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Sherry J. Jones

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To the Graduate Council:

I am submitting herewith a dissertation written by Sherry J. Jones entitled "The Question of Learning Equity between Online and Onsite Undergraduate Mathematics Courses in Rural Appalachia." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.

Vena M. Long, Major Professor

We have read this dissertation and recommend its acceptance:

Lynn L. Hodge, Stephanie O. Robinson, P. Mark Taylor, Morwen Thistlethwaite

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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The Question of Learning Equity between Online and Onsite
Undergraduate Mathematics Courses in Rural Appalachia

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Sherry J. Jones

August 2008

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ABSTRACT

This mixed-methods study focused on equity in learning as reflected in the final grades of online and onsite students from the same mathematics course. Onsite students were defined as students who attended regular class sessions. The onsite class did not consist of the professor solely transmitting information. Onsite students were expected to work and discuss problems in the class. Online students only attended an orientation session and a final exam.

Simonson's Equivalency Theory (2000) served as the theoretical framework for this study as it promotes an equivalent sum of learning experiences for all students even though their learning environments and learning events may be quite different. Equity of learning between students was defined as learning that is equivalent in value and was measured by final course grades. Final course grades for all online student participants and all onsite student participants were compared statistically to see if there was a significant difference in learning. Statistical tests were also conducted on a number of subsets drawn from all participants' final grades in order to search for any underlying differences that might exist and to help answer whether the student need for equity in learning was being met.

This research also focused on whether online mathematics courses are meeting the needs of rural Appalachian students. The strengths of quantitative and qualitative research techniques were utilized to help answer whether the needs of rural Appalachian students are being met by online mathematics classes. Surveys, interviews, field notes, observations, tutoring records, communication records, WebCT reports, student transcripts, and student work provided rich sources of data for this study.

Participants in this study were 24 student volunteers, 18 years old or older, from a mathematics course at Glenville State College during the Spring 2008 semester. The findings of this study revealed no significant differences in online and onsite student final grades, in rural online and rural onsite student final grades, or in rural and nonrural student final grades. Equity of learning occurred among the student groups in this study. Further, the needs of at least some rural Appalachian students are met by online mathematics courses.

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Chapter I

INTRODUCTION

Online (Internet or web-based) instruction is often described as a medium of course delivery that bridges gaps in access to educational opportunities between urban/suburban and rural schools. The phenomenal growth of technology is having a significant impact on rural education around the globe. By September of 2006, English and mathematics were being taught online by 106 schools out of 138 in the province of Newfoundland and Labrador. Educational leaders are delivering courses to communities where shrinking classroom enrollments would require students to leave their communities to get an education (Canadian Broadcasting Network, 2006). In Pakistan and throughout Asia, the Internet has become increasingly available in the most remote locations. Pakistan's countryside students must move to the city to get an education. If a student can financially afford to go to school in the city, there is no guarantee that there will be human resources available to cope with the number of youth who seek an education (Waldick, 2006).

American rural schools face some of the same problems found in other rural areas of the world. Rural school students need more highly qualified teachers, instruction focused on higher-level mathematics, and more equitable access to education (Murray, 2003). In the United States, online enrollments in higher education courses have been growing substantially faster (9.7%) than overall enrollment by student population (1.5%). Nearly 3.5 million students were taking at least one online course during the fall 2006 term representing almost twenty percent of all U.S. higher education students (Allen & Seaman, 2007).

Mathematics stands as the gatekeeper to higher education, which in turn, is the likely route to economic and life success (Moses & Cobb, 2001; Howley, Howley, & Huber, 2005; Lucas, 2005, Anderson, 2006). Rural students, who may face challenges of isolation from higher education by distance and other factors, must have access to college mathematics courses in order to further their education and employment opportunities. Online mathematics courses may help meet a need for access to college mathematics courses. The increase in demand for mathematics online course offerings makes a study such as this one imperative. This study sheds light on the impact of web-based mathematics instruction through a rural Appalachian higher education institution. In particular, this study examines achievement in an online versus a traditional mathematics course and whether an online mathematics course meets rural student needs.

Issues

Resistance to Rural Distance Education

In the predominantly rural mid-western state of South Dakota, a growing teacher shortage has caused consolidation of school districts. Even with consolidation, a lack of specialist teachers exists. A lack of specialist teachers means there must be a reduction in curriculum scope across all levels of education. South Dakota has implemented a statewide distance education project to address these problems. Distance education, however, appears to be both a part of the solution and a part of the problem for this rural state (Wheeler & Amiotte, 2005).

Native Americans in South Dakota seek to preserve and protect their cultural identities. A Native American community exemplifies a type of rural community that has a strong sense of place and being. Because social, economic, and technological changes have had a detrimental

effect on indigenous populations, the distance education system in South Dakota has been a hotly contended issue, especially among the Native American population. These rural community members may see online distance technology as a threat to the preservation of their community (Wheeler & Amiotte, 2005).

Wheeler and Amiotte (2005) describe technology-based distance education tensions that can develop into rural resistance. One tension is in the contrast between the identity of the rural community and the identity of the global community. By its very nature, online distance education promotes a global community. The global community tends to adopt a common identity whose common purpose is worldwide communication and trading. This common identity causes a blurring of cultural identities. A global community's purposes may be at odds with the purposes of a rural community where an individual identity separate from the rest of the world is valued.

Caution must be applied in generalizing about the resistance of all rural communities based on the resistance of rural communities in South Dakota to distance education technology. However, the resistance of rural communities to the destruction of strong community ties is a prominent theme in the rural schooling literature (Howley, Howley, & Huber, 2005; DeYoung, 1995). The rural schooling literature lends credibility to descriptions of rural-global tension (Wheeler & Amiotte, 2005). This study helps determine whether online mathematics learning is being embraced in rural Appalachia, at least on the part of the participants in the study.

Lack of Personal Contact

Rural students are often geographically isolated. Distance learners report feelings of personal or emotional isolation when there is no physical face-to-face contact with any of their

fellow students or instructors in an online learning environment (Engelbrecht & Harding, 2005b). Although any online student may feel somewhat isolated from instructors and fellow students, the feeling of isolation may be exacerbated by physical geography as well as virtual geography. Isolation by virtual geography can occur because needed infrastructure allowing fast Internet connections may be absent in rural areas.

Engelbrecht and Harding (2005a, b) conducted an informal study of cooperative learning in web-based calculus classes. These researchers maintain that cooperative learning is a way of addressing the problem of isolation as well as encouraging less dependence on the instructor and more opportunities to explore problems within the group. Verbalizing and explaining ideas to others is a crucial factor in learning mathematics online according to these authors. Such verbalization and explanation can occur in cooperative learning groups.

Importance of Classroom Community

Cooperative learning and discussion groups, in addition to facilitating learning, can be helpful in developing a classroom community that is comparable to the traditional classroom. The classroom community is “a type of community that is applied to an educational setting” (Rovai, 2002, p. 47). The importance of developing classroom community in the virtual environment is indicated in this statement: “The development of community in the online environment must be embraced since it seems to be one of the best ways to foster success in the virtual classroom” (Stumpf, McCrimon, and Davis, 2005, p. 364). Prior research indicates a sense of community is related to interactivity, a sense of well-being, the quality of the learning experience, and effective learning (Rovai, 2002).

Rovai's work is an attempt to study students' sense of community in an online learning environment and indicates that it may be possible to establish a sense of classroom community that is at least comparable to that of the traditional classroom. This is encouraging news to those schools that are trying to offer successful educational opportunities to rural students who have a strong sense of community. Listening to the voices of rural students as they relate their experiences in online mathematics courses reveals whether the need for a sense of community is being met in web-based learning opportunities.

The Pedagogy of Online Teaching

Creating a strong sense of community in online courses is only one of several pedagogical recommendations for successful teaching and learning. Mayes (2004) reviewed distance education literature and found that special skills are required on the part of distance education students and instructors. Instructors must design learning processes that occur differently than in the traditional classroom. Learner characteristics and motivation to learn in an online environment will affect learning and teaching success because the ability of students to engage in self-directed learning under their own initiatives is critical for success in an online course. Instructors and students must navigate their way through obstacles that arise in utilizing technology as the medium of course delivery, which again is outside the roles of the traditional classroom.

Engelbrecht and Harding (2005b) indicate that web-based learning may require a shift in teaching to a more constructivist approach, requiring a role shift from authoritative teacher to facilitator. These researchers view the Internet as an environment that will engage learners in meaningful learning through reflection, application, and interaction. The availability of

meaningful learning experiences, however, does not guarantee student engagement in the learning process.

High dropout rates exist in many distance-learning courses. The difficulty of retaining students that the instructor may never see points to the importance and significance of effective pedagogy in teaching online learners. Mayes (2004) recommends at least a few face-to-face class meetings to help provide an orientation for students and help them adjust to their new roles as distance learners. This study reveals whether rural Appalachian students are accepting and adjusting to roles of distance learners.

Mayes (2004) cites quality distance-education benchmarks from the literature. These benchmarks include institutional technology support; guidelines for minimum standards for course development, design, and delivery; instructional materials; faculty/student interaction; feedback to students; student support; faculty support; and evaluation and assessment. Interactivity and communication between faculty and students take a different form in online learning, but their presence and frequency is just as important, if not more so, in online classes as opposed to traditional classes.

Course Content in Online Mathematics Courses

Fewer research articles deal with course content in online mathematics courses than deal with pedagogy in online mathematics courses. There is some indication that mathematics course content in solving real world problems may support student-centered learning. Theobald (2005) states, "If you want students (pre-school through doctoral level) to achieve at high levels, the insertion of context is currently seen as critical by the great majority of the world's cognition theorists" (p. 1). An important component for student success is a text with explicit content

events. Overall quality of instructional materials is a key issue affecting student perceptions of online courses (Mayes, 2004).

NetMath, an online math program started at the University of Illinois at Urbana-Champaign, offers “visual, hands-on courses, which promote active learning” (Hislop, 2006, p. 1) in the following courses: Calculus I, Calculus II, Calculus III, Introduction to Linear Algebra, Differential Equations, Linear Algebra, and Probability and Statistics. NetMath uses Calculus&Mathematica (C&M) courseware to introduce basic ideas in interactive notebooks, proctors to supervise two midterm exams and a final exam, and student mentors to answer questions. Faculty and students interact regarding weekly assignments. The interaction occurs in a lab or by e-mail, and online quizzes reinforce the material covered by the homework. Because NetMath courses are self-paced, students may enroll and begin a course at any time. Most students complete a course within 16 to 32 weeks. The NetMath website indicates that rural high school students as well as university and home schooled students have taken courses online since 1991 (Hislop, 2006).

Engelbrecht and Harding (2005a) describe three successive web-based calculus courses taught at the University of Pretoria in South Africa. Each calculus course requires a textbook, and WebCT instructions guide the student through the course on a day-by-day basis. One contact hour per week is devoted to discussion. The course material is broken down, first into themes, and then into units with study objectives, short lecture notes; and problems of the day. Students complete four hard-copy assignments and one group project that requires the use of mathematical software such as Matlab or Maple.

Since mathematics involves symbolism and abstraction, the very nature of the subject may present difficulties in teaching and learning in an online environment (Mayes, Luebeck,

Mays, & Niemiec, 2006). Monitoring student comprehension in an online environment becomes more difficult. Nonverbal behaviors cannot be observed; there is no eye contact to indicate attention or comprehension. “The course must do many things that mimic human interaction. To the student, it must converse, engage, entertain, encourage, challenge, and sympathize” (Engelbrecht & Harding, 2005b, p. 257). Mayes (2004) recommends a synchronous component to an online mathematics course to address some of the difficulties in delivering mathematics content noted above. Overall, very little research exists to inform the presentation of mathematics content and learning online.

Background of the Study

Equity in online mathematics can be discussed from at least two different perspectives: the perspective of access and the perspective of learning. Since mathematics is the gatekeeper for success in nearly any occupation, equity of access to mathematics for all students is critical. On the other hand, a student’s access to mathematics courses offered online does not guarantee that at least an equal amount of learning occurs when compared with learning in a traditional classroom setting. However, without equity of access to mathematics learning, we cannot hope to achieve equity of mathematics learning.

For purposes of this research study, equity of learning between online and onsite students is defined as learning that is equivalent in value. The equivalency in value is measured by achievement of learning objectives as reflected in the final course grade. Equity of access to mathematical learning, for purposes of this study, is implied in the flexibility of course offerings that allows students to choose the method of course delivery and learning opportunity that best

fits their needs. Further, online course offerings provide access to mathematical learning that would not otherwise be available to some students.

Students who live in rural Appalachia are likely to live in remote areas that are a great distance from a college. In order to participate in traditional college learning experiences, students may have to drive over treacherous mountain roads daily or leave their homes where there are strong family and community ties. Students may have disabilities that prevent them from participating in on-campus courses. In addition to geographical and other challenges, rural Appalachian students have a great need for quality mathematical learning experiences that will help them retain and honor their attachment to their rural communities while maintaining successful occupations in a global economy.

Higher education leaders recognize the need for a better-educated workforce for the global economy. Even lower level jobs require a high degree of skill, making a better-educated workforce with specialized knowledge necessary. In the past, many rural students have had to migrate out of their community to find employment. In the current technological age, it is now possible for work to move to where people live, rather than people relocating to work. These new situations have significant implications for rural people and their educational opportunities.

The Problem

Online courses certainly have the potential to create equity of access to education for some students. Can equity of learning be created as well? Do undergraduate online students achieve at the same level as onsite class students?

Many online student experiences are likely different from one another and need to be told. Online undergraduate mathematics learning in rural Appalachia has received thin, if any,

exploration. It is important to hear the voices of rural students as they make choices between online and onsite courses. Does online learning reduce or enhance feelings of isolation for rural Appalachian students? Does online learning help students honor their commitment to place and prepare them for an economically viable future? Is online learning meeting the needs of Appalachian students? Listening to the thoughts of students in rural Appalachian areas reveal unique opportunities and challenges that have not been explored in the research literature.

Purpose of the Study

One purpose of this study is to determine if there is a significant difference in mathematics learning between students who complete a mathematics course in an onsite format and students who complete the same mathematics course in an online format. A second purpose of this study is to determine if there is a significant difference in mathematics learning between students who successfully complete a mathematics course in an onsite format and students who successfully complete the same mathematics course in an online format. Learning is measured by final grades in the course, which are largely determined by achievement on content assessments. The content assessments will be the same for both groups of students. Successful completion of the course is defined as a grade of 70% (a C) or better in the course

If there is a significant difference in student learning between the two formats of the course, a third purpose of the study is to determine what variable(s) may account for the variability and differences in learning. A fourth major purpose of this study is to determine if rural student needs are being met by online mathematics learning.

Research Questions

This study will address four research questions as follows:

1. Is there equity in learning between online and onsite students completing the same mathematics course?
2. Is there equity in learning between online and onsite students successfully completing the same mathematics course?
3. If there is a significant difference in online and onsite students' learning, as found in answering Questions 1 and/or 2, what variables may explain these differences?
4. Are online mathematics courses successfully meeting the needs of rural Appalachian students?

Need for the Study

Online mathematics course offerings have increased rapidly over the last ten to fifteen years, and research has not been able to keep pace with the growth and variability in online mathematics course offerings. The research on online mathematics course achievement and whether online mathematics courses meet rural needs is extremely thin. This study makes a significant contribution to understanding what is happening in online mathematics courses in rural areas. The findings have implications for practice in how teachers offer mathematics courses to rural students and how rural and other higher education institutions meet the needs of their students, communities, and other stakeholders.

Mayes, Luebeck, Mays, and Niemiec (2006) indicate there is an ever-growing demand for mathematics courses for place-bound students. This research study helps educational

organizations meet the demand of the marketplace in a rapidly changing technological world while still upholding a standard of quality educational offerings. Without question, there is a need for extensive research on the learning and teaching of mathematics online.

Equity in learning for students in online mathematics and onsite courses is a worthy goal for institutions desiring quality course offerings for all their students. Documenting and analyzing any significant differences in achievement between online and onsite mathematics students helps institutions address learning equity issues. Higher education institutions must know whether student needs are being met by online undergraduate mathematics courses. The answers to the research questions in this study contribute important information to an education institution's decision-making processes and efforts to offer quality learning experiences to meet student needs. The knowledge and clarity gained in the study helps the researcher, as well as other professors, change and focus the lens through which online mathematics learning is viewed.

Limitations

Conditions in this study over which the researcher has no control and that may influence the study's outcome include the following: a student's academic and social background, preferred learning style, study habits, responsibilities and circumstances affecting study time, and prior mathematics experiences and classes. Students in this study enroll in the course format of their choosing. The researcher has no control over whether a student chooses to take the course in an online or onsite format. Further, it is not possible to control the type of Internet connection a student uses or technical difficulties that arise from the use of technology. The sample size for this study is small, which limits the generalizability of the study.

Delimitations

This study is limited to students in two sections of one course taught during the Spring 2008 semester. Both sections of the course were taught by the same professor at the same college. Only participants of age 18 or older were accepted for the study. Further, the two sections of the course were purposely structured to be very similar in class requirements except for required attendance at the onsite class sessions. Onsite students were required to attend class meetings; online students were only required to attend two class sessions. Other mathematics courses may be structured differently and may have different student populations than those represented in this study.

Although great care was exercised to keep personal bias from influencing the results of this study, the findings of this study are important to the researcher. The researcher has an interest in the findings from the perspectives of a faculty member, an online course committee member, a doctoral student in the ACCLAIM program, and a person with a disability.

Assumptions

This research study rests on the following assumptions made by the researcher.

1. The final grade in the course is an accurate reflection of student achievement.
2. Each student's grades reflect his/her own work effort.
3. Each student made an effort to succeed in the course.
4. Each participant completed the survey accurately and honestly.
5. Each interviewee was open and honest in his/her responses.
6. Each student chose the course format that he/she perceived best met his/her needs.

Definitions of Terms

Equity of learning between online and onsite students is defined as learning that is equivalent in value. Any two students may not have the same combinations of learning events in their sum of learning experiences in a class. The sum of the learning experiences, however, should create learning that is equivalent in value. The equivalency in value of learning is measured by achievement of learning objectives as reflected in the final course grade.

Equity of access to mathematical learning, for purposes of this study, is implied in the flexibility of course offerings that allows students to choose the method of course delivery and learning opportunity that best fits their needs. Further, online course offerings provide access to mathematical learning that would not otherwise be available to some students due to various barriers to traditional college learning experiences. Rural students have a need for equity of access to mathematical learning. This study helps determine if that need is being met.

Online distance learning is defined for the purposes of this study as a type of distance education where high school, undergraduate, or graduate courses are offered in either a synchronous or asynchronous format or both using the Internet as the delivery medium for the bulk of the course content via the Internet. In a synchronous format, the instructors and students interact with each other simultaneously. The class meets at a specified time and comes together in a virtual setting. In an asynchronous format, the class communications do not occur at the same time. Class does not meet at an established time. Some online courses use both synchronous and asynchronous components in their structure.

Distance learning is defined “as an instruction and learning practice, utilizing technology and involving students and teachers who are separated by time and space.” (Stumpf, McCrimon, & Davis, 2005, p. 259) Distance learning components include media other than the Internet to

provide a nontraditional type of classroom format. Online learning is one type of distance learning.

Onsite students are defined for purposes of this study as students who are taking a course in a college classroom taught by a college professor who is present for the class meetings and conducts the class. The onsite class did not consist of the professor solely transmitting information. Onsite students were expected to work and discuss problems in the class.

The stakeholders of educational institutions include students, faculty, staff, administration, governing boards, public and private educational organizations, state legislators, business owners and leaders, and other community organizations and members. Stakeholders benefit from the success of the efforts of the educational institution to provide quality learning opportunities. Likewise, stakeholders suffer from the demise of an educational institution

MacIver and Page, as cited in Peshkin (1978), defined community as “an awareness of sharing a way of life as well as the common earth” (p. 6). The concept of community implies a sense of belonging to shared values and common goals.

Rural is defined in many different ways, perhaps the simplest being “not urban.” Coding of data according to rural and nonrural areas is discussed in the methodology section of this document. National Center for Education Statistics (NCES) codes were used to classify survey-identified schools as to location (rural or nonrural) and size (NCES, 2005-2006).

Rural communities have characteristics that affect schooling in important ways; such characteristics have been documented in the rural literature. These characteristics would include, among others, an identity with place, a tight-knit cohesive structure of values, and often a distrust of outsiders. Geographic isolation from urban sprawl is often viewed as a welcome relief to rural

inhabitants. Long bus rides and commutes are common in rural areas where schools in the same district may be 30 to 50 miles apart (Education Development Center, Inc., 2003).

A traditional student is defined as a student under 25 years of age, and a non-traditional student is defined as a student 25 years of age or older.

Appalachia is that section of the United States that stretches along the Appalachian Mountain range. It contains all of the state of West Virginia and parts of twelve other states from Mississippi to New York.

Rural student needs include: equal access to mathematics education when compared with nonrural students' access to mathematics education; mathematics education grounded in a sense of place that honors commitments to family and community; employment opportunities that do not require leaving the rural area; appreciation of mathematics as a key to higher education and career opportunities; engaging and relevant learning experiences that help students construct their mathematical knowledge both independently and as an active participant in a community of learners, and an equitable sum of learning experiences when compared with students who take a course via a different delivery medium.

Theoretical Framework

The constantly changing and diverse environment of distance education has inhibited the development of a single theory on which to base practice and research (Simonson, Schlosser, & Hanson, 1999). Simonson's Equivalency Theory (2000) serves as the theoretical framework of this study as it promotes equivalent learning experiences for all students even though their learning environments may be quite different. The environment of the online learner is fundamentally different than that of the traditional classroom learner. Rather than attempt to

make experiences equal for online and face-to-face learners, Simonson (2000) recommends providing different, but equivalent-in-value learning experiences:

Equivalency is achieved through a variety of learning experiences that are tailored to the environment and situation in which students find themselves. It is likely, for example, that different students in various locations, learning at different times and rates, may require a different mix of learning experiences. Some may need a greater amount of observing, whereas others need a larger dose of doing. Thus, the goal of instructional planning is to make the sum of experiences for each learner equivalent and to select instructional technologies that store and deliver the learning experiences effectively. (p. 30)

The equivalency approach is based on core American educational values such as: the use of teachers to facilitate teaching and learning, rapport between teacher and learner, and personalized learning (Simonson, Schlosser, & Hanson, 1999). The professor must design learning events, the sum total of which provide equal value in achieving learning outcomes. Decisions about learning events are made based on the best way to facilitate learning. A variety of learning experiences may be required to meet the needs of individual learners, but the sum of the learning experiences for a traditional classroom student should be equivalent to the sum of the learning experiences for the virtual classroom student. “The more equivalent the learning experiences of distant learners are to those of local learners, the more equivalent will be the outcomes of the educational experiences for all learners” (Simonson, Schlosser, & Hanson, 1999, p. 7).

For example, online students may choose to utilize learning events such as online discussions and individual study to master the learning outcomes. Onsite students, in order to master course objectives, may rely more on in-class discussions and seeing problems worked in class. It is also likely that no two students will have exactly the same combinations of learning events in their sum of learning experiences as there is a wide variety of course learning events

from which to choose. The implementation of equivalency theory requires the availability of many different learning events and choices.

The equivalency of online student learning and onsite student learning in this study is determined by a comparison of overall student achievement in each class, as measured by final grades. Is the sum of online student learning experiences equivalent in value to the sum of onsite student learning experiences, allowing both types of students to achieve learning outcomes?

Summary

The distance required for some rural students to travel to a higher education institution may prevent them from pursuing a college education. Other issues including family responsibility, health and physical disabilities may also limit access to continued education. If online mathematics courses are available to rural students, opportunities for a college education may follow. Mathematics courses such as algebra and calculus are often considered “gatekeeper” courses that enhance students’ chances of furthering their education and career choices (Moses & Cobb, 2001; Howley, Howley, & Huber, 2005). Equity of mathematics learning for online students and onsite students is an important consideration for higher education institutions.

The tight-knit cohesive nature of a rural community may indicate both encouragement and deterrents to rural students taking online mathematics courses. The comfort of familiar surroundings and supportive community environment could enhance student learning. An online curriculum that focuses on global identity may be discouraging to place-bound rural students and viewed as intrusive by the rural community. A mathematics curriculum that is relevant to rural student needs and interests will be more successful in drawing and retaining the rural student

population. If a community of online learners can be established, the rural student may be encouraged to join a community that is more like the community experienced in the rural environment.

C. Howley, A. Howley, and Huber (2005) indicate that 30.3% of students, 40.9% of schools, and 63.7% of districts in the United States are located in rural areas. This study is conducted in a college where 90% of the student population is from West Virginia, a predominantly rural Appalachian state. Understanding the experiences and achievements of rural students in online mathematics courses is crucial if higher education institutions are to meet the needs of this significant schooling population. This research study is vital to institutions whose mission is providing a quality education for its students.

Organization of the Study

Chapter I of this research study is an introduction that will include the issues/problem statement, the purpose of the study, the need for the study, the limitations and delimitations of the study, definitions of terms used in the study, and the theoretical framework of the study. Chapter II includes a review of the literature that informs this research study. Chapter III explains the design of the study, the participants in the study, the setting for the study, and the procedures for the study. Chapter IV discusses the data analysis and results. Finally, Chapter V reveals the findings and implications of the study.

Chapter II

REVIEW OF THE LITERATURE

In today's digital age, accelerating change has become a normal part of everyday life. Educational institutions are hard-pressed to keep pace with the tremendous depth, breadth, and rate of this change in an age where technology brings new approaches to learning never before possible. Making wise decisions regarding online instruction to students will require shifts in thinking, decision-making, and leadership. Educational organizations need to realign their course delivery with changing conditions and environments (Lemke, 2001). This view is supported by the literature that establishes the context for the research questions in this study. In this chapter, three main bodies of literature will be examined: Rural Education, Mathematics Education, and Online Education. These bodies of research may be visualized as in Figure 2.1 below.

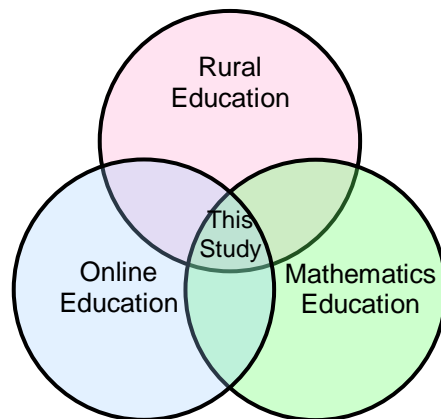


Figure 2.1. Three Related Bodies of Literature.

Although each body of literature is distinct in its own right, there are areas of intersection between the literatures that establish informative relationships between the bodies of work. This research study is in the common intersection of all three bodies of literature where it is informed by complete and incomplete studies of the distant and recent past. This research study is poised in a sparsely populated intersection of the three bodies of literature.

Rural Education

A rich descriptive and empirical literature exists on rural education. Highlights of this literature are presented by reviewing the work of major scholars in the field. Kannapel and DeYoung (1999) review key literature on rural education and provide an overview of the characteristics and conditions of rural schools. These scholars briefly trace the history of the rise of centralization and bureaucratic management of all schools that has resulted in consolidation of many rural schools and a relatively uniform model of schooling based on urban schooling designs. As a result of consolidation and the urbanization of schools, many rural schools have lost much of their uniqueness and consequently, many of their strengths. In several cases, the academic excellence promised by consolidation did not occur. Rural education researchers call for school improvement efforts that build on the strengths of rural settings and are responsive to the needs of rural schools and communities.

Rural Characteristics

Rural scholars find it difficult to define the concept “rural” because rural United States communities are so diverse. There are certain characteristics of rural communities, however, that are similar. “Most rural communities not adjacent to growing metropolitan areas are

experiencing population loss, are poorer, and offer fewer opportunities for educational and occupational advancement than do urban communities” (Kannapel and DeYoung, 1999, p. 68). Agriculture dependent counties have lost population to outmigration of the working-age population, leaving a higher proportion of elderly residents than metropolitan counties. Big business automation has largely replaced rural jobs in agriculture, mining, and timbering (Howley, 1997; Theobald, 1997). Other significant trends are rural women having fewer children and working outside the home more than in the past and an increase in single-parent homes. Many rural researchers (Eller, 2001; Harmon, 2001; Howley, 1997; Theobald, 1997) remain convinced that these statistics do not capture the quality of rural life.

The economic and educational value systems of rural communities differ from urban value systems. High-paying jobs are not as important as staying close to family and friends. Rural residents often think in terms of jobs that will allow them to stay near home rather than considering jobs that may lead them away from their rural area. Sometimes, white-collar jobs are associated with a perception of oppressive anti-union corporate administrators. As a result, rural perceptions of laboring jobs in their local areas are more positive than an outsider might imagine. Generally, rural youth are less likely than their urban counterparts to take college preparatory classes and to attend college. Those students who do go on to college tend to migrate out of the rural community. Typically, few rural jobs require an advanced degree, so local occupational structures do not reward going to college (Kannapel & DeYoung, 1999).

While the rural education literature depicts a somewhat dismal statistical portrait of economics in rural communities, social life is depicted just the opposite. Attachment to place describes an important component of rural social life. Many rural residents strongly identify with their place of residence and do not like to leave it to pursue higher education or careers.

Relationships and connections to other people hold priority. A person's word is a binding agreement. Layers of bureaucracy are lacking, which facilitates direct, verbal communication (Kannapel & DeYoung, 1999).

Since work can now come to the place of residence via technological advances, rural preferences of place and residence can be honored in ways that were not possible in the industry-building years. With online mathematics and other courses, rural residents have the opportunity to further their education and take advantage of highly skilled jobs, via the Internet, that now require more than a high school education.

Service of Rural Schools

In reference to the question, "Whom do the schools serve?," rural education scholars maintain that schools serve national government interests because students have been prepared to participate in the national economy. At the beginning of the twentieth century, industrialization and urbanization required people who were prepared to work in an industrialized labor force and urban careers. The factory model guided the organization of schooling and imposed efficiencies and economies-of-scale on all types of schools. Current school reforms, as a reflection of changing economic structure, are aimed at preparing students to manipulate information rather than perform repetitive, assembly-line jobs that have now been largely automated and computerized (Kannapel & DeYoung, 1999).

Several rural education scholars (Eller, 2001; Harmon, 2001; Howley, 1997; Theobald, 1997) maintain that national economic goals should not be the primary goals for our schools. A standardized outcome-based education movement devalues local goals for schooling and further separates rural people from the education of their children. A primary purpose of rural schooling

should advance intellectual pursuits in their own right. The conflict over the purpose of schooling is at the heart of rural school problems today. State and national reform leaders have a national agenda while rural scholars believe rural schools should contribute to the stability of the community and serve community interests. Symbolically, rural people want to see their culture honored in schooling.

For a school improvement effort to be successful, local stakeholders must identify with the problem being addressed and must believe the solution is working. Rural communities often do not embrace school reform because reform in the past has led to school consolidation, tax increases, and loss of local control. These factors have not been directed toward local needs and have prepared students to leave the community. School improvement efforts responsive to local needs have been more successful (Kannapel & DeYoung, 1999).

Rural scholars (Eller, 2001; Harmon, 2001; Howley, 1997; Theobald, 1997) emphasize capitalizing on strong links among the rural school, community, and place in order to improve education. Improvement efforts must include grounding in a sense of place; valuing outcomes arising from individual situations rather than predetermined results; inviting contributions from those who are usually marginalized in community development and reform; comprehensive and multi-faceted projects; and strengthening rural communities. “Real accountability is found in community satisfaction with the schools, and in student ability to succeed after school in ways that are sustaining to themselves, the community, and society at large” (Kannapel & DeYoung, 1999, p. 77).

Theobald (1997) claims that the school could become an agent for strengthening community values and increasing the odds for a stronger democracy and a better future.

We need to foster a sense that community is a valuable societal asset,

something to be promoted rather than destroyed. Rural schools, through concerted pedagogical and curricular attention to the dynamics that impinge on their particular place, can rekindle community allegiance and can nurture that suppressed part of us that finds fulfillment in meeting community obligations. (p. 1)

Harmon (2001) agrees that leaders of rural schools must find ways to contribute to community and economic development by finding ways to make the curriculum incorporate the strength of the community. The new version of rural education must combine education and the rural economy in a way that strengthens them both. Student and community needs should be the mission of rural education. Some of the key characteristics of rural education must be decentralization, diversity, low bureaucracy, community engagement, and technology-enhanced. Course delivery must more closely reflect learning situations students experience throughout their lives.

Appalachia and Rural Today

Appalachia and rural America today are diverse and complex. Eller (2001), Harman (2001), and Howley (2003) agree that an overall pattern of economic disadvantage exists in many rural areas. Harman (2001) projects: “Connecting rural America to the digital economy and raising the skills of workers and leaders will be essential to compete more effectively” (p. 2). Low-skill, low-wage rural labor faces fierce global competition. The low density, small-in-scale settlement patterns of rural areas present challenges in reaching students who need to further their education. The rural economy has changed from a dependence on farming, forestry, and mining to a diversity of economic activity. Communication and transportation improvements have reduced rural isolation and removed many cultural differences between rural and urban.

Old images of Appalachian rural society as desolate and backward, shaped by urban stereotypes and elite assumptions, are still spun by urban-based journalists and scholars, but the images no longer apply (Eller, 2001). “Old” Appalachia still has ties to agriculture, mining, and light manufacturing. “New” Appalachia is being shaped by a new generation of professionals that see promise in a digital age to free rural areas from a resource-based economy and still allow families to remain in rural areas rather than out-migrating to urban areas to find employment (Eller, 2001; Harmon, 2001). With the advent of the Internet, improved communication technologies, and e-commerce, it is no longer necessary for rural areas to be at a market disadvantage or be as isolated as they once were.

Despite these technological advances, many areas of Appalachia are still poor in the sense that there are still a significant number of low incomes, a greater dependency on transfer payments, higher rates of unemployment, poor housing, and major health problems. Further, Appalachia has fewer people with any post secondary training. Although progress is visible in some areas, Appalachia still lags behind in many social and economic measurements (Eller, 2001). Educating both traditional and non-traditional students is very much a reality for colleges serving rural Appalachia. It is relatively common for multiple family members from two different generations to be taking college courses at the same time.

Place-Based Education and Rural

Several rural scholars, Eller (2001), Harman (2001), Howley (1997) and Theobald (1997), agree that rural Appalachian students and communities can build on their rural values and strengths if given the chance in place-based education. Dewey (1916) proclaimed the virtues of this type of education long before it was called “place-based.” Concerning one’s own

unique life experiences, Dewey states, “The inclination to learn from life itself and to make the conditions of life such that all will learn in the process of living is the finest product of schooling” (p. 51). He maintains that “when schools depart from the education conditions effective in the out-of-school environment, they necessarily substitute a bookish, a pseudo-intellectual spirit for a social spirit” (p. 38). The result of a pseudo-intellectual spirit is a lack of motivation for learning that is not relevant to the student, and creative problem solving and thinking decreases. Schooling must encourage the unique qualities of students and provide an environment that will help them develop their native talents for the good of the community.

A current definition of place-based learning comes from the September 2005 edition of *Rural Policy Matters*, a newsletter of the Rural School and Community Trust:

Place-based education is learning that is rooted in what is local – the unique history, environment, culture, economy, literature, and art of a particular place. The community provides the context for learning, student work focuses on community needs and interests, and community members serve as resources and partners in every aspect of teaching and learning. This local focus has the power to engage students academically, pairing real-world relevance with intellectual rigor, while promoting genuine citizenship and preparing people to respect and live well in any community they choose. (p. 3)

Further, it is recommended that the academic work be sustained and all participants expect excellent work from one another. Schools must mirror the democratic values they seek to instill. Each student’s participation must be needed and wanted (*Rural Policy Matters*, 2005).

Gunn (2005) describes the views of Salinas, a champion of utilizing place-based education in rural communities. Salinas maintains that place-based education is particularly important in rural communities for providing a context for learning and making learning relevant for kids as well as adults. Place-based education connects students to the community and teaches them how to be part of a community and contribute to society as a whole. Rather than rural

education being a catalyst for people to leave their rural communities for urban areas, education can be a catalyst for successful rural living for those who want to live in a rural area. Salinas suggests portfolio assessments as a way of getting the community involved in education and vice versa.

Three separate portfolios reflect student learning, community impact, and contributions to sustainability of the community. Place-based teaching is often interdisciplinary and portfolios may layer math learning with learning in other disciplines. Portfolios presented to an audience beyond the school in the community can add dimensions of assessment outside the school as well as folding student work into community sustainability with real-world application. Portfolio assessment is not a substitute for other forms of assessments, but rather offers an additional source of assessment information (Gunn, 2005).

Hatfield (2003) maintains that if we are to understand the problems of educating rural people in mathematics, then we must understand the background contexts in which they live and grow up, both in historical and contemporary terms. Understanding the strengths and weaknesses of these contexts will help address improving mathematical education for students and other stakeholders.

Mathematics Education

Howley (2003) states: “Rural communities need an infrastructure of good mathematics knowledge, according to some observers” (p. 1). Mathematical knowledge is projected as the path to political and cultural power, but for rural communities it is the key to economic survival (Long, Bush, & Theobald, 2003). In 2003, Silver, editor of the *Journal for Research in Mathematics Education*, stated that very little research has occurred on teaching and learning

mathematics in rural places. At that point in time, Silver could not identify a single article dealing explicitly with the teaching or learning of mathematics in rural settings that had been submitted to the Journal. At a time when equity, including issues of access, opportunity to learn, culture, race, and language, has moved to the mainstream of attention in mathematics, rural mathematics research is sadly lacking and rural mathematics appears to not be getting the attention that it deserves.

Mathematics and Rural

Hatfield (2003) believes a “culture of failure” (p. 8) in rural school mathematics exists in the three domains of school, home, and community. He states that it appears to be socially acceptable to fail to understand or achieve in mathematics. In turn, teachers and administrators lower local standards and expectations, and they give up on many students ever learning and succeeding in high quality school mathematics. “Paradoxically,” Hatfield (2003) states, “the community as a whole may manifest attitudes that outwardly recognize the importance of learning mathematics while implicitly accepting the overall failure of local youth to strive for excellence in the subject” (p. 10).

Silver and Castro (2002) offer insight into a culture of failure that persists. These scholars state: “Thus, there is a complex confluence of factors – related to social capital, risk management, desired destinies, and hopes for intergenerational cohesion – that influence students’ aspirations in rural communities” (p. 9). Rural adolescents frequently experience conflict between career aspirations and preference of residence. Some rural students and parents who want to retain their son or daughter in a rural area view “too much education” (p. 11) in a negative way because it means migrating from the area. In a community where jobs do not

require any knowledge beyond algebra, people may perceive advanced mathematics as irrelevant. For these reasons, mathematics is often susceptible to avoidance behaviors. High school students in rural schools, as well as in inner city schools, are less likely than students in suburban schools to enroll in advanced mathematics courses such as advanced algebra, geometry, trigonometry, or calculus.

Now that leaving a rural area to find employment may not be necessary due to new opportunities for work to come to home, rural students will hopefully begin to value the more advanced mathematics that is required for technologically skilled jobs. These “new” circumstances for rural areas become opportunities for higher education institutions to reach rural students in need of further education.

Mathematics and Appalachia

A folkography study, conducted by Lucas and a team of undergraduate students, asked people from a small Appalachian town what they thought about mathematics in its importance in everyday life and in the education of students and their futures. A folkography allows one to study the culture of a group of people through the eyes of that same people. Folkography, invented by Lucas to focus on the “folk,” gives voice to the people (Nichols, 2005).

Results of this study indicated an expression of a deep appreciation for the acquisition of mathematics skills. Lucas (2005) summarized, “For most participants, mathematics understanding and mastery is motivated by the potential use of employment in the future. In other words, the need to know mathematics is directly linked to how math skill will or can be used” (p. 100). Participants, who were surveyed and interviewed, connected mathematics with

intelligence and success in life, shown in the following excerpts from a few Lucas (2005) interviews:

These days, you gotta make math relate, you know? You gotta get kids to see how math can make them produce and help in all that they do. ...We have to get these kids to like math and learn to use math in all they do. You tell those people at your university not to give up. People need to learn math and we have to have trained people to teach it. (p. 10)

Math is the single most important subject in the world. (p. 14)

Results also indicated that adult and senior participants made a noticeable distinction between *basic math* and *advanced math*, while these distinctions were not as clear to the young people interviewed. The participants seemed to follow an “If you can’t use it, don’t bother” (Lucas, 2005, p.112) approach to learning mathematics. Many saw little use in the community for higher forms of math unless employment and living situations improved from their present status. Informants appeared to believe *basic math* was sufficient for those who stayed in the region. The results of this study confirm the complex intertwining of math avoidance behaviors, educational value systems, and attachment to place cited in the rural education literature discussed earlier in this chapter.

Observation, interviews, field notes, and debriefing meetings where researchers discussed their observations and interviews allowed triangulation of the data. An interesting technology component added value to the study process: a live website allowed tracking of the activities of the team through postings to the site at the end of each debriefing and writing session. This invited participation from others and allowed sharing of thoughts that added to the research in real time (Nichols, 2005). A weakness of this study is the absence of a way to determine researcher influence on the voices of the participants. Were the participants just telling the researchers what they wanted to hear? The similarities of many interview responses, however,

would be difficult for participants to produce without some prior agreement among themselves. These voices of rural Appalachia confirm the importance of finding a way to make mathematics relate to real life and to provide place-based mathematics education that not only gives a context for learning, but also provide the opportunity to make learning relevant to the learner.

Mathematics, Place-Based Education, and Rural Education

Hatfield (2003) calls for a new kind of rural mathematics culture that would help rural citizens of all ages construct and appreciate mathematical knowledge in their lives and help mathematics professionals understand and respect the unique needs and values of rural Appalachian citizens. Achieving this cultural change would require a new type of partnership involving participants from the schools and higher education partners, homes, and communities—educators, parents, citizens.

The current systemic reform in mathematics education, based on a constructivist approach, supports the notion of making learning relevant to students' lives in all contexts. In 2000, the National Council of Teachers of Mathematics (NCTM) recommended all levels of school mathematics include opportunities to learn by working on problems arising in contexts outside of mathematics. Contexts outside of mathematics would include other subject areas and disciplines as well as students' daily lives. All NCTM standards can be examined from the perspective of rural circumstances in the interest of designing lessons informed by the rural experience (Theobald, 2005).

Long, Bush, and Theobald (2003) indicate that although standards-based mathematics curricula have students solve problems, investigate ideas, and make connections to daily life, few of the curricula connect directly to the culture of rural communities. Contextual or place-based

learning is claimed to be effective in developing higher-level thinking, knowledge transfer, and collecting, analyzing, and synthesizing information and data from multiple sources. Authentic context brings meaning to the learning process and is critical for rural learners to reverse both out-migration of rural youth and the devaluing of rural communities. Authentic context promotes the value of mathematics, which must be developed at high levels if communities and local regions are to survive economically.

Theobald (2005) is careful to point out that place-based education is not the only route to student engagement in mathematics. Mathematics can be appreciated for its beauty and symmetry disconnected from its utilitarian value. Regardless of the method of engagement, the mathematics curriculum and instruction must resonate with each student.

Mathematics Reform

Silver and Castro (2002) maintain that contemporary approaches to mathematics through applied problem solving and modeling hold possibilities for combating mathematics avoidance behavior. Schoenfeld is a leading researcher of mathematics teaching and learning, particularly as it occurs in college classrooms. Schoenfeld (1992) summarizes the literature relevant to mathematical thinking and problem solving in Chapter 15 of the *Handbook for Research on Mathematics Teaching and Learning*. The more recent literature over the last 15 to 20 years conceives of mathematics learning as a social as well as cognitive activity and an essentially constructive activity. Mathematics is not learned best by absorption of rules, facts, and procedures. The constructivist approach has its roots in Piaget's work from the mid 1950's. Over the last twenty years, the constructivist perspective has become widely accepted by the research

community as being well grounded and complemented by studies of metacognition and other cognitive science areas.

Constructivism has been extended from the cognitive sphere to the social sphere as it blends with theory from the social literature. The notion of socialization, or enculturation, is centrally related as it emphasizes the importance of perspective and point of view as key aspects of knowledge. Enculturation, entering or picking up the values of a community or culture, is well grounded in the anthropology literature, but it is relatively new to the mathematics education literature. The main idea of enculturation as it relates to mathematics education is that one's community molds the unfolding of one's point of view. Having a mathematical point of view and being a member of a mathematical community are believed to be central to having mathematical knowledge (Shoenfeld, 1992).

Enculturation implies that rural students' perceptions of mathematics have been influenced by their communities. This idea agrees with the rural education body of literature reviewed earlier and makes the connection to place-based education as well. Further, having mathematical knowledge depends on being a member of a mathematical community. The mathematical community could be a "class," traditional or online. Connections to establishing an online community of learners is revealed in the discussion of the body of online and distance learning literature.

In order to establish a mathematical community of learners, students must have opportunities to explore a broad range of problems and problem situations and develop a broad range of problem-solving approaches and techniques. Students should be helped to develop a mathematical point of view, which will allow them to analyze, perceive structural relationships, and understand how things fit together. Students should communicate mathematically both in

oral and written form. Mathematics should prepare students to become independent learners and users of mathematics. Modeling, abstraction, optimization, logical analysis, inference from data, and the use of symbols are recommended for learning experiences. Classrooms (traditional or virtual) must be communities in which mathematical sense-making is practiced in order to help students develop the same (Schoenfeld, 1992). Classroom discourse, solid classroom interactions, and building on students' prior knowledge are productive features of instruction drawn from research in urban schools that should also help rural schools promote mathematical sense-making (Silver & Castro, 2002). The online literature also recommends these features of effective mathematics instruction.

It is interesting to note that in addition to contextual or place-based education, Dewey (1916) recommended constructivist approaches long before the current reform efforts. He described the importance of a variety of problem-solving methods and establishing cross-connections in different subjects and with past learning: "It puts the student in the habitual attitude of finding points of contact and mutual bearingseducation is not an affair of 'telling' and being told, but an active and constructive process" (p. 38).

Current Mathematics Achievement in Rural Schools

The popular perception among urban dwellers is that all rural schools are inferior (Harman, 2001). Howley and Gunn (2003) refute the common assumptions about rural deficiency in mathematics achievement. Over the last 50 years, as farming declined as an American occupation, gaps in literacy rates and educational attainment rates between rural and nonrural areas narrowed and converged by the close of the 20th century. A mathematics achievement gap, which existed 25 years ago between rural and non-rural, has now been closed.

Gaps in mathematics achievement do correlate with socioeconomic status, but not with schooling locale. Surprisingly, even though rural mathematics course offerings are not as advanced as nonrural course offerings, national data sets do not show a significant difference in mathematics achievement scores.

Howley and Gunn (2003) discuss a mathematics achievement gap at the state level in 40% of states. Half of these states show a gap in favor of rural and the other half show a gap in favor of nonrural. Schooling conditions account for 70% of the rural/nonrural variations. Thus, difference in mathematics achievement as measured by tests cannot be attributed to the location where schooling takes place. College mathematics professors need not be concerned that rural students have had an inferior mathematics education as compared to nonrural students. Howley and Gunn (2003) conclude: “Allegations of inferiority derive from cultural and ideological dominance, as well as from a long line of misinterpretations of available evidence” (p. 93).

Online Education

The quantitative research on online and distance education is extremely thin. Most of the literature that exists is empirical and experiential in nature. Mayes (2004) reviews the distance education literature and looks at articles that focus on mathematics distance education. Only 11 articles are classified as having any focus on mathematics, and these articles reveal a lack of solid research. No mention is made of any articles that deal with rural mathematics distance education. This study helps fill a gap in the research that has been conducted thus far.

Pedagogy and Content

Online teaching and learning is a type of distance education, so examining the distance education literature, particularly as it relates to mathematics education, is helpful in establishing the context for this study. The literature reveals several pedagogical and content issues in distance education. Mayes (2004) summarizes recommendations from the literature for mathematics distance education as follows: 1) Course design should be based on the constructivist learning theory with math modeling as the course focus. 2) Mathematical problems should reflect the real world. 3) Learning should be student-centered, interactive, and interdisciplinary. These recommendations are similar to those endorsed by NCTM for any mathematics course taught in a traditional format.

Noteworthy findings from the review of the distance education literature relate to components and characteristics of any distance education course. Both instructors and students find themselves in new and challenging roles in the virtual classroom. Instructors must become facilitators of learning rather than relying on the traditional onsite format. Visual cues available through direct eye contact are missing in a distance education format, and, as a result, teachers must rely on other ways to get quick feedback. Frequent formative assessments for students and professional development for instructors are recommended to combat this problem. The anonymity of distance education provides a more positive learning environment for shy or quiet students and math-anxious students because the dynamics of peer pressure in the traditional classroom are no longer a problem. Students enrolled in distance education courses tend to be older, non-traditional students and females. Student attitudes about quality of an online course are largely influenced by the quality of course materials. Visual aspects of a course, such as

computer-generated representations of mathematical concepts and demonstrations of practical applications, invoke positive student attitudes (Mayes, 2004).

Jung (2001) used Transactional Distance Theory in a study of teaching and learning processes of web-based instruction (WBI). Transactional Distance Theory, which first appeared in 1972, uses the extent of pedagogical relationships of dialogue, structure, and learner autonomy to define the degree of transactional distance between teachers and learners. Empirical studies reviewed indicate that transactional distance decreases when dialogue increases. This causes structure to decrease and become more flexible. When structure increases and becomes more rigid, dialogue decreases, and transactional distance increases.

Jung (2001) discusses weaknesses in the studies she investigated:

Unfortunately, not many studies investigated pedagogical processes in WBI in a rigorous manner. That is, what was really happening in teaching and learning processes of WBI and why it happened were seldom the focus of the studies. Rather how to design effective WBI, how to encourage interaction, and what were the effects of WBI on learner satisfaction and perceived learning outcomes were the most frequently asked research questions (p. 528).

Distinct features of web-based instruction, identified in Jung's (2001) study include:

“student-centered learning environment,” “full of multimedia resources,” “expanded interactivity,” and “adaptability to different student characteristics” (p. 529). Researchers in Jung's study agreed that WBI can provide a flexible teaching and learning environment because of the technical features of the Web. The structural flexibility of WBI is linked to expandable and interactive features of its contents that can extend beyond those prepared by instructors.

Two influential factors that predict the use and perceived benefits of the Internet as an instructional tool are interpersonal interaction and social integration. It is important in WBI for learners to feel or perceive that they are a socially integrated part of a virtual community and that

there is a sense of human contact in the network. Three types of virtual communities affecting dialogue in WBI include: an academic community formed by interaction between learners and instructors or content experts; an intellectual community provided through peer interaction; and an interpersonal community developed through interpersonal encouragement and assistance (Jung, 2001).

Recommendations from the distance education literature for developing community include forming small collaborative groups that meet virtually, frequent faculty-student contacts via synchronous chat rooms and reflective e-mails, multiple support systems, threaded discussion boards, weekly projects, electronic bulletin boards, and photographs of students. Making class participation a higher percentage of the grade will also encourage interaction and development of community (Mayes, 2004).

Rovai Study of Classroom Community

Using the background of community and classroom community literature, Rovai (2002) sought to determine how a sense of community differs between students enrolled in traditional face-to-face classrooms and students enrolled in asynchronous learning network (ALN) courses. Incorporating a Sense of Classroom Community Index (SCCI), Rovai conducted a quantitative study using 326 adult learners enrolled in a mix of 14 undergraduate and graduate courses at two urban universities. An adult learner was defined to be a university student over the age of 18. The student subjects self-volunteered to participate in the study. Of the 326 students, 52 were enrolled in seven online learning courses and 274 were enrolled in seven traditional face-to-face courses. The online courses consisted of approximately 60% male students and 40% female

students. The traditional courses consisted of approximately 70% male students and 30% female students. The courses met for one semester.

The SCCI was determined from student answers to a 40-item questionnaire that focused on determining students' feeling about spirit (their connections to others in the course), trust, interactions, and learning. The questionnaire was completed in the final weeks of the semester in both the traditional and online courses and used a five-point Likert scale that allowed Rovai to perform quantitative comparisons. His findings indicated no significant difference in overall sense of classroom community between the two groups of subjects. Interestingly, students in five of the seven online courses with the highest community means had a significantly higher sense of community than the group of students in the seven traditional courses. Rovai (2002) stated, "This finding suggests that the feeling of disconnectedness and isolation that have been reported in many post-secondary e-learning courses tend to be related to individual course design and/or pedagogy rather than to the e-learning system itself" (p. 52).

Discriminant analysis revealed a significant overall difference in community structure between the two groups. A moderate positive relationship between classroom community and the number of messages posted by online students confirmed that interactivity was an important component of community building. The results also supported the ideas that structure tends to increase distance (decrease community) and dialogue tends to decrease distance (increase community).

Rovai claimed that the SCCI possesses high face validity in that the items on the questionnaire appear to measure what is needed to assess a sense of classroom community. He also claimed that the procedures used to develop the SCCI provide high content and construct validities. Rovai (2002) stated:

Considerable effort was expended to ensure that (a) the concept of classroom community was based on the general concept of community as contained in the professional literature, (b) classroom community is seen as a type of community that is applied to an educational setting, and (c) the SCCI captures all four components of classroom community. (p. 47)

The four components of classroom community in Rovai's study are the same as those discussed above as being measured on the questionnaire: spirit, trust, interaction, and learning.

Cronbach's coefficient alpha was applied to SCCI scores to determine instrument reliability. The coefficient for internal consistency was .96 for the overall SCCI score. Rovai maintained that the findings provided "evidence that classroom community and each of its components have high to very high internal consistency and that the SCCI can reliably measure classroom community in a group of post-secondary students" (Rovai, 2002, p. 47).

Rovai used the causal-comparative method in this research and disclosed that no attempt was made to assign student subjects to specific kinds of courses. Therefore, it is possible that student subjects in traditional courses and online courses could differ from each other in unknown ways that would confound the results of the study. For example, if there were more sociology students in the traditional course groupings, would the results show higher community scores than a group of online mathematics students? There is a further concern about the reliability of these results. It is not known how much experience the traditional and virtual classroom teachers had in fostering a sense of classroom community. Unmatched teacher experience in the traditional classroom and the online classroom could make the results totally unreliable. This would be a difficult construct to control, but there is no indication that Rovai attempted to match the two groups in teacher experience. Instructional design in online courses may have varied significantly between the online courses and the traditional courses. Techniques to encourage community could have been utilized more in some courses than others.

The elements of community, spirit, trust, interaction, and learning, may or may not be enough elements to compose all three types of communities identified by Jung (2001), academic, intellectual and interpersonal. No distinction is made between types of communities experienced by online learners versus traditional learners in this study.

Certainly, this study is flawed, and it is not possible to generalize results beyond the confines of the study. However, it does serve as a preliminary attempt to study students' sense of community in an online learning environment and indicates that it may be possible to establish a sense of classroom community that is at least comparable to that of the traditional classroom.

Engelbrecht and Harding Study of Cooperative Learning

A concern in any web-based course is the lack of personal contact. Engelbrecht and Harding (2002) attempted to combat isolation and encourage constructivist practices by requiring cooperative learning groups in their online calculus classes. A group of three or four students was the preferred group size. The online calculus classes were large groups of 100 to 200 mostly residential students who were expected to “meet” physically or online to discuss the course content and work on assignments and projects as a group. The instructors used a questionnaire to determine the strengths and weaknesses of the cooperative learning student experiences.

An interesting finding from the student questionnaires was that 28% of students preferred to work alone. These students essentially had no face-to-face contact because of geographical location, and they were permitted by the instructors to form a cooperative learning group of one. A surprisingly small group of students met in their cooperative groups via the web. Most students preferred to meet in a physical location to work together rather than meeting in a virtual location. Accordingly, 69% of students indicated that group activities were important for student

success in a web-based course in mathematics. Engelbrecht and Harding (2002) concluded from this informal study that cooperative learning was very important to a web-based mathematics course, but it was difficult to implement. They reported being disappointed that students did not utilize the cooperative learning groups to their full potential.

Unfortunately, the report omits many details of the study, such as the exact questions used on the questionnaire, examples of group assignments and projects, and other aspects of the structure of the calculus courses that might clarify the dynamics of the cooperative group. Although some Appalachian students and some South African students may share a common characteristic of geographical isolation, their cultures are likely very different. Cultural, as well as geographic, characteristics may have influenced the preference of some students to work alone. It is difficult to imagine that the geographically isolated student had an equivalent learning experience to others in the class who participated in a cooperative learning group consisting of more than one person.

Achievement in Online Courses

Cognitive outcomes have been difficult to ascertain, and research findings have been scant and general. Two comparison studies found no significant difference in grades between online and onsite versions of a course, but one study indicated that test scores of online students did significantly decline during the semester (Mayes, 2004).

An interesting study compared learning experiences in a classroom-based instructional method with two distance education systems. In this study, three options were available for students to take an introduction to statistics course: a web-based course, a video-based telecourse, or a classroom-based course. The results showed no significant difference in the final

course grades in the distance learning courses as compared with students' performance in the traditional classroom (Ryan, 2001).

A concern with Ryan's (2001) study is the difference in final grade calculations. The distance learning course final grades were determined by using a non-comprehensive final exam combined with a midterm exam. The classroom-based course final grades were determined by using a comprehensive final exam combined with test scores taken during the term. The courses were not taught by the same faculty member and there were possibly higher than average withdrawal rates.

Few quantitative studies have been done, especially in rural areas, to shed light on achievement in online mathematics course. This study helps populate the intersection of rural, online, and mathematics literature with a quantitative study of achievement in a mathematics course offered in an online format compared to an onsite format.

Equivalency Theory, Rural, Mathematics, and Online Education

The premise of Equivalency Theory (Simonson, Schlosser, & Hanson, 1999) is the idea that the more equivalent the learning experiences of distant learners and local learners, the more equivalent will be the educational outcomes for all learners. Equivalent learning experiences may be different for each student, tailored to the student's environment and situation.

Just as a triangle and a square may have the same area and be considered equivalent even though they are different geometrical shapes, the experiences of the local learner and the distant learner should have equivalent value even though these experiences might be very different. (Simonson, Schlosser, & Hanson, 1999, p. 7)

Different students in various locations may require a different mix of learning experiences, but the sum of the experiences for each learner should be equivalent in value.

Simonson (2000) recommends a wide collection of activities to help make learning personalized and equitable. Personalized learning under this theory connects well with place-based learning or contextual learning deemed especially important to rural learners. Equivalency theory also connects closely with the Equity Principle from NCTM's *Principles and Standards for School Mathematics* (2000): "Excellence in mathematics education requires equity—high expectation and strong support for all students" (p. 12). NCTM also maintains that every student may not receive identical instruction, but instructional programs should help students see the utility of continued mathematical study for their own futures. An equitable mathematics program will provide solid support for learning in response to students' prior knowledge, intellectual strength, and personal interests. "Well-documented examples demonstrate that all children, including those who have been traditionally underserved, can learn mathematics when they have access to high-quality instructional programs that support their learning" (NCTM, 2000, p. 14).

Summary of the Literature

For the past one hundred years, urbanized education has marginalized rural community needs and viewed rural culture and its people as deficient. Recent research has indicated that according to national data sets, rural students are not deficient in mathematics. It is socioeconomic status, not locale, which accounts for achievement differences in mathematics prior to college. Characteristics of rural areas such as the importance of staying close to family and friends and attachment to place can be honored in education that contributes to the stability of rural communities. Meaningful rural schooling entails place-based education that involves and promotes the community.

Reformers in mathematics education now emphasize a constructivist approach to learning that is meaningful in context and tailored to the needs of students. NCTM promotes availability of a high level of mathematics education for *all* students (including rural). Mathematics is still the “gatekeeper” subject for post-secondary education and careers. The literature reveals the complex intertwining of rural community values, mathematics achievement, and outmigration of the best and brightest rural students.

Mathematics course delivery with online technology has the potential to allow rural community members to further their education and take advantage of new jobs created by the technology revolution. Online course delivery is requiring changes in teacher and student roles, pedagogical techniques, and course content. These changes closely resemble changes promoted by mathematics reformers. Research studies have explored the importance of community and collaborative learning in web-based instruction, and researchers agree that establishing community is vital to the success of online students. Virtual communities of learning created by utilizing a variety of technological and mathematical course components can combat isolation and high drop-out rates associated with web-based instruction. With online capabilities and new perspectives on mathematics education, educational institutions have opportunities to realign their services to meet the needs of rural students.

The message of Equivalency Theory and the Equity Principle is clear. Although rural students may have been underserved in the past for a variety of complex reasons, they need and deserve a college education rich in mathematics. All students, rural and nonrural are dependent on mathematics in every career choice. Online mathematics courses help provide equitable access to mathematics for some college students. The question is whether equitable learning is

occurring in online mathematics courses as compared to onsite mathematics courses at the undergraduate level.

Chapter III

METHODS AND PROCEDURES

This study will address four research questions as follows:

1. Is there equity in learning between online and onsite students completing the same mathematics course?
2. Is there equity in learning between online and onsite students successfully completing the same mathematics course?
3. If there is a significant difference in online and onsite students' learning, as found in answering Questions 1 and/or 2, what variables may explain these differences?
4. Are online mathematics courses successfully meeting the needs of rural Appalachian students?

A quasi-experimental, mixed methods design is needed to answer these questions.

Quantitative research was used to answer all or parts of Questions 1, 2, 3, and 4. Quasi-experimental designs represent a step between strictly experimental and nonexperimental paradigms. Quasi-experimental designs solve some of the problems raised with respect to experimental control in instructional research, such as random assignment of participants (Anglin, 1995). In this study, learning is compared between students enrolled in an online section of a class and students enrolled in an onsite section of the same class. The design is experimental, but without random assignment of participants. Students may freely enroll in the class format of their choosing; thus, the researcher has no freedom to assign students randomly to

an experimental group. Quasi-experimental designs allow statistical analysis of the data without having a random sample of participants.

Quantitative research is used for responding to yes/no types of questions. Qualitative research is used for answering how, what, and why types of questions. Qualitative inquiry typically focuses in depth on relatively small samples selected purposefully and provides information-rich cases. The purpose of each type of research is different, so in combination, the strengths of the two types of research illuminate the answers to the questions in this study (Patton, 2002). A mixed methods design of quantitative and qualitative research was utilized to answer Question 4.

Participants

Participants in this study were student volunteers in a mathematics class taught in the Business Department at Glenville State College by the researcher. The mathematics class was BUSN 230, Quantitative Business Analysis I (QBAI). QBAI is similar to a business mathematics course that is sometimes taught in mathematics departments in other colleges. One section of the course was offered in an online format, and the other section of the course was offered in an onsite format. All QBAI students in the Spring 2008 semester were invited to participate in this study.

Class Setting

There is no required prerequisite course for QBAI; however, business advisors discourage a student from taking the course until the student has successfully passed MTHF 001,

Developmental Mathematics: Arithmetic, if the student is required to take this learning support course because of academic deficiencies.

The Glenville State College Catalog (2007-2008) lists the following course description for QBAI: “This course emphasizes the mastery and use of mathematical and quantitative management procedures needed for coursework in the various business disciplines of accounting, computer science, marketing, management, and business technology” (p. 250). All business majors, whether a two-year or four-year degree candidate, are required to complete the course with a grade of C or better. Most business students take the course during their freshman year. The content of the course begins with a review of the basic operations of whole numbers, fractions, and decimals. Other content topics include working with percents and ratios, calculating cash and trade discounts, depreciation, inventory values, taxes, insurance premiums, payroll, simple interest, compound interest, and investment proceeds.

The online section of QBAI met in a classroom setting twice during the semester. An orientation meeting was held during the first week of classes for the spring semester. The online students met again in the classroom to take their final comprehensive exam at the end of the course. A WebCT platform for the course was available to both sections of the class. The onsite section of QBAI met regularly twice a week for a total of 2.5 hours of instruction and learning time per week. The onsite class did not consist of the professor solely transmitting information. Students worked and discussed problems in addition to material that the professor presented. Both the online and onsite section students took the same pretest at the beginning of the course, the same online chapter exams during the course, and the same teacher-generated final comprehensive exam at the end of the course. The online chapter exams are described in the Data Collection section of this chapter.

Institutional Setting

Glennville State College is a public, open-enrollment college in Glennville, West Virginia.

The Glennville State College Catalog (2007-2008) describes the location of the college as follows:

Glennville (population 1,500) is located near the geographic center of West Virginia. The town is surrounded by hills whose beauty inspired the state song "The West Virginia Hills." The area is rich in Appalachian culture and the town of Glennville is the site of the West Virginia State Folk Festival held each June. Glennville State College is nestled deep within the colorful Appalachian hills. Surrounded by towering trees and rich foliage, the campus overlooks the rural town of Glennville. Glennville is a community where students and residents come together, along the shaded banks of the Little Kanawha River, to create an informal, friendly atmosphere that leaves a lasting impression. (p. 2)

Approximately 1400 students are enrolled at Glennville State College; 90% of students come from West Virginia, the only state that is entirely within the geographical region known as Appalachia. Students from 22 other states and 4 foreign countries comprise the remaining 10% of GSC students. The average age of students is 22.5 years, with 80% of students under 25 years of age and 20% of students at 25 years of age or older. "Known affectionately as the 'Lighthouse on the Hill,' Glennville State College has 28 buildings on 30 acres at the main campus and 325 acres in a wide variety of wooded properties" (Glennville State College Catalog, 2006-2007, p. 5).

Glennville State is typical of many small colleges in rural Appalachia. "Nearly ninety percent of Glennville's students are residents of West Virginia and approximately eighty-four (84%) percent of our graduates remain in the state following graduation" (Barr, 2007, p. 5). Less than 9% of Glennville State students have two parents with baccalaureate degrees, while 62% of Glennville students have low income backgrounds. Two-thirds of Glennville's first time, full-time freshmen are first generation college students. First generation college students are twice as likely to drop out of college (Barr, 2008).

The West Virginia Higher Education Policy Commission (WVHEPC) and the West Virginia Community and Technical College System (WVCTCS) released statistics in 2007 that indicate 47% of 2007 West Virginia high school graduates who enrolled at Glenville State College in the Fall 2007 semester were placed in a developmental mathematics course. This statistic compares to the average of 17% of West Virginia high school graduates who enrolled at a West Virginia public college or university in the Fall 2007 semester and were placed in a developmental mathematics course. These Glenville State statistics confirm the necessity of a strong mathematics background in order to complete a postsecondary education and represent a challenge to meet this need.

Central West Virginia Setting

Gilmer County, the home of Glenville State College, is surrounded by eleven other Central West Virginia counties. All twelve Central West Virginia counties are slowly declining in student population. Limited business opportunities and scarce jobs have contributed, in part, to the decreasing number of high school graduates and new residents. The main employers in Gilmer County, in addition to Glenville State College, are a new federal correctional facility, oil and gas companies, timber production companies, and the local school system. Central West Virginians reflect the same well-known assets as all West Virginians. These assets include a strong work ethic, strong family and community ties, and a commitment to a quiet, safe environment (Barr, 2007).

The central West Virginia counties of Barbour, Calhoun, Clay, Doddridge, Gilmer, Lewis, Nicholas, Randolph, Ritchie, Roane, Upshur, Webster, and Wirt each have a high school graduation rate that is below the state average of 75.2%. A number of initiatives are being

proposed by the president of Glenville State College, to increase the high school graduation rate and decrease the necessity of remedial coursework for freshmen students. The college president hopes to increase an “appreciation for the necessity of a college education for participation in a knowledge-based global economy” (Barr, 2007, p. 6).

In his address to Glenville State College faculty and staff on January 8, 2008, the college president presented several statistics regarding the service area of the college. In the thirteen county region mentioned above, approximately 10% of people aged 19-64 possess a college degree compared to 17-18% in West Virginia and 15% nationwide (Barr, 2008). These statistics emphasize the importance of the mission of Glenville State College to provide quality educational offerings to the surrounding communities and to create equitable access to higher education.

State Concerns and Goals

Serious educational challenges face West Virginia in preparing and encouraging students to participate in postsecondary education. The 2007 – 2012 Master Plan for West Virginia Higher Education “acknowledges the significant demographic challenges facing West Virginia, especially the low level of education attainment of its citizenry (last among states in percentage of adults with a bachelor’s degree) and the low median family income of \$44,012” (Ness, 2007, p.1).

Although the college-going rates of West Virginia high school graduates have increased from 49.3% in 1997 to a high of 59.3% in 2004, only 58.3% of 2006 high school graduates enrolled in higher education for Fall 2006. Policymakers in West Virginia wish to ensure that more students move successfully through the K-20 educational pipeline so that all West

Virginians have the opportunity to participate in post secondary education (WVHEPC & WVCTCS, 2007).

In 2007, students who took the ACT Test and enrolled in West Virginia's baccalaureate institutions were outperforming the national composite average ACT score (WV students – 21.9; National average – 21.6). In spite of this statistic, the average math sub score for the same West Virginia students was 20.7 as compared to the national average math sub score of 21.0 (WVHEPC & WVCTCS, 2007).

The 2007-2012 Master Plan for West Virginia Higher Education identifies higher education access as a crucial component and recommends strengthening student preparation, facilitating transitions from high school to college, enhancing outreach initiatives, providing opportunities for adult learners, and finding efficiencies in course offerings (Ness, 2007). The growth of online learning opportunities for students will provide educational opportunities for adult learners that might not otherwise have access to higher education.

The 2007-2012 Master Plan for West Virginia Higher Education cites distance learning as the key to making lifelong learning accessible to all citizens, which in turn will enhance the citizenry's ability to compete in a knowledge-intensive, global economy. The Plan specifically states, "On-line courses contribute to developing a culture of lifelong learning by providing educational experiences that are engaging and challenging and that encourage self-motivation and self-direction" (WVHEPC, 2007, p. 14). A need for high-speed Internet access throughout the state is a necessity if web-based learning is to become available to all West Virginians. Currently, many rural areas have only dial-up Internet service.

The state's economic growth and higher education have a reciprocal relationship. The enhancement of one results in the enhancement of the other. The upward mobility of the state's

citizenry is enhanced by higher education and economic growth and vice versa. Problems abound, however, in developing and delivering higher education programs due to a continual decrease in state funding for higher education and projections for slow growth in the economy. West Virginia is ranked 49th in the nation in state appropriations for operating costs and 15th among the 16 Southern Regional Education Board states in state funding per full-time equivalent student (FTE). Higher education institutions must work hard to come up with more and more financial resources while keeping costs to students at a minimum affordable level (WVHEPC, 2007).

Once again, the importance of research that examines whether online mathematics courses are meeting the needs of rural Appalachian students is evident. All students deserve equity in access to mathematics and equity in learning experiences. Although student identities are not revealed in this study, the study gives a voice to students who experienced the opportunity to choose between a mathematics course offered in an online format and an onsite format. The results of this study will help higher education institutions plan to use their scarce resources wisely in meeting student needs.

Data Collection

QBAI students of age 18 or older were invited to participate in this research study during the Spring 2008 semester. Students who chose not to participate in the study were not be penalized in any way. Student participants were part of the population of students who completed any course at Glenville State College that was taught in both online and onsite formats. Further, these student participants could be considered part of a larger population of

students who completed a course(s) that is taught in both online and onsite formats at any college.

Those QBAI students who volunteered to participate were asked to sign an informed consent form and an additional form giving the researcher permission to view their high school and college transcripts as well as use their class work, grades, and number of tutoring hours for research purposes. A copy of the informed consent is available in Appendix A, and the additional permission form is shown on the survey form in Appendix B. Volunteer participants were asked to fill out a four-page survey form to gather information about possible student achievement variables and indicators of student needs. Various other data collection instruments were utilized during the Spring 2008 semester in order to provide a rich collection of information for this study. All human subject identifying information was removed from all data items and statistics reported in the research study. Further precautions were taken during the data analysis process to protect human subjects. Detailed descriptions of data collection instruments and analysis are described below.

Survey Form - In addition to gathering contact information, the survey served as an instrument to collect personal information about whether the student lives in a rural, urban, or suburban area and whether the student resides in campus housing or commutes to the college. Student characteristics, including disabilities, and non-academic commitments that could affect study time for the course were indicated on the survey. The student's gender, birth date, educational background, reasons for course format preference, and type of Internet connection were also be collected on this survey form. Students were asked how they are paying for their college education. A copy of the survey form is included in Appendix B.

Course Work – All student course work, including grades, communications, tutoring time, and researcher observations as she is teaching the class and communicating with students were part of the data set. The researcher recorded her observations, reflections, and communications with students in a field log as described below. E-mail communications were saved electronically. All grades were determined by electronic grading procedures and stored in a digital database as well as the researcher's gradebook.

Tutoring time records in the Academic Support Center are readily available to Glenville State College professors who have recommended students for tutoring services. Electronic tutoring through an off-campus website provider (Smarthinking) is also available to students. Electronic records of Smarthinking tutoring sessions are available to Glenville State College professors. Tutoring time in the researcher's office, tutoring time in the Academic Support Center, and tutoring time from the Smarthinking website were recorded by the researcher in the field log. When available, tutoring topics were also recorded in the field log.

Pretest – Online and onsite students were given a short pretest at the beginning of the semester in order to assess the content knowledge of students as they entered the course. This also allowed the researcher to determine if students have prior knowledge of the mathematical content of the course that might influence their final grade in the course. The pretest consisted of 10 problems that are identical in structure to 10 of the 33 problems on the comprehensive final exam. A copy of this pretest is included in Appendix C.

Online Exams – All online and onsite students completed an online exam on most chapters of the text. MathCue.Business (MathCue) software was used to administer and grade these assessments. The software could be installed on a computer using a CD or the software could be accessed through a link in WebCT. George W. Bergeman, a teacher of math for over

25 years and a creator of instructional software for over 20 years, developed the software. MathCue.Business is both a learning and assessment tool as it makes tutorial-practice exercises available as well as exams. Students may answer the practice exercises and receive immediate feedback including step-by-step solutions for each problem. The software, using algorithmically generated problem sets, created the exams. The course professor customized the problem sets on the exam by selecting the number of problems that will assess each course objective. Because each problem is linked to a specific course objective, the professor could easily view objectives that students have not mastered. For this research study, the typical number of problems per exam was 10-15. Features in the MathCue.Business software documented the amount of time students spent taking each chapter exam. Student exam scores were recorded in the professor's MathCue electronic gradebook through an Internet-based course management system (Brechtner, 2006).

Final Exam – Online and onsite students were given identical final exams created by the professor of the course. The exam consisted of 33 problems in a multiple-choice format. The students entered their answers on an answer sheet, and a scanning device scored the exam electronically. A copy of the type of final exam is included in Appendix D.

Field Log –The researcher kept a field log to document observations and informal conversations with students. The frequency and topic of online and office student help sessions was documented. All e-mail communication regarding the QBAI course was saved. The field log was supplemented with information from the Reports and Tracking feature of WebCT that recorded a detailed summary of activity for individual students and an overview of how often components of the course were used. The field log was also used to record researcher reflections on the data as it was gathered.

Interviews – Interviews were conducted to discover and gain a deeper understanding of important themes that helped answer the research questions. As the data unfolded from other data collection instruments, such as student exam grades, student surveys, and the researcher field log, questions needed to be answered and emerging themes needed to be clarified. The unfolding data thus guided the purposeful selection of students for interviews. It was not possible to know the specific interview questions that would be asked until the data began to unfold from the student surveys, communications, student work, and the researcher’s field log. The interviews were semi-structured around the questions found in Appendix F. The interviews were not audio taped. Participant checking was used to verify the accuracy of interview notes. The interviewee was asked to examine the interview notes for any objectionable content or interpretation.

Selected students were interviewed by phone or in the researcher’s office. Interviews were conducted to clarify any written responses on the survey instrument and emerging themes in the data, to explore reasons why a student was struggling in the course or did not complete an exam(s), and to explore how the course met or did not meet student needs. Interviews were conducted throughout April 2008.

Transcripts – High school and college transcripts were viewed by the researcher to determine participant’s success in previous mathematics courses as well as overall academic success. Transcripts were also be used to verify the accuracy of the following information provided on the survey form by participants: the overall grade point average, number of hours of coursework this semester, number of college credits completed to date, highest math course in college, highest math course in high school, location of high school, college major, and birth date.

Researcher – The researcher was also the professor for the course and has taught QBAI for twenty years. During the previous six semesters, the researcher taught the course with an online format available to students. The online format of the course evolved from a basic framework to a more diverse menu of learning aids for student success.

Equity of Access

To determine if there was equity in learning for online and onsite students, variables in the course sections were controlled as much as possible while giving students every opportunity for success in learning. Since the same professor at the same college taught both sections of the class, the setting of the class was controlled. Further, students in both sections of the course used the same assessments and the same textbook. The professor did not score the exams directly; the exams were scored electronically. All students had equal access to individual help during office hours, by e-mail, by phone communication, and through online discussions. All students were given a detailed syllabus, instructions for accessing the course in WebCT, instructions for accessing the online exams, a list of recommended homework problems from the text, chapter hints, a reminder calendar of chapter exam due dates, and a study guide of topics to be reviewed for the final exam. The study guide may be found in Appendix E of this document. All students had access to practice tests in the MathCue.Business software, the textbook student resource site, and Excel extra credit exercises. All students had access to two hours of free peer tutoring weekly through the Academic Support Center on the GSC campus. Electronic Smarthinking tutoring sessions were also available to GSC students via an off-campus website.

Both online and onsite students were subject to an attendance policy and could be suspended from the course for excessive absences. Excessive absences were defined as three

consecutive online tests for the online students and three class absences for the onsite students. If students are suspended from a course, they are not allowed to complete the course unless they appeal their suspension and win the appeal. If a student is suspended after the last day to withdraw with a “W” has concluded, the student’s grade for the semester is “FIW,” failure due to irregular withdrawal. The number of students who received a “W” or “FIW” is reported in this study in Chapter 4.

In short, the basic difference between the requirements for the two sections of the course was that onsite students were required to attend regular class sessions while online students did not attend class sessions where the content of the course was discussed and practiced. Online students had access to a dedicated 2 ½-hour period per week where the professor was online and available to discuss problems, address questions, and work example problems with students. It is noteworthy that GSC students who take an online course are assessed a \$100 fee in addition to tuition for the course.

Procedures – Question 1

Learning for students who completed either the online or onsite class was measured by the final course grade determined from online chapter content assessments, discussion postings, Excel extra credit exercises, and a final paper-and-pencil exam taken in the classroom. Each online and onsite student’s final percentage course average were entered (without student names) into *Statistical Package for the Social Sciences* (SPSS) software. Once the overall online class mean and overall onsite class mean were computed, they were compared to determine if they were significantly different.

In order to answer the first research question, the following null hypothesis was tested.

$H_0: \mu_{online} = \mu_{onsite}$ (There is no statistically significant difference in mean achievement between online and onsite students completing the same mathematics course.)

Basic descriptive statistics were calculated for each class section. Tests for normality indicated whether it was appropriate to assume a normal distribution of data for each class. Box plots indicated the shape of the distribution and any outliers in the data groups. A quantile-quantile probability plot helped determine whether normality held for the data. The normality of the data (or lack thereof) determined the appropriate statistical tests for comparison of the online class final grade mean with the onsite class final grade mean. The t -test for independent samples was used to test for statistical significance for data that can be considered normally distributed.

Landau and Everitt (2004) describe the t -test this way:

The independent samples t -test is used to test the null hypothesis that the means of two populations are the same, $H_0 : \mu_1 = \mu_2$, when a sample of observations from each population is available. The observations made on the sample members must all be independent of each other. ... The variable to be compared is assumed to have a normal distribution with the same standard deviation in both populations. (p. 29)

If the data were not normally distributed, the Mann-Whitney U-test was used to test the null hypothesis.

Procedures – Question 2

A business student who completes QBAI must make a grade of C or higher; otherwise, the student must repeat the course. For purposes of this study, a student who successfully completed QBAI was defined as a student who earned a final grade of 70% (C) or higher. In order to answer Question 2, the data sets for each section of the course, online and onsite, were

adjusted to exclude final course grades of D or F. The same statistical procedures for Question 1 were then applied in order to answer Question 2.

Procedures – Question 3

Quantitative Procedures

Data from the survey instrument were coded and disaggregated according to several variables. Variables included the following: Overall Grade Point Average (GPA), Number of Miles Commuting (NMI), Work Hours Per Week (WHR), Number of Tutoring/Help Sessions (NHP), Number of Hours of Coursework This Semester (NSM), and Number of College Credits Completed to Date (NCR). Categorical variables included the following: Highest Math Course in College (HMC), Highest Math Course in High School (HMH), Location of Residence – Rural, Urban, or Suburban (RES), Gender (GEN), Disability (DIS), Special Circumstances (SPC), College Major (MAJ), College Minor (MIN), Size of High School (SHS), Location of High School (LHS), Mathematics Ability (MAB), Financial Aid (FAD), Online Course in the Past (OCP), Online Course(s) in the Present Semester (OCS), and Type of Internet Connection (INC).

From the survey, a student's birth date was used to classify each student as traditional or non-traditional under the categorical variable Traditional Student (TRD). A traditional student was defined as a student under 25 years of age, and a non-traditional student was defined as a student 25 years of age or older. National Center for Education Statistics (NCES) data was used to classify survey-identified schools as to location (rural or nonrural) and size (NCES, 2005-2006). These classifications informed the data coding of variables such as (SHS) and (LHS).

Appropriate statistical tests in SPSS in answering Question 1 and Question 2 determined whether further analysis was needed to answer Question 3. If a significant difference was found in Question 1 and/or Questions 2, then more statistical tests were necessary to identify relationships between disaggregated variables and whether any disaggregated variables accounted for differences in achievement between online and onsite students. Chi-Square tests of Independence, correlation analysis, multiple linear regression, Analysis of Variance, and collinearity diagnostics are some of the statistical techniques in SPSS that are helpful in revealing relationships between variable and accounting for variances in achievement.

Qualitative Procedures

Qualitative research methods promote a deeper understanding of phenomenon than might be possible through quantitative techniques alone. Qualitative methods provide additional in-depth details and fresh insights to the research process (Strauss & Corbin, 1990). Qualitative research is especially powerful at developing grounded theory, theory that emerges from the data (Patton, 2002; Strauss & Corbin, 1990). This research study followed procedures for building theory grounded in the data.

Observations were open and unstructured (Boaler, 1994) in an attempt to gather data that not only reflected routine classroom teaching and learning practices, but also reflected problems and their resolutions. Observations were recorded in the researcher's field notes, which were supplemented with e-mail and other communications, tutoring records, WebCT reports, and researcher reflections. In a similar manner to that described by Hodge (in press), field notes and surveys were used to provide background information to develop interview questions.

Semi-structured interview techniques (Boaler, 2000; Hodge, in press; Strauss & Corbin, 1990) enabled the pursuit of issues raised by the survey forms, observations, and communications with students. Students were given prompts to elicit their comments, but students were allowed much freedom in voicing their thoughts and experiences. Student interviews revealed issues not previously gathered by other techniques. The freedom to pursue issues raised in the interview itself is also implied in a semi-structured interview and was used to clarify any new information revealed by students. Participant checking was utilized to assure the accuracy of the interview data.

A systematic cycle of gathering data, and analyzing data, and then gathering more data and analyzing that data ensured that the development of theoretical perspectives and themes were grounded in the data. Analysis of and collection of data was ongoing throughout the research process (Maxwell, 2005; Strauss & Corbin, 1990). Validation of the data and its analysis was achieved by triangulation of the data and recurring collection and analysis cycles.

Analysis of interviews, survey short answer questions, and researcher field notes revealed the emergence of themes in the data. As described by Hodge (in press), data was identified and grouped in categories. Open coding (Boaler, 2000; Hodge, in press; Strauss & Corbin, 1990) was used to reveal themes in the data. Open coding is “the process of breaking down, examining, comparing, conceptualizing, and categorizing data” (Strauss & Corbin, 1990, p. 61). Multiple stages of coding were necessary. First, individual student interviews and survey questions were analyzed to identify student perspectives and characteristics. Next, looking across interviews, survey questions, and field notes helped identify commonalities and variations among student perspectives and characteristics (Hodge, in press). Identifying convergence as well as divergence of the data was critical (Patton, 2002). Conjectures of themes were tested and revised according

to the evidence that further data analysis revealed (Hodge, in press). Field notes and survey information were coded in multiple stages. Any data that did not support emerging conjectures was further explored to determine its validity and meaning. Revision of conjectures followed. With careful analysis of the multiple data forms, accuracy in theoretical premises and themes was supported.

Quantitative and Qualitative Procedures

Short answer questions on the survey, interviews, information from the field log, and researcher observations supplemented, contradicted, illustrated, and/or further explained in detail the information from the statistical tests described above in determining if there were significant differences in the final course grades of online and onsite students. The quantitative and qualitative methods informed each other in a process of comparison and re-analysis (Boaler, 1997). The multiple forms of data collection were more than sufficient to triangulate the data. The strengths of quantitative and qualitative research built a rich base of data to use in answering Question 3.

Procedures – Question 4

As the data unfolded and answers to Questions 1-3 became known, the mixed methods design of this study provided a rich assortment of data and findings with which to answer Question 4. Interviews and participant checking helped clarify answers to Question 4.

Comparisons of rural versus nonrural student final grade averages and number of rural versus nonrural student course withdrawals or suspensions in both sections of the course were helpful in answering Question 4. Comparing the percentage of rural students in the online versus

onsite sections of the course and looking carefully at the qualitative data gathered also helped reveal whether the needs of rural Appalachian students are being met by an online course format for learning. Pretest questions were compared with like questions on the final exam to indicate whether students improved on these questions. Chi-Square tests of Independence, correlation analysis, multiple linear regression, Analysis of Variance, and collinearity diagnostics performed, if appropriate, in answering Question 3, are helpful in revealing relationships between disaggregated variables as well as relationships between disaggregated variables and significant differences in student grades. Quantitative analysis will help reveal whether the online rural student need for an equitable sum of learning experiences (when compared with students who take a course via a different delivery medium) is being met.

The rich assortment of qualitative data and its analysis as described in the procedures for preparing to answer Question 3 were also critical in answering Question 4. Responses to survey form items that revealed student responsibilities, location of residence, college education finances, mathematical background, and choice of QBAI format were particularly useful in exploring themes about student needs and formulating interview questions to clarify student need issues. The observations and other field note data also helped inform the interview process and in turn, the interview results informed focuses for additional observations. Conclusions reached about whether online courses are meeting the needs of rural students were grounded in the data by a systematic process.

Summary of Methodology

In summary, the strengths of both quantitative and qualitative methods were combined to collect data, analyze the data, and ultimately answer the research questions. Collecting and

analyzing the data was an ongoing and iterative structured process that eventually ended in conclusive themes and answers grounded in the data. Table 3.1 summarizes the methodology for this research study as outlined in this chapter.

Table 3.1. Research Questions and Analysis.

Question	Data Sources	Method of Analysis
<p>1. Is there equity in learning between online and onsite students completing the same mathematics course?</p>	<p>Final course grades (Final grades are determined by online exams and extra credit points for online discussions and completion of Excel exercises)</p>	<p>Quantitative methods – statistics generated by SPSS statistical software to determine if there is a significant difference in online class mean and onsite class mean (For example: descriptive statistics, quantile-quantile probability plot, box plots, tests for normality, <i>t</i>-test for independent samples or Mann-Whitney U-Test)</p>
<p>2. Is there equity in learning between online and onsite students successfully completing the same mathematics course?</p>	<p>Final course grades (Final grades are determined by online exams and extra credit points for online discussions and completion of Excel exercises)</p>	<p>Quantitative methods – statistics generated by SPSS statistical software to determine if there is a significant difference in the mean grade of online successful class completer and the mean grade of successful onsite class completers (For example: descriptive statistics, quantile-quantile probability plot, box plots, tests for normality, <i>t</i>-test for independent samples or Mann-Whitney U-Test)</p>
<p>3. If there is a significant difference in online and onsite students' learning, as found in answering Questions 1 and/or 2, what variables may explain these differences?</p>	<p>Student course work and grades Surveys Transcripts Interviews Field Log containing: observations and reflections E-mails and other communications Tutoring time and topics WebCT reports</p>	<p>Quantitative methods – statistics generated by SPSS statistical software (For example: Chi-Square tests of Independence, correlation analysis, multiple linear regression, Analysis of Variance, and collinearity diagnostics) Qualitative methods – Open coding of interviews and information from the field log and surveys – identify themes</p>

Table 3.1. Continued.

Question	Data Sources	Method of Analysis
<p>4. Are online mathematics courses successfully meeting the needs of rural Appalachian students?</p>	<p>Student course work and grades</p> <p>Surveys</p> <p>Transcripts</p> <p>Interviews</p> <p>Field Log containing: observations and reflections</p> <p>E-mails and other communications</p> <p>Tutoring time and topics</p> <p>WebCT reports</p>	<p>Quantitative methods – statistics generated by SPSS statistical software</p> <p>(For example: comparison of rural vs nonrural final course grades, comparison of achievement on pre-test and final exam questions, Chi-Square tests of Independence, correlation analysis, multiple linear regression, Analysis of Variance, and collinearity diagnostics)</p> <p>Qualitative methods – Open coding of interviews and information from the field log and surveys – identify themes</p>

Chapter IV

RESULTS

Research results in this chapter are organized by participant characteristics, quantitative analysis in reference to research questions 1, 2, and 3, and finally qualitative and quantitative analysis in reference to research question 4. The research questions were as follows:

1. Is there equity in learning between online and onsite students completing the same mathematics course?
2. Is there equity in learning between online and onsite students successfully completing the same mathematics course?
3. If there is a significant difference in online and onsite students' learning, as found in answering Questions 1 and/or 2, what variables may explain these differences?
4. Are online mathematics courses successfully meeting the needs of rural Appalachian students?

Participant Characteristics

Twelve students in each section of QBAI volunteered to participate in this research. In the online class, there were two nontraditional male participants. In total, there were four male participants and eight female participants in the online class. In the onsite class, there were two nontraditional male participants, and one nontraditional female participant. In total, there were seven male participants and five female participants from the onsite class. Five online class student participants and three onsite class student participants had enrolled in QBAI in a previous

semester and had withdrawn or were suspended from the course. No participants withdrew or were suspended from the course during the Spring 2008 semester. Only two student participants resided in nonrural, suburban areas. These two students were in the onsite class. All other students resided in rural areas of population less than 6,000 people (U.S. Census, 2000). Thus, 83% of the onsite student participants came from rural homes, while 100% of the online student participants came from rural homes.

National Center for Education Statistics (NCES) locale codes (2005-2006) were used to identify the location of students' high schools as either rural or nonrural. For purposes of this study, locations of the following urban-centric codes were all classified as rural: 41-Rural, Fringe; 42-Rural, Distant; and 43-Rural, Remote. All other urban-centric codes were classified as nonrural for purposes of this study. Only one online student graduated from a nonrural high school, while six onsite students graduated from nonrural high schools. One online student attended a rural high school, but did not graduate. Instead, the student earned a Graduate Equivalency Diploma (GED). Year of participant high school graduation ranged from 1979 – 2007.

Sixteen of 24 participants in this study (67%) indicated a Pell Grant was helping them pay for their college education. Ten of these 16 participants were in the online section of the course. The Pell Grant is a need-based form of financial aid that usually helps the lowest of income students. Fifteen students indicated student loans were being used to help pay for their education. Nine students received at least one scholarship, two students received veteran benefits, and nine students were working at part-time or full-time jobs. The number of hours worked at jobs ranged from 5 to 45 hours per week.

Five participants had a young child or children at home that required a great deal of their time. Three of these parents were in the online class. Twelve participants commuted to the college campus an average of 19.3 miles one way. The range of miles commuted was from 3 to 41 miles one way. Seven online students commuted an average of 22.3 miles, while five onsite students commuted an average of 15.2 miles.

The online class participants were comprised of two freshmen, four sophomores, four juniors, and two seniors. The onsite class participants were comprised of five freshmen, five sophomores, one junior, and one senior. Seven online students and five onsite students had taken at least one foundation of mathematics course prior to QBAI. For four online students and four onsite students, the highest college mathematics course completed was a foundations course. Thirteen students had completed a college algebra or higher mathematics course. One student had completed a beginning calculus course. Three students had completed no college mathematics courses prior to taking QBAI. All but one student had completed at least Algebra II or Geometry in high school. One student had completed Consumer Mathematics as the highest mathematics course in high school.

A wider range of majors was present in the online class. The online course participants were registered in the following majors: Management (3 students); Natural Resource Management (3 students); Marketing (1 student); Elementary and Early Education, PreK-6 (1 student); Business Education, 5-Adult (1 student); Biology (1 student); Associate in Business (1 student); and Undeclared Major (1 student). The onsite course participants were registered in the following majors: Management (5 students); Sports Management (2 students); Natural Resource Management (1 student); Physical Education, PreK-Adult (1 student); and Associate in Business

(3 students). No student participants were registered in a minor, so the variable MIN was deleted from the data set.

Quantitative Analysis – Questions 1, 2, and 3

Final course grade data were analyzed using the features of *Statistical Package of the Social Sciences* (SPSS v. 16) software. All hypotheses were evaluated at the .05 level of significance.

Analysis – Research Question 1

Student learning was defined as achievement in the course as measured by final course grades, so descriptive statistics were generated for final course grades in each of the two sections of the Quantitative Business Analysis I course. Section 1 of the course was the onsite section; Section 2 of the course was the online section. Quantile-quantile (QQ) plots, box plots and tests for normality were generated to see if the data set for each course section was normally shaped.

Although the interquartile range of each data set was nearly identical, one outlier was present in each data set. These outliers are attributable to one student in each class who earned a very low final grade. The lowest grade and highest grade of any student participant were both in the online class, indicating a range of 72.6 compared to a range of 54.1 in the onsite class (See Table 4.1).

These descriptive statistics and observations are represented visually in the box plots (See Figure 4.1). Note the one low score in each class is represented as an outlier in each box plot (Nancy and Carla). While Nancy and Carla's final course grades are outliers in their respective

Table 4.1. Final Course Grade Descriptive Statistics, N =12.

Class Section	N	Mean	Median	Standard Deviation	Minimum Grade	Maximum Grade	Interquartile Range
Onsite	12	77.808	80.250	14.7108	38.6	92.7	16.0
Online	12	75.633	76.750	18.6389	24.0	96.6	16.1

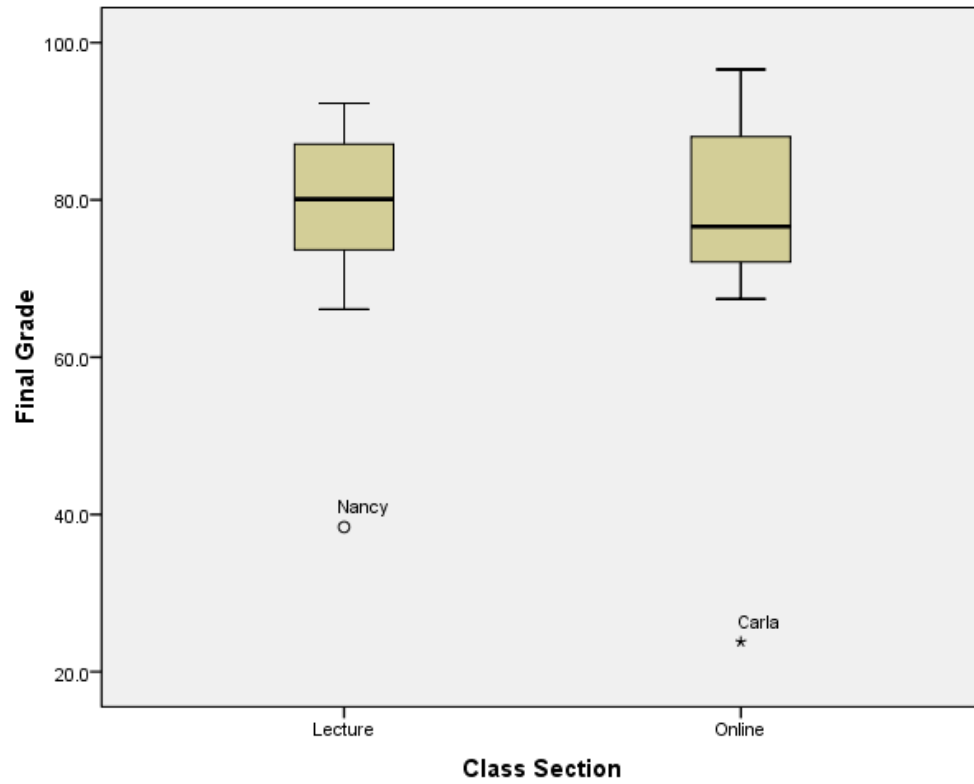


Figure 4.1. Final Course Grade Box Plots, N =12.

data sets, the rest of the data appears somewhat normally shaped. Carla's grade is an extreme outlier as it lies more than three box-lengths from the edge of the box on the box plot figure. The outliers in each data set are also noticeable on the QQ plots (See Figure 4.2 and Figure 4.3). The QQ plots confirm that the rest of the data, exclusive of the outlier in each set, are somewhat normally shaped.

Levene's test for homogeneity of variance indicated that the variance in the onsite class final grades was not significantly different from the variance in the online class final grades, $F(1, 22) = .112, ns$ at $.741$. Using the Shapiro-Wilk test for normality of the data, however, both the onsite and online final grade data sets appeared to be significantly non-normal. In the onsite class data, $W(12) = .825, p = .018$; in the online class data, $W(12) = .790, p = .007$. Therefore, the Mann-Whitney U non-parametric test was utilized to test the following hypothesis:

$H_0: \mu_{online} = \mu_{onsite}$ (There is no statistically significant difference in mean achievement between online and onsite students completing the same mathematics course.)

Achievement in the course was measured by the student's final percentage grade in the class. The comparison of course percentage grades in the two sections of the course resulted in no significant difference between the percentage course grades in the online class and the percentage course grades in the onsite class. Output from the Mann-Whitney U test indicated $U = 63.5, p = .641$.

Since the two data sets, online course final grades and onsite final grades, appeared nearly normal except for the skew caused by one very low grade in each course, the t -test for independent samples was also run with all student final grades in each data set ($N = 12$ in each course section data set). There was no significant difference in the mean scores for the two class sections ($t(22) = .317, p = .754$).

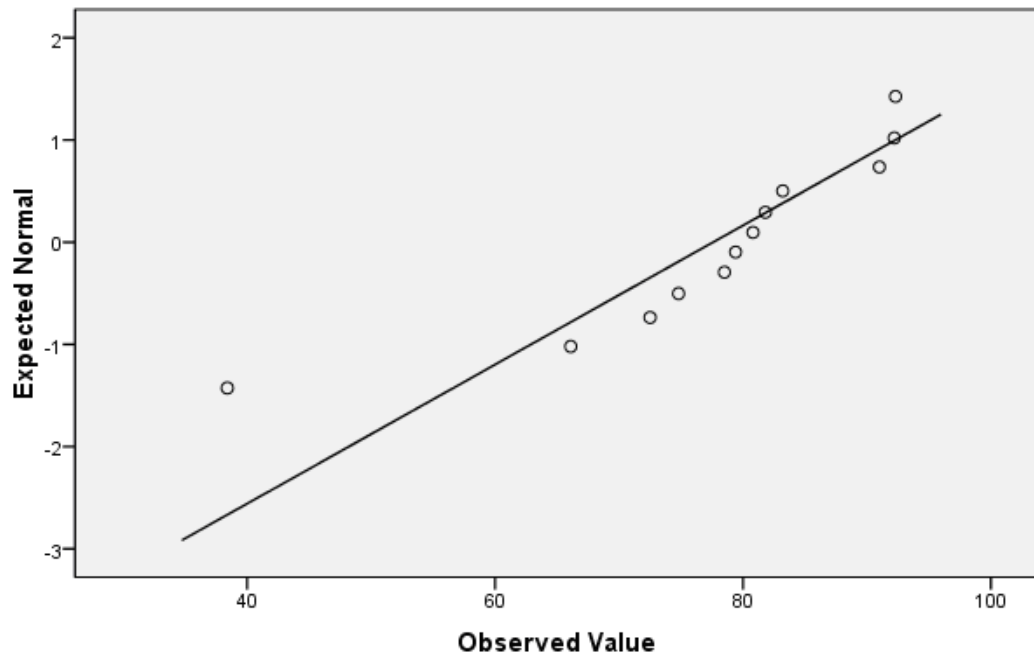


Figure 4.2. Final Course Grade – Section 1 QQ Plot, N = 12.

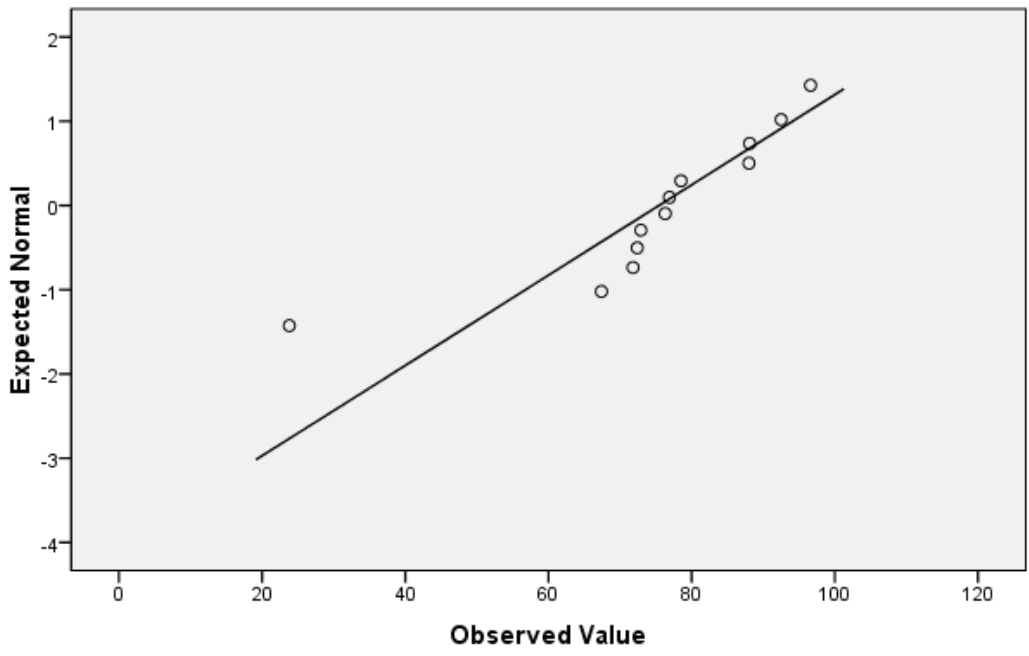


Figure 4.3. Final Course Grade – Section 2 QQ Plot, N = 12.

Next, the outlier was removed from each data set ($n = 11$ in each course section data set) and tests for normality were repeated. The Shapiro-Wilk normality test no longer showed any significant results when the outlier in each data set was removed. In the onsite class data, $W(11) = .947, p = .607$; in the online class data, $W(11) = .919, p = .314$. Levene's test for homogeneity of variance indicated that the variance in the onsite class final grades was not significantly different from the variance in the online class final grades, $F(1, 20) = .722, ns$ at $.406$. With the outlier threats to normality in the data sets removed, an independent-samples t -test was conducted once again to compare the mean course grades between the two classes. The mean of onsite student grades became 81.373 , while the mean of the online student grades became 80.327 . There was no significant difference in the mean scores for the two class sections ($t(20) = .273, p = .788$).

Analysis - Research Question 2

A student who successfully completes QBAI was defined as a student who earned a final grade of 70% (C) or higher. There were two students in each course section, a total of four students, who earned a grade below 70% (two grades of D and two grades of F). These four grades were deleted from the data sets leaving ten grades ($n = 10$) in each data set. Table 4.2 shows descriptive statistics generated from the adjusted data sets. There is a range of 20 in onsite student scores while there is a range of 24.6 in online student scores.

The box plots indicate that the middle 50 percent of onsite student scores range from approximately 78 to 92 while the middle 50 percent of online student scores range from approximately 73 to 89 (See Figure 4.4). The QQ plots indicate somewhat normal distributions for the two data sets (See Figure 4.5 and Figure 4.6). This was confirmed by the Shapiro-Wilk

Table 4.2. Final Course Grade Descriptive Statistics, n = 10.

Class Section	n	Mean	Median	Standard Deviation	Minimum Grade	Maximum Grade	Interquartile Range
Onsite	10	82.880	81.500	7.0988	72.7	92.7	13.9
Online	10	81.600	78.000	9.0367	72.0	96.6	16.4

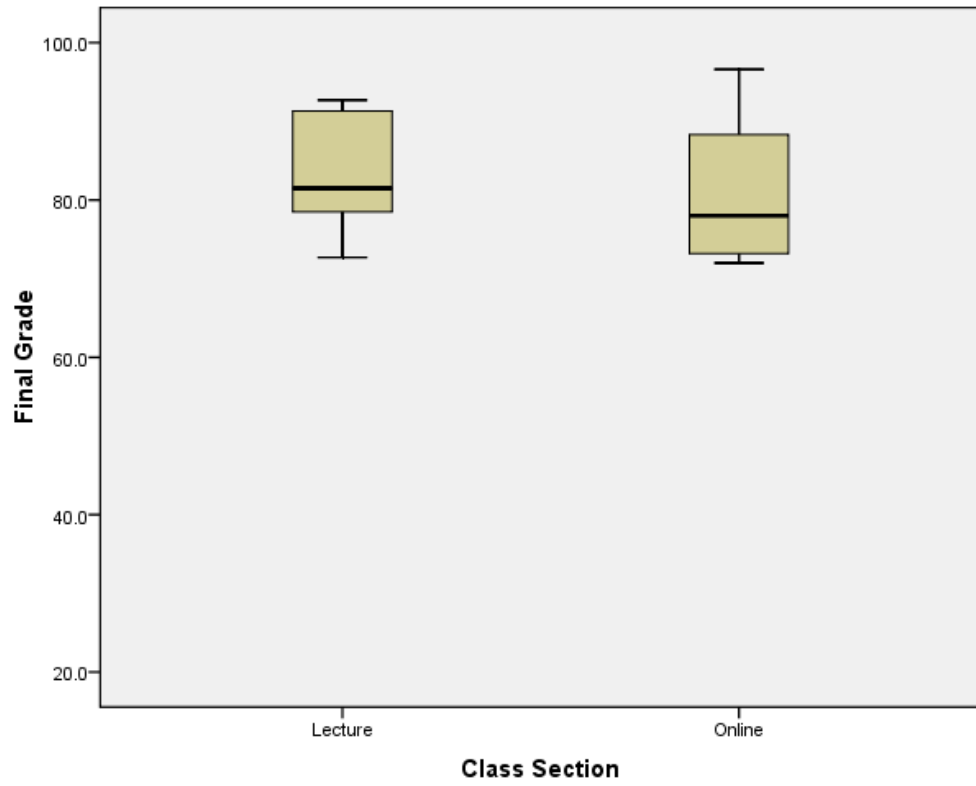


Figure 4.4. Final Course Grade Box Plots, n =10.

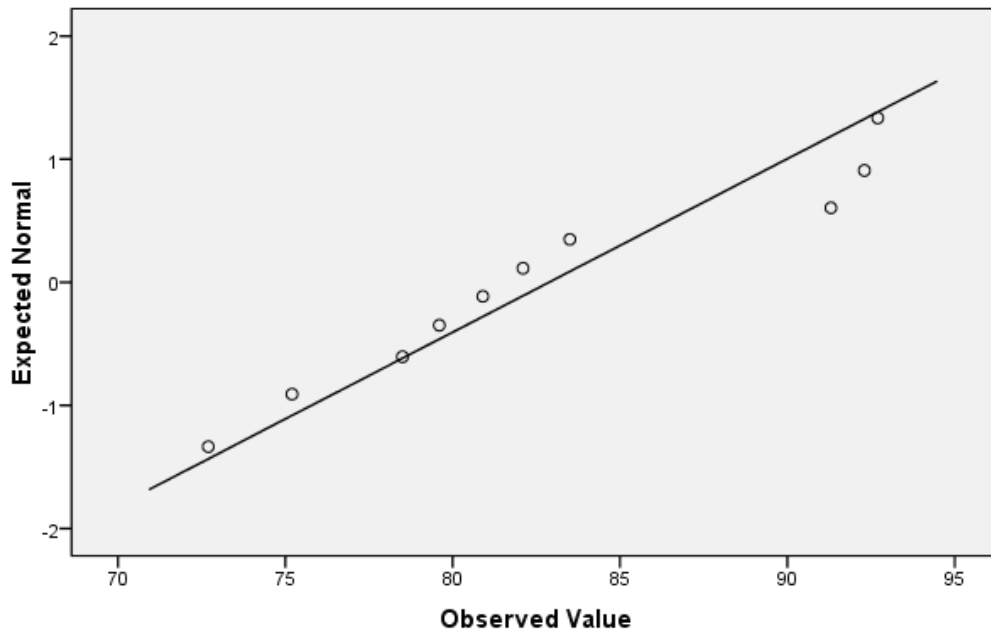


Figure 4.5. Final Course Grade – Section 1 QQ Plot, n = 10.

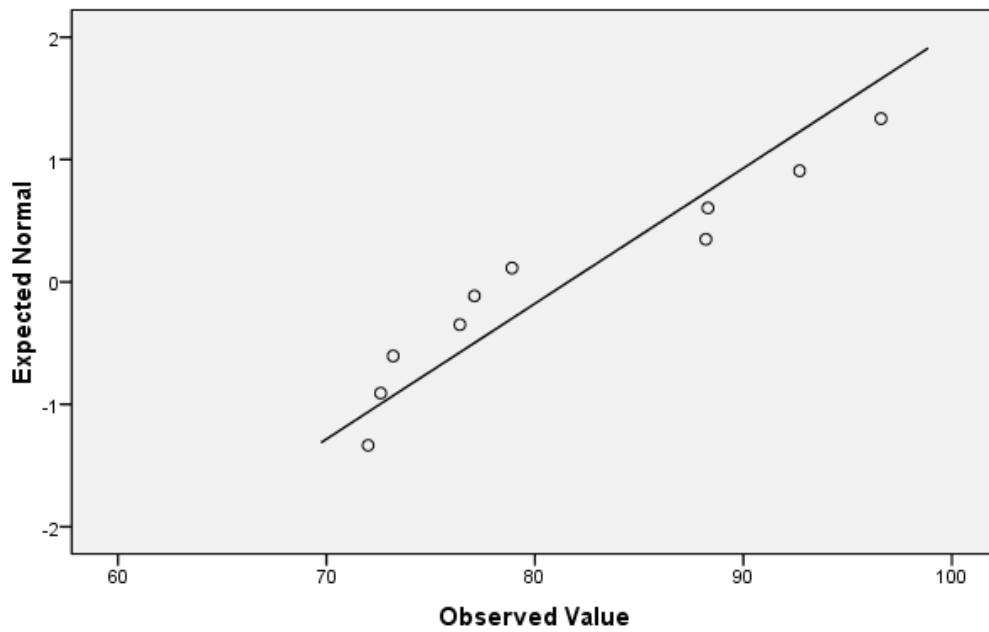


Figure 4.6. Final Course Grade – Section 2 QQ Plot, n = 10.

test for normality of the data. In the onsite class data, $W(10) = .915$, $p = .317$; in the online class data, $W(10) = .884$, $p = .143$. Since $p > .05$ in both cases, normality of the data holds.

Further, Levene's test for homogeneity of variance indicated that the variance in the onsite class final grades was not significantly different from the variance in the online class final grades, $F(1, 18) = 1.798$, *ns* at .197. The *t*-test for independent samples was utilized to test the following hypothesis related to the second research question:

$H_0: \mu_{online} = \mu_{onsite}$ (There is no statistically significant difference in mean achievement between online and onsite students who successfully complete the same mathematics course.)

No significant difference was found between the mean scores for successful online course completers and successful onsite course completers ($t(18) = .352$, $p = .729$).

Analysis – Research Question 3

Since no significant difference was found between online and onsite students' learning in answering research questions 1 and 2, examining variables to explain differences became inappropriate. Explanatory variables became a moot consideration in relation to final grades in the two sections of the Quantitative Business Analysis I course.

Qualitative Analysis – Question 4

In the analysis of 23 interviews, 24 surveys, over 425 e-mails, 87 discussion board postings, assignments, tutoring records, and numerous conversations, observations, and field notes, the following themes were identified:

- 1) An excessive number of technical problems were encountered by students in completing the MathCue chapter tests.

- 2) Students were sometimes frustrated by the precise nature of answers required on MathCue exams.
- 3) Several students expressed a need to see and/or hear problems and concepts explained by the professor.
- 4) Many students did not use available resources to help them be successful in the course.
- 5) Although Appalachian students question the value of learning mathematics and a college education, several participants indicated they saw practical value in the content of the course.

Each of these themes will be analyzed and supported with data and its analysis below. Student perspectives regarding the question of whether online mathematics courses are meeting the needs of rural Appalachian students are interspersed in relation to the identified themes. Pseudonyms have been used in this discussion to protect the identity of the participants.

Technical Problems

Student participants in both sections of QBAI reported a variety of technical problems. Some problems were attributable to student error, but others were caused by breaks in Internet or MathCue server connections. Often, problems that occurred were traced to incorrect date or time settings on a student's computer, incorrect password use, completion of a test after midnight on the due date, failure to follow directions or due dates, usage of a wrong link, JAVA issues, usage of other Internet sites while taking a test, or failure to update software when prompted to do so. One student had her Internet phone line connection broken by a dozer that was being operated on the land around her house.

Students utilized a wide variety of types of Internet connections in accessing the course and MathCue tests. A few students used more than one type of Internet connection during the semester. Table 4.3 shows the types of Internet connections and the number of students who used a particular type of Internet connection. One student in the onsite class related that she could not afford Internet service at her home, so she would drive the short distance to the college parking lot where she could pick up wireless service and complete her chapter tests on her laptop while she was in her vehicle.

All students in both sections of the course were required to complete 18 chapter tests via online MathCue software that closely followed the textbook content. Students could access the tests through a link in the WebCT Vista course platform or they could install the software from a CD that accompanied the textbook. Several students did not receive CDs with their textbooks; these students, therefore, were restricted to accessing their tests via the link in WebCT Vista. Eleven students in the onsite course section and ten students in the online course section accessed MathCue tests through the link in WebCT Vista. One student in the onsite course section and four students in the online course section used the installed version of the software. Three of the four students in the online course section who used the installed version of the software sometimes used the WebCT link to the software instead.

Accessing the MathCue tests through the link in WebCT Vista meant using the Internet version of the software as opposed to the installed version of the software. The Internet version “required communication with the server for every interaction with the math content as well as interactions with the course management functions “ (Bergeman, G., personal communication, June 13, 2008). The installed version only required Internet communication with the server at the beginning and end of a testing session.

Table 4.3. Types of Internet Connections Utilized by Students.

Type of Internet Connection	Number of Onsite Students	Number of Online Students
Dial-Up Service	2	4
College Wireless Service	2	2
College Ethernet	5	2
College Library or Lab	4	3
Verizon DSL	2	5
Other DSL or Cable	1	1
Other Wireless	0	1

Thirteen student participants (six onsite students and seven online students) reported they experienced no technical problems in taking the MathCue tests. Eight student participants (four onsite students and four online students) reported problems in staying connected to the MathCue server long enough to take tests. Out of the eight students who reported such problems, three students, in particular, had difficulty with completing three or more of the eighteen required tests. The technical problems these three students experienced were very frustrating for them and necessitated their retaking portions or all of some tests again. Two of the three students with the most difficulty were in the online section of the course.

One of the onsite students commented that he felt online courses cater to those on or near campus where high speed Internet services were available. While slow dial-up service might discourage students from accessing optional learning aids, some students on dial-up connections experienced no technical problems. Having a fast Internet connection did not insulate a student from experiencing disconnect problems.

Sorting out and resolving these problems took a great deal of time and effort on the part of Mr. George Bergeman, the MathCue software author, who searched the logs of student work on the server. At least 94 e-mails were necessary for communication between the researcher and the MathCue software author during the semester. Students provided detailed descriptions of their difficulties to help Mr. Bergeman determine the source of the problems. Multiple test make-up opportunities were afforded students in order to ensure that any technical problems did not negatively impact their grades in the course.

Sorting Out and Resolving Issues – The Case of Thomas

On January 26, 2008, an online student reported that she was having difficulty with disconnects, but indicated that it might be her computer and she was going to get her computer checked. On February 7, an onsite class student reported having difficulty accessing the Chapter 6 exam. Mr. Bergeman indicated that the publishing company had recently changed their server configuration, and it appeared there were some issues to address. Mr. Bergeman also pointed out that if students could use the installed version of the software, there would be less potential for Internet or server issues. If students were working on campus computers, however, the installation would be cleaned from the server nightly as part of the college's technology security measures.

On February 18, Thomas, an online student and one of three students who experienced several major MathCue problems during the semester, emailed to say that he could not access his Chapter 8 test. On February 19, Thomas e-mailed again saying that he had tried once again to take the Chapter 8 test. This time, he spent nearly an hour working problems, only to suddenly receive a message, "The mathcue server just died." On February 21, Thomas was finally able to take the test, but he did receive the error message again. This time, after about five minutes, he was allowed to resume his work. Thomas wrote in an e-mail, " 'The server has just died' is very discouraging."

Upon notification of these problems, Mr. Bergeman indicated that there had been no other reports of this ever happening before. He was able to see that Thomas did complete the Chapter 8 test and scored 91.7% on it. This score represented Thomas' second attempt at taking the test, but the score had not come back to Thomas or to the professor's gradebook.

On February 27, another online student could not receive feedback on a practice test, and on February 28, Mr. Bergeman could not access the MathCue server either. At this point, automatic MathCue server monitoring was started to help prevent extended interruptions. Mr. Bergeman also provided an Internet address for the QBAI students to use to download the MathCue software and install it on their computers. On March 6, this Internet address was e-mailed to all QBAI students by the professor of the course.

Thomas once again lost his connection to MathCue, on March 17, before he could answer the last question on the Chapter 13 test. On March 29, after spending three hours reviewing Chapter 14 and working practice problems, Thomas was in the middle of completing his Chapter 14 test when he once again received the error message that the server had died. Thomas wrote in an e-mail, "This is getting a little old. ... I'm so frustrated that I am getting upset." Thomas did try a second time to take the Chapter 14 test and was able to complete the test with no further problems.

Mr. Bergeman responded with apologies and indicated that the migration to the new server seemed to be making this error message appear. He and other technology experts continued to search for the root cause. Strangely, there had been very few reports of any problems at all from other higher education institutions where the MathCue software was being used. The few problems that were reported from other higher education users were due to students who needed updates for using MathCue under the Windows VISTA operating system.

Thomas had experienced problems on two different computers with two different types of Internet connections. One connection was Digital Subscriber Line (DSL); the other was cable. The error message changed slightly with the cable connection. Thomas was running Windows XP and XP Pro operating systems on his computers.

In early April, as students were being interviewed for this research project, two more cases of problems were revealed. The problems were similar to those reported by Thomas. Mr. Bergeman and other technology experts began trying to recreate the symptoms reported by the students. By combining feedback from the students and running further tests, Mr. Bergeman and his helpers were able to construct some theories about why the problems had happened. They concluded that the trouble occurred when there was a brief delay in the Internet communication back and forth with the server. On April 6, Mr. Bergeman emailed to say that he had inserted additional code into the software to manage such communication issues. Thomas experienced no further difficulties in completing his chapter tests.

In spite of the problems Thomas experienced, his outlook on the online class was a positive one. In an e-mail dated March 30, Thomas wrote, "I feel like this class is very useful and it is a good class to take online." In an interview on April 8, Thomas indicated that he had no regrets about taking the class online. Thomas said the onsite class would help those who do not understand the content, but he was able to read and understand on his own. He liked the way the class was set up.

Thomas is a nontraditional rural Appalachian student who was in the military and developed good study habits, spending two to three hours studying every night. His high school GPA was low, and he said that he failed Algebra II twice because he did not study in high school. He attributed his success as a college student to the discipline and attitude he developed in the military. Thomas completed 20 hours of college coursework in the spring semester in order to graduate May 2008. He graduated Magna Cum Laude.

Follow Up – Technical Problems

The code that Mr. Bergeman added to the Internet version of the software seemed to alleviate the problems. One of the onsite class students was completing a test near the end of the semester and was bumped from his dial-up connection by a phone call. He was able to go back into his test and resume where he left off.

I asked Mr. Bergeman about his theories regarding the cause of the technical difficulties experienced by some of the QBAI students. I wondered if the lack of robust Internet connections in a rural hilly Appalachian area could have caused the disconnection problems. Because other higher education institutions had not reported such problems, a geographical explanation seemed plausible. Since there were server problems experienced by Mr. Bergeman himself, the geographical explanation did not seem to explain all the problems away. Mr. Bergeman's thinking about these issues are as follows:

- 1) I don't think it could be just the new server, because we still haven't received any trouble reports from other users.
- 2) I don't think it could be just your location, because you didn't have too many such troubles before the migration.

Therefore...

I'm really wondering if the problems you saw earlier this semester were, in fact, due to both the server migration and your particular location taking together.

The new server is a much bigger, more powerful server than we had before. However, MathCue shares it with other programs and perhaps there is just a tiny bit more lag time in communication because of sharing issues. At the same time, your location may tend to cause a tiny lag in communication. Perhaps the two time lags added together caused sufficient grief to the request/response timing mechanism to cause the troubles we saw occasionally. Just a guess, but it seems plausible based on 1) and 2) above. (Bergeman, G., personal communication, May 3, 2008)

In summary, while several students appeared frustrated with technical problems at times, no students indicated they would not have taken the class online if they had known there would be technical problems. There were more technical problems than the professor of the class anticipated, but as is the case with many problem situations, the resolution resulted in a strengthened service to students. Because student participants in this study had difficulties with staying connected to the MathCue exams, the Internet version of the software was strengthened as a direct result.

Precise Answers

Students expressed mixed reactions to the online MathCue testing and grading format. One issue that sometimes frustrated students was the precise nature of the answer required by the software. Test problems stated how an answer was to be rounded or in what form the answer was to be given. Students were encouraged to print or screen capture any problems or feedback they did not understand and bring the issue to the attention of the instructor for discussion.

On January 31, 2008, John, an onsite section student, brought a problem solution to the professor's office that MathCue had marked as incorrect. In his land surveying class, when asked to round to hundredths place, students were taught to insert two zeros after the hundredths place value. For example, if he were rounding 94.6430 to hundredths place, he would give the answer as 94.6400. MathCue would have expected the answer to be 94.64. I explained that the two zeros he had given could indicate rounding to ten-thousandths place if the original number were 94.64002. In the context of the QBAI class, the correct answer rounded to hundredths place would be 94.64.

Next, John asked about a HP33 Engineering Calculator that was producing an answer of $5/8$ for an answer that should be $7/11$. According to the online calculator manual, I determined there was a mode setting causing this issue. Fortunately, John was working the problems out on paper and not relying totally on his calculator, so he did not miss any MathCue problems due to the calculator issue.

Frustration and Challenges – The Case of Keith

Keith is currently a non-traditional rural Appalachian college student, but his K-12 education was in nonrural areas. Keith raised a question in class on February 28 about a difficulty he was experiencing. He was working a problem using his calculator and did not arrive at the same answer as the example in the text. His answer was slightly different by a decimal place or two. The calculator he was using was a very simple one that did not appear to be rounding correctly. Keith claimed that this was likely the cause of him missing some problems on the last few tests as his answers were only slightly off. I recommended that he purchase a new calculator that would provide a few more functions and accurate rounding. He did purchase a new calculator and reported on February 29 that his test score from the night before was greatly improved.

On March 6, Keith had once again missed some problems on a test because his answer was off by a few cents. We discussed rounding once again, as we had discussed in class on various occasions. I shared an example using the simple interest formula, $I = Prt$. If the principal were \$5,000, the rate of interest were 10%, and the time was 243 days exact interest, the formula would become $I = 5,000 (.10)(243 / 365)$. If one does not round until the final answer, the interest equals \$332.88. If, however, one rounds $(243/365)$ to .6658 and then

multiplies by the principal and rate, the answer produced is \$322.90. In this example, rounding early in the computation caused a difference of two cents in the answers. Keith said he was rounding early in the process and that had caused him to miss the problem.

On another occasion, March 26, Keith stopped by the instructor's office to "let off steam," as he expressed it, regarding the MathCue tests. He felt the tests were difficult, frustrating, challenging and not simple enough. "The test needed to be simple enough just to apply the equations," he said. Yet, he also stated he felt we focused on equations and how to get the problem right rather than the concepts. One of the purposes of QBAI is to help students develop some mathematical background for concepts they will study in more depth in accounting, economics, management, and marketing classes. Since Keith had not had many of these courses yet, he related that he was struggling to make some of the connections in the curriculum.

In a WebCT discussion posting on April 10, Keith expressed his distaste over the precise answers required by MathCue. He stated, "These tests need to be multiple choice, Then (sic) you can see if you are at least close. It's either sink or swim with them. I don't like this testing format very much." In his interview on April 15, Keith said he felt he would do better on the tests if they were multiple choice. "For example," he said, "suppose I thought an answer was 1490, and I see in a multiple choice question that the answer is 14,900. I can realize that I forgot a 0." Keith also realized that multiple choice might allow a student to figure out the answer without really knowing the material being tested.

In Keith's interview, he indicated that he saw a lot of benefit of the course, but the course was "not a cake walk." He indicated the course helps you be a better consumer and small business owner. He felt the course will make more sense when he takes accounting. He also

commented that he realized he did not use all of the resources available to help him be successful in the course. In particular, he had not used the practice tests, but planned to start doing so in order to increase his test scores.

More Student Perspectives

JoAnn, an onsite class student, indicated that in the beginning of the course, she missed a few problems until she became accustomed to what MathCue was expecting. She liked taking the tests online because there was less pressure and more flexible time to complete the tests. On the other hand, JoAnn felt that in a traditional testing situation, a student might get credit for “close” answers, but that was not possible with the testing software as MathCue required certain answers. Debbie, another onsite class student, indicated that she too appreciated the flexibility in taking a test whenever she wanted as long as the test was finished by the due date.

An online student, Lori, stated that she felt the MathCue tests were really difficult. She also said that the examples in the book were difficult to learn on your own. Paula, a second online student, in speaking of the MathCue tests said, “They are tedious, which makes them hard.” Amy, an onsite class student, found the inflexibility of MathCue grading frustrating because the answers had to be given “a certain way.” Three other students, two from the online class and one from the onsite class, indicated they missed a few problems during the semester due to rounding.

Three online students had positive thoughts to share about the MathCue tests. Maggie stated, “The MathCue tests are just fine.” She indicated that the practice tests and problem solutions were really useful, and she felt QBAI should be offered in an online format. Bill stated that he liked the way MathCue gave the solutions step by step instead of just the answer in its

feedback. Lisa, a third online student, indicated that she found the practice tests extremely beneficial. She would sometimes do the practice tests twice before attempting a chapter test for a grade.

One of the onsite students, Kent, related that the MathCue tests really become a learning tool for him because they “forced” him to learn. Brenda, an online student, expressed a similar sentiment but with a different perspective. Brenda took QBAI once before and could not remember to take the online tests. Since then, she said, she has learned to manage better and not procrastinate or wait to take the tests. Brenda did not use a book in the course this time. She still had the MathCue CD from the first time she took the course. Brenda took the practice tests, printed out questions she did not understand, and then used these printed problems to prepare to take the tests that counted as part of her grade.

In summary, QBAI students appreciated the flexibility of being able to take tests when they wanted to and with less pressure than they might experience in a traditional classroom setting. No one said they would rather have taken the tests in a traditional classroom setting. Some students, however, had difficulty adapting to providing precise answers to the test problems and felt they might have scored higher if more flexibility in answers was allowed.

In an interview, Cindy, an online student, commented that the MathCue tests are challenging and hard. “Sometimes you can figure out why you missed something. Sometimes you cannot. The teacher is not there to help you.” This comment by Cindy leads to the next theme that emerged from the research regarding students needing to see problems worked by the teacher.

Teaching and Learning

During the interviews, students often talked about their reasons for taking the course in the online format or in the onsite format. For students who were happy with their choice, these reasons were frequently related to their preferred way of learning mathematics. If students were unhappy with their choice of course section, the reason was also related to their preferred way of learning mathematics. Nine out of twelve student participants (75%) in the onsite class and four out of twelve student participants (33%) in the online class said they needed to see problems worked and explained by the teacher. Some students voluntarily described themselves as visual learners. Students also discussed whether they would consider taking an online mathematics course in the future. The following are summaries of comments and explanations given by the QBAI student participants.

Onsite Students

Amy felt she could benefit from instruction and felt she had a need to see someone work the problems. She claimed she was a procrastinator and needed the structure of an onsite course. She would not ever take an online mathematics course. Roy also mentioned that he felt he would procrastinate in an online class whereas the onsite class gave him a more structured approach to learning and completing the work.

Kent expressed a need for a “live person” to go to for help, so an onsite class was better for him. Curtis and John both felt they would spend a lot more time trying to learn the course material if they were attempting to take the class online. Curtis said he preferred the onsite class because of the way he learns. He wanted to see someone showing him how to do the mathematics, then go through it himself, and finally, do the mathematics again on his own. John

indicated that he had to have mathematics taught to him and would probably not consider taking online mathematics courses.

Cindy took QBAI last semester, but withdrew from the course. She said she did not know where to begin to learn the material because she is a visual learner who needed to see problems “worked out.” Cindy said taking a mathematics class online is not worth it for her.

Keith stated that he is not strong in mathematics and felt that he needed to be taking the course in a regular classroom setting. He would recommend against taking the class online unless one is strong in mathematics. JoAnn and Nancy both expressed the need to see problems “worked out.” Nancy related that someone talking and explaining while solving the problem helps her the most. Both JoAnn and Nancy described themselves as being “bad” or “weak” in mathematics. JoAnn felt she could not teach herself. Roy speculated that it would be difficult for someone with a weak mathematics background to do well in an online mathematics course.

Debbie indicated that a one-on-one connection with the teacher was important to her in the classroom. She wanted to be able to ask, “Could you explain that further please?” Eli commented that he felt he understood the work a little better by taking the course as an onsite class. Eli had tried the course in a previous semester as an online class.

No onsite class students expressed any regrets about taking the course in the traditional classroom setting as opposed to taking the course online. Two onsite class students had exceptionally strong mathematics backgrounds when compared to the rest of the onsite class. One of the students had taken calculus at another college. These two students still felt that they benefited from taking the course in an onsite format as opposed to the online format.

Online Students

Four online students claimed they regretted taking QBAI as an online course. Paula indicated on her survey that an online class was more convenient for her since she commutes to college. She also said that she sometimes felt intimidated in a regular class and tended not to ask questions. With an online class, she could work in her own home, but she could still get help if needed. Later in the semester, when interviewed, Paula said she would not have taken the course online if the onsite section had fit into her schedule. She struggled with trying to understand the work on her own. She felt that interaction with the teacher and other students in the class was important, and she preferred to do practice problems where instruction is given “step by step.” Paula said that she would not take mathematics online again, and she would recommend to others to take QBAI in the classroom.

Bill echoed the sentiments of Paula. He felt he does better when he has someone to explain the material. If he had it to do over, he would have chosen the onsite section of the course. According to Bill, while online courses allow working at your own pace, they put those who do not understand the material “in a tight spot.” Likewise, Lori indicated that she needed to see the teacher breaking the steps down in a way similar to how she was taught in high school. She regretted taking the course online because she is a visual learner. Lori said she took the course online in order to fit more classes into her schedule. She worked at on-campus and off-campus jobs, spending over 40 hours per week working. She could work on the online classwork while she was working at her job in the residence hall. Because Lori found it difficult to learn on her own, she felt that online mathematics courses were not meeting student needs.

Judy also related that she regretted taking QBAI online “a little bit.” While the online class allowed her to have a more flexible schedule around her job and was great for a busy life,

the course would have been easier for her if she could have seen examples “worked out” in a regular class. Judy said that if a student was an A or B student, then the student would probably be OK with an online mathematics class. She believed online classes make it harder for those who struggle to learn mathematics. Judy stated that a student has to be willing to learn the material. When asked why she did not ask for help with the course, Judy said she procrastinated. In a discussion posting in WebCT, Judy stated, “Sometimes it is easier to deal with a course online than it is to get up and drive for approximately an hour to come to class. I can actually spend more time at home rather than spending all of my time in a college library or being at work.”

A fifth online student, Brenda, did not say that she regretted taking QBAI online because online classes are easier to fit into her schedule and are good for students who do not have a lot of time. She tried to go to school on Tuesday and Thursday and work on Monday, Wednesday, and Friday. Brenda did say that although online classes are helping her get her degree, she did not feel she is learning as much as she should in online classes. Brenda said she cannot learn mathematics by reading. She needs someone to “show her” in order for her to learn. She needs to see the mathematics explained and understand why. Brenda is a business education student. She related that her goal has been to get the credits she needs and worry about whether she learned the material later. Now Brenda is wondering whether she will know what she is supposed to know in order to teach.

Six out of twelve online student participants (50%) expressed no regrets in taking QBAI as an online course. Lisa, an elementary education major, considered herself a student who has struggled with mathematics, but indicated that she had more success in this course than in any other mathematics course she has taken. In fact, Lisa related, “When a teacher explains it their

way, it is not as good for me as when I can take the book and put the pieces together in a way that makes sense to me.” Lisa would definitely consider taking an online mathematics course again. Online courses fit her schedule better and she enjoys working at her own pace. She likes a dependable structure in online courses, and she felt such a structure was provided in this course. Lisa feels online mathematics courses meet her needs.

Additional online students expressed advantages of online learning from their viewpoints. Thomas appreciated online courses because he could work at his convenience and learn on his own. He stated, “I learn concepts well on my own. After understanding the concepts from the book, and working through some practice problems, I was able to do well on the tests. The textbook was very clear and concise. It explained concepts well. This helped me a lot.”

Joe agreed that the book does a good job with examples. He also stated that this class was the most organized and structured online class that he has taken. He said that he needs a structure that he can depend on, and a strong mathematics background is helpful. Joe appreciated being able to work on the class when he wanted without feeling pressured. He indicated that an online class gives the student more control and teaches students to be more responsible. He felt the course was meeting his needs and he learned “a lot” from the course.

Rhett agreed that he had learned “a fair amount” from the course and would consider taking another online mathematics course in the future. He shared that he was skeptical about taking the course online, but he felt that it worked out pretty well. He appreciated the opportunity to work on the course after his children were in bed for the night and at his own pace. Rhett tried the course online before, but he withdrew from the class because he fell behind in his work.

In summary, while four students were not completely happy with their choice of taking QBAI online, six students indicated they were happy with their choice. In discussions, the

students often focused on “needing” to learn mathematics in a certain way as well as appreciating the flexibility of online courses as meeting “needs” associated with a busy lifestyle.

Further Perspectives of Online Courses from Onsite Students

The onsite students shared their various perspectives on online courses and whether they were meeting rural Appalachian student needs. Curtis indicated that he could see that online mathematics was probably good for some people. Older students (like him), however, did not “grow up with computers” and a background of familiarity with computers might factor into why online classes would work for some students. He could see advantages for students who could not afford to go to traditional classes or did not have access to traditional classes.

Debbie said she had mixed feelings about online classes. She felt some students were just trying to cheat their way out of coming to class. On the other hand, online was the second best choice for students who could not make it to the classroom. She is glad the school offers online as an alternative. She could see where online courses may be beneficial and helpful for disabled people, commuters, and single parents.

Nancy, a student with a disability that requires use of a wheelchair, stated that she did not really like an online course. Nancy expressed a need to be “out among people” to get some of her independence back. She likes people and likes to be out of the house.

John stated that whether needs are being met depends on the person. If a student can understand the math by looking at it, then yes, needs are being met in an online course. If the student is like him, however, then no, needs are not being met because he learns better in a regular class.

Eli felt online courses are meeting student needs. He stated that some students are not traditional test takers and can perform better in an online course. It is more convenient for a student to sit in the library or in his/her room and take a class. From his perspective, online is easier if you have to work at a job while going to school.

Further Perspectives of Online Courses from Online Students

Three online students offered some additional advantages of online classes. Lisa, a rural West Virginia student, stressed the importance of online courses in rural places. She talked about teacher shortages and the limiting effect this has on classes offered to students. Lisa gave an example from her own experience. She took two online courses, while in high school, from a teacher in California. She would not have had the opportunity to take these two courses otherwise.

Norma, a biology major with a particular love for mathematics, opted to take QBAI as an elective course during a semester when she was expecting her first child. There were some complications with the delivery of her child, and she expressed being thankful for the opportunity to continue school in her condition.

Maggie indicated that online courses such as QBAI give students opportunities. She commutes 41 miles from a very rural area and enjoys the opportunity to take this class online. The steep mountainous terrain that she travels keep her from attending classes on winter days when the roads are too dangerous.

In summary, online and onsite students pointed out many benefits and advantages of online mathematics courses. Thirteen students discussed a need to see problems, as they described it, “worked out” by the professor of the course. While onsite students certainly were

exposed to seeing problems explained, worked, and discussed within the classroom, the online students also had access to ways they could see and/or hear problems explained. This point leads us to the next theme revealed in this research study.

Resource Use

A myriad of resources were available to help students be successful in the course. Among these resources, in addition to the textbook, were tutoring resources, WebCT components and links, and practice tests in the MathCue software. The use of these resources was explored through student interviews and was tracked through WebCT options. Field notes and Academic Support Center records were also helpful in monitoring the use of some of the resources. Student use of various resources is described in the paragraphs that follow.

The Textbook and Related Resources

The use of the textbook has been discussed in relation to other themes already identified. Several students indicated that the textbook was very useful and a necessary component for success in the course. Exceptions to this sentiment were Brenda from the online class, and Eli from the onsite class. Brenda was using the MathCue practice problems as her textbook. Eli, on the other hand, was not bringing a textbook to class.

On February 14, 2008, an addendum to the syllabus was distributed in the onsite section of the course. This addendum modified the attendance policy of the course in that students who came to class without a textbook and calculator, basic tools for success in the class, would be counted absent for the day. After February 14, Eli always brought his textbook to class.

Eleven out of twelve onsite students interviewed and ten out of eleven online students interviewed indicated they sometimes or frequently read the chapters from the textbook

carefully. Ten students from each section of the course indicated they sometimes or frequently worked the recommended homework problems. Eleven onsite students specified they used the summary formula charts at the end of each chapter, while only eight online students specified use of these charts.

Students utilized the textbook online resource site infrequently. Only one onsite student and only four online students indicated any use of this site. The textbook online resource site was linked to the WebCT platform of the course and the direct website address was noted on the course syllabus. Flash cards, key terms, and a tutorial quiz were located on the textbook resource site and available for each chapter of the textbook.

As mentioned earlier in this document, several students reported the value of utilizing the MathCue practice tests prior to taking a chapter test that counted as part of their final grade in the course. Students could choose as many problems as they wanted to practice for each objective in each chapter. The practice tests were automatically graded to provide immediate feedback to the student, and step-by-step solutions for problems were available. Seven students in the onsite course section reported using the practice tests at least sometimes, while five students reported they never used the practice tests. Nine students in the online course section reported they used the practice tests at least sometimes, while two students reported they never used the practice tests.

Chapter hints for selected textbook chapters were posted in WebCT by the professor of the course. Six onsite students and seven online students reported utilizing these chapter hints at least sometimes. From time to time, a few students asked a content question on a chapter by e-mail. The professor often sent messages to the classes by e-mail. Several students did not check e-mail regularly and a few students missed messages because their mailboxes were full.

Tutoring Resources

A Chat/Whiteboard feature was available to online students for 2.5 hours each week. Students were notified of times when the professor of the course would be available to answer questions and work problems on the Chat/Whiteboard feature. On two different occasions, a student came into the chat feature (for about 90 seconds) at a scheduled time and posted a question. The Chat/Whiteboard feature could be used to discuss and work problems, but students did not utilize this resource to its full potential.

Smarthinking is an online tutoring and study aid service that was available to students for the first time during the Spring 2008 semester. Tutors were available to receive student questions and offer help. Students were encouraged to explore this service, but no QBAI students took advantage of this opportunity.

Tutoring was also available through the college Academic Support Center. All students had access to two hours of free peer tutoring weekly through the Academic Support Center on the GSC campus. Only two onsite class students took advantage of this opportunity. One student received tutoring once in February for one hour. The other student received tutoring on three different occasions in March and April for a total of 4 hours and 15 minutes. No online students received tutoring from the Academic Support Center.

Students could also come to the professor's office for help. Maggie, an online student, came to the office three times during the semester with questions regarding problems she did not understand. Her tutoring time totaled an approximate 70 minutes. The topics ranged from different types of percentage problems to various forms of depreciation. In late April, Paula, also an online student, spent about 10 minutes in the office asking a few questions about compound

interest problems. Thus, two online students spent a total of 80 minutes in the professor's office for tutoring.

Two students from the onsite class also visited the professor's office for help. In late January, John came to the office with rounding questions and calculator questions. This visit was discussed in the "Precise Answers" section of this document, and it lasted 15 minutes. In late March, John called briefly with a question regarding how to count the number of days in a credit card billing cycle. In early April, John came to the office to get help with work he had missed because he was absent from class. This visit lasted 20 minutes.

Keith was the other onsite student who came to the office for help. When he purchased a new calculator in late February, he needed to learn how to use the exponent key. I helped Keith with this difficulty, and I explained how to screen capture any test questions that he did not understand so we could discuss them. (Each student received a slightly different set of questions on a test, so in order to answer a very specific question from a student, it was necessary to see the original test problem.) This office visit lasted about 10 minutes. In March, Keith came to the office once for help. This 10 minute visit was described in the "Precise Answers" section of this document where we discussed rounding issues in a simple interest problem. Thus, onsite students were tutored a total of 55 minutes in the professor's office.

Two students, one in each section of the course, reported that a friend, who had taken the course before, provided tutoring. Four students in each section of the course reported studying with another student, at least sometimes. In review of the data, it is clear that very few students in either section of the course took advantage of the many tutoring and help sessions that were available to them.

Extra Credit Resources

Two extra credit incentives were offered to students. In order to encourage student participation in the discussion board postings in WebCT, 10 extra credit points were awarded for substantive postings for each of 5 separate topics. Thus, a student could earn a maximum of 50 extra credit points for participation in the discussion board postings. Discussion board postings will be discussed in more detail in the next section of this document.

The other extra credit opportunity, Excel exercises, was also worth a maximum of 50 extra credit points. The Excel exercises were practical application problems that students would work and solve using Microsoft Excel software for the calculations. Students were asked to enter correct formulas in order to solve the problems that were content specific to several course topics. There were 15 Excel exercises with 3 points possible for each exercise completed correctly. If a student submitted all 15 exercises, he or she received an extra 5 points, making a total of 50 points possible.

Seven of 12 onsite student participants submitted the Excel extra credit exercises. One of these 7 students chose to complete only 10 out of 15 exercises. Nine of 12 online student participants submitted the Excel extra credit exercises. One of these 9 students chose to complete only 10 out of 15 exercises.

Discussion Board Resources

In order to encourage students to develop a sense of community and mathematical sense-making, discussion boards were available in WebCT. Five topics were organized as follows: Introduce Yourself, Chapters 1-7, Chapters 8-13, Chapters 14-20, and Practical Applications. The due dates for postings were January 31, February 14, March 27, May 3, and May 3,

respectively. As suggestions for substantive postings, students were encouraged to ask a question, answer a question, share a helpful hint, and/or discuss what they were learning.

In the onsite course section, 11 out of 12 participants posted at least once to the discussion board. There were 27 postings by these 11 students. In the online course section, all 12 participants posted at least once to the discussion board. There were 60 postings by these 12 students. Only two students in each course section posted to all five topics. Some students posted multiple times to a topic.

WebCT tracked the number of messages read by individual students and the total number of messages read for each class section. The number of messages read by an individual onsite student ranged from 0 messages read to 32 messages read. The total number of messages read by all participants in the onsite session was 107. The number of messages read by an individual online student ranged from 9 messages read to 80 messages read. The total number of messages read by all participants in the onsite session was 365. Messages posted by the professor of the course were included in the total number of messages read.

The introductory postings were usually very open and friendly. Students talked about their majors, homes, families, and interests. Some of the helpful hints posted by students included encouraging each other to: take the practice tests, know the formulas and terms, read the problems and book carefully, do the suggested homework problems, double check work, watch out for problems with no salvage value, pay attention to the format of answers submitted, be careful with chart details, and remember to complete assignments on time. Sometimes, students seemed to use the discussion board as a confession of the need to study more or take more time with the problems. A few students posed questions, but a student would seldom

answer content questions. The professor was more often the one that posted content answers to student questions.

On March 28, the professor posted a message to students in each section of the course to try to encourage them to use the discussion board to go beyond helpful hints and attempt to have virtual conversations with each other about topics they were learning in the class. Students were challenged to think deeply about the concepts and not just the logistics of working the problems. Students were asked to share what they had learned from real life experiences as these experiences related to the current content topics. This prompting by the professor was largely ignored by most onsite students, but it did prompt the online students to share more substantial postings than they had in the past and to relate what they were studying to real life examples. Some of these examples will be shared in the discussion of the next theme.

In summary, students were free to choose from several resources that were available to help them be successful. There were at least 14 activities or resources available to students. Onsite student participants used 3 to 10 of these resources for an average use of 46% of the resources available to them. Online student participants used 3 to 11 of the resources for an average use of 57% of the resources available to them.

Practical Value in Rural Appalachia

The rural Appalachian students in this study exhibited characteristics that have been identified in the rural and Appalachian research literature. One identified characteristic of rural people is an attachment to place. Several students have plans to stay in West Virginia to work. One student already has an Appalachian business with clients in other states.

Maggie lives on a farm and commutes 41 miles one way to attend college. She is building a small business from her home. At this point, she has not advertised or built a presence on the Internet because she has all the business she can handle while attending school. She sees the possibilities, however, of offering a unique product that can be widely marketed and yet allow her to live in a remote rural area.

Kent and Paula are two local high school graduates who went to other colleges in the state initially. Kent said he went to a larger state university for two years, but had “too much fun” so he came home to go to school. Paula indicated that she returned to Glenville to attend college because “There is no place like home.” When asked to elaborate on what she meant, Paula said, “Glenville is home for me. I’ve always lived here so I thought that I wanted to go somewhere else, but after I got out there I figured out that there is no place like home.” She indicated that people in the local area know her, so she feels comfortable in her home area. She said no one would help her at the other college and everyone at Glenville is a lot more friendly and helpful. Paula closed her remarks with, “Glenville is home. It always will be.”

Paula was one of the online students who regretted her decision to take the course online. While online students Lisa, Norma, and Rhett indicated they did not feel isolated in an online course, Paula said she did feel somewhat isolated because there is no class involvement. “I don’t go to a classroom so that is why I feel isolated. It isn’t just the math class; it is all online classes in general,” she said. Paula’s views disagreed with Norma’s views which are revealed in the next case.

A Former Urban Student's Perspective – The Case of Norma

In her interview, Norma indicated that if a student was feeling isolated and was not contacting the teacher, then it was the student's fault. Norma attended urban public schools on the West Coast until she moved to West Virginia during her high school years. Norma said that she has seen a lot of diversity in rural students and that online classes are probably fine for some, but others would not be successful. A student has to have "drive" to be successful in an online class. Norma had noticed there is not a lot of "push" in students. The only "push" she had noticed in several rural students was to get out of high school. If a student does not have "drive," a student would not enjoy an online class.

For example, Norma described herself as having "drive." Norma wanted to be able to understand and explain the concepts. She would like to be able to explain mortgages to consumers and how reducing the number of years on a loan can make a drastic difference in the interest you pay over the life of the loan. She felt it is important to care about the consumer. She did not think many students would care about this. Most students just "push to get by," but she wants a better understanding. That is important to her.

Norma related another example. She had been looking at savings accounts for her daughter. She did not understand interest, but now, she can work the entire math out herself. She now feels she could help consumers be less confused about financial decisions. She could help a person be a wiser consumer.

Although Norma appreciates the more relaxed pace of the rural lifestyle she has found in West Virginia, she is concerned about the lack of "push" as she describes it among many rural students. She likes the fact that people help one another in rural areas, but she has noticed that some students do not seem to possess a love of learning that she describes herself as having.

Norma indicates she took this course because her favorite things in life are a challenge to her mind and mathematics. When she was younger, Norma would ask her parents to make up mathematics problems for her to solve. She said her passion for learning mathematics drives her need to succeed.

Norma's passion shines through in her WebCT discussion posting on April 13 under the topic "Practical Applications." The following is a direct quote from that posting.

I recently just had a child and I've been searching for a good savings account so I have money saved for when she goes to college. I've been looking into long term savings and bonds in order to gain the most amount of money possible in each and every year. I've looked at IRA accounts which have quarterly earnings and then in comparison I've spoken with Chase banks about college savings which have earning period (sic.) of monthly to annually. I've found that Chapter 11 from our book has really come in handy and I can actually understand what the Banks Savings personnel are trying to explain. I can do that math on my own as well which helps because I can be in the comfort of my own home and search for a savings account online with the best interest and earning periods for the conditions I need.

I've also been looking at housing arrangements and mortgages and Chapter 14 has helped me to understand all kinds of different mortgages and how higher monthly payments over a shorter period are sometimes more beneficial because it saves you from spending too much in paying off the interest of the loan. This is one book I've purchased since beginning school that I really do intend to keep instead of passing on or selling back.

Other Student Perspectives on Mathematics

Some rural student perspectives added credence to Norma's observations about the lack of "push" she had noticed among some students in the local rural area. For example, in his interview, Kent, a local high school graduate, noted that the typical rural Appalachian is not a college student. He shared that not many from his high school graduating class went on to college but are rather working in oil field or timber jobs or not doing much. Kent indicated that

he has always struggled with mathematics and could never make himself concentrate on mathematics “for whatever reason.”

Nancy claimed that she never had to use math in her Army job as a secretary. Nancy, along with two other students, Lori and Curtis, indicated that “one way” to do mathematics was easier for them and they wished mathematics would be taught that way. In fact, Lori stated that if one teacher taught a “short cut” to do a problem, then other teachers should teach it too. JoAnn stated that when she has taken mathematics in the past, she always told herself that she would never use it. She added that recently she found out that she would really use what she learned in this course because she talked to a family member who is an accountant.

Debbie shared a personal story about the practical use of the mathematics she encountered in this course. She and her son were involved in a hit and run accident where another vehicle side-swiped her car. She said if it had not been for her familiarity with the course information on different types of insurance policies, her insurance company would not have helped her. She said she was able to correct the insurance company’s stance on the situation and receive the help that she deserved from paying insurance premiums.

Keith shared in a discussion posting that his wife, who is a loan officer, pointed out a practical application of what he was learning. Keith had asked his wife why he had to bother learning how to calculate amortization payments if a computer could do it for him. Keith’s wife indicated that she still has to do the mathematics for her customers quite often in order to show them why their payments fluctuate when they make payments early.

In the discussion postings, Joe indicated that taking the course had strengthened his knowledge and understanding of mortgages, depreciation, property and income taxes, vehicle insurance, and investments. He said that inventory valuations were much more complicated than

he first thought. Joe, Thomas, and Paula all spoke of how the topics covered in the course were of direct relevance to their lives. Judy indicated that she could see how the course content related to concepts she was learning about in other courses.

Maggie also talked about the relevance of the course to real life situations. In particular, she focused on tax issues in her May 3 discussion board posting. In Maggie's rural West Virginia area, families are moving in from New Jersey and Connecticut because rural property taxes are much lower. She also mentioned how she was learning about income tax from her small business and shared that she had to file quarterly sales tax reports and income tax reports. She related, "I'm learning what a big responsibility it is. Although it's fun to be my own boss, it might just be easier to work for someone else and let them take care of the taxes and paper work."

In summary, it was evident that at least some of the QBAI students were relating the mathematics to real life applications and practical usefulness. When compared to the onsite students, the online students used the discussion board more frequently to share these applications. Practical applications were routinely tied into the onsite class discussions, so onsite students may have felt posting practical applications was unnecessary.

Quantitative Analysis – Question 4

In addition to qualitative data analysis, quantitative data analysis was needed to help answer the fourth research question, "Are online mathematics courses successfully meeting the needs of rural Appalachian students?"

Rural Final Grades

Noting that 10 out of 12 (83%) of the onsite student participants came from rural residences and 12 out of 12 (100%) of the online student participants came from rural residences, a comparison of rural onsite student and rural online student final grades was conducted. The mean of rural onsite student final grades was 77.510, while the mean of rural online student final grades was 75.633.

Levene's test for homogeneity of variance indicated that the variance in the rural onsite student final grades was not significantly different from the variance in the rural online student final grades, $F(1, 20) = .162$, *ns* at .692. Using the Shapiro-Wilk test for normality of the data, however, both the onsite and online rural final grade data sets appeared to be significantly non-normal. In the onsite class data, $W(10) = .763$, $p = .005$; in the online class data, $W(12) = .790$, $p = .007$. Therefore, the Mann-Whitney U non-parametric test was utilized to test the following hypothesis:

$H_0: \mu_{online} = \mu_{onsite}$ (There is no statistically significant difference in mean achievement between rural online and rural onsite students completing the same mathematics course.)

The comparison of rural student final grades in the two sections of the course resulted in no significant difference between the rural onsite student final grades and the rural online student final grades based upon output from the Mann-Whitney U Test, $U = 50.5$, $p = .551$.

Rural Successful Completer Final Grades

Next, rural student grades of less than 70% were removed from the two course sections. This left 9 rural students who successfully completed the onsite class and 10 rural students who successfully completed the online class. A new comparison of rural onsite student and rural

online student final grades (representing those who successfully completed the course) was conducted. The mean of the final grades of the rural onsite students who successfully completed the class was 81.833; the mean of the rural online students who successfully completed the class was 81.600.

Levene's test for homogeneity of variance indicated that the variance in the rural onsite student final grades was not significantly different from the variance in the rural online student final grades, $F(1, 17) = 2.784$, *ns* at .114. The Shapiro-Wilk normality test did not show any significant results. In the onsite class data, $W(9) = .936$, $p = .536$; in the online class data, $W(10) = .884$, $p = .143$. Therefore, normality of the data sets was assumed, and the *t*-test for independent samples was performed to test the following hypothesis:

$H_0: \mu_{online} = \mu_{onsite}$ (There is no statistically significant difference in mean achievement between rural online and rural onsite students successfully completing the same mathematics course.)

There was no significant difference in the mean scores of rural student successful completers in the two class sections ($t(17) = .063$, $p = .950$).

Rural Appalachian Final Grades

Of the 22 rural students in both sections of QBAI, 21 students resided in the state of West Virginia. One rural student was from a state not in the Appalachian region. For this reason, the tests described in the previous section were repeated to see if there were any differences in test results when only students from Appalachia were considered in the data set from each course. Nine rural Appalachian student final grades in the onsite class were compared with 12 rural Appalachian student final grades in the online class. The mean of rural Appalachian onsite

student final grades was 77.400, while the mean of rural Appalachian online student final grades was 75.633.

Levene's test for homogeneity of variance indicated that the variance in the rural Appalachian onsite student final grades was not significantly different from the variance in the rural Appalachian online student final grades, $F(1, 19) = .050$, *ns* at .826. Using the Shapiro-Wilk test for normality of the data, however, both the onsite and online rural final grade data sets appeared to be significantly non-normal. In the onsite class data, $W(9) = .776$, $p = .011$; in the online class data, $W(12) = .790$, $p = .007$. Therefore, the Mann-Whitney U non-parametric test was utilized to test the following hypothesis:

$H_0: \mu_{online} = \mu_{onsite}$ (There is no statistically significant difference in mean achievement between rural Appalachian online and rural Appalachian onsite students completing the same mathematics course.)

The comparison of rural Appalachian student final grades in the two sections of the course resulted in no significant difference between grades in the onsite class and grades in the online class based upon output from the Mann-Whitney U test , $U = 45.5$, $p = .567$.

Rural Appalachian Successful Completer Final Grades

Next, rural Appalachian students who earned a final grade of less than 70% were removed from the two course sections. This left 8 rural students who successfully completed the onsite class and 10 rural students who successfully completed the online class. A comparison of rural Appalachian onsite student and rural Appalachian online student final grades (representing those who successfully completed the course) was conducted. The mean of the rural

Appalachian onsite students who successfully completed the class was 82.250; the mean of the rural Appalachian online students who successfully completed the class was 81.600.

Levene's test for homogeneity of variance indicated that the variance in the rural Appalachian onsite student final grades was not significantly different from the variance in the rural Appalachian online student final grades, $F(1, 16) = 2.138$, *ns* at .163. The Shapiro-Wilk normality test did not show any significant results. In the onsite class data, $W(8) = .940$, $p = .614$; in the online class data, $W(10) = .884$, $p = .143$. Therefore, normality of the data sets was assumed, and the *t*-test for independent samples was performed to test the following hypothesis:

$H_0: \mu_{online} = \mu_{onsite}$ (There is no statistically significant difference in mean achievement between rural Appalachian online and rural Appalachian onsite students successfully completing the same mathematics course.)

There was no significant difference in the mean scores of rural Appalachian student successful completers in the two class sections ($t(16) = .167$, $p = .869$).

Rural Final Grades by High School Location

While 10 out of 12 (83%) of the onsite student participants came from rural residences and 12 out of 12 (100%) of the online student participants came from rural residences, not all of these students graduated or attended rural high schools according to the NCES coding system utilized to identify high school location. Six out of 12 (50%) of the onsite student participants graduated from a rural school according to NCES coding. Eleven out of 12 (92%) of the online student participants graduated or attended a rural school according to NCES coding. One student

attended, but did not graduate from a rural school. This student obtained the Graduate Equivalency Diploma.

All of the above statistical procedures were repeated with adjusted data sets according to high school location. Rural Final Grades, Rural Successful Completer Final Grades, Rural Appalachian Final Grades, and Rural Appalachian Successful Completer Final Grades analysis were all conducted in like manner to that described above. The Rural Final Grades and Rural Appalachian Final Grades became identical data sets because only West Virginia Appalachian students were classified as rural according to high school location. In these data sets, there were 6 students in the onsite course section and 11 students in the online course section.

Normality threats were present in this data, so the Mann-Whitney U test was utilized to test for significant differences. The mean of rural onsite student final grades was 75.050, while the mean of rural online student final grades was 74.082. The Mann-Whitney U test for Rural (and Rural Appalachian) Final Grades data indicated $U = 26.0$, $p = .525$, so no significant difference was found in final grades for rural (and rural Appalachian) onsite students versus rural online students.

Rural Successful Completer Final Grades and Rural Appalachian Successful Completer Final Grades became identical data sets because only West Virginia Appalachian students were classified as rural according to high school location. In these data sets, there were 5 students in the onsite course section and 9 students in the online course section.

No threats to normality were present in this data, so the t -test for independent samples was performed. Homogeneity of variance held for the data sets. The mean of the rural (and rural Appalachian) onsite students who successfully completed the class was 82.340; the mean of the rural (and rural Appalachian) online students who successfully completed the class was 80.367.

No significant difference was found in the mean scores of onsite students versus online students in Rural (and Rural Appalachian) Successful Completer Final Grades ($t(12) = .451, p = .660$).

In summary, whether rural students were defined as rural by their residence or by their high school location, no significant differences were found between rural onsite student final grades and rural online student final grades. Further, no significant differences were found in the final grades of onsite and online rural Appalachian students from the state of West Virginia. See Table 4.4 for a summary of all statistical tests on final grade comparisons between the online and onsite sections of QBAI.

Rural and Nonrural Final Grades

Noting that 22 out of 24 (92%) of all student participants came from rural residences and 2 out of 24 (8%) of all student participants came from nonrural residences, a comparison of rural and nonrural student final grades was conducted. The mean of all rural student final grades was 76.486, while the mean of all nonrural student final grades was 79.300.

Levene's test for homogeneity of variance indicated that the variance in the rural student final grades was not significantly different from the variance in the nonrural student final grades, $F(1, 22) = .070, ns$ at .793. Using the Shapiro-Wilk test for normality of the data, however, the rural data set appeared to be significantly non-normal. In the rural grade data, $W(22) = .791, p = .000$. Since only two items were in the nonrural data set, Shapiro-Wilk was not calculated for this data. The Mann-Whitney U non-parametric test was utilized to compare rural with nonrural final grades and produced the following result: $U = 21.000, p = .949$. The comparison of rural and nonrural final grades indicated no significant difference.

Table 4.4. Summary of Final Course Grade Comparison.

Comparison	Class Section	N/n	Mean	Standard Deviation	Level of Significance	
					Mann Whitney U	t Test
All participants	Onsite	12	77.808	14.7108	.641	.754
	Online	12	75.633	18.6389		
One outlier removed	Onsite	11	81.373	8.3871		.788
	Online	11	80.327	9.5558		
All participant class completers	Onsite	10	82.880	7.0988		.729
	Online	10	81.600	9.0367		
Rural residents	Onsite	10	77.510	15.0449	.551	
	Online	12	75.633	18.6389		
Rural resident class completers	Onsite	9	81.833	6.6609		.950
	Online	10	81.600	9.0367		
Rural Appalachian	Onsite	9	77.400	15.9533	.567	
	Online	12	75.633	18.6389		
Rural Appalachian class completers	Onsite	8	82.250	6.9943		.869
	Online	10	81.600	9.0367		
Rural high school	Onsite	6	75.050	18.6252	.525	
	Online	11	74.082	18.7183		
Rural high school class completers	Onsite	5	82.340	5.9197		.660
	Online	9	80.367	8.6462		

Next, final grades between rural and nonrural were examined by using the NCES coding for rural high school location. Seventeen out of 24 (71%) of all student participants graduated from or attended a rural high school, while 7 out of 24 (29%) of all student participants graduated from a nonrural high school. The mean final course grade for rural high school graduates was 74.424; the mean final course grade for nonrural high school graduates or attendees was 82.300.

Levene's test for homogeneity of variance indicated that the variance in the rural high school graduates' final course grades was not significantly different from the variance in the nonrural high school graduates or attendees' final course grades, $F(1, 22) = .275$, *ns* at .605. Using the Shapiro-Wilk test for normality of the data, however, the rural final grade data set appeared to be significantly non-normal. In the rural grade data, $W(17) = .803$, $p = .002$; in the nonrural grade data, $W(7) = .879$, $p = .220$. Therefore, the Mann-Whitney U non-parametric test was utilized to test for any significant difference in rural and nonrural final course grades.

No significant difference was found between rural and nonrural final course grades according to Mann-Whitney U test results, which indicated $U = 44.000$, $p = .342$. In summary, whether rural was defined by student residence or location of student high school, no significant differences were found between rural and nonrural final course grades in QBAI.

Pretest and Final Exam Questions

Onsite and online students were given a pretest at the beginning of the semester in order to assess the content knowledge of students as they entered the course. The pretest consisted of 10 problems that are identical in structure to 10 of the 33 problems on the comprehensive final exam. A copy of the pretest is included in Appendix C.

A comparison of scores on the 10 pretest problems and nearly identical 10 post test problems from the final exam was conducted for each section of QBAI. A perfect score on the pretest or post test was 100. In Section 1 of QBAI, the onsite section of the course, the mean pretest score was 38.33 compared to a mean post test score of 80.00. Individual onsite student scores on the pretest ranged from 0 to 70 while individual onsite student scores on the post test ranged from 40 to 100. In Section 2 of QBAI, the online section of the course, the mean pretest score was 25.83 compared to a mean post test score of 61.67. Individual online student scores ranged from 0 to 60, while individual online student scores on the post test ranged from 10 to 90.

A paired samples *t*-test was conducted to evaluate the difference in pretest and post test scores in each section of the class. In Section 1, there was a statistically significant increase in scores from the pretest ($M = 38.33$, $SD = 22.088$) to post test ($M = 80.00$, $SD = 15.374$, $t(11) = -4.451$, $p = .001$). In Section 2, there was a statistically significant increase in scores from the pretest ($M = 25.83$, $SD = 17.816$) to post test ($M = 61.67$, $SD = 25.879$, $t(11) = -4.694$, $p = .001$). Students in both sections of the course showed significant gains in learning based on their pretest and post test scores.

Since a difference of two letter grades was noted in the mean post test grades between the two sections of the course (Section 1 – 80.00 and Section 2 – 61.67), a statistical comparison of onsite and online post test scores was conducted to test for a significant difference between the two sections of the course. Levene's test for homogeneity of variance indicated that the variance in the onsite student post test grades was not significantly different from the variance in the online student post test grades, $F(1, 22) = 3.044$, *ns* at .095. Using the Shapiro-Wilk test for normality of the data, however, the onsite data set appeared to be significantly non-normal. In the onsite post test grade data, $W(12) = .839$, $p = .027$; in the online post test grade data, $W(12) = .881$,

$p = .090$. The Mann-Whitney U non-parametric test was utilized to compare onsite with online post test grades and produced the following result: $U = 36.500$, $p = .038$. A significant difference was found between onsite and online post test grades.

Summary

This chapter presented the data analysis related to each of the four research questions in this study. The quantitative analysis with SPSS software provided distinct ways of comparing learning as reflected in final course grades. Conclusions and answers to the first three research questions are inferred from the quantitative analysis as no significant difference were found between online and onsite student final grades.

The qualitative research provided rich data from surveys, field notes, student interviews, e-mails, discussion board postings, tutoring records, and student work. Five themes emerged from the qualitative data analysis. These five themes were presented in this chapter and their discussion was interspersed with student perceptions of their needs and whether online courses were meeting those needs. The five themes related to technical difficulties and frustrations in completing the MathCue tests, the need to see problems worked by the professor, the use of learning resources, and student views of practical applications of mathematics. The qualitative analysis of this data complements the quantitative analysis conducted in relation to the fourth research question.

Further quantitative comparisons of final grades in the onsite and online classes were conducted by forming subgroups of data from the original data sets of the 12 participants in each class. Comparisons of rural students by residence, rural student course completers by residence, rural Appalachian students by residence, and rural Appalachian course completers by residence

showed no significant difference in final grades between the onsite and online grades in these subgroup categories. Comparisons of the same subgroup types were repeated using location of high school to identify rural students. No significant differences in final grades resulted in these comparisons.

Rural student final grades were compared with nonrural student final grades using first residence and then location of high school to identify the categories of rural and nonrural. Again, no significant differences resulted from this comparison. Finally, a comparison of pretest and post test scores was conducted for all participants in the onsite and online sections of the class. Significant gains in learning were shown for each section of the class. A significant difference in post test scores between the onsite and online students was noted. The qualitative and quantitative analysis together provided a wealth of information upon which to base conclusions and answers to the fourth research question.

Chapter V

CONCLUSIONS

Online mathematics course offerings have increased so rapidly that it has been difficult for research to keep pace with this growth. Research in the area of online mathematics course offerings in rural areas, especially in Appalachia, has been nearly nonexistent. One purpose of this research was to determine if there is equity in mathematics learning between students who complete a mathematics course in an onsite format and students who complete the same mathematics course in an online format. The onsite format means that students attend class on a regular basis. The onsite format does not mean that the teacher just transmits information to students. Students are expected to work and discuss problems in the class.

Another major purpose of this study was to determine if rural student needs are being met by online mathematics learning. This research study makes a significant contribution to understanding what is happening in online mathematics courses in rural Appalachian areas. Mathematics stands as the gatekeeper to higher education and career choices. It is critical that students have access to quality mathematics courses. The findings of the study offer important information to higher education institutions who seek to offer quality online courses that meet the needs of their students and communities.

Summary of Study

This mixed-methods study focused on equity in learning as reflected in the final course grades of online and onsite students from the same mathematics course. This research also focused on whether online mathematics courses are being embraced by rural Appalachian

students as a way of meeting their needs. One need of rural online students is to have an equitable learning experience compared to onsite students. In this sense, the two focuses of the study were intricately connected.

Simonson's Equivalency Theory (2000) served as the theoretical framework for this study as it promotes equivalent sums of learning experiences for all students even though their learning environments and learning events may be quite different. For purposes of this study, equity of learning between online and onsite students was defined as learning that is equivalent in value and measured by final course grades. Final course grades for all onsite student participants and all online student participants were compared statistically to see if there was a significant difference in learning. Statistical tests were also utilized on a number of subsets drawn from all participants' final grades in order to search for any underlying statistical differences that might exist and to help answer whether the rural Appalachian student need for equity in learning was being met.

Qualitative research techniques were employed to further answer whether the needs of rural Appalachian students are being met by online mathematics classes. Surveys, interviews, field notes, observations, tutoring records, communication records, WebCT reports, and student transcripts provided rich sources of data that contributed to this study. The strengths of qualitative and quantitative research, employed jointly in this study, fortified the reliability of the findings.

The setting of this study was a Quantitative Business Analysis I class (QBAI) in an open-enrollment, rural college in West Virginia, the only state totally in the Appalachian region. Two sections of QBAI were offered in the Spring 2008 semester. One section of the course was offered in an online format, and the other section was offered in an onsite format. An onsite

format means that students met regularly in the classroom but does not imply the professor simply transmitted information to students. Students discussed problems, asked and answered questions, and talked about practical applications of the mathematics they were learning. Learning in each course section was assessed in an identical manner. The main difference between the requirements of the two sections of the course was class attendance. Onsite students were required to attend class meetings, but online students were only required to attend an orientation meeting and the final exam. Both sections of the course were taught by the researcher, a college professor with twenty years of experience in teaching the course.

Findings

The findings from the analysis described in Chapter IV will be presented here and organized by research question. Answers to Questions 1, 2, and 3 are based on quantitative analysis. The answer to Question 4 relies on a combination of quantitative and qualitative analysis.

Research Question 1

Question: Is there equity in learning between online and onsite students completing the same mathematics course?

In this study, equity in learning was defined as learning that is equivalent in value. Any two students in this study may not have had exactly the same combinations of learning events in their sum of learning experiences in the class. The sum of the learning experiences, however, should create learning that is equivalent in value. The equivalency in value of learning, or equity

in learning, was measured by comparison of achievement of learning objectives as reflected in the final course grade.

There were numerous learning resources available to students, and students could choose, in large part, which resources they wanted to use for their learning experiences. The onsite students were required to attend regular class sessions as part of their learning events, while the online students did not attend regular class sessions. Analysis of the final percentage course grades in the onsite class compared to the final percentage course grades in the online class showed no significant difference in the grades. The analysis supports a conclusion of equity in learning between the QBAI online and onsite students.

Research Question 2

Question: Is there equity in learning between online and onsite students successfully completing the same mathematics course?

Students who successfully completed QBAI were defined as students who made a final course grade of a C (70%) or higher. Business students who made a D or F in the course are required to repeat the course. There were two student participants in each section of QBAI who did not successfully complete the course in the Spring 2008 semester. These student grades were removed from the data sets and a new analysis of grades was conducted. Analysis of the final percentage course grades of successful completers in the onsite class compared to the final percentage course grades of successful completers in the online class showed no significant difference in the mean grades. The analysis supports a conclusion of equity in learning between the QBAI online and onsite students who completed the course successfully.

Research Question 3

Question: If there is a significant difference in online and onsite students' learning, as found in answering Questions 1 and/or 2, what variables may explain these differences?

Since no significant differences were found between online and onsite students' learning in the answers to Questions 1 and 2, it was not appropriate to explain differences in learning.

Research Question 4

Question: Are online mathematics courses successfully meeting the needs of rural Appalachian students?

Rural student needs were defined in this study to include the following: equal access to mathematics education when compared with nonrural students' access to mathematics education; mathematics education grounded in a sense of place that honors commitments to family and community; employment opportunities that do not require leaving the rural area; appreciation of mathematics as a key to higher education and career opportunities; engaging and relevant learning experiences that help students construct their mathematical knowledge both independently and as an active participant in a community of learners, and an equitable sum of learning experiences when compared with students who take a course via a different delivery medium. Findings related to each of these needs will be considered separately in answering Research Question 4.

Equal Access

Equal access to mathematics education is an important need for all students. It is critical for all students to have access to college mathematics courses in order to further their educational

and employment opportunities. Rural students must have equal access to mathematics education when compared to nonrural students. Equity of access to mathematical learning, for purposes of this study, was implied in the flexibility of course offerings that allowed rural and nonrural students to choose the method of course delivery and learning opportunities that best fit their needs. Several online students in this study cited examples of how the online QBAI course gave them opportunities to study mathematics that they might not have had otherwise.

Maggie spoke of how her 41-mile commute caused her to miss class in the winter and how online learning alleviated this problem. Norma related how she appreciated the opportunity to take a mathematics class online in a semester when she was expecting her first child. Thomas and Lisa related that they learned mathematics best by studying it in an online manner. Some students indicated that taking this course online gave them more flexibility in their schedules to take other classes or remain employed to help pay education and living expenses.

All 12 research participants from the online class were rural West Virginia residents, as compared to 9 rural West Virginia residents out of 12 research participants in the onsite class. These enrollment numbers seem to confirm that there is a need for online mathematics classes among rural Appalachian residents. The data analysis also showed that some onsite students felt that online mathematics courses increased access to college courses for students who experience various barriers that prevent them from attending traditional college courses.

Equity of access to mathematical learning for both rural and nonrural students was promoted by the structure of the online and onsite sections of the course. All students had access to multiple learning experiences and study aids. Students in both sections of the course used the same assessments and the same textbook. All students had equal access to individual help during office hours, by e-mail, by phone communication, and through online discussions. All students

were given a detailed syllabus, instructions for accessing the course in WebCT, instructions for accessing the online exams, a list of recommended homework problems from the text, chapter hints, a reminder calendar of chapter exam due dates, and a study guide of topics to be reviewed for the final exam. All students had access to practice tests in the MathCue software, the textbook student resource site, and Excel extra credit exercises. All students had access to two hours of free peer tutoring weekly through the Academic Support Center on the GSC campus. Electronic Smarthinking tutoring sessions were also available to GSC students via an off-campus website. Online students had access to a dedicated 2 ½-hour period per week where the professor was online and available to discuss problems, address questions, and work example problems with students. This time was allotted to provide an equivalent number of instructional hours to online students when compared to onsite student instructional time.

Rural and nonrural students, whether in the onsite or the online course, had many choices about the learning events that they chose to use in their own individual sum of learning experiences in the class. The data analysis revealed at least 14 activities or resources were available to students. Onsite student participants used 3 to 10 of these resources for an average use of 46% of the resources available to them. Online student participants used 3 to 11 of the resources for an average use of 57% of the resources available to them. Noticeably, access to resources does not guarantee resources will be used because several students did not take advantage of some of the learning resources available to them. Whether students' choices of learning events created equity in learning for them will be discussed under the topic "Equitable Learning."

Through the two course formats and the multiple course learning aids, an attempt to provide equity of access to rural and nonrural students was apparent. An issue that brought

equity of access for rural students into question was the number and severity of technical problems experienced by students. Although the rural hilly Appalachia area itself did not seem to account for the technical problems entirely, the software author thought that perhaps the rural area in conjunction with a server change (together) may have caused the problems.

Another technical and infrastructure issue is the lack of fast Internet connections in rural West Virginia. In many rural Appalachian areas, dial-up is the only option for an Internet connection. The lack of a fast Internet connection can discourage rural students from taking online courses that might allow them access to a college education. One rural student perceived that online classes cater to those on or near campus where fast Internet connections are available.

In short, although online classes support equity of access to college mathematics courses for rural Appalachian students, issues with the availability of technology still need to be addressed. Affordable Internet connections that are faster and more reliable must become available in rural Appalachian areas if equity of access is to truly become a reality for all students.

Sense of Place

A second rural need is a mathematics education grounded in a sense of place that honors commitments to family and community. In some ways, this need is closely connected to the need for equity of access because many rural Appalachian students need to live in their home communities while attending college rather than having to leave their communities in order to attend college. Attachment to home communities is usually attributable to a mixture of reasons, including financial and child care issues. Five student participants in this study had a small child or children at home. Three of these parents were in the online class. Ten of the 16 students

receiving Pell Grants were in the online class. An online class with an extra tuition fee of \$100 is still less expensive than driving long distances to attend class. An online mathematics course allows students to honor their family commitments while working toward a college degree.

Many of the students in this study mentioned they planned to continue to live in West Virginia upon completion of their college degrees. According to the research literature, this finding is not surprising as Appalachians have deep roots in their communities (Kannapel & DeYoung, 1999). Paula spoke of coming back to her local college because it was “home” where people knew her and would help her.

In addition to the online class helping students maintain family and community commitments while attending college, some online students in this study discussed how the mathematics was related to these commitments. For example, Norma, an online student and new parent, discussed how the mathematics would help her make wise investment choices for her daughter’s education and how she could explain to others how to save money on mortgages and other important purchases. Although these practical applications are important for anyone, for some rural Appalachians who are trying to rise above their economic circumstances while remaining in their rural areas, this type of mathematical knowledge is critical.

At least for some of the participants in this study, the data analysis showed the need for a mathematics education grounded in a sense of place that honors commitments to family and community appeared to be met by the online QBAI course.

Employment Opportunities

A third rural need is the availability of employment opportunities that do not require leaving the rural area. Although online mathematics courses cannot provide employment

opportunities, they can help students be successful in employment opportunities that do not require leaving the rural area. The data analysis gave an example of this in Maggie's home business that she is building while attending college and taking some of her classes online. Maggie was able to directly relate much of the course content to her home business. She particularly discussed the relevance of the course content on taxes to her business. Maggie also realized how building a web presence for her business could help it to grow in the future without her having to leave her rural Appalachian community.

Mathematics Appreciation

A fourth rural need is an appreciation of mathematics as a key to higher education and career opportunities. In the analysis of the qualitative data gathered, it was noted that a few students described a lack of appreciation for mathematics and higher education on the part of themselves and their peers. Norma described noticing what she called a lack of "push" among several rural students to learn beyond the high school level. Kent said that many of his peers were not attending college. Thomas described himself as being a student who did not apply himself to his high school mathematics studies. These findings confirm Silver and Castro's (2002) descriptions of math and education avoidance behaviors among some rural youth. Such issues have been noticed by higher education officials. West Virginia higher education officials have made plans to increase the college-going rate among high school graduates and increase the preparation level of high school graduates for college mathematics (WVHEPC, 2007).

In this research study, a few rural Appalachian participants indicated they had questioned the practical value of past mathematics courses. Further a few students questioned why they had

to learn the content of QBAI. These students initially had an “If you can’t use it, don’t bother” approach which agrees with the findings of Lucas (2005).

Nearly all the online participants did seem to realize by the end of the course, if not at the beginning, the relevance of the mathematics course to their lives and to other courses in their college curriculums. More West Virginia and rural Appalachian high school graduates need to see the importance of mathematics and a college education and realize that a college degree is within reach. The online mathematics course in this study certainly helped some students achieve or work toward their degree goals.

Engaging Learning Experiences

A fifth rural student need is for engaging and relevant learning experiences that help students construct their mathematical knowledge both independently and as an active participant in a community of learners. In this study, half of the online students indicated they were happy with their choice of taking QBAI in an online format.

Lisa, in particular, claimed that she had more success with this course than any previous mathematics course she had taken. She described her mathematics learning as “putting the pieces together in a way that made sense to her.” What she described indicated that she was constructing her mathematical knowledge. Thomas also indicated that he learned very well on his own. Joe stated that an online course gives the student more control and teaches students to be more responsible. These comments by online students support the conclusion that, at least for some online students, engaging and relevant learning experiences helped students construct their mathematical knowledge independently.

On the other hand, five online students found it difficult to construct their mathematical knowledge independently. These students believed they would have learned more in the traditional classroom. Whether these students would have worked at constructing their own knowledge independently in a traditional classroom is questionable as they expressed a desire “to be shown” how to work problems.

While a few online students indicated they studied mathematics with another student, no online students really participated in a community of learners to the extent that is preferable in a mathematics class. The discussion board postings were intended to encourage development of a community of mathematical learners, but fell short of this goal. While online students certainly used the discussion board more than the onsite students did, very little mathematical dialogue on problem solving occurred between the online students. This finding supports Engelbrecht and Harding’s (2002) finding that establishing an online community of learners is a difficult task. The online students in this study seemed to visualize mastering the course material as an individual task. They resisted forming a community of learners even though they were encouraged to do so by the professor.

Student needs for engaging and relevant learning experiences that helped them construct their mathematical knowledge both independently and as part of a group were at least partially met for some online students. This indicates that it is possible for online mathematics courses to provide the opportunity for such learning experiences. In this study, the researcher would like to have seen evidence of the development of a community of learners, but that did not occur.

Equitable Learning

The sixth and last rural student need identified in this study was a need for an equitable sum of learning experiences when compared with students who take a course via a different delivery medium. This need brings our focus back to the question of learning equity between online and onsite students. In the quantitative analysis connected to Research Question 4, no significant difference was found in the final grades of rural online students and rural onsite students. Further, no significant difference was found in the final grades of rural students and nonrural students.

These statistical findings lead us to the conclusion that rural students in this study must have formed an equitable sum of learning experiences whether they took QBAI online or in an onsite format. Further, rural students formed an equitable sum of learning experiences when compared to nonrural students' sum of learning experiences.

In answering Research Question 4, more evidence points to a positive answer to the question than to a negative answer to the question. Yes, online mathematics courses are meeting the needs of rural Appalachian students. Is there room for improvement in meeting student needs in online mathematics courses? Of course.

Discussion and Recommendations

Since there were some rural Appalachian online students who indicated they regretted taking the course online, thoughtful advising of students in their course format choices is critical. Students must think carefully about their choices and their reasons for those choices. Students may need guidance from advisors in thinking about their learning preferences, time commitments, and mathematical backgrounds.

Over half the online students in this study had taken at least one foundation in mathematics course prior to the Spring 2008 semester. This is an indication that these students were not prepared to take a college mathematics course when they entered college. In an open-enrollment institution, it is not unusual that a large percentage of students will come to college deficient in their mathematics skills.

If, as a few participants in this study surmised, a student has already struggled in past mathematics classes, taking a mathematics class online may require more discipline, determination, and time commitment than taking the class in a traditional classroom. On the other hand, taking a mathematics class online could be a great opportunity to develop time management skills and take on more responsibility for one's learning. Depending on the teacher to show how problems are worked and making the teacher a transmitter of information (rather than a facilitator of information) does not create the best scenario for student learning. In fact, it is entirely the opposite of the constructivist approach to learning recommended by leaders in the field of mathematics research (NCTM, 2000; Schoenfeld, 1992).

The voices of several rural Appalachian students in this study indicated they were accustomed to a "transmitter of information" learning environment, and they wanted the teacher to continue showing problems "worked out." A resistance to change in their learning styles was noticeable. A certain resistance to change in schooling in rural areas has been noted by several rural scholars (Howley, 1997; Theobald, 1997).

A resistance to forming an online community of learners was also noted in this study. This may be partly explained by the types of learning environments that several students were familiar with. While the concept of community was not foreign to these students, forming a community of learners may have been a foreign concept to many of the students. A student's

previous mathematical experiences may not have included forming a community of learners.

Perhaps a number of observations can also help explain the resistance to forming an online community of learners. Since all the online students were from rural West Virginia, they may have already felt a sense of community from a common culture (the type of community they were familiar with). Only one student indicated she felt “somewhat” isolated in the online class. Several online students said they did not feel isolated. This finding contradicts reports of feelings of isolation in other studies (Englebrecht & Harding, 2005b). There is also a cultural component to West Virginians in that while they help each other, they are also fiercely independent in many ways and do not like to ask for help. Offering help is one thing; admitting help is needed is another. Some online students explained away not asking for help by simply saying, “I procrastinated.” Perhaps they procrastinated because of their culture. Perhaps they did not develop a community of learners for the same reason.

Upon reflection, the students in this study could be characterized as holding one of three perspectives regarding online mathematics learning. One perspective was “Online is fine for others, but it is not for me. I cannot do mathematics on my own.” A second perspective was “Online is attractive to me, but I found I do not like to struggle with the mathematics.” A third perspective was “Online mathematics is great! I am happy with my learning and effort.” Clearly, online mathematics is not a good choice for every student, nor was it intended to be. A student’s personal characteristics and past mathematical experiences will help determine whether an online mathematics course is appropriate for that student. Online mathematics does meet the needs of some rural Appalachian students, particularly those students with the third perspective.

For those students who maintain the second perspective from trying the online course, it is important to note that these students all showed increased scores on their post test when

compared to the pretest. Significant mathematics learning did occur in this group of students. This brings us to another insight. These students, for the most part, did what was needed to achieve in the class. Would these students have learned even more in the classroom or would they retain their learning longer if they taken the course in a classroom format? These are questions that are not answered by this study, but could be explored in further research. Since a significant difference was noticed in onsite student post test scores and online student post test scores, more research is needed to understand this issue and related questions.

Professors offering online mathematics courses to undergraduate Appalachian students must take into consideration a number of complex issues. Certainly, a student's mathematics background must be considered, but it is just as important to consider a student's cultural background and its influences. The maturity of the student and his/her ability to engage in self-directed learning is critical to success in an online class. A student must be able to navigate their way through obstacles. Some of these obstacles can be removed by increasing the availability of affordable high speed internet connections in rural areas.

Understanding the strengths and weaknesses of the rural context will help professors address improving online mathematics course offerings to this population. The rural context is present in an online class even though the students seldom see each other or the teacher. Because of the lack of face-to-face contact, student needs might be easily forgotten. The implications of this study remind us that we must think about the needs of students and their contexts in designing mathematics courses if we want mathematics to resonate with each student and promote its usefulness in their lives.

Conclusions

This study contributes research to the sparsely populated intersection of the three bodies of literature that formed the context for this study, Rural Education, Mathematics Education, and Online Education. The research revealed that some Appalachian students are accepting and adjusting to roles of distance learners and that these students have embraced online mathematics courses. This study makes a significant contribution to understanding what is happening in online mathematics courses in rural areas. The findings of this study have implications for practice in how professors offer mathematics courses to rural students and how rural and other higher education institutions meet the needs of their students and communities.

The findings of this study showed no significant differences in onsite and online student final grades, in rural onsite and online student final grades, or in rural and nonrural student final grades. Equity of learning, as defined by achievement reflected in final grades, occurred among the students in this study. Further, the needs of at least some rural Appalachian students are met by online mathematics courses such as QBAI.

Limitations

The sample size of this study was small. There were 24 student participants in total with 12 participants in the onsite section of the course and 12 participants in the online section of the course. This study was conducted in a college where 90% of the student population is from West Virginia, a predominantly rural Appalachian state. Due to the small sample size and rural location of the study, generalization of findings to other populations is limited. Studies where mathematics courses are taught or structured differently than the course in this study could also yield different results.

Implications for Research

More research on the learning and teaching of mathematics online is necessary in order to keep pace with the rapid growth of online courses. Based on the results of this study, the following suggestions for further research are offered.

- 1) Repeat this study in other rural and nonrural areas and compare the results to see if there is a pattern of equity of learning.
- 2) Investigate whether rural students choose online mathematics courses more frequently than they choose traditional mathematics courses. Why or why not?
- 3) Study what components of an online mathematics course are most useful to rural students and why.
- 4) Research whether Appalachian students resist forming a community of learners in other online classes and why or why not.
- 5) Study how many and what type of online mathematics courses are available in rural areas and how many rural students are taking advantage of these opportunities.
- 6) Investigate organizational structures that either enhance or inhibit the growth of online mathematics courses in Appalachia.
- 7) Study the adjustments to teaching and learning mathematics online that professors and students must make.
- 8) Determine the pedagogical experiences of teachers in online mathematics teaching.

In the end, the ideal learning situation is for all students to have personal, face-to-face, excellent instruction in mathematics. Any attempt to compare this type of opportunity to learn with a situation in which technology comes between the learner and the instructor could produce less than equitable learning. Given that the ideal is not available to all students, however, the choice becomes a less than ideal learning situation or no learning situation. The focus of future research needs to determine how to make a less than ideal learning situation of the highest quality possible.

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APPENDICES

Appendix A

INFORMED CONSENT STATEMENT

The Question of Learning Equity between Online and Onsite Undergraduate Mathematics Courses in Rural Appalachia

INTRODUCTION

If you are at least 18 years of age, you are invited to participate in this research study. A goal of this research is to determine if there is any difference in student learning between the online section of QBAI and the onsite section of QBAI. Student learning will be defined as achievement in the course as measured by final course grades. If differences in learning are found, variables explaining these differences will be sought. Also, the study will focus on whether rural Appalachian student needs are being met by online mathematics courses.

INFORMATION ABOUT PARTICIPANTS' INVOLVEMENT IN THE STUDY

Your participation is entirely voluntary. Minimal effort beyond the regular class requirements will be required to participate in this study. The research will be conducted during the Spring 2008 semester between January 14, 2008 and May 12, 2008. Participants will need to do the following:

- 1) sign this informed consent statement.
- 2) sign the permission to allow your instructor to view your high school and college transcripts and utilize your transcript information and work in this course in her research. This permission will include allowing use of grades, tutoring time, conversations, researcher observation notes, and interviews for research purposes. In short, any of your work or communication for QBAI may be used for research.
- 3) complete a four-page survey that will take approximately 10-20 minutes to complete.
- 4) possibly be interviewed by Mrs. Jones. This interview would last no more than 15 minutes and will not be recorded.

The researcher will follow the following procedures in her research. All data will have names and any identifying information removed before being reported in the research study. Names and contact information will be removed from the survey form and kept separate from the data.

The final course grades for students completing the online or onsite class sections will be entered (without student names) into a statistical software package such as SPSS. The mean final grade for each course section will be calculated and statistically compared to determine if there is a significant difference in achievement between the students in the two courses. Next, grades of D and F will be removed from the data sets and mean final grades for students successfully completing the course in each course section will be calculated and statistically compared.

If a significant difference in achievement exists between the two course section means, statistical procedures will be used to determine variables that may account for these differences. Information from a survey completed by student participants, student high school and college transcripts, a field log kept by the researcher, notes from non-recorded student interviews, and all course work and communication with students will be utilized in determining variables that may be contributing to differences in achievement. It is not possible to know the specific interview questions that will be asked until the data begins to unfold from the student survey, communications, student work, and the field log kept by the researcher. The purpose of the interviews will be to clarify emerging themes in the data and help answer the research questions in this study. Interviewees will be asked to verify the accuracy of notes taken by the researcher during the interview process (participant checking).

_____Initials _____Date

Finally, from all of the data gathered using the instruments and procedures described above, the question of whether rural student needs are being met through online mathematics courses will be answered.

RISKS

There is minimal to no foreseeable risk to any student participant in this study. Your class standing or grades will not be affected in any way by participating or not participating in this study. Confidentiality will be maintained at all times and any identifying information will be removed from the data before the results of the study are reported. Your professor is the only person who will have access to all the data. Other authorized individuals may have access to your grades and absence record as a normal part of routine college recordkeeping. Data will be kept securely in locked storage or password-protected files. You may choose to withdraw from the study at any time.

BENEFITS

Knowledge gained from this research will be beneficial to decision-making processes at colleges where online course offerings are available to students. This study gives a voice to students who are experiencing the opportunity to choose between a mathematics course offered in an online format and an onsite format. In particular, this study gives you the opportunity to have your thoughts heard without being identified. The information gathered in this study will also be used to meet a requirement in your professor’s doctoral program.

CONFIDENTIALITY

Information in the study records will be kept confidential. Data will be stored securely and will be viewed only by Mrs. Jones. No reference will be made in oral or written reports which could link participants to the study.

CONTACT INFORMATION

If you have questions at any time about the study or the procedures, (or you experience adverse effects as a result of participating in this study,) you may contact the researcher, Sherry Jones, at 239 Bennett Academic Complex, Glenville State College, and 304-462-7361, ext 7255. If you have any questions about your rights as a participant, contact the Compliance Section of the Office of Research, University of Tennessee, (423) 974-3466.

PARTICIPATION

Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at anytime without penalty and without loss of benefits to which you are otherwise entitled.

CONSENT

I have read the above information. I have received a copy of this form. I agree to participate in this study.

Participant’s signature _____ Date _____

Investigator’s signature _____ Date _____

Appendix B

SURVEY FORM

The Question of Learning Equity between Online and Onsite Undergraduate Mathematics Courses in Rural Appalachia

I agree to be a participant in research conducted by Sherry Jones regarding the Quantitative Business Analysis I Spring 2008 students, their academic and social backgrounds, and their academic achievements. I understand that my name will not be publicized in this research project in any way and that strict confidentiality will be observed. I grant permission to Sherry Jones to view my college and high school transcripts and to use transcript information as well as the information provided on this form and my work in this class for her research. I understand this permission will allow my grades, tutoring time, conversations, and researcher notes and observations to be used in this research. In short, any of my work or communication for QBAI may be used for research. As necessary, I agree that Sherry Jones may contact me regarding her research.

Signature _____ **Date** _____

Please **Print or Type** your responses. You may use the back of the paper if needed.

Full Name : _____

Permanent Mailing Address: _____

Local Address if different from above: _____

Telephone Number(s): _____

GSC i-mail address: _____

Do you live in a rural, urban, or suburban area? _____

Do you _____ commute to campus or _____ live on campus or _____ live within walking

distance of campus? If you commute to campus, how many miles do you drive one way? _____

How many hours per week do you work at a job or perform volunteer work? _____

Please share where you work or volunteer: _____

Do you have a documented disability? _____ Yes _____ No

Do you have circumstances other than a job, volunteer work, or a disability that may impact your study time and/or achievement in this class? (for example: family responsibilities) _____ Yes _____ No

Please share how any of the above, commuting, working, having a disability, or other circumstances, may impact your study time and/or achievement in this class: (for example: child care issues or care of elderly relatives)

Birthdate _____

Gender : _____ Male _____ Female

Educational Background and Characteristics

Current GSC class status: ____ Freshman ____ Sophomore ____ Junior ____ Senior

Major/Minor: _____

How many hours of coursework are you taking this semester? _____

Colleges other than GSC attended and dates of attendance: _____

What college-level mathematics courses have you completed (all MATH and MTHF courses)? _____

Current Overall G.P.A. _____ Number of total college credits completed to date _____

*High School Attended: _____ Year Graduated _____

Location of High School (City and State) _____

*If you attended more than one high school, please list all high schools attended and dates of attendance: _____

Size of Graduating Class: ____ less than 50 ____ 50-99 ____ 100 – 149
____ 150-199 ____ 200 or greater

Mathematics Courses Completed in High School: _____

Name, Dates, and Location of Middle School(s) attended: _____

Name, Dates, and Location of Elementary School(s) attended: _____

How would you characterize your mathematics ability? ____ strong ____ average ____ weak

Please describe your mathematical experiences so far. _____

How are you financing your college education? Please check all that apply:

Pell Grant

Student Loans

Promise Scholarship

Other Scholarship (Please specify: _____)

Part-time work

Full-time work

Work Study on campus

Work Ship on campus

Veterans Benefits

Other Benefits (Please specify: _____)

Appendix C

BUSN 230 – Quantitative Business Analysis I

Pretest

Mark your answers on the Scan Tron form. Do not write on this test. Turn in your work papers with your exam when finished.

1. A small garden space measures $33 \frac{3}{4}$ yards long by $10 \frac{2}{3}$ yards wide. What is the area of the garden in square yards?
 - A. $330 \frac{1}{2}$
 - B. $330 \frac{1}{3}$
 - C. 360
 - D. $360 \frac{5}{12}$
2. Convert to the decimal equivalent, and round to hundredths if necessary: $\frac{3}{51}$
 - A. .06
 - B. .0589
 - C. 17
 - D. .17
3. Julia is writing a check for \$42.59. What should she write for the word form of this amount on the check?
 - A. Forty-two + 59 cents
 - B. Forty-two and .59
 - C. Forty-two and $\frac{59}{100}$
 - D. Forty-two, $\frac{59}{100}$
4. A contractor's cost in renovations to a customer's home was \$23,450. What price should he charge the customer if percent markup based on selling price is 35%?
 - A. \$31,657.50
 - B. \$67,000
 - C. \$38,692.50
 - D. \$36,076.92
5. Tom's base pay rate is \$14.50 per hour, with overtime paid at time-and-a-half. Find his gross pay if he worked 44.5 hours Monday through Saturday.
 - A. \$645.24
 - B. \$677.88
 - C. \$710.50
 - D. \$967.88

6. Dustin borrowed \$10,000 on July 6, at 14% interest. If the loan was due on October 9, what was the amount of interest on the loan using the exact interest method?
- A. \$369.44
 B. \$364.38
 C. \$700
 D. \$1400.00
7. Suppose you are financing the purchase of a used car costing \$13,900 by taking out an installment loan. The loan requires a 20% down payment and equal monthly payments of \$496.00 for 24 months. Find the total deferred payment price.
- A. \$14,684
 B. \$16,680
 C. \$11,904
 D. \$11,120

8. During the past year, Kabelos sold 618 jackets. Inventory records for the year are as follows:

Date		Quantity	Cost	Total
January 1	Beginning Inventory	50	\$27	\$ 1,350
July 6	Purchase	450	34	15,300
August 24	Purchase	150	29	4,350
December 28	Purchase	150	40	6,000
Total Available for Sale		800		\$27,000

Using the FIFO method of inventory pricing, calculate the dollar value of the ending inventory.

- A. \$21,162
 B. \$5,838
 C. \$6,928
 D. \$20,072
9. Kitchen equipment purchased by The Eatery is expected to last 5 years. The purchase price was \$35,000. Shipping costs were \$1500. The trade-in value is \$5,000. Prepare a depreciation schedule using the straight-line method; then enter the accumulated depreciation at the end of year 2 as your answer.
- A. \$12,000
 B. \$14,000
 C. \$22,400
 D. \$12,600

10. The board of directors of Winchester Airlines has declared a dividend of \$3,000,000. The company has 300,000 shares of preferred stock that pay \$0.60 per share and 1,000,000 shares of common stock. After first finding the amount of dividends due the preferred shareholders, calculate the dividend per share of common stock.
- A. \$3.00
 - B. \$2.82
 - C. \$2.70
 - D. \$3.18

Appendix D

BUSN 230 – Quantitative Business Analysis I

Final Exam

Mark your answers on the Scan Tron form. Do not write on this test. Turn in your work papers with your exam when finished.

1. Last month was a good month for flower sales and Mike's daily sales for roses totaled \$3,482. This month's sales are \$2,304. How much more did Mike's store earn during the last month?
 - A. \$5,786
 - B. \$1,182
 - C. \$1,178
 - D. \$1,078
2. Benny's Warehouse, a family company, has 25 employees on its payroll. Last year Mr. Benny spent a total of \$202,925 in additional employee benefits. What is the amount of additional benefits per employee?
 - A. \$202,900
 - B. \$50,725
 - C. \$9,565
 - D. \$8,117
3. Jennifer sold $13\frac{3}{4}$ acres of her $35\frac{1}{2}$ acre farm. How many acres of farm are left?
 - A. $23\frac{3}{4}$
 - B. $22\frac{3}{4}$
 - C. $22\frac{1}{2}$
 - D. $21\frac{3}{4}$
4. Robert shipped three packages to New York. If the packages weighed $26\frac{1}{3}$, $34\frac{2}{3}$ and $11\frac{2}{5}$ pounds, what was the total weight?
 - A. $72\frac{2}{5}$
 - B. $71\frac{5}{11}$
 - C. $71\frac{11}{15}$
 - D. $72\frac{1}{10}$
5. A carpet measures $7\frac{1}{2}$ yards long by $4\frac{2}{3}$ yards wide. What is the area of the carpet in square yards?
 - A. $34\frac{1}{2}$
 - B. 35
 - C. $12\frac{1}{6}$
 - D. $28\frac{1}{3}$

6. 79.2 square yards of flooring costs \$2,090.88. What is the cost per square yard?
- A. \$24.60
 B. \$26.40
 C. \$19.42
 D. \$20.00
7. Convert to the decimal equivalent, and round to hundredths if necessary: $\frac{5}{24}$
- A. .2083
 B. 4.80
 C. .21
 D. 4.667
8. Marcus is writing a check for \$45.29. What should he write for the word form of this amount on the check?
- A. Forty-five, 29/100
 B. Forty-five + 29 cents
 C. Forty-five and .29
 D. Forty-five and 29/100
9. Mia received her bank statement on March 6, showing a balance of \$1,729.73. The balance shown in her checkbook was \$1,527.58. Deposits in transit amounted to \$602.44 and there was a service charge of \$7.00. Outstanding checks were \$155.44, \$291.26, and \$342.03, and the bank statement showed interest accrued on the account in the amount of \$22.86. Find the reconciled balance.
- A. \$1,550.44
 B. \$1,520.58
 C. \$1,566.30
 D. \$1,543.44
10. Find the total for the invoice below-

Stock #	Quantity	Unit	Description	Unit Price	Total
424	26	ea.	Sm. Shirts	\$22.50	
501	23	ea.	Md. Shirts	20.00	
127	19	ea.	Lg. Shirts	11.50	
				Invoice Subtotal	
				Shipping Charges	\$54.00
				Invoice Total	

- A. \$1,263.50
 B. \$1,317.50
 C. \$1,290.50
 D. \$1,002.00

11. A clothing store buys shirts and slacks with a list price of \$12,000. If the wholesaler offers trade discounts of 35/25/10, find the single equivalent discount.
- A. .56125
 - B. .00875
 - C. .43875
 - D. .70000
12. Luggage World buys briefcases with an invoice date of September 28. The terms of sale are 2/15 EOM. What is the last discount date for this invoice?
- A. October 15
 - B. October 17
 - C. November 17
 - D. November 15
13. A customer just paid \$34,320 for a delivery van. If the percent markup based on cost is 30%, what was the cost?
- A. \$49,028.57
 - B. \$44,616.00
 - C. \$24,024.00
 - D. \$26,400.00
14. A retailer purchased a small tractor for \$20,250. What selling price should be used, if the markup is supposed to be 45% based on selling price?
- A. \$31,387.50
 - B. \$36,818.18
 - C. \$45,000.00
 - D. \$29,362.50
15. A dishwasher that previously sold for \$409.99 has been reduced to \$381.29. What is the markdown percent? (Round to the nearest whole percent)
- A. 10%
 - B. 7%
 - C. 8%
 - D. 2%
16. Karen's base pay rate is \$11.50 per hour, with overtime paid at time-and-a-half. Find her gross pay if she worked 42.5 hours Monday through Saturday.
- A. \$733.13
 - B. \$488.75
 - C. \$503.13
 - D. \$640.00

17. Jesse has a job making baskets. Last week he made a total of 226 baskets. Calculate his gross pay if he is paid on the following differential piecework schedule:

Pay Level	Items Produced	Rate
1	1 – 105	\$5.10
2	106 – 255	\$6.14
3	Over 255	\$7.78

- A. \$1387.64
B. \$1278.44
C. \$742.94
D. \$1152.60
18. Tristan takes out a loan of \$9,500 at 9% simple interest, for 3 months. What is the maturity value of the loan?
- A. \$213.75
B. \$9,713.75
C. \$10,355.00
D. \$9286.25
19. Edwin borrowed \$7,000 on July 10, at 10% interest. If the loan was due on October 9, what was the amount of interest on the loan using the exact interest method?
- A. \$174.52
B. \$700.00
C. \$176.94
D. \$172.60
20. Roberta invests \$9,500 at 10% interest, compounded semiannually for 12 years. Calculate the compound amount for his investment.
- A. \$29,815.07
B. \$17,060.64
C. \$30,638.45
D. \$93,572.46
21. You wish to have \$22,500 in 15 years. Find how much you should invest now at 12% interest, compounded quarterly in order to have \$22,500, 15 years from now.
- A. \$3,818.99
B. \$14,441.89
C. \$3,209.50
D. \$6,624.25

22. Linda deposits \$800 at the END of each six months for 8 years in a savings account. The account pays 8% interest, compounded semiannually. Linda calculates that the future value of the ordinary annuity is \$17,459.62. What would be the future value if deposits are made at the BEGINNING of each period rather than the END?
- A. \$18,158.01
 - B. \$18,259.62
 - C. \$18,323.62
 - D. \$18,070.71
23. What amortization payment would you need to make each year, at 12% interest compounded annually, to pay off a loan of \$6,000 in 7 years? (Use Table 12-2)
- A. \$1314.71
 - B. \$857.14
 - C. \$972.90
 - D. \$954.22
24. Suppose you are financing the purchase of a computer system costing \$3,900 by taking out an installment loan. The loan requires a 20% down payment and equal monthly payments of \$196.00 for 24 months. Find the total deferred payment price.
- A. \$4,704.00
 - B. \$5,604.00
 - C. \$5,484.00
 - D. \$4,782.00
25. You wish to finance the purchase of some living room furniture for \$2,800. A bank offers an APR of 16.75% on a 36-month installment loan. After first using Table 13-1 to find the finance charge, calculate your monthly payment.
- A. \$298.43
 - B. \$77.78
 - C. \$118.14
 - D. \$99.48
26. You purchase a home for \$89,000 at 6% for 20 years. The property taxes are \$2,850 per year, and the hazard insurance premium is \$638 per year. Find the monthly PITI payment. (Use Table 14-1)
- A. \$638.13
 - B. \$928.80
 - C. \$1,513.63
 - D. \$290.67

27. During the past year, Veltron International sold 518 jackets. Inventory records for the year are as follows:

Date		Quantity	Cost	Total
January 1	Beginning Inventory	50	\$27	\$ 1,350
July 6	Purchase	450	34	15,300
August 24	Purchase	150	29	4,350
October 26	Purchase	300	36	10,800
December 28	Purchase	150	40	6,000
Total Available for Sale		1,100		\$37,800

Using the FIFO method of inventory pricing, calculate the dollar value of the ending inventory.

- A. \$19,028.00
 B. \$20,628.00
 C. \$19,999.64
 D. \$18,772.00
28. A refrigerated delivery truck purchased by Basket of Flowers is expected to last 3 years. The purchase price was \$75,300. Shipping costs were \$763. The trade-in value is \$3,163. Prepare a depreciation schedule using the straight-line method; then enter the accumulated depreciation at the end of year 2 as your answer.
- A. \$25,684
 B. \$24,300
 C. \$48,600
 D. \$48,091
29. Vehicle Parts Unlimited purchased a copy machine for \$2,199. Delivery costs totaled \$57 and handling costs were \$57. The useful life is 5 years and the salvage value is \$198. Using the sum-of-the-years' digits depreciation method, calculate the book value at the end of year 3.
- A. \$1,269
 B. \$1,629
 C. \$1,890
 D. \$423
30. Carrie owns property with an assessed value of \$62,450. If the tax rate is 7.82% of the assessed value, how much tax does Carrie owe?
- A. \$48,835.90
 B. \$57,329.10
 C. \$4,883.59
 D. \$5,732.91

31. Joan was involved in an auto accident in which she was at fault. Her own car sustained \$3,827 damages and the other vehicle cost \$1,709 to repair. Joan was not injured, but the driver of the other car required medical treatment costing \$34,550 and a passenger's injuries totaled \$3,944. Joan's policy includes 15/30/10 liability, \$250 deductible collision and \$100 deductible comprehensive. How much of the damages must Joan pay?
- A. \$15,000
 - B. \$19,550
 - C. \$19,800
 - D. \$250
32. The board of directors of Premiere Airlines has declared a dividend of \$3,050,000. The company has 300,000 shares of preferred stock that pay \$0.60 per share and 1,750,000 shares of common stock. After first finding the amount of dividends due the preferred shareholders, calculate the dividend per share of common stock.
- A. \$0.10
 - B. \$1.89
 - C. \$2.92
 - D. \$1.64
33. Lance bought 120 shares of stock at \$25.28 per share. Several months later he sold the stock at \$25.80 per share. His broker charges 3% commission for round lots and 4% for odd lots. Calculate the gain or loss on the transaction. (Show loss in parentheses.)
- A. \$3,129.66
 - B. \$62.40
 - C. (\$131.70)
 - D. (\$98.04)

Appendix E

Study Guide for BUSN 230 Final Exam

You may use your calculator, book, and notes for the exam. You should bring a #2 lead pencil.

Chapters 1-3	Add, subtract, multiply, and divide whole numbers, fractions, and decimals. Convert fractions to decimals to percents and vice versa
Chapter 4	Write word forms of amounts on checks Reconcile a bank statement and checkbook balance
Chapter 7	Find an invoice total, single equivalent discount, and last discount date for an invoice with special terms such as ROG, EOM, extra dating
Chapter 8	Find markup, cost or selling price for markup based on cost and markup based on selling price problems
Chapter 9	Calculate overtime wages, gross pay, differential piecework wages
Chapter 10	Calculate any part of the formula $I = prt$, maturity value Know the difference between exact and ordinary interest
Chapter 11	Find compound amount (future value) and present value in compound interest problems (Know how to use the formulas rather than the table)
Chapter 12	Calculate the future value of an ordinary annuity and an annuity due using the formulas. Calculate an amortization payment by using Table 12-2.
Chapter 13	Find total deferred payment price Find monthly payment on an installment loan by using Table 13-1
Chapter 14	Find monthly mortgage payments using Table 14-1. Find monthly PITI payment.
Chapter 16	Calculate LIFO, FIFO, average cost method of inventory
Chapter 17	Calculate straight-line and sum-of-the-years' digits depreciation
Chapter 18	Calculate property taxes based on assessed value of the property
Chapter 19	Compute the insurance company's payment following an accident
Chapter 20	Calculate dividends for common stock and preferred stock Calculate the gain or loss on a stock transaction

Appendix F

SEMI - STRUCTURED INTERVIEW QUESTIONS

Have you had any technical problems with the MathCue tests?

How do you feel about the MathCue tests?

Do you take your MathCue tests by entering through WebCT or have you installed the software?

What type of Internet connection are you using to take the tests?

If I observed your typical preparation for tests, what would I see you doing?

Please tell me if you use the following resources to support your learning and how often you use them. For example, Used frequently, Used sometimes, Never used

MathCue Practice Problems
Discussion Item Postings
Chat/Whiteboard Help from Instructor
Office Help from Instructor
Academic Support Center Tutoring
Smarthinking Web-based Tutoring
Formula Charts (at the end of the chapters)
Recommended Homework Problems
Chapter Hints posted in WebCT
Text book Resource Site
Excel Extra Credit
Student Resource CD
Read Chapters Carefully
Study with Another Student(s)

If I was new to this course, and I asked you what I needed to do to succeed, what would you tell me?

Would you take an (or another) online course?

Have you felt isolated in any way while taking this course online?

Do you feel online mathematics courses are meeting the needs of rural Appalachian students?

Please tell me about your hometown.

Is there anything I haven't asked about that you think I should know?

VITA

Sherry Jones has lived in central West Virginia all her life. She graduated as Valedictorian of her class at Gilmer County High School in Glenville, West Virginia. Her Bachelor of Arts in Education was earned at Glenville State College, and her Master of Arts in Education was completed at West Virginia University. She is a doctoral student in Cohort 2 of the Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics (ACCLAIM) program. Sherry holds a permanent teaching certificate from the state of West Virginia with four areas of specialization: Mathematics 7-12, Secretarial Studies 7-12, Gifted 7-12, and Language Arts 7-9.

As a teacher of mathematics at Gilmer County High School for seven years, Sherry was honored with the Gilmer County Teacher of the Year award in 1987. She has taught in the Business Department at Glenville State College since January of 1988 and was recently awarded the Curtis Elam Professor of Teaching Excellence Award, 2005-2008. Sherry teaches the mathematics courses offered in the Business Department, Quantitative Business Analysis I, Quantitative Business Analysis II, and Introduction to Statistics. She taught Applied Business Communication for several years.

In addition to her teaching responsibilities, Sherry serves on several campus committees, including the Curriculum Committee, the Professional Development Committee, and Financial Aid Appeals Committee. She also served on the committee to write guidelines and policy for online courses at the college. In May 2008, Sherry was named Chair of the Business Department.

Sherry spoke at the Association of Mathematics Teacher Educators (AMTE) in Tulsa, Oklahoma in January 2008 and at the West Virginia Council of Teachers of Mathematics in Flatwoods, WV in March 2007. Other professional affiliations include the Appalachian Association of Mathematics Teacher Educators, National Council of Teachers of Mathematics, West Virginia Education Association, and National Education Association. The *Rural Mathematics Educator* has published three of Sherry's articles about rural and mathematics education topics (2006-2008).

Sherry has been involved in community projects requiring statistical analysis. She has conducted various workshops and presentations to mathematics and methods classes as well as various community, education, and business organizations. Sherry has been teaching online classes for three years and other forms of distance education classes for ten years at Glenville State College.