involvement in this study,
- no one at [redacted] will be made informed as to any participant in this study, and
- all transcripts of interviews will be maintained confidential by you for a minimum of 5 years from date of completion of the research study.

Sincerely,

Michael Chase

Dr. Michael Chase, Dean
School of Adult and Graduate Studies

[redacted]

Appendix C: Email Invitation to Participants

Dear _____:

I am writing to ask your help with a research project I am conducting on a course you participated in while at [redacted] As you may remember, BUSA 432 - Statistics for Quality Management was one of the last courses you took while in the degree completion program at [redacted] I, Dr. Karl Kinkead, am both the original designer and only instructor of this course since January 2012. I am asking for your help in evaluating the effectiveness of one part of the course, the weekly collaborative problem-solving sessions. As you remember, after completing a short 1-hour lecture each week, a lab session followed during which small groups of two or three students worked on scenario projects. At the end of each week's lab session, each team of students submitted an "Executive Summary" of their findings. I am interested in hearing your perceptions of this part of the instructional methodology.

If you agree to participate in this study, I would like to interview you in person, by phone, or by Skype for approximately 1-hour. The reasons for this research were twofold. First, I am a doctoral student at Walden University, and I am conducting this research as part of the requirements for graduation. Of equal importance was my second purpose, looking for ways to improve the learning experience for all students. During the 1-hour interview, I would like to ask you to give me your thoughts regarding the following question:

- What are your perceptions of the team-based problem-solving method used during the lab portion of each statistics class?
- Were there any advantages or disadvantages to you personally in working on a problem-solving team?
- If you had a choice, would you prefer to work on in-class projects on a team or independently, and what drives your preference?
- How did working on a collaborative team affect your anxiety over taking this statistics class?

The study I am conducting is voluntary. I respect your decision of whether or not you choose to participate. Nobody a[redacted]e knows whether you agreed to participate in this study or not. However, the college is aware of this research and provided permission to contact past students of the course. Furthermore, if you decide to join the study, you can still change your mind at any time and excuse yourself. Any information you provide during the interview be kept confidential and no personal information be included in my study.

If you are willing to participate in a short 1-hour interview, would you advise me of your interest by return e-mail? I contact you within the next two weeks about

scheduling an interview. If you have questions about the research, please feel free to e-mail or call me at your convenience.

Sincerely,
Karl J. Kinkead, Ph.D.
[redacted]

Appendix D: NIH Certification

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that Karl Kinkead successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 09/24/2012

Certification Number: 1009057

Appendix E: Participant Consent Form

PARTICIPANT CONSENT FORM

You are invited to take part in a research study of your experience with the Statistics for Quality Management course that you participated in while in the Bryan College Adult and Graduate Studies degree completion program. I am inviting only individuals who successfully completed the course since January 2012. This form is part of a process called "informed consent" that helps you to understand this study before deciding whether to take part.

This study is being conducted by a researcher named Karl J. Kinkead, who was a doctoral student in Higher Education and Adult Learning at Walden University. You may remember that I was the instructor in the course, however this study was separate from that role and in no way affect your status in the Bryan p[redacted]m if you are currently enrolled.

Background Information:
The purpose of this study was to understand past student perceptions of the team-based learning methods used during class for the course lab projects and final exercise.

Procedures:
If you agree to be in this study, you be asked to be interviewed by for approximately 1-hour either in person, by phone, or online through Skype™ or some other instant messaging means.

Here are some sample questions you be asked to comment on:

- What are your perceptions of the team-based problem-solving method used during the lab portion of each stats class?
- Were there any advantages or disadvantages to you personally in working on a problem-solving team?
- If you had a choice, would prefer to work on in-class projects on a team or independently, and what drives your preference?
- Please take a moment and read through this definition of a phenomenon called statistics anxiety and then comment on the extent that this phenomenon affected your performance in the class.
- How did working on a collaborative team affect your anxiety over taking this statistics class?

Voluntary Nature of the Study:
This study was voluntary. Everyone respects your decision of whether or not you choose to be in the study. No one at [redacted] College knows whether you agreed to participate in

this study or not. Furthermore, if you decide to join the study, you can still change your mind at any time and excuse yourself from the study.

Risks and Benefits of Being in the Study:
Being in this type of study involves some risk of the minor discomforts that can be encountered in daily life, such as fatigue, stress, or becoming upset. Being in this study would not pose risk to your safety or wellbeing. If the study possibly involves more than minimal risk of harms that go beyond normal daily experiences, the preceding two sentences should be replaced with a tailored description of the potential harms of the study. If possible, describe "risks" in terms of both the estimated likelihood of harm and estimated magnitude of harm.

The purpose of this study was to gain an understanding of adult student perceptions of working on a problem-solving team and any perceived benefits or harms from the method. Findings from this study will aid me in refining the course instructional methods for future students.

Payment:
Other than a cup of coffee and possibly a light snack, no compensation will be offered for participating in this study.

Privacy:
Any information you provide during the interview, including all recordings and instant message transcripts, will be kept confidential. I will not use your personal information for any purposes outside of this research project. I will, likewise, not include your name or anything else that could identify you in the reports generated from this study. All interview recordings and transcripts will be kept secure for at least 5 years by on my personal computer that was password protected, as required by Walden University.

Contacts and Questions:
You may ask any questions prior to agreeing to participate in the interview. My personal cell number and e-mail address was at the bottom of this page. If at any time you would like to talk privately about your rights of as a participant, you may contact Dr. Leilani Endicott. She was the Walden University representative who can discuss this with you. Her phone number was 1-800-925-3368, extension 1210. Walden University's approval number for this study was **IRB was enter approval number here** and it expires on **IRB enter expiration date.**

If you agree to participate in this study, please complete the bottom portion and return it via e-mail to me directly at kinkead@msn.com. Also, please print or save this consent form for your records.

Statement of Consent:

I have read the above information and I feel I understand the study well enough to make a decision about my involvement. By **replying by e-mail with the words, "I consent," I understand that I am agreeing to the terms described above**.

Only include the signature section below if using paper consent forms.

Printed Name of Participant _____

Date of consent _____

Participant's Signature (or "I Consent") _____

Researcher's Signature _____

Appendix F: Formal Interview Protocol

I. Opening Remarks (paraphrased)
- I am a doctoral student at Walden University and am conducting research on student perceptions of the business statistics course that you completed while at [redacted].
- I will use the results of the 10 to 15 interviews in a "Project Study" I am completing for Walden University as part of the requirements for an EdD.
- The overall purpose of this study was to gain understanding of adult perceptions of the effectiveness of group, or team project work as an in-class instructional methodology in a business statistics course.
- I hope to use what I learn from you and others who took this course to improve the instructional methods used in the course.
- You already signed the consent form, but let me go back over a couple of important items:
    - You may excuse yourself at any time and for any reason from this interview or from having your interview used in any way in my research.
    - If you are uncomfortable with any question, please feel free to let me know and I will move on to the next question.
    - I will not use your name, student number, or any other identifying notations as to who you are in any documents that I produce in this research.
    - I would like to digitally record this session if you agree.
    - If you would like a copy of your transcript, I am more than happy to send it to you and allow you to comment on these subjects.
    - Do you have any questions at this point?
- I will attempt to keep this session to around 1-hour. If you are ready, could we begin?
- What I am interested in learning your perceptions regarding the business statistics course you took:
    - First, I would like to explore your thoughts, perceptions, and opinions regarding the team-based problem-solving instructional method that I used in the lab portion of each class session.
    - Second, I am interested in learning about your experiences with the subject of statistics in general and a phenomenon called *statistics anxiety* that I will explain in a minute.

II. I would like to start with my first area of questioning. One of the core instruction methods used in the statistics class to practice statistical methods was team-based or collaborative problem-solving. If you remember, each of the first four classes, you teamed up with another student and worked together on a scenario project. Each team submitted one paper each week and received a common grade for each project submission.

- **AOI-1**: I would like to hear your general thoughts regarding working on a collaborative team for assignments.

- **AOI-2**: Second, I would be interested in hearing your perceptions of collaborative problem-solving within the context of the business statistics course.
    - Follow up question 1 – Can you think of any specific advantages or disadvantages to you personally from working on in-class projects as part of a problem-solving team in the Business Statistics class?
    - Follow up question 2 – If you had a choice between working on statistics problems individually or as part of a team, which would you choose?

- **AOI-3**: Third, would you tell me about your collaborative partner, did you know him or her prior to class, how did the partnership work for you during the class.

III. The education literature regarding statistics instruction discusses a phenomenon called "Statistics anxiety." I would like to hand you a card for you to read and think about. The card includes one of the definitions of statistics anxiety that I found in the literature. Would take a second to read it and then maybe comment on it in any way.

> Onwuegbuzie, Leech, Murtonen, and Tahtinen (2010) defined statistics anxiety as:
> - being characterized by worry, intrusive thoughts, mental disorganization, tension, and physiological arousal
> - when exposed to statistics content problems, instruction, or quizzes, and
> - was commonly claimed to hinder performance among students by
> - a factor that interferes with a student's ability to understand statistical methods, work statistical problems, or analyze data. (p. 139 paraphrased)

- **AOI-4**: Would you take a minute and comment on statistics anxiety. I would then like to ask you how statistics anxiety may or may not be a factor in your experience with the business statistics course.
    - Follow up question 1 – Would you comment on statistics anxiety and the phenomenon may or may not have affected your attitude towards the statistics course?

- **AOI-5**: Do you have any thoughts on collaborative learning as a method to reduce statistics anxiety?
    - Follow up Question 1 – Would you discuss whether collaboration was of any benefit to the anxieties you had regarding the statistics course?

Appendix G: Matrix of Frames of Analysis and Response Domains

Participant Pseudonym	Gender	Attitude Regarding Collaboration in General (1)	Experience with Collaboration During Class (2)	Prior Experience with Partner (3)	Important Partner Compatibility Factors (4)	Self-perception of S/A level (5)	Self-perception of M/A Level (6)	Effects of Collaboration on Anxieties (7)
Adam	M	A	H	Y	K W/E	E/H	M/L	H
Barbara	F	A	H	N	K W/E GPA	E/H	M/L	H
Carl	M	A	P	N	K W/E GPA	M/L	N	M/P
Dorothy	F	C	H	Y	K W/E GPA	M/L	M/L	H
Everett	M	Q	H	Y	K W/E	N	N	H
Fran	F	C	H	Y	K	M/L	M/L	H
Gwen	F	C	P	N	K	E/H	E/H	H
Harold	M	C	H	Y	K W/E	E/H	E/H	H
Iris	F	Q	H	Y	K W/E GPA	N	N	H
Jessica	F	C	H	Y	K W/E GPA	E/H	E/H	H
Kay	F	A	P	N	W/E GPA	N	N	M/P
Laura	F	Q	H	Y	K W/E GPA	E/H	E/H	H
Mary	F	Q	P	Y	K W/E GPA	N	N	M/P
Nancy	F	Q	H	Y	K W/E	M/L	M/L	M/P

Appendix G (Cont.)

Key to Matrix of Frames of analysis and Response Domains

1. Attitude regarding collaboration in general
    - Alone (A) – Generally prefers to work alone on all assignments in all classes. Generally these individuals commented that they:
        - did not like working on team projects,
        - do not want to trust their grade to another person, or
        - can seldom find anyone who is compatible.
    - Qualified (Q) – These individuals prefer to work collaboratively if they know the partner is compatible; otherwise, these individuals typically prefer to work alone. Comments were along the lines of:
        - I like working on a team with someone who can help me learn,
        - I like working with someone with similar expectations for a grade in the course, and
        - working collaboratively is okay with a partner with whom I am familiar."
    - Prefers Collaboration (C) – Participants in this realm of response commented that they preferred to work collaboratively whenever possible. Comments made were along the lines of:
        - I enjoy working on a team,
        - I feel more secure working with someone I can share ideas/knowledge/perspectives with, and
        - I prefer working with a partner who can help me with skills that I am lacking (computers, word processing, database management, or statistical software program)
2. Experience with collaboration during the business statistics class
    - Helpful (H) – Individuals in this realm of response typically found the experience with collaborative problem-solving to be in some way helpful or enjoyable. Comments in this realm generally followed the following:
        - my partner helped me with _____,
        - I enjoyed the experience, collaboration helped me learn,
        - two heads are always better than one, and
        - I was relieved to have someone to work on the assignments with.
    - Problematic (P) – Participants in this category typically alluded to collaboration during the statistics course as being less than beneficial. These participants alluded to a partner who was incompatible, detached, or uninvolved.
3. Prior experience with collaborative partner
    - Yes (Y) – Participants categorized in this realm of response knew and/or had worked with their collaborative partner prior to coming to the statistics class.
    - No (N) – Participants in this response domain had to choose a partner with whom they had no prior experience or knowledge of prior to the business statistics class.
4. Compatibility factors perceived as important for a working partnership

- Knowledgeable (K) – Individuals voicing comments in this response realm placed importance on a partner who was skilled or knowledgeable in an area the

Appendix G (Cont.)

- participant felt challenged with such as word processing, database spreadsheets, and statistical software and/or comfortable with math-based courses.
- Work Ethic (W/E) – Individuals categorized in this response realm commented on the importance of a collaborative partner being willing to work, participate, contribute to the effort. These individuals typically alluded to the importance of a collaborative partner being diligent in attendance, willing to learn the materials before coming to class, and to participate in the collaborative problem-solving exercise equally.
- Grade Point Average (GPA) – Individuals in this realm voiced a concern for their collaborative partner having an equal interest in attaining a high grade in the course in order to support a high overall grade point average.

5. Self-perceptions of Statistics Anxiety (S/A)
   - Extreme to High (E/H) – Participants comments categorized in this realm generally voiced a lack of confidence in their ability to complete a statistics course on their own. These adults typically admitted to challenges with formulas, analysis, and/or word problems. Also included in this were individuals who professed to have some level of anxiety over a lack of computer skills: including word processing, database management, and or an ability to learn the requisite statistical software package used in the course. Typically, these students expressed a fear of being able to complete the course. Comments included:
     - I was very stressed the thought of having to take statistics,
     - any kind of statistics scare me,
     - I am not good at any math type class,
     - I was dreading this course, and
     - the reputation of this course from other students scared me.
   - Moderate to Low (M/L) – These comments were typically characterized by concern, worry, and or intimidation due to experiences with math-based courses. Comments were along the lines of the following:
     - I was worried about holding my GPA,
     - I did not know how well I could do
     - I am not strong in math (algebra, etc.),
     - the reputation of statistics initially worried me, and
     - I did not know what to expect in the course.
   - None (N) – Individuals in this realm of response indicated that they had a high level of competency with any math-based courses. Comments were along the lines of:
     - this definition [for statistics anxiety] is not me,
     - I had no problem with the course
     - I enjoyed the challenge,

- I was looking forward to learning statistics, and
- I had no fear of this course.

Appendix G (Cont.)

6. Self-perception of Math Anxiety (M/A)
   - Extreme to High (E/H) – Individuals in this realm attested to a lack of competency in any form of math and math-based subjects (algebra, trigonometry, calculus, word problems). Comments were along the lines of:
     - I am not good at math,
     - formulas (math, algebra, trigonometry, geometry) scare me,
     - I am not good at word problems, and
     - I dislike any form of math/algebra/numbers.
   - Moderate to Low (M/L) – The participants in this realm professed to having no fear of basic math, but were challenged with higher-order math subjects (algebra, trigonometry, geometry, calculus, word problems, formulas).
   - N (None) – Participants in this realm had no fear of any math subjects. Comments were along the lines of:
     - I am good at math,
     - I enjoy math and math problems,
     - I play math games or do math puzzles, and
     - math has never been a challenge for me.
7. Effect of Collaboration on Anxieties
   - Helpful Experience (H) – Participants in this realm of response commented on collaboration helping them to get past their fears of statistics. Typical comments were along the lines of:
     - I like working with the partner I had, we worked well together
     - it was a good experience, I found collaborating enjoyable,
     - my partner really helped me, we clicked,
     - where he or she was good, I was weak and where I was strong, I could help my partner.
     - two heads better than one, I was not alone in the course, and
     - we shared the responsibility.
   - Minimal or Problematic experience (M/P) – Participants in this realm of response voiced having problems with his or her collaborative partner. Comments included the following:
     - I had a partner who contributed very little, so it didn't help much,
     - It was not a good experience working with my partner,
     - my partner did not help much,
     - I did not have any anxiety, so I do not know if collaboration helps, or no opinion was expressed.

Appendix H: Confidentiality Agreement

Name of Signer: Marsha, A. Harwell, Ph.D**.**

During the course of my activity in analyzing and providing input regarding data collected for research conducted by Karl J. Kinkead entitled "A Qualitative Assessment of Collaboration as a Teaching Methodology in a Business Statistics Course" by Karl J. Kinkead, I will have access to information, which was confidential and should not be disclosed. I acknowledge that the information must remain confidential, and that improper disclosure of confidential information can be damaging to the participant.

By signing this Confidentiality Agreement, I acknowledge and agree that:

1. I will not disclose or discuss any confidential information with others, including friends or family.
2. I will not in any way divulge, copy, release, sell, loan, alter, or destroy any confidential information except as properly authorized.
3. I will not discuss confidential information where others can overhear the conversation. I understand that it was not acceptable to discuss confidential information even if the participant's name was not used.
4. I will not make any unauthorized transmissions, inquiries, modification, or purging of confidential information.
5. I agree that my obligations under this agreement will continue after termination of the job that I will perform.
6. I understand that violation of this agreement will have legal implications.
7. I will only access or use systems or devices I am officially authorized to access and I will not demonstrate the operation or function of systems or devices to unauthorized individuals.

Signing this document, I acknowledge that I have read the agreement and I agree to comply with all the terms and conditions stated above.

Signature: *Marsha A. Harwell, PhD* Date: November 19, 2013

Consent by e-mail address: marshaharwell@yahoo.com

Appendix I: Curriculum Vitae

Karl J. Kinkead

Education

2015	Ed.D., Walden University, Minneapolis, MN
2010	Ph.D. Oxford Graduate School, Dayton, TN & Oxford, UK
1973	MS Auburn University, Auburn, AL
1971	BS, Auburn University, Auburn, AL

Professional Experiences

2004 to Present	Adjunct Professor of Statistics
2004 to 2006	Graduate School Professor of Quantitative Methods
1991 to 2002	President, Group Vice President for a large conglomerate
1973 to 2001	General Plant Manager, plant manager, assistant Plant Manager

Teaching Experiences

- Undergraduate adjunct professor of business, quality control, and research statistics (9 years)
- Graduate level adjunct professor of research methods & research statistics (4 years)
- Doctoral dissertation review board (1 year)