A COMPARISON OF INSTRUCTIONAL DELIVERY MODELS FOR TEACHING MATHEMATICS AT THE COLLEGE LEVEL

by

MICHAEL EDWIN MCCALLUM

(Under the direction of James Wilson)

ABSTRACT

The introduction of the personal computer in the late 1970's, the creation of the World Wide Web, and other forces within higher education, such as pressures to reduce operating and capital budgets and to reach a more diverse student population, have all combined in recent years to engender the development of other course models to challenge the traditional semester-length course model. This dissertation is a report of research comparing two alternative instructional delivery models used for mathematics instruction at a major proprietary institute of higher learning with the traditional semester length instructional delivery model. Both of the alternative models are described in the literature as "intensive" models. One model, the compressed model, uses only classroom instruction and the other, the accelerated model, is a hybrid model having an online component utilizing a web-based course management system. Both models have an eight-week duration.

The research methodology used is primarily qualitative using interviews and classroom observations. Quantitative methods, such as embedded test item results and course final grades, were used to evaluate instructional outcomes. The overarching research question was; how do these models compare to one-another in terms of student learning, student satisfaction, instructional delivery, and instructor satisfaction? The research shows each instructional

delivery model has advantages when compared to the others. The traditional 15-week model is advantageous for teaching mathematics to college students with weak mathematics backgrounds or to older students who have not been in school for several years and are finally continuing their education. The research found that the learning outcomes for the compressed and accelerated models were significantly better for the population studied compared to the learning outcomes for the standard model. The major advantage of the accelerated model is the model requires less classroom time for instructional delivery, which enables better utilization of classroom space to better serve growing student populations without adding additional space.

INDEX WORDS: Instructional delivery models, hybrid courses, pedagogy, alternative instructional delivery models, alternative teaching methods, course management systems, mathematics teaching

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By

MICHAEL EDWIN MCCALLUM

BEE, Georgia Institute of Technology, 1970

MS, University of Miami (FL) 1977

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MICHAEL EDWIN MCCALLUM

Major Professor: James Wilson

Committee: Sybilla Beckman
Denise Mewborn
John Olive
Patricia Wilson

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
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DEDICATION

This dissertation is dedicated to my wife Myra without whose cooperation and support these past six years I would never have achieved this lofty goal.

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TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION AND RESEARCH QUESTIONS

The traditional semester-length college course in which the student sits in a brick and mortar classroom for 15 or 16 weeks has been the norm at most colleges and universities. The introduction of the personal computer in the late 1970's, the creation of the World Wide Web, and other forces within higher education, such as pressures to reduce operating and capital budgets and to reach a more diverse student population, have all combined in recent years to engender the development of other course models to challenge the traditional semester-length course model. These new course models began with asynchronous video taping of classroom lectures for distance delivery in the 1970's and 1980's and progressed to 100 percent online courses using a course management system connected to the Internet in the late 1990's. They also include the time-shortened courses offered during the summer at most colleges and universities and something relatively new, hybrid courses offered as a combination of seat-time in a brick and mortar edifice and online time using a course management system.

These new instructional delivery models are a cause of concern to many in academia. Their worry is these new delivery models are not as effective as learning environments when compared to the traditional semester-length instructional delivery model. This research investigates these concerns as they apply to mathematics education at Newbern University.

Background

Newbern University is a large, proprietary institution of higher learning with campuses and educational centers throughout the United States and in Canada. Newbern offers bachelors degrees in business, computer information systems, network communications management,

electrical engineering technology, computer engineering technology, and biomedical engineering technology. They offer associates degrees in electrical and computer technology, network systems administration, and health information technology. They also offer graduate degrees in management.

In 2001 Newbern University, it was then named Newbern Institute of Technology, began offering undergraduate business core courses in a seven and one-half week accelerated format as a part of their evening and weekend offerings for adult students. The first attempts at accelerated course delivery were based on the content prescribed for a standard fifteen-week course offering. The accelerated version of the course was taught in one five-hour block of time per week regardless of the course content or course credit hours. This, of course, meant there was an intrinsic difference between the quality of delivery of a three credit-hour course and a four or five credit-hour course based on the quantity of material to be covered in a unit of time. There was little time to cover the course content to the depth it would be covered in a standard 15-week course offering. There was also little time to cover the breadth of material prescribed for the courses. As a result, instructors were neglecting the course objectives they perceived as relatively unimportant when compared to the major objectives. This created a real difference in quality between courses delivered in a traditional 15-week term and courses delivered in the accelerated delivery model. In recognition of this an effort was begun to develop a methodology to deliver the accelerated courses in a manner providing the same perceived quality in terms of depth of coverage and breadth of coverage as the standard fifteen-week courses.

Other pressures made this effort all the more important. The crash of the dot-coms in 2000 caused a serious decline in enrollment in the computer related degree programs with a resulting loss of operating revenues for Newbern University. One way to reduce instructional

delivery cost was determined to be to increase the accelerated course offerings by expanding them to cover all of the evening and weekend programs. Also, in the spring of 2002, Newbern Institute of Technology became Newbern University. One of the outcomes of becoming a university was the unification of the Newbern Institute of Technology (Newbern) undergraduate programs and the Johnson Graduate School of Management (JGSM) graduate programs under one management umbrella. JGSM had been running five, ten-week terms per year. It was desired to unify the calendars of Newbern and JGSM so the academic terms would start and end at the same times. In order to do this, it was decided JGSM would have six, eight-week sessions per year beginning in July 2003. The start of every second session would coincide with the start of an undergraduate fifteen-week term.

One of the objectives in reducing the term from ten to eight weeks was that no course content be lost in the graduate courses so no major changes in the curriculum would be necessary. This problem was similar to the problem with the accelerated delivery format in the undergraduate courses. However, condensing a 10-week course into an 8-week course is not quite the same as condensing a 15-week course into an 8-week course.

Newbern had been delivering pure online versions of the undergraduate courses for about three years using the WebUniversity ® course management system (CMS). These courses were in an eight-week format and were offered six times per year at eight-week intervals with two weeks off in December and two weeks off in July. When a solution to the accelerated delivery problem was sought, one of the ideas was to use the WebUniversity ® CMS to augment the face-to-face (FTF) classroom delivery with an online (OL) module to provide the same in-depth coverage that could be accomplished in a standard fifteen-week FTF undergraduate course or a standard ten-week graduate course. The solution decided upon was to delivery each

undergraduate course in an accelerated format consisting of 3-½ hours FTF and *x* hours OL augmentation, where the value of *x* is dependent upon the course credit hours. The formula for calculating the online hours is $x = n - 1$, where *n* is the number of credit hours for the course. For example, a four credit hour math course would meet 3 ½ hours per week FTF and have an equivalent of 3 hours of online work per week. This format was named the Blended Integrated Learning System © (BILS). In the literature a course format of this type is called hybrid or blended.

Once it was decided to adopt this format a concentrated effort was begun to convert all undergraduate courses delivered in an accelerated format to the BILS format and to train the instructors who would be teaching these courses in the use of the format. This effort is ongoing and is expected to be completed by the end of fiscal year 2005.

There are different problems when converting an undergraduate 15-week course to the eight-week BILS format than when converting a ten-week graduate course to an eight week BILS format. The most obvious is there is much more material in the 15-week undergraduate course to be converted to the new model. At the graduate level, the CMS is used to supplement the course by providing a forum for threaded discussions to augment the normal discussions occurring in a typical graduate business classroom. Because of the additional materials to be covered in an undergraduate course, more than augmentation was required. Some of the course objectives would have to be covered in a purely online mode. The philosophy used in converting an undergraduate course to the BILS format was to first sort the course objectives into those the developer, who also had experience instructing the course, felt must be taught FTF and those the developer felt could be taught in an OL format. A course shell was then developed using the WebUniversity ® CMS to deliver the OL objectives. Course shell is an unfortunate choice for

naming the product actually produced. A course shell is not empty, as the word shell would lead us to believe. A course shell consists of a sample syllabus, a course outline, and seven weeks of online readings, lectures, threaded discussion questions, and homework assignments, all keyed to a textbook chosen for the course by a curriculum committee. Provisions were also made in the course shells for threaded discussions of weekly assignments so students could collaborate with one another and also receive help and feedback from the instructor to take the place of what would happen in a normal classroom where collaborative instruction and instructor interaction occur naturally. The course shells were developed along with a coordinated FTF course instruction plan based upon the course objectives selected for the FTF instruction mode. A similar project was undertaken on the JGSM side of Newbern University.

At the same time this effort was being made, Newbern introduced another instructional format for undergraduate courses called compressed. A course taught in compressed format meets for double the seat time per week as a semester length course, but for only eight weeks. In the literature, courses taught in this, or similar formats, are called intensive courses. The summer semester courses at the University of Georgia are good examples of intensive courses. Beginning with the Fall 2003 term, Newbern began rolling out a complete degree program in which all of the courses will be taught in the compressed format. This program is a day program as compared to a night and weekend program. Almost all of the night and weekend programs at Newbern use the accelerated delivery mode. The students are the traditional night and weekend students who, for the most part, are older and have full-time jobs. The students in the new compressed programs will more closely resemble traditional college and university students who are full-time students and may work part-time. The research indicates this more traditional

student does not do as well in intensive courses as the more mature students found in the night and weekend programs (Scott, 1993).

Rationale and Research Questions

The four unique undergraduate instructional delivery models in use at Newbern present an interesting opportunity for research. What are the strengths and weaknesses of these models for teaching mathematics? Are there problems with any of the models and, if so, what are these problems and what is unique about mathematics teaching and learning engendering these problems? The use of these models to teach mathematics at Newbern University will be the focus of this research.

The research naturally breaks down into two areas, mathematics teaching and mathematics learning. There are two similar questions in each area. For mathematics teaching the questions were:

1. What, if any, are the pedagogical differences for teaching mathematics among the three models, standard, compressed, and accelerated? I am omitting the online only model from the study because of the difficulties in identifying students and instructors in these courses.
2. How does instructor satisfaction compare when teaching mathematics in each of the models?

For mathematics learning, which emphasized the student point of view, the questions were:

3. What, if any, are the differences the students see in learning mathematics among the three models?
4. How does student satisfaction compare when learning mathematics in each of the models?

One final outcome related research question was of interest:

5. How do student mathematics learning outcomes differ among the three models?

The sixth question is overarching and is the nexus of the research:

6. What are the relative strengths and weaknesses of each model for teaching college mathematics at Newbern University?

The emphasis in searching for the answers to these questions was to find those characteristics of instructor, student, and pedagogy most likely to assure successful mathematics learning using each of the instructional models. This research will be of particular interest to my colleagues at Newbern University. It will also be of interest to mathematics educators, and others, who are looking for alternative instructional delivery methods and have questions about the relative strengths and weaknesses of each of the alternative models.

CHAPTER 2

REVIEW OF THE LITERATURE

As the literature search began it became clear this study would involve other things than just a comparison of traditional and intensive course delivery models. Topics that arose were: the uses of technology in instruction, more effective instructional delivery (pedagogy), reducing instructional delivery costs (this is a major driver toward intensive courses from a management view), and instructor and student satisfaction. These topics impact almost every aspect of mathematics education, including but not limited to: teacher competencies, epistemology, pedagogy, evaluation and measurement, and equity.

My search identified about 120 books, papers, reports, dissertations, and articles relevant to the study of intensive courses. This literature has been grouped into eleven categories: instructional delivery models (traditional and intensive), the uses of technology in instruction, epistemology (learning), pedagogy (teaching), teacher competencies, evaluation and measurement, educational outcome studies, time and learning studies, comparisons of traditional versus intensive courses, equity, and faculty and student attitudes toward intensive courses.

Instructional Delivery Models

The review of the literature will begin with delivery models because the major emphasis of this study is a comparison of delivery models. The literature search identified more than 20 writings concerning delivery models. These writings include comparisons of traditional and intensive courses, hybrid or blended courses, and faculty and student attitudes toward intensive courses. Only a few of these writings directly concern mathematics education as a research

base. However, the writings do provide a point of view to begin research on intensive courses in mathematics.

Hybrid, sometimes called blended, courses are courses where part of the instruction is online using a CMS or a CMS is used to augment the classroom instruction in some manner. Hybrid courses have several formats: augmenting a traditional course using online materials, either a website or a CMS, to provide enrichment for the classroom instruction; using a CMS to reduce seat time by providing some of the instruction in an online format for the purpose of better facilities utilization; or, as in the case of Newbern University, using a CMS to provide a portion of the instruction in an accelerated course taught in half the normal calendar time. The literature search failed to find any materials related to hybrid course models similar to the accelerated instructional delivery model.

Patricia Scott is one of the leading researchers in the field of instructional delivery models. She has contributed four research papers during the period 1995 to 2003 related to instructional delivery models (Scott, 1995, 1996, 2003; Scott & Conrad, 1991). In addition to this, her Ph.D. dissertation was a comparison of intensive and traditional courses (Scott, 1993). The conclusion of Scott's dissertation was intensive courses, with certain identified qualities, were as instructionally effective, if not more instructionally effective, as traditional semester-length courses. If the instructional qualities she identified were not present, however, then intensive courses were not as effective. Scott's dissertation research was done at a medium sized midwestern university of about 8,500 students. She selected two courses, each taught in the summer and fall, with the summer classes using an intensive format and the fall classes using the traditional format. Neither of the courses was a mathematics course. Each pair of courses had the same instructor. Her research was very thorough, using class observations, videotape, and

interviews along with collecting grade data on assignments and tests in each course. The overall research design was qualitative and the quantitative grade data collected were inconclusive. Her claim that intensive classes are as instructionally effective or more effective than traditional classes cannot be supported by the quantitative data presented and must be considered in the light of the overwhelming amount of qualitative data presented, the dissertation is over 500 pages long, supporting the claim.

In her 2003 article Scott reaffirmed these qualities as related to two broad categories, instructor characteristics and course organization. Good instructor characteristics were defined as enthusiasm, knowledge, experience and good communication, willingness to learn from students, student orientation, teaching methods, active learning classroom interaction and discussion, and experiential and applied learning. Theses characteristics are not uniquely desirable of instructors of intensive courses; they are universally desirable of all instructors.

According to Scott, course organization in intensive courses should emphasize depth over breadth (Scott, 1993). Scott also observed students were more likely than faculty to have positive attitudes toward intensive courses (Scott, 1993). Most of the other researchers who have done studies of instructional delivery models have reported similar results. In a study of a hybrid course delivery experiment at the University of California at Davis, Murphy reported that

> Students liked the convenience and flexibility of having the lecture material available online… However, students – especially freshmen – expressed a preference for regularly scheduled face-to-face classes, citing concerns about procrastination. Also, they stated their perception that a UC education should be based on face-to-face interaction with faculty, not on computer-based instruction (Murphy, 2002, p. 3).

These were students at a residential institution who did not have to juggle class schedules around part-time or full-time jobs. They expected to have the face-to-face contact with their instructors.

One of the keys to success in online instruction is course design. In a recent survey of college professors who had taught both online and face-to-face courses, Smith and his associates report

> Every lecture must be converted to a typed document. Directions for every assignment must be spelled out in a logical, self-contained way. Therefore, Web-based distance classes require considerably more work, often including hundreds of hours of upfront work, to set up the course. On the other hand, the development of an online class, especially one that began as a face-to-face course, makes the instructor confront and analyze the material in new and different ways (G. G. Smith, Ferguson, & Mieke, 2001, p. 2).

They go on to say, "This great amount of work sounds intimidating; however, most online instructors looked forward to their time spent online as time away from their face-to-face jobs" (G. G. Smith et al., 2001, p.2). That is, most of the online faculty enjoy being away from the classroom for the time it takes to instruct the online course. This was a survey of 21 instructors Smith and his colleagues describe as "distance learning" instructors the majority of whom taught for the State University of New York (SUNY) using the SUNY Learning Network. Most of the survey was done through interviews conducted by email. The SUNY Learning Network is only given a brief description, but that description implies that the network supports distance learning based on web pages, threaded discussions, and email. Their results are applicable to the online portion of the accelerated model.

Concerns about academic integrity are often brought up in discussions with the faculty at Newbern when we discuss online and hybrid instruction. Tests are given online in the Hybrid courses at Newbern University and some faculty are obsessed with the opportunity students have to cheat on these tests. Smith and his associates posit the students exhibit an "online identity" allowing an instructor to accurately identify student work and that, "This emergence of online identity may make the whole worry of online cheating a moot point. Often stronger one-to-one relationships (instructor—student and student – student) are formed in online courses than in face-to-face courses" (G. G. Smith et al., 2001, p.3). My experience from teaching two statistics classe using the accelerated model does not concur with this observation.

Eileen Daniel (2000) published a review of the literature on intensive courses. One of the more interesting findings in the review is learning outcomes are not significantly different between traditional semester-length courses and time-shortened courses. In fact, she reports that

> …contrary to conventional wisdom that intensive courses sacrifice rigor and academic quality for convenience, the literature strongly indicates that time-shortened formats, whether during summer session, intersession, weekend, or regular semester, can produce favorable outcomes as measured by test scores. The research also suggests that most courses, regardless of discipline, can effectively utilize time-shortened courses without sacrificing learning (Daniel, 2000, p. 6).

Daniel did find some negatives reported in the literature. Most of the negatives were related to time constrains and course workloads and were reported by students. She reports that Smith (1988) concluded from a 36 item survey of students enrolled in both time-shortened and matched semester length courses that, "…students in the intensive group were more likely to report there

was not enough time to complete assignments and felt the volume of work required was too high" (As cited in Daniel, 2000, p. 4). Another negative Daniel reported was that the literature indicates faculty teaching intensive courses tend to leave out things they would have included in a standard semester-length course such as term papers and often would not cover as much material (Daniel, 2000, p. 3). Daniel reviewed 38 reports, articles, and books published from 1963 to 1998 compiling this review. Her discussion of the literature brought out many of the same criticisms found in the section of Patricia Scott's dissertation headed "Critique of the Literature" and did not seem to have much originality. While the conclusions are valid based on the literature, this report is more valuable for its reference list.

Uses of Technology in Instruction

The use of technology in the form of a CMS is one of the major features of the accelerated model used at Newbern University. There are hundreds of articles, books, and papers reporting research related to the use of technology in instruction. The search was limited to those that in some manner were related to hybrid or intensive course models or to the use of a CMS. The literature search has identified less than 30 items in the literature on the uses of technology in instruction that are related to the study. Few of the researchers have written more than one of the papers identified from the search. One of the main themes in these articles is equal access to technology (Green, Brown, & Ramirez, 2002). One of the difficulties in deploying technology in education has been that the economically disadvantaged have not had the wherewithal to take advantage of the technology being used. Munoz has this to say about the "digital divide:"

> Clearly the "digital divide" that separates the informed (haves) from the uniformed (have nots) is contributing to the construction of additional instantiations of inequities, in large part due to the 21st century economy's shifting cultural formations, ideological assumptions, and material consequences. The digital divide is a "significant difference in the access to and equity of technological experiences based on categories of incomes, race, gender, locations, or education" (Swain, 2001, as cited in Munoz, 2002, p. 24).

The bright side to this is that the rapid deployment of technology on campuses is providing access to technology to those of the disadvantaged who attend their local community college as a means of educational and economic advancement (Choi, 1999). The "digital divide" is apparent at Newbern University, particularly at the campuses with a large inner-city student population. Entering students at these campuses often have no experience using computers and this places them at a disadvantage because, almost immediately, they are required to use computers to do a variety of tasks such as; registering for classes, communicating with their instructors by email, submitting typed documents in language arts classes, and, in some cases, participating in the online portion of accelerated classes.

Another recurrent theme is changes in pedagogy necessary to successfully deploy technology (Alley & Jansak, 2001; Chickering & Ehrmann, 1996; Chickering & Gamson, 1987; Harmon & Jones, 2001; Kadlubowski, 2000). The main argument of these researchers is that basic changes in pedagogy may be necessary for the successful use of technology in education. Kadlubowski, in his 2000 paper, asks several insightful questions regarding the use of web-based instruction:

> But what of the interaction that takes place in the traditional classroom? What becomes of the theoretical arguments an experienced educator would foster, stimulate, and encourage among the students, and/or the educator? What becomes of the personality and strength of conviction that normally results as a benefit of these stimuli? Can a chat session accomplish and achieve the finer points of theoretical argument without having the face-to-face stimulants and reactions that are readily apparent in a traditional classroom (Kadlubowski, 2000, p, 14)?

These five questions cause great concerns among college and university faculty as their institutions migrate toward more web-based instruction. Kadlubowski goes on to say, "I believe that regardless of how well web-based instruction is designed, if it is designed solely as a stand-alone product without any human interface or interaction it will not meet its ultimate goal to educate (Kadlubowski, 2000, p. 14)". Kadlubowski presented this paper at the 2000 NAWeb Conference in New Brunswick, Canada and it is mostly his opinion based on his experience. His questions could be the basis for further research on Web-based instruction.

The preponderance of contemporary learning theorists agree that learning is a social activity. Can web-based instruction be designed so that it facilitates the social activity necessary for effective learning or will there always be an attenuation of the socialization among the students and faculty that interferes with the learning process? It may be that we can design web-based instruction well enough if we heed the advice of others who have written on this topic.

Two of the others are Lee Alley and Kathryn Jansak who published "The Ten Keys to Quality Assurance and Assessment in Online Learning" in the *Journal of Interactive Instruction Development* in 2001. They astutely point out that, " Making a class 'happen' in a web-based environment is so new and different that neither broad principles nor narrowly prescriptive

practices are helpful when we sit at a computer and try to reinvent our teaching in this new environment" (Alley & Jansak, 2001, p. 3). The authors present their ten keys along with explanations and notes on actual practices and applications. Their ten keys are:

1. Knowledge is constructed (p. 6).
2. Learning is more effective if a student can take responsibility for her own learning (p. 7).
3. Student motivation is a strong determinant of the outcomes and success of learning (p. 8).
4. Higher order learning requires reflection (p. 10).
5. Learning is unique to the individual (p. 11).
6. Learning is experiential (p. 13).
7. Learning is both social and private (p. 14).
8. Inexorable epistemological presumptions can misdirect higher order learning (p. 15).
9. Learning is spiral (p. 16).
10. Learning is "messy" (Alley & Jansak, 2001, p. 17).

Alley's and Jansak's article could have been subtitled, "The Pedagogy of Instructional Technology." The discussions of each of the ten keys is accompanied by a section providing examples of practice that exemplify the key. They follow up with application notes on how to implement this advice. The ten keys presented by Alley and Jansak are nothing new and can be applied to any instructional model. The real value of this paper is the advice that they include

with each of the keys related to the pedagogy of online teaching and learning. The advice could be valuable to someone designing the online portion of an accelerated course at Newbern whether they were veteran online instructors or first-timers.

Stephen Harmon and Marshall Jones report on their successful experiences in a jointly presented online course. Their paper presents a good example of how successful a web-based course can be if designed and conducted well (Harmon & Jones, 2001). This course was a web-based course on designing web-based instruction, so the student populous was particularly motivated and adept. They are honest about what was successful and some of the difficulties experienced in producing and conducting the course. One of their observations was, "Technical skill was not a prerequisite of the class, but to a certain degree, students who were technically stronger participated more actively and enjoyed the class more than those who were not as proficient" (Harmon & Jones, 2001, p. 275). I interpret this to mean the students were not required to be technically competent to enroll in the class. They had this to say about the hardware and software issues:

> Almost without exception, students in the course felt a high degree of frustration at one time or another. This frustration was almost inevitably caused by failures or perceived failures of the hardware and software components of the class. Ironically, these crashes contributed to the evolving sense of community as the students commiserated with each other (Harmon & Jones, 2001, p. 277).

This was also the experience at Newbern as the accelerated instructional delivery model was deployed. In their conclusion Harmon and Jones provide us with this observation:

> …online learning environments are not the same as traditional environments. And while this truth may seem obvious, it appears to be lost on the vast majority

> of people in the great rush to Internet-based learning. Careful consideration must be made of your learners, the environment and other issues associated with an educational system. For example, one of the most obvious issues in Internet-based learning, the technology itself, provided one of the biggest surprises and the most challenges for a technically oriented group of people. For others we can expect this to be an even greater issue (Harmon & Jones, 2001, p. 279).

The others in this last cautionary sentence are the vast majority of instructors and professors in our colleges and universities. As more web-based instruction is forced on our educators, as is happening at Newbern University, there is a large amount of anxiety and frustration associated with becoming technically proficient in using the new technologies effectively. Harmon and Jones are both professors of Instructional Technology and wrote this article from the perspective of their profession. They both developed and instructed the online course that was the basis for the article.

In 1996, Arthur Chickering and Stephen Erhmann published an article in the American Association of Higher Education (AAHE) Bulletin on using technology as an aide to implementing the "Seven Principles for Good Practice in Undergraduate Education (Chickering & Ehrmann, 1996)." The Seven Principles have a somewhat longer history having been developed in the 1980's by Chickering and Zelda Gamson and first published in the AAHE Bulletin in 1987. That original paper is now available from a variety of sources. The Seven Principles are:

Good practice in undergraduate education:

1. encourages contact between students and faculty,
2. develops reciprocity and cooperation among students,

3. encourages active learning,
4. gives prompt feedback,
5. emphasizes time on task,
6. communicates high expectations, and
7. respects diverse talents and ways of learning (Chickering & Gamson, 1987)

In the 1996 article, later revised and enhanced by Erhmann in a 2003 revision, Chickering and Erhmann take each of the Seven Principles and associate it with technology that can enhance the implementation of that principle. For instance, with the first principle, "encourages contact between students and faculty," they suggest that the communications technology provided by the World Wide Web and email can be used to enhance contact between students and faculty, even extending to outside of normal class hours (Chickering & Ehrmann, 1996). The Seven Principles have had a long life and the extension of these pedagogical principles to instructional technology seems natural.

Teaching and Learning

When all is said and done, the purpose of instruction is learning. One purpose of this research is to examine how the instructional delivery model used affects learning. Under the heading "Learning" I include also instructional outcomes and evaluation and measurement studies; to determine the effects of instructional delivery on learning we must have some means to measure and evaluate instructional outcomes (learning). This naturally leads me to include writings concerning teaching.

Active learning as discussed by Bonwell and others describes many of the qualities that Scott says are characteristic of high-quality intensive courses (Bickman, 2003; Bonwell & Eison, 1991). The goal of active learning is to actively engage students in the learning process. Bonwell and Eison define active learning as "activities involving students doing things and thinking about what they are doing" (Bonwell & Eison, 1991, p. 2). They go on to say that while lecturing and active learning are about equal in promoting mastery, active learning is much better in developing the students' higher order thinking and writing skills. Hence, active learning is a way of teaching with a goal of maximizing learning. Bonwell and Eison go on to suggest several methods for implementing active learning and to describe some obstacles that may inhibit that implementation such as limited class time, additional preparation time, large class sizes, and lack of needed support (Bonwell & Eison, 1991). They go on to say, "Perhaps the single greatest barrier of all, however, is the fact that faculty members' efforts to employ active learning involves risks" (Bonwell & Eison, 1991, p. 3). These risks are perceived by some faculty to be professionally threatening and the support and encouragement of academic administrators will be needed to overcome these risks. Martin Bickman recently published a monograph on active learning that is an interesting read if only for the history of the American educational system that it contains (Bickman, 2003). He has this to say about lectures:

> I blush to say it, but I was never tired or bored by my own lectures. And yet I know I cannot keep my mind from wandering after about a half hour of someone else's lecture no matter how good it is. As Clark Bouton and Russell Garth have pointed out, "The active role of the teacher in the traditional classroom contrasts sharply with the passive role of the students. It is not surprising that teaching is the best learning. The teacher's activity makes the traditional method a very

effective method of learning – for the teacher" (Bouton& Garth (1983); as cited in Bickman, 2003, p. 154).

This is a powerful argument for getting the learners actively involved in the instruction. To take this further Bickman asks, "Why should we hoard all the wealth and shoulder all the responsibility? Why have just one person prepare to run a class when every student could benefit from such preparation" (Bickman, 2003, p. 154-5). What he means is why shouldn't students get the benefit that an instructor gets as he or she prepares to teach a class? In an innovative paired set of classes, one with graduate students who were in a teacher preparation program and the other of undergraduate students in a literary criticism class, Bickman and his graduate class experimented with active teaching methods until they found what worked best for them (Bickman, 2003, Chapter 9). What they ended up with was called "the structured and prepared discussion" (Bickman, 2003, p.155). The undergraduate class, which was the subject of the experiment, was divided into groups of six to eight students for discussion purposes. Each student was to read the assignment and write about it for each class session. Students were not allowed to participate in the discussions until they presented their papers (students who came to class without their writings were made to do them during class time before being allowed to participate in the discussions). These student writings became the basis for the discussions in the groups. This made the students articulate their knowledge in writing. Bickman believes unless one can articulate something they cannot be said to have knowledge of it.

Klemm (1998) proposes a solution to the problem of getting all the students in a course to participate in online discussions.

1. Require participation – don't let it be optional.

2. Form learning teams.

3. Make the activity interesting.

4. Don't settle for just opinions.

5. Structure the activity.

6. Require a "hand-in assignment" (deliverable).

7. Know what you are looking for and involve yourself to help make it happen.

8. Peer grading (Klemm, 1998 p. 63-64).

Klemm provides a short explanation of each of his eight ways and also suggests how they might be implemented. His main point is instructors need to get every student involved in online discussions to maximize the learning potential of these discussions for the individual student (Klemm, 1998). Klemm's eight ways could be equally applied to classroom discussions and activities. There is nothing about Klemm's eight ways unique to the online environment except, it may be easier in an online environment, such as a threaded discussion area, to track student participation. Peer grading is problematic. Klemm is not espousing having students do all the grading, just grading group work or other in-class activities. Still, some students may feel uncomfortable grading another student's work and may also feel uncomfortable about having another student grade his or her work. There is also the problem of consistency with peer grading. Some students may grade harder than other students. For consistency, having one person, the instructor or the teaching assistant, grade all of the assignments would be preferable to the researcher even though some believe that peer grading can be a valuable learning experience for students. I do not disagree with this point, I would just prefer not to use peer grading.

Smith, et al, (2001) in their report of a survey of online instructors, said this about the differences in pedagogy teaching online versus face-to-face.

> Some of the most important, most emphasized, and most frequent responses made points we had not directly asked about. …Some instructors feel as if a lifetime of teaching skills goes by the wayside. They can not use their presence and classroom skills to get their point across. Nor can they use their oral skills to improvise on the spot to deal with behavioral problems or educational opportunities (G. G. Smith et al., 2001 p. 19).

Online instructors must learn new ways to teach and the fact that some the teaching skills learned over the lifetime of their teaching experience are not useful for teaching online is probably threatening to some. The instructors who feel, "as if a lifetime of teaching skills goes by the wayside," are over reacting. While presence and classroom skills are important, they are not the only skills that make a good teacher. Teaching online requires monitoring threaded discussions and responding to student questions in the threads. It also requires responding to numerous student questions submitted by email. There is a lot of communication and teaching that occurs, but it is all done using the written word, rather than the spoken word (G. G. Smith et al., 2001).

Contrary to Klemm's claim some students are reluctant to participate in online discussions (Klemm, 1998), Smith and his colleagues claim

> Because of the lack of physical presence and absence of many of the usual in-person cues to personality, there is an initial feeling of anonymity, which allows students who are usually shy in the face-to-face classroom to participate in the online classroom. Therefore it is possible and quite typical for all the students to

> participate in the threaded discussions common to Web-based classes (G. G. Smith et al., 2001 p. 25).

It is true that, without physical presence, there is anonymity in the online environment and a shy person may thrive in this anonymity and participate eagerly in threaded discussions. Egos, however, exist even online. Someone with low self-esteem (weak ego) may be threatened by any activity that may lead to criticism by peers or instructors. These students are seen online as the "lurkers" described by Klemm (2001). Also, some students may be reluctant to participate in threaded discussions because they consider such to be a waste of their time or "busy work." Klemm addresses this concern with the first of his eight ways, "Require participation – don't let it be optional" (Klemm, 2000 p. 63). He suggests assigning sufficient weight to the grade for the threaded discussions that the students cannot ignore participation (Klemm, 2000).

Learning outcomes will be an important measure in the comparison of instructional delivery models that is a part of this research and, as a consequence, papers and articles on evaluation and measurement are also relevant. On outcomes, Patricia Scott had this to say, "The results suggested that contrary to conventional wisdom, intensive courses can be rewarding and sometimes powerful learning experiences for students if taught properly" (Scott, 1995, p. 207). She was speaking of time-shortened courses that were taught in a conventional manner without the use of technology. She emphasized that the intensive courses consistently produced a more focused learning experience when they were compared to traditional length classes. Scott goes on to say that the students in her study believed their academic performance improved in intensive courses as opposed to traditional courses for a number of reasons. One reason was that they took fewer courses, usually one or two, at a time. Another reason was that the short

duration of the courses kept them on task because they were afraid to procrastinate on assignments as they often did in traditional courses. They also reported fewer absences and greater retention and understanding (Scott, 1995). In a 1993 study of microeconomic classes taught both in a traditional and an intensive format, Van Scyoc and Gleason found that the students in the three-week classes actually performed better on a standardized test given at the end of the course than comparable students in the traditional 15-week class. However, when retention was measured by re-testing using the same instrument at a later date, they found no significant difference between the two groups (Van Scyoc & Gleason, 1993). This indicates that at worst, the intensive format does no harm to learning outcomes.

Teacher Competencies and Teacher Practices

A question arising when comparisons of instructional delivery models are made is: Are there differences in the sets of teacher competencies required for successful instruction between the models? The literature search identified four papers relevant to teacher competencies that were also relevant to intensive or online instruction. Spector and de la Teja, in their 2001 article compare competencies for classroom teaching with the additional competencies necessary for online teaching (Spector & de la Teja, 2001). Their main assertion is that online teaching requires additional skills related to the technology and delivery formats for online teaching, such as moderating threaded discussions, etc. Thomas Cyrs, in a review of four studies of competencies for distance teaching, identified six competencies important for success: course planning and organization, verbal and nonverbal presentation skills, collaborative teamwork, questioning strategies, subject matter expertise, and involving students and coordinating their activities (Cyrs, 1997). These seem to be no different than the competencies necessary for successful classroom teaching. In a paper reporting on the results of a study of six professors

teaching using distance education (DE) courses, Schoenfeld-Tacher and Persichitte point out several interesting things that the research indicates concerning competencies for teaching DE courses. These are also applicable to online courses and hybrid courses (Schoenfeld-Tacher & Persichitte, 2000). In a broad overview of the results they state: "…faculty must also have a firm understanding of basic instructional design strategies and learning theory in order to be able to design effective interactive lessons" (Schoenfeld-Tacher & Persichitte, 2000, p. 3). These seem to be competencies any faculty teaching in any instructional mode should have, but they are more important in online instruction. They go on to say that in addition to the skills any classroom teacher should have, teachers teaching DE courses should have a long list of other skills related specifically to distance learning. These skills are listed in the paper as:

- Familiarity with basic research on the characteristics of DE learners, their needs, and how these differ from those in f2f (face-to-face) settings.
- Application of basic principles of instructional design (e.g., congruence of content, activities, media, assessment; selection of appropriate media for the content).
- Thorough knowledge of subject matter and common misconceptions.*
- Deep understanding of the necessity of learner-centered environments in online settings.
- Ability to design constructivist learning environments.*
- Practical applications of adult learning theories, self-paced instruction, and computer mediated communication.
- Appropriate selections of online strategies and tools that promote reflection and deep processing of the content (e.g., synchronous discussion, asynchronous discussion, alternative assessment).
- Use of strategies that promote interaction among learners, instructor, and content.*
- Fostering a sense of community among learners.*
- Adaptability and flexibility with the capabilities and limitations of the delivery media.
- Sufficient familiarity with the delivery media to provide basic trouble shooting.

- Ability to multi-task.
- Time management (e.g., respond to students in a timely manner, extensive advance preparation and planning).*
- Professional characteristics (e.g., motivated to teach, self-confident, articulate, good writer)* (Schoenfeld-Tacher & Persichitte, 2000, p. 12-13).

Schoenfeld-Tacher and Persichitte posit this list of skills is in addition to those needed to be a good classroom teacher, which is a prerequisite to being a good DE teacher. However, the skills marked with an asterisk (*) are not unique to the distance learning environment and could be considered to be skills needed to be a good classroom teacher. My impression of most of the lists of desirable instructor characteristics and skills presented in the literature on intensive instructional delivery models, online instruction, and distance learning is that they all list a large proportion of skills and characteristics that exemplify most good instructors.

Carole Holden describes a faculty development effort to train instructors in the effective use of instructional technology (Holden, 1999). The effective use of instructional technology is one of the keys to success of the blended model used for accelerated instruction at Newbern University. These papers provide a base for evaluating instructors' use of technology, which is an important part of the research.

CHAPTER 3

RESEARCH METHODOLOGY

The modern trend in educational research studies has been away from quantitative studies using objective data and inferential statistics to qualitative studies using subjective data gathered from interviews and observations and ethnographic analysis techniques. There are, however, some things, such as learning outcomes, very difficult to handle in a qualitative manner. Both qualitative and quantitative data are required to successfully answer all of the research questions. I collected data from four sources for this research. Data from three of the sources are qualitative and were analyzed using ethnographic techniques, and the data from the fourth source were quantitative learning outcomes data gathered from class records and embedded examination questions that were analyzed using inferential statistics. So this research is neither exclusively qualitative nor quantitative. In this chapter I discuss each data source in some detail, giving the nature of the data, how it was collected, and how it was manipulated and analyzed. The research was conducted during the Spring 2004 term at Newbern University, which began the first week of March.

Description of Instructional Delivery Models

Standard Instructional Delivery Model

The standard instructional delivery model at Newbern University is a typical fifteen-week model. There are 14 weeks of classroom instruction and week 15 is final examination week for all the standard courses. Classes are usually scheduled in two-hour blocks. There are exceptions to this. However, College Algebra, the course used for the research, is a four credit-hour course and is always scheduled in two-hour blocks. Only day classes are delivered using the standard

instructional delivery model. At Newbern University this means that the student population for these courses has the demographics that are typical for freshman level courses at any other university, recent high school graduates in the 18 to 20 year old age bracket. Five sections of College Algebra were selected for this study and two of them were delivered using the standard instructional delivery model. There were a total of 70 students in the two classes combined. One of the classes started out with 59 students, which is a large class at Newbern University. The other class started with only 11 students, which is a small class at Newbern University. Class sizes are normally about 30 to 35 for those delivered using the standard instructional delivery model.

Compressed Instructional Delivery Model

The compressed instructional delivery model at Newbern University is an eight-week model in which the seat time per week is doubled from the seat time in the standard instructional delivery model. In the case of College Algebra what this means is that the classes meet for eight contact hours per week in the compressed instructional delivery model versus four contact hours per week in the standard instructional delivery model. During the semester being studied, all of the class sections of College Algebra delivered using the compressed instructional delivery model were scheduled in two, four-hour blocks. The compressed instructional delivery model is used mainly for day-time classes where the demographics are similar to the demographics for the standard instructional delivery model.

Two sections of College Algebra were selected for this study that utilized the compressed instructional delivery model, one instructed by Professor Brown and one instructed by Professor Algorwal. Professor Brown's class was very small, having only four students. Professor Algorwal's class was somewhat larger, although still small by Newbern University standards,

with 12 students, 6 of whom completed the course and took the final examination. There was an obvious disparity in class sizes between the standard instructional delivery model classes and the compressed instructional delivery model classes. One conjecture explaining this disparity is students were avoiding the intensive format day classes. The intensive classes had only been offered for a short while and the students were not familiar with these new instructional delivery formats and could have been avoiding the unfamiliar. I was not able to confirm this through the interview process because I was not able to interview any of the students in the standard instructional delivery model classes.

Accelerated Instructional Delivery Model

The accelerated instructional delivery model uses a combination of face-to-face and on-line instruction. This model is often called a blended or hybrid instructional delivery model in the literature. At Newbern University, this hybrid instructional system is called the Blended Instructional Learning System (BILS). At the time of the research, Newbern had been using the BILS for one year and not everyone was comfortable or proficient in the use of BILS. Classes using this model meet three and a half hours per week face-to-face in a regular classroom. Each class also has an on-line component that students are required to complete. This component is expected to occupy the students three or four hours per week depending upon the credit hours for the course. The courses are taught in an eight-week session similar to the classes taught using the compressed instructional delivery model. The on-line component of the course uses the WebUniversity® course management system (CMS). Each course has what is termed a course shell in the WebUniversity® CMS. Students access this shell to get assignments, look at on-line lectures, which can be Power Point® presentations or video presentations, download reading assignments, and take tests. They also are expected to participate in on-line discussions using a

threaded discussion area where the students can post questions and also post answers to questions. This allows the students an opportunity to collaborate on the assignments and also get help from the instructor outside of the classroom. Instructors are required to spend time monitoring these threaded discussions and step in whenever the students need instructional support to answer questions. Although, inspection of the threaded discussion areas in the College Algebra online shells indicate that instructors often do not comply with this requirement. The threaded discussions also allow for help with understanding the topics taught face-to-face in the classroom. All testing, except for the final exam, is done on-line using the WebUniversity® CMS. One advantage of using the WebUniversity® CMS is the grade book area where students can keep up with their grades in the course without having to ask the instructor. Students like this feature because they always know where they stand in the class.

One of the objectives of the University when the accelerated instructional delivery model was being developed was to provide as much consistency as possible in course delivery across the many campuses and centers as possible. A committee of instructors from across the Newbern University System selected a textbook for each course and a WebUniversity ® course shell was developed based upon that textbook. An instructional designer, who was an instructor who had experience teaching the subject using the selected textbook, was recruited to develop the shell based on the recommendation of his or her supervisor and the instructor's willingness to do the development. The topics for the on-line component of accelerated courses are selected from the course terminal objectives and were those topics that the instructional designer judged were easiest to teach on-line. The other topics that the instructional designer judged were better taught face-to-face because of their difficulty were allotted to the classroom. The first group of shell developers was given training in course design and online pedagogy and then set to their

tasks. Later, course shell developers were selected by need for a new course shell and these instructors did not receive the same level of training as the first group of shell developers. The instructors who actually taught the courses using the accelerated instructional delivery model were given training in how to use the WebUniversity ® CMS only and were assigned course sections to instruct. Every professor and instructor at Newbern University was required to take the WebUniversity ® training. Training in the pedagogy of online instruction was not provided.

Course Selection

In order to minimize the potential effect on the study results that could be caused by using more than one course in the research, I studied only one course. My objective when selecting the course to use was to find a course that was being taught using all three instructional models of interest, standard fifteen-week, compressed, and accelerated, and was being taught by two instructors using these models. The online instructional delivery model was omitted from the study because of the difficulties involved in gathering student and instructor interview data. On line instructors and students could be located anywhere in the United States. I determined that College Algebra was the course that best fit these criteria from an examination of the course schedules for the Spring 2004 term. Two instructors were teaching College Algebra in multiple instructional delivery models, one using the standard fifteen-week model and the compressed model and the other using all three instructional delivery models, standard, compressed, and accelerated. There were no other instructors using all three instructional delivery models who were teaching College Algebra or any other mathematics course.

Most students take college Algebra in their second term at Newbern University. This increased the probability that the student subjects would have had experience with two or more instructional delivery models at Newbern. In fact, I found most of the students interviewed had

previous college experience at other institutions on which to make comparisons. This added to the validity of the results by making the comparisons well grounded in past experience. It is unfortunate that both instructors were not using all three models. Both instructors, however, had experience instructing using all three models. This reduced the effect on the results of the study caused by the imbalance of one instructor using only two of the instructional delivery models during the period of the research. All the names of subjects used in this dissertation are pseudonyms to protect the privacy of the participants.

Research Subjects

The research subjects were two instructors teaching College Algebra during the Spring 2004 term at Newbern University and four students enrolled in their classes. One instructor, Rani Algorwal, is a native of India whose family immigrated to the United States when she was a child. She was educated in American schools and has been a professor at Newbern University for five years. She is generally considered by her students and her peers to be an excellent mathematics instructor. The other instructor, Jerome Brown, is an African American who has been a professor at Newbern for eight years. Professors Algorwal and Brown teach at separate campuses with very different student demographics. Professor Algorwal teaches at a suburban campus whose student population is typically suburban middle class in origin. Professor Brown teaches at a campus where the student population is mostly inner-city and most of the students are the first in their families to attend college.

The four students I was able to interview were all in Professor Algorwal's classes. Three of them were in her accelerated College Algebra class and the other was in her compressed College Algebra class. In spite of intensive efforts, such as personally telephoning 80% of his students, I was unable to recruit any student volunteers from Professor Brown's class. There

were one male student and three female students. The male student, Viktor Karoli, is an emigrant from Romania and is one of the older students at Newbern. He has recently returned to school after a lapse of about 30 years. His mathematics ability is, by his own admission, weak from lack of use. He was a student in Professor Algorwal's accelerated College Algebra class. He was very concerned about learning and I observed him to work very hard in my observations of Professor Algorwal's class. He was unable to complete the College Algebra course and withdrew in about week five to re-enroll in Intermediate Algebra during the next term. One of the female students, Mary James, is a with-it late 20's female who is in a hurry to get her degree. She exudes confidence and knows what she wants. She is taking all of her classes in the accelerated instructional delivery model and the online instructional delivery model. Her driving motivation for furthering her education is career advancement and she wants to earn her degree as soon as possible. Another of the female students, Erica Castro, is a young Latina who recently moved to the Atlanta area from Texas where she went to community college for one year. When she moved to Atlanta she completed an Associates Degree program at a local business college. Erica attracted my attention during my observations of Professor Algarwal's class with her active participation and willingness to help others in the class. She is a self-professed good mathematics student and is pursuing a bachelor's degree in business with a concentration in accounting. The third female student, Wendy Hall, is a white female who works full-time and attends Newbern during her off-hours from work. She professes to like mathematics, but also professes to have difficulties learning mathematics.

Data Collection and Analysis

I conducted an interview with each of the individual participants after the courses were completed. I used two separate interview scripts, one for the instructors and one for the students.

The interview scripts are included in Appendices A and B. The interviews were conducted using ethnographic interview methods described by Kvale (1996). The interviews were recorded and later transcribed for analysis using qualitative coding methods described by Coffey and Atkinson (1996). The results of the analyses were written using ethnographic methodologies prescribed by Wolcott in several texts (1994, 1999, 2001).

I conducted multiple classroom observations of each class section. There were a total of 12 classroom observations conducted at various times during the term. These observations were done from the point of view of a non-participant observer. I endeavored to keep myself apart from the classroom activities as much as possible and was mostly successful at doing that. My presence in the classroom, however, probably had some effect on the conduct of each class simply because I was there and observing what was going on. It is impossible to observe or measure something without influencing the outcome, no matter how slight the influence. The classroom observations were also analyzed and coded according to methods outlined in Coffey and Atkinson (1996), and written up using methods outlined by Wolcott (2001). A time line of these data collection activities appears in Table 3-1.

In addition to the classroom observations, I collected the threaded discussions from the online portion of Professor Algorwal's accelerated course. These gave me a measure of how effective the online portion of the course was as a teaching and learning tool.

I provided each instructor with ten problems to be imbedded in their final exams. The purpose of these imbedded problems was to provide a measure of the learning outcomes from each instructional delivery model. The problems were based upon the learning objectives outlined in the curriculum guide for College Algebra. I graded these problems myself using a

five point grading rubric. This rubric is shown in Table 3-2. The results were analyzed using

Table 3-1:

Time line of data collection activities

Date	Activity	Professor or Student
February 2004	Recruited Professors	
March 30, 2004	Classroom observation standard class	Brown
March 30, 2004	Classroom observation compressed class	Brown
April 2, 2004	Classroom observation standard class	Algorwal
April 2, 2004	Classroom observation compressed class	Algorwal
April 12, 2004	Classroom observation compressed class	Brown
April 16, 2004	Classroom observation compressed class	Algorwal
May 2, 2004	Classroom observation accelerated class	Algorwal
May 4, 2004	Classroom observation standard class	Brown
May 7, 2004	Classroom observation standard class	Algorwal
May 14, 2004	Classroom observation standard class	Algorwal
May 23, 2004	Classroom observation accelerated class	Algorwal
June 6, 2004	Classroom observation accelerated class	Algorwal
June 23, 2004	Interview	Castro
June 29, 2004	Interview	Karoli
July 6, 2004	Interview	Hall
July 9, 2004	Interview	Algorwal
July 14, 2004	Interview	James
September 14, 2004	Interview	Brown

standard statistical analysis methods. Professor Brown, unfortunately, did not remember to make the embedded test items a part of his final examination. Hence, I did not get data on the 26 students who completed his class. This turns out to be immaterial to the research results for reasons to be discussed in Chapter 4.

Table 3-2:
Scoring Rubric

Points	Description
0	Does not attempt or shows no knowledge of how to solve.
1	Shows some knowledge of how to solve or makes some attempt to solve
2	Shows knowledge of how to solve but makes basic errors in computation
3	Shows knowledge of how to solve and makes minor errors in computation
4	Shows complete knowledge of how to solve and has correct solution

I also collected grade data on each class. These data consisted of WF rates and class aggregate grade point averages (GPA's). A WF rate is the portion of students who either withdraw (receive a grade of W) from a class or earn a grade of F for the class. These data were also analyzed using standard inferential statistical methods. For comparison, I collected grade distribution data for all of the College Algebra classes offered during the Spring 2004 term at the two campuses. Table 3-3 summarizes the variables used in this research.

Table 3-3:
Summary of Research Variables

Variable	Data			
Course	College Algebra			
Instructional Delivery Model	Standard	Compressed	Accelerated	
Professors	Algorwal	Brown		
Students	Karoli	James	Castro	Hall
Embedded Test Item Scores	Standard	Compressed	Accelerated	
Aggregate GPAs By Model	Standard	Compressed	Accelerated	
WF Rates By Model	Standard	Compressed	Accelerated	
Interviews				
-- Professors	Algorwal	Brown		
-- Students	Karoli	James	Castro	Hall
Classroom Observations				
-- Algorwal	Standard	Compressed	Accelerated	
-- Brown	Standard	Compressed		

The final data used were the results of a second-party survey of instructors using the BILS © instructional delivery method. The data from the survey were culled for relevant questions and responses and then analyzed and written up using methods mentioned above.

Relevance of Research

This research should be of interest to any who are looking at alternative instructional methods to the standard semester length format, particularly those who are mathematics

educators. Although the literature shows that, given certain conditions which are elaborated in the review of the literature, intensive (here meaning compressed) course delivery can be a much richer learning experience for the students. Much of the literature also finds that certain courses, mathematics and science courses for example, are not as easily taught in an intensive format.

I do admit to bias based on personal experience, that the BILS © is not as good an instructional model for teaching statistics in particular as the standard fifteen-week semester model. This experience was from teaching two semesters of a Statistics course using the BILS © model and an informal comparison of the results with several semesters of teaching the same course in a standard 15-week format.

I also must disclose my roles as the Chair of Mathematics and Science and as a Mathematics Curriculum Manager at Newbern University. In these roles I have had first hand experience with the development and deployment of the two alternative instructional delivery models of interest that may influence my judgments related to the research. Also, I am the supervisor of the two professors who are subjects of this research. The professors freely volunteered to participate in this research and each signed consent agreements to participate.

My institution, Newbern University, has a vested interest in the results of this research because of its efforts to better utilize classroom and laboratory space to better accommodate a growing night and weekend student population without investing in additional physical plant. The motivation for the introduction of the accelerated instructional delivery model was a direct result of this effort. The accelerated model effectively doubles the available classroom and laboratory space if it is used to instruct all the night and weekend courses.

CHAPTER 4

ANALYSIS AND RESULTS

Introduction

The research was conducted during the Spring 2004 term at Newbern University, which began the first week of March. Two instructors agreed to participate in the study, Professor Rani Algorwal and Professor Jerome Brown. Professor Algorwal taught three sections of College Algebra during the Spring 2004 term, one using the standard instructional delivery model, one using the compressed instructional delivery model, and one using the accelerated instructional delivery model. Professor Brown taught two sections of College Algebra during the term, one using the standard model and one using the compressed model. At the end of the term, four students agreed to participate in the study by being interviewed.

The results will be presented in the following order; a report of the results of each instructional delivery model with the standard model first, the compressed model second, and the accelerated model last. Within each of these result sections I will report on class observations first, instructor interviews second, and the student interviews third. All of this will be followed by a section on the learning outcomes.

Standard Instructional Delivery Model

Instructors

Algorwal

In her standard classes, Professor Algorwal typically begins with about ten minutes of announcements and housekeeping chores such as returning graded work. She then conducts a

short review of the homework and previous instruction the length of which depends on student questions, but is normally less than 15 minutes. On one occasion this review lasted for a full 40 minutes on a topic that Professor Algorwal had spent over two hours presenting in previous classes. This would be an unlikely occurrence in an accelerated delivery class because of the time constraints.

Professor Algorwal's instruction normally follows a set pattern, short lecture introducing a new skill, demonstration of the new skill or a new facet of a previously presented skill, seatwork for the students to practice the new skill, board work where a student presents her or his seatwork, and answering questions on the new skill. This pattern is repeated twice before a short break at the end of the first hour and then repeated twice again in the second hour. Professor Algorwal normally ends a class by assigning homework to be done before the next class meeting. As she goes through this cycle, Professor Algorwal is careful to construct knowledge by building on knowledge and skills that the students have previously mastered.

In her standard classes Professor Algorwal continually interacts with the students. She keeps them engaged by conducting a continuing conversation with the students as she lectures and demonstrates, prompting them for answers using probing questions and soliciting their help during the demonstrations. She attempts to have the students see how what they have learned before can be applied to learning the new skill being demonstrated. She willingly allows interruptions from students for their questions related to the lecture or demonstration and gives detailed answers to their questions and tests for understanding before continuing. She allows and even encourages the students to collaborate on the seatwork. The pace of the standard course was noticeably slower than the compressed course. I observed a lesson on polynomial functions in each class and the standard delivery class was noticeably slower paced.

During the interview, Professor Algorwal showed a remarkable grasp of the differences between the instructional delivery models and expressed her opinions with thoughtfulness and with clarity. Professor Algorwal was very forthcoming concerning her opinion of the standard instructional delivery model.

> I think that the standard model, in most cases, is probably the best method of delivery because it gives the students a lot more time to get prepared. In other words, they have more time if they are weak students to get tutors or they have time to come in and use the office hours for the end of the chapter [to prepare for quizzes]. Also, you're, the instructor, is not so pressed for time and so you solicit more class participation (R. Algorwal, personal communication, July 9, 2004).

The emphasis in this quote is on time. Professor Algorwal mentions time in several contexts, time for the students to get prepared, time for the students to get tutoring, time for students to get help from the professor during office hours, and time for soliciting class participation. Time is the overarching theme of Professor Algorwal's feelings toward the three instructional delivery models. She is concerned that students have the time to digest the material and learn to use the skills. Later we will see that she does not feel that the other delivery models allow enough time for this.

When Professor Algorwal was asked how she perceived the students' attitudes toward the delivery models she had this to say,

> In the standard model what I found was that a lot of the students were, you know, less stressed and actually they came up to me and said they couldn't handle it in the compressed or the accelerated models. So I'm assuming that the comfort level is a lot greater because they feel they have those fifteen weeks to, I guess, absorb

> the materials. And they pretty much had,… for the most part I think it was a good class. They had a really good attitude. They kept up with their homework. They used my office hours. They did a lot of team learning. I actually saw them set up times to meet each other and go over their homework and so on and so forth. So, I found their attitude was really geared towards, to learn…. Yeah, for the most part the students were very comfortable in the standard model (R. Algorwal, personal communication, July 9, 2004).

Her perception is that the students prefer the standard instructional delivery model. She sees a lot more student interaction and collaboration, which is a good indicator of student motivation. She also sees that the students are more comfortable and relaxed in the classroom than they are when the accelerated instructional delivery model is used.

Professor Algorwal noticed a difference in how successful students were on formal assessments between the delivery models. This difference she related to time and schedule when comparing the standard instructional delivery model to the compressed instructional delivery model. When comparing the standard instructional delivery model to the accelerated instructional delivery model she related this to the differences in the models themselves. She had this to say about preparing her students for the final examination in the standard instructional delivery model class section:

> Now, in the case of the standard session what I had done was, I gave them one day to review on their own and the next day I went over the review. And then the following day they get the final. They had a day between my review and the final. So, they had a chance to put all the material together and I allowed them to use their textbook on the final. So, they had it fairly well organized and so on

> and so forth. They had the posted notes and everything. And, uh, a lot of them actually did a lot better than I expected. So I think in terms of preparation for the test, they were very well prepared (R. Algorwal, personal communication, July 7, 2004).

When comparing this to the compressed delivery model Professor Algorwal said that because of the scheduling of the class, the students had very little time to prepare and get organized for the examination because the examination was the next day after the review. She went on to say that using a different schedule would have eliminated this problem.

When asked what her personal attitudes were toward the different instructional delivery models, Professor Algorwal expressed a definite preference for the standard instructional delivery model.

> I had a very good attitude and actually am very enthusiastic about the standard and the compressed models. I think they give me the same amount of class time and uh, If I would get all of the class periods, the compressed would be the same amount of class time and I think I can take my time to explain concepts to them and actually lead them to the concept, to their own thought processes and questions and so on and so forth. And, so, I really have, I'm more enthusiastic about teaching a standard or compressed class than I am about teaching an accelerated session…(R. Algorwal, personal communication, July 9, 2004).

Again, we see that what Professor Algorwal is concerned with is having the time to teach in the manner that she finds most satisfying and effective for her students. Professor Algorwal is very student oriented and genuinely wants her students to be successful. She makes every effort to adjust her teaching to the needs of the students within the bounds of her primary teaching

style. She expressed her concern for her students later in the interview by saying that she saw a tremendous amount of reluctance to enroll in mathematics courses in her students. She related that reluctance to possible past experiences in high school. She went on to say, "…the first thing I tell them in a standard or compressed class is that this is the classroom, this is our environment, don't be scared to ask any questions. I said, there is no question that is unnecessary. Take every opportunity you get to come work out a problem on the board because it's totally a non-threatening environment. No one is judging you."

In summary, Professor Algorwal believes that the standard instructional delivery model is preferable for teaching mathematics. Her beliefs are based on her perceptions of the time available for the students to absorb the material and to get help in the form of tutors or personal instruction from the professor and the amount of time available for the students to study and prepare for tests and exams.

Brown

The other professor who participated in this study is Jerome Brown. Professor Brown is a mid to late thirties African-American male from Pennsylvania. He has been teaching at Newbern University for eight years and is generally well liked by his students who find him to be friendly and open. His students seem to like him very much and often choose their classes so as to have him again for their second mathematics course. He primarily teaches intermediate and college algebra, but sometimes teaches statistics.

I observed Professor Brown twice in the class that used the standard instructional delivery model. This was a very large class for Newbern University. There were 59 students in a classroom that only had 55 desks. There were chairs placed along the wall on one side of the classroom and those students who were late were forced to use these chairs for seating.

Professor Brown's delivery style is quite different than Professor Algorwal's lecture-demo-seatwork-board work-feedback style described previously. Professor Brown began each class with about five minutes of announcements and housekeeping. Then he began his lecture without going over previous class material or homework. Professor Brown worked from the textbook most of the time and the examples he used on the board came straight from the textbook. The students followed along in the textbook and parroted the material when Professor Brown asked questions on the topic. There seemed to be ongoing two-way communication between Professor Brown and his students, but mostly the students were responding to questions with what they read from the textbook in front of them. The only seatwork I observed in Professor Brown's classroom was a calculator exercise on rational exponents designed more to convince the students of the nature of rational exponents than as practice of what was demonstrated.

One incident provided evidence the communication that seemed to be taking place was not. During one demonstration of solving polynomial equations by using factoring by grouping, Professor Brown made an error and questions arose from the students. It was evident from Professor Brown's response to the questions that he did not understand what was confusing his students. This issue was never resolved and the students were left without an answer to their question. From this and other observations, I conclude that Professor Brown has problems understanding non-routine questions that come up in his classroom. Professor Brown's main method of testing for student understanding is oral questioning. Since the students do virtually no seatwork in his class, they get no opportunities to practice what they have been shown other than the homework assignments.

The main difference between Professor Brown's instruction in this class and in his compressed instructional delivery model class was not related to the differences in the delivery

models at all. The compressed instructional delivery model class was very small. There were only four students in the class, compared to the standard instructional delivery model class of 59 students. The relationship with the students in the standard class was less personal than the compressed class, where Professor Brown could afford to instruct almost one-on-one in more of a tutorial style.

During the interview when I asked Professor Brown to describe the differences between his instructional delivery styles among the three instructional delivery models his reply concerning the standard instructional delivery model contradicted what I observed in his classroom.

> Okay, let's go with the instructional delivery for the fifteen-week [model]. It would be more of a group-oriented style of teaching where I can get the kids in groups of five and then work with them in their groups. The pace is a lot slower, because I have more time. So I have more time for actual instructional delivery in terms of getting them involved with board work; in terms of getting them involved with, you know, getting them to use the computer lab, and different things like that (J. Brown, personal communication, September 14, 2004)

This is not what I observed in Professor Brown's classroom. I observed no group work, no board work, and the instructional delivery was only lecture. This may have been because of the large size of the class and the lack of space for group work in a crowded classroom. He later describes himself in the standard instructional delivery model as being, "more as a lecturer." This concurs with what I observed.

Later in the interview, when I asked Professor Brown how he perceived the students' attitudes toward each of the instructional delivery models he had this to say about the standard instructional delivery model:

> Now with the standard class it's like an extrovert (sic) style because it's more large, so the students, sort of like, you as an instructor have to pull out answers and questions from the students because they have a tendency, either they do not want to be embarrassed, not want to be put on the spot so to speak. So they are more laid back and you have to do more pulling out and getting more information (J. Brown, personal communication, September 14, 2004).

There is a contradiction in this statement involving the use of the word extrovert. The affect described is introvert as opposed to extrovert. Professor Brown also later misused introvert to describe an extrovert behavior so there is consistency. The affect described, whether extrovert or introvert is applicable, should be more properly related to class size and not to instructional delivery model. However, at the time of this research the compressed instructional delivery model was just being introduced and students were avoiding enrollment in compressed classes when a standard delivery model class was also being offered at a convenient time. This indicates the students preferred the standard instructional delivery model to the compressed instructional delivery model, either through ignorance of the differences or by actual preference. When asked what he thought caused the differences in attitude toward the models, Professor Brown related the differences to differences in class size. In his experience, standard instructional delivery model classes were large when compared to the other alternative delivery models.

Later in the interview, when I asked Professor Brown about his attitudes toward the different instructional delivery models, he had this to say about the standard instructional delivery model.

> With the standard group, my attitude is that, it's a traditional way of teaching and there is nothing wrong with that, but it is traditional where you are doing more lecturing. So, I don't know if I am reaching every student per session until a measuring is done (J. Brown, personal communication, September 14, 2004).

This comment agrees completely with my observations. Professor Brown's style of lecturing permits very little feedback from the students to allow for continuous learning assessment. The comment, however, conflicts with his previous statement that the fifteen-week model is a group-oriented model. This was a very large class and that may have had an effect on how the class was conducted. Professor Brown's interaction with his students was much different in the compressed instructional delivery model class, which was much smaller. I will discuss the differences later in this chapter.

There is some conflict with Professor Brown's actual teaching practices and what he professes to in the interview. There is even internal conflict in the interview itself with Professor Brown saying that he uses group work in the standard instructional delivery model and later saying that he mostly lectures, which matches the observations. The main point to understand is that he does teach differently in the standard instructional delivery model than in the compressed instructional delivery model.

Students

Viktor Karoli

Viktor indicated in his interview that he did very well in the courses using the standard instructional delivery model but that he thought the accelerated instructional delivery model was more his pace. He admitted he would have been more successful if he had taken College Algebra in the standard format. He believes, however, that he becomes easily bored with the slow pace when he is in a course using the standard instructional delivery model. He blamed his lack of success on not having taken Intermediate Algebra before attempting College Algebra. When asked if there were courses he would prefer to take in the standard format he indicated that courses like history, where there is a lot of reading and memorization, would be better if instructed using the standard instructional delivery model.

Mary James

During the interview I came to the following conclusions concerning Ms. James. She understands what she needs and how to get it. She is forced to take the online and accelerated courses to get ahead in her career. She is bright, so she can be successful in the online and accelerated courses. She realizes that in order to really learn a subject, however, she needs the standard instructional delivery model or the compressed instructional delivery model in order to process the knowledge into long-term memory and be able to transfer it to other applications. For this reason, she takes the courses that she feels she needs the most help in the accelerated instructional delivery model to get the face-to-face contact that is missing in the online instructional delivery model. Based on the following quote from the interview, I think that, if not for the career pressures, Ms. James would prefer the standard instructional delivery model for mathematics.

> If I wasn't in a hurry to do the things I need to do in order to further my career, which is why I'm doing the accelerated model, I probably would be doing the full, you know, fifteen-week on campus set of course work because, you know, you probably get a more in-depth education that way. And then it also has some networking benefits that you don't necessarily get in online (M. James, personal communication, July 14, 2004).

Time is the theme here also, although not in the same sense as time is the theme with Professor Algorwal. Ms. James is interested in compressing her educational experience into as short of a time interval as possible. As a result, she is taking classes in instructional delivery formats that she believes are not as conducive to long-term learning.

Erica Castro

Erica is a very motivated young lady. She chooses the instructional delivery models for the courses she takes based on her interest in the subject matter. If she is interested in the subject, which was the case with College Algebra, she prefers the accelerated instructional delivery model because her interest helps her to keep up with the pace of the instruction. If she has moderate or low interest in the subject she prefers the compressed or the standard instructional delivery model because the slower pace, in the case of the standard instructional delivery model, and the increased face-to-face instructional time provide for more time to absorb the material, which she finds boring.

When asked to compare the differences in pedagogy between the standard instructional delivery model and the accelerated instructional delivery model, she was unable to articulate any differences. She genuinely felt that there were no differences.

Ms. Castro did very well in the accelerated College Algebra course. However, she also took College Algebra at another institution within three years of taking this College Algebra course.

Wendy Hall

Contrasting with Erica Castro, Ms. Hall struggled in an accelerated intermediate algebra class. She had this to say about repeating the intermediate algebra course in a class section using the standard instructional delivery model.

> Then I moved to 15 a standard week course. A 15 standard week I passed. I found that since it was a slower pace and I had just got back into it, it helped. So it was kind of a switch of deals that time. I took 15 standard weeks for MATH100 a second time and,.. I passed (W. Hall, personal communication, July 6, 2004).

The major theme of Ms. Hall's comments is that in the classes using the standard instructional delivery model there is time to learn and grasp the concepts being presented. Based on the following comment, Ms. Hall prefers the standard instructional delivery model for mathematics.

> So, I've always had a hard problem with math, word problems especially. And it's something I have a hard time getting over. And math is a really rough subject for me to do. But, uh, so it takes me a little longer. So I'd have to say for me that, math-wise fifteen-week courses are better for me because I have time to really grasp everything and work things through at my own pace (W. Hall, personal communication, July 6, 2004).

Ms. Hall had a bad experience in the accelerated intermediate algebra class. She and the instructor had conflicts that affected both their attitudes and resulted in a failing grade. Ms. Hall

then took the intermediate algebra course in the compressed instructional delivery format with the same instructor and the conflict was still apparent and the result was the same, a failing grade. She took the course for a third time and was in Professor Algorwal's standard instructional delivery model classroom where she excelled. Ms. Hall also did very well in Professor Algorwal's College Algebra class which used the compressed instructional delivery model, so there was probably some validity to the conflict with the previous professor.

Summary

The standard instructional delivery model has been the norm for decades in American institutions. It is what students and professors are used to and comfortable with. The standard instructional delivery model provides time, both in-class time and longitudinal time (15 weeks) for instruction that is missing from the other two instructional delivery models, particularly the accelerated instructional delivery model. This is important for some students who need this time, particularly the longitudinal time, to study and absorb the concepts and materials presented in a college mathematics course. There are some students, particularly the better prepared students, who can be bored by the slow pace of the standard instructional delivery model and suffer the effects that usually come with boredom such as inattention. At least one of the students interviewed, Mary James, was this type of student. The research results show the less prepared students, or the students without recent mathematics experience in an academic setting, such as Viktor, often do better in a standard instructional delivery model setting. These are the students mentioned above who need this longitudinal time to absorb the concepts and develop the skills.

Compressed Instructional Delivery Model

Instructors

Algorwal

Professor Algorwal's pedagogy using the compressed instructional delivery model is almost a mirror of her pedagogy using the standard instructional delivery model. The main differences were related to the scheduling of the classes. The class using the compressed instructional delivery model was schedule on Thursdays and Fridays in two, four-hour blocks. There were effects from this scheduling that became apparent during both the class observations and the interview with Professor Algorwal. One effect observed in the classroom was that the students became restive after about three hours and any instruction after that time was ineffective because the class became disengaged from whatever was going on in the classroom. This was observed more than once in this particular classroom and has also been my experience in my own classroom. In one particular case, the class had been in session for about three hours and fifteen minutes when Professor Algorwal attempted to introduce a new topic. It was obvious that the students were not receptive to new information and the lecture collapsed and the class was terminated fifteen minutes later. The instruction on the new topic was continued in the next class meeting. This probably would not have happened with a different class schedule, say four, two-hour blocks per week. The effect of this on instructional time was the loss of about two hours per week of the eight hours per week of classroom time for instruction. The effect of this on pedagogy was to increase the pace of instruction. I observed that Professor Algorwal used the same instructional cycle in the compressed instructional delivery model classroom as she did in the standard instructional delivery model classroom. The main difference was that she did not allow as much time for student questions and did not use as much seatwork or allow as much

time while students were doing seatwork as in the standard instructional delivery model class. One behavior difference related to pedagogy was that Professor Algorwal did not allow as much time for students to respond to her questions in this classroom. Often she would show impatience and provide answers to her own questions before the students could respond. Although this did save class time, it is not good practice.

The differences in pedagogy between Professor Algorwal's standard instructional delivery model class and her compressed instructional delivery model class were all related to time. Because of the two, four-hour block schedule, Professor Algorwal lost about two out of eight hours of effective instructional time per week. This loss of time was compensated for by shortening the amount of time she normally allowed for things such as seatwork and informal assessments. As a result, her students in the compressed instructional delivery class did not receive what they deserved from Professor Algorwal, though this was the best Professor Algorwal could make of the situation.

When Professor Algorwal and I discussed the compressed instructional delivery model during her interview, she indicated a preference for the standard instructional delivery model but thought that the compressed instructional delivery model was almost as good. The only problem was the scheduling of the compressed class she was teaching, which was in two, four-hour blocks per week. There are several problems with two, four-hour blocks per week. A major problem is that if one of the days that a four-hour block is scheduled happens to be a holiday, then you loose the equivalent of one week of instructional time in a standard instructional delivery model class. Newbern University does not adjust the calendar of their terms to allow for holidays like most other institutions. Hence, if a class meeting is scheduled on a holiday, that meeting is lost and the professor has to adjust his or her teaching schedule to allow for the loss.

Another is that if the four-hour blocks are on consecutive days, then the students do not have sufficient time between class meetings to do homework, get feedback, or to prepare for tests. Professor Algorwal had this to say in the interview:

> …but still there is some kind of pressure when you are teaching the compressed model because, if you lose even one day, you are losing pretty much a whole week of class time. And that happened to me in the past and you know, once you are behind you are behind…. If you get the entire time and if we were to schedule the classes in such a way that the instructor had all the available dates, then I think the compressed and the standard are, say, equally good. But, once you have these holidays coming in, the compressed, to me, does not look as good a model as the standard (R. Algorwal, personal communication, July 9, 2004).

I brought up the possibility of scheduling the compressed classes differently in the future, say four, two-hour blocks, and received a very positive response from Professor Algorwal. She was very enthusiastic about this possibility because she thought it had benefits for the students because students taking their classes in the compressed instructional delivery model only take two or three classes at a time as opposed to five or six classes if they were taking their classes in the standard instructional delivery model. With fewer classes at a time the students can concentrate more of their effort on the two or three courses they are taking rather than spreading their effort over five or six classes. This should result in better learning outcomes.

Another problem with the four-hour blocks is absenteeism. If a student misses a day of class it, has the same affect as though the student missed an entire week of class in a standard instructional delivery model class. Professor Algorwal brought this out very well with the following comments:

> I had a couple of people in there whom I thought would probably have done better in the standard session because if they miss one compressed class, they miss a lot [of instruction]. When you come in late for a compressed class you miss a lot. I mean, you miss half an hour, you miss a lot…. I think that's what caught some of the students in my compressed class was just the fact that they missed that one class because they had an emergency, and they either did not try or they weren't able to understand the material that I presented in the session that they missed (R. Algorwal, personal communication, July 9, 2004).

The students, unfortunately, get way behind very quickly if they miss a class when the classes are scheduled in four-hour blocks. This would not be a problem if the classes were scheduled in two hour blocks.

When we discussed the student learning outcomes, Professor Algorwal pointed out another problem with the two, four-hour blocks per week schedule,

> What I found in the compressed model was that we covered new material and we did the review on the day before the final. So, when they came in the next day, they didn't have their things organized and most of them, I would say, 90% of the students did not have their material organized and, uh, some really bright students who had been doing very well, I mean, they really messed up on the final because, uh, I think I had one maybe two A's and the other two had gone to the final with solid B's just about barely made it. You know, barely kept their B's. It really pushed them down (R. Algorwal, personal communication, July 9, 2004).

Professor Algorwal summarized her feelings about the compressed instructional delivery model by saying, "If I could get all of the class periods, the compressed [instructional delivery model]

would be the same amount of class time and I think I can take my time to explain concepts to them and actually lead them to the concept, to their own thought processes and questions…" I did not think to ask Professor Algorwal if four-hour blocks that were scheduled on non-consecutive days would be acceptable. Such a schedule would have allowed her students time to prepare and organize for their final exam after the review.

From the observations, the pedagogy Professor Algorwal used in the compressed instructional delivery model was almost a mirror of the pedagogy she used in the standard instructional delivery model. The main differences in pedagogy were related to the class schedule for the compressed class. This led to a loss of approximately two hours of effective instructional time per week, which in turn led to less question and answer interaction between the students and the instructor.

From the interview, Professor Algorwal's preference is the standard instructional delivery model. However, she could see the benefits of the compressed instructional delivery model and thought that, with proper scheduling, the compressed model would be the preferable model for both students and professors. The major problems with the compressed instructional delivery model as scheduled are the possible loss of an equivalent week's seat time if a class falls on a holiday, and the lack of time for students to prepare for tests and examinations when the two, four hour blocks fall on consecutive days as was the case in this study.

Brown

Professor Brown's College Algebra class instructed using the compressed instructional delivery model was significantly smaller than the College Algebra class he instructed using the standard instructional delivery model, four students versus 59 students. All of the differences in

pedagogy that were observed between the two instructional delivery models can be attributed to this difference in class size.

Professor Brown's relationship with the students in the compressed instructional delivery model class was friendly and informal, whereas in the standard instructional delivery model class, the relationship was formal and less friendly, although not to the point of being adversarial. Professor Brown was able to give personal attention to the students' needs in the compressed instructional delivery model class, often walking over to a student's desk to help clarify a concept. There was more of a student-instructor dialog going on in the compressed class when compared to the standard class. As a result, the compressed instructional delivery model class was significantly more student oriented than the standard instructional delivery model class. Since the main difference between these two class sections was class size, not the available face-to-face instructional delivery time, these pedagogical differences are probably related to class size.

The results from the observations were reinforced by the interview. Professor Brown attributed all of the observed differences in pedagogy to the difference in class size between the compressed instructional delivery model class section and the standard instructional delivery model class section, "…the compressed, it's more individualized, more hands on, the classes are smaller. So, therefore I can work with the kids almost like a tutorial session style of teaching. I can work with them one-on-one. I might have ten in a class, and then I can work with them." At another time during the interview Professor Brown had this to say to further reinforce the influence of class size on the difference in pedagogy:

> I think what causes the differences is the class size. I think the class size has a lot to do with the setting. I think that when you have a larger class, students are more

> concerned about what maybe is going to be said about them amongst their peers and cohorts when they leave the classroom and during the classroom. With the smaller setting the students are just wide open where they don't, they're not concerned because, it's almost like this is your family. It's like a family environment and so therefore with a family you can share, you can open up and you can talk on just about anything. And that's what I see the differences are (J. Brown, personal communication, September 14, 2004).

He describes his teaching style in the compressed instructional delivery model class as being, "more of a mentor. I'm more of a hands-on approach. I'm able to sit with the students, work with them individually, maybe get involved with their problems and look at them and address their problems one-on-one." He goes on to describe the attitude of the class as, "more laid back because the classroom size is smaller. So it's a more intimate setting." This accurately describes what was observed in the compressed instructional delivery model classroom.

When queried concerning differences in student learning outcomes, Professor Brown expressed the opinion that the outcomes were better in the compressed class.

> I think that in the compressed setting the learning outcomes have been I think the students are gaining more of the concepts that are being taught because you are able to work with them individually and you are able to see on the spot whether or not they have mastered the concept. So I think the learning outcomes have been a lot more favorable with compressed group as opposed to the standard group. I think that the learning outcomes, I have to wait and see the results and those results are given through the examinations and those results are given through the labs. So, I may know with the compressed group instantaneously what the

> problem is, you know what the learning outcome will be…instantaneously. Where as, with the standard group I may not find that out until actually giving an examination. And then that's my measuring of the learning outcomes to see, okay, well, because of the test scores, maybe they didn't master those concepts (J. Brown, personal communication, September 14, 2004).

Professor Brown expressed his opinion that the compressed instructional delivery model was the best model later in the interview, "With the compressed class I think my attitude is that it is the best setting. Because to me it's almost like the students are getting, sort of like, a hands-on education. And I am learning what their feedback is instantaneously and I am learning the learning outcomes. So with all three of them, I think that the compressed group, I'm delivering a more quality of instruction and they're getting a more quality education."

During the interview I realized that Professor Brown's preference for the compressed instructional delivery model was based on the smaller class sizes he had experienced when using this model. So, I asked the question, "Now, what if the compressed classes were larger? How would that affect your attitude? What if there were 25 or 30 students in a compressed class?" Professor Brown still expressed his preference for the compressed instructional delivery model.

> Well, even there, I think that that would be a little bit better and that's just me talking because I don't know if everybody else has that scenario. I'm averaging, in my standard class, about 40 to 50 students. So if we use the number and you are still making it smaller, I think the same results would occur. You know, just, maybe the dynamics would be a little different. Now, if we say that the compressed class is the same size as the standard class, and I have never experienced that, but if that were the case then I think I would have difficulty

> trying to get that compressed class to do all of the work that I have required my standard class to do in that eight-week period. I think that there would be some challenges there. But personally, I have never faced that because all of my compressed classes have been, have almost always been half of the size of a standard class. But I think that if they were the same then there would be some challenges with that compressed class. And I think that there would be some challenges because now I have to deliver seven weeks or eight weeks of standard, well, instruction, whereas before I had fifteen weeks. I think that might be a challenge. And I have never personally faced that challenge. I've been able to master that because the class sizes have been smaller (J. Brown, personal communication, September 14, 2004).

He could see some challenge in teaching the compressed instructional delivery model classes if the class sizes were larger, but he did not think that larger class sizes would make the model less preferable. He summarized his feelings as:

> I think mathematics is easier to instruct in the compressed model provided that your classroom size is smaller. And the reason why is because I find that I can go around individually to individual students and I can teach and give them some lessons to do, give them some assignments to do, find out instantaneously if they know how to do that assignment and then go back selectively and work as a group.. as a body and go over their problems. So I think that, because I am able to move around and see where the difficulty is, that individual student is now getting their problem addressed and a lot of times their problem is another person's problem. So as a whole, we're ironing out the problems in the classroom session

> and because we are in there for that four hours, I'm also, which is a big variation, the time limit as opposed to two hours, I now have four hours. So I am able to address more, I'm able to spend more time on difficult areas, so I think overall, the compressed for me is the better way to go, and for those reasons (J. Brown, personal communication, September 14, 2004).

From the observations I found that in the compressed instructional delivery model class the atmosphere was informal and friendly compared to the more formal and less friendly atmosphere of the standard instructional delivery model class. This may be attributed to the extreme difference in class sizes, 4 for the compressed class and 59 for the standard class. This difference allowed for a less formal approach to teaching in the compressed class. The techniques used for classroom management in a classroom of 59 students require some measure of formality to maintain control of the situation, in particular if the instructor is not comfortable with letting the students control the class. This is not a problem in a small class of four students where the instructor knows exactly what each student is doing all of the time and the students are less likely to be off task because of the added attention. All of this let the compressed instructional delivery model class be more student oriented.

The interview reinforced the findings of the observations. Professor Brown said that the compressed instructional delivery model class was more individualized and hands-on than the standard instructional delivery model class. The compressed class was more like a tutorial class than a regular instructional session. In his comments, Professor Brown attributed this difference to the difference in class size. He professed a preference for the compressed instructional delivery model, mainly because of the small class sizes that he had experienced using that model. When pressured, Professor Brown indicated that he would prefer the compressed instructional

delivery model, even if the class size approached 30 or more students. He thought it would be more of a challenge, but doable. One item that really bothered Professor Algorwal was seen as a plus by Professor Brown. That was the two, four-hour blocks for which the compressed class was scheduled. Professor Brown commented at one point, "So as a whole, we're ironing out the problems in the classroom session and because we are in there for that four hours, I'm also, which is a big variation, the time limit as opposed to two hours, I now have four hours. So I am able to address more, I'm able to spend more time on difficult areas, so I think overall, the compressed for me is the better way to go, and for those reasons." I do not believe that I ever observed Professor Brown use the entire four-hour block for instruction. Usually he would dismiss his class after only three of the four hours was completed. I therefore find this comment suspicious.

The differences observed between Professor Brown's standard and compressed classes were all related to class size and not to the model being used for instructional delivery. This is unfortunate because the data collected from the observations of his classroom is irrelevant to the research and cannot be considered when making conclusions.

Students

Mary James

Ms. James is the student who was taking all of her courses on-line and in the accelerated instructional delivery model. She used the accelerated model for mathematics because of its face-to-face component. She feels that she needs this face-to-face exposure to a live instructor to help her understand a subject, in this case mathematics, that she knows she has difficulty learning. Ms. James took a lower level mathematics class at a local university during the summer term. This class was taught using the compressed instructional delivery model, so her

comments on the differences between the models, specifically accelerated and compressed, can be considered to be from experience. She would prefer to take mathematics courses, or any course, using the standard instructional delivery model or the compressed instructional delivery model because she realizes that she learns the material more thoroughly and retains the material better when taking classes using these models. She says she gets a more in-depth education using these models.

Erica Castro

Ms. Castro, unlike Ms James, likes the accelerated model for mathematics but would prefer the compressed instructional delivery model or the standard instructional delivery model for other subjects that do not generate much interest for her or that she feels she is not as capable in as mathematics.

Wendy Hall

Ms. Hall related both good and bad experiences with the compressed delivery model. From her interview, the differences between the good and bad experiences were attributable to two things; Ms. Hall shows a lot of what is colloquially called 'attitude' and is very sensitive to criticism. This attitude leads to the second thing, clashing with her instructors' personalities. The passage from the interview that follows illustrates this.

> The only difference between the fifteen-week, the compressed, and the accelerated I noticed is just when I took Miss Rani's class was that, uh, more information was crammed into a shorter period of time. And it was very hard. I understood it, I was able to keep up with it, but still, it was harder for me to do in the eight-week, class. Uh, in my other accelerated classes that I have had, again,

> my instructor has gone to just read the book, or she has been cutthroat, or we've been in a fight. So, I was unable to accomplish anything for several math classes until I got to Miss Rani's class (W. Hall, personal communication, July 6, 2004).

Ms Hall also lavished Professor Algorwal with praise several times during the interview. "And when Miss Rani [Algorwal] did it, the thing was, doing the homework created questions for me to ask when I was in the class. It made me think, 'what questions do I have to ask?' And so, uh, I think with that, for me it was actually mainly difference with the teachers." Ms. Hall's interview indicates that she can thrive in the compressed instructional delivery model with the right instructor, but that she prefers the standard instructional delivery model.

Summary

Differences in pedagogy were observed between the compressed instructional delivery model and the standard instructional delivery model. For one of the instructors, the differences were related to available instruction time, which was affected by the class schedule, two, four-hour blocks. For the other instructor, the differences were related to class size and not to the model. The compressed instructional delivery model class was significantly smaller than the standard instructional delivery model class.

Both instructors felt that the compressed instructional delivery model was a good model for teaching mathematics. One of the instructors, Professor Brown, preferred the compressed instructional delivery model because, in his experience, all of the compressed model classes were small. The other instructor, Professor Algorwal, thought that the compressed instructional delivery model was almost as good as the standard model and would have been better had the scheduling of the compressed model class been in four, two-hour blocks instead of the two, four hour blocks she experienced.

The students had little experience with the compressed instructional delivery model. The one student, Wendy Hall, who was in the compressed model class expressed that she would take a mathematics class that used the compressed instructional delivery model only if the right, meaning Professor Algorwal, instructor was teaching the class. Another student, Mary James, who took a compressed mathematics class at another institution, said she would prefer the standard or compressed model for all of her courses, but she was trying to complete her degree as soon as possible while working full-time and that was not possible so she was taking only on-line and accelerated classes.

Accelerated Instructional Delivery Model

Instructors

Algorwal

This was only the third term in which Professor Algorwal had used the BILS for instructing an accelerated class section. She was beginning to become comfortable with the use of BILS. The class section met on Sunday afternoons from 12:30 p.m. to 4:00 p.m. A surprising number of students like the Sunday afternoon accelerated courses, particularly those who have full time jobs or work nights. This class started with six students and five of them completed the course and received final grades.

Professor Algorwal's pedagogy in the accelerated instructional delivery model is different from either the standard instructional delivery model or the compressed instructional delivery model. These differences in pedagogy seem to be time related. First, she uses a different teaching pattern. She lectures for a short while to introduce a new concept, then she demonstrates this concept on the board. She then assigns the students seatwork and walks around the classroom while they are doing it. There is no board work for the students and no

time allowed for clarifying questions at the end of the seatwork. Professor Algorwal simply works the problem given for seatwork on the board herself and then goes on to the next topic. Also I observed that she is not as forgiving in the accelerated classroom of students' lack of prior mathematical knowledge. She assumes that they all have sufficient prior knowledge and leaves out elementary steps and takes shortcuts in her demonstrations. If the students have problems understanding the demonstration, she does not show the patience that she had in both the standard and compressed classrooms. In week four these students were still having difficulty with basic concepts of functions such as domain and range. In a standard instructional delivery model classroom this would have been week eight. By week eight in Professor Algorwal's standard classroom the students were very comfortable with these concepts.

The accelerated instructional delivery model can be very difficult for students who are not native speakers of English. Viktor Karoli was one of the students in this class. He is an immigrant from Romania, and while his English skills seemed to be strong, he often had trouble communicating with Professor Algorwal and often she could not understand what Viktor was questioning in the lecture or demonstration.

By the time of my last observation of this class in week six, one of the students, Victor Karoli, had dropped the class. During this observation a spontaneous conversation arose among the students concerning the accelerated instructional delivery model. One of the items to come out of this conversation was a desire to have mathematics classes in alternative instructional delivery models available for night and weekend course takers. This is an indication of students' dissatisfaction with the accelerated instructional delivery model for mathematics instruction.

During the last observation, Professor Algorwal introduced logarithmic and exponential functions. When compared to the instruction in the standard instructional delivery model

classroom, the instruction was very sketchy and almost superficial. Logarithmic and exponential functions are the most abstract topics in the College Algebra course at Newbern and should not be given such a superficial coverage. This was due to time constraints placed on the instruction by the model. At the end of the class period none of the students had demonstrated a grasp of the concepts.

As part of the research, I monitored the on-line component of the course. The main interest was the threaded discussions. At the beginning of the class the students were participating in the threaded discussions often. Some of the comments were enlightening during the first week. One student, in particular, commented that the first class meeting was overwhelming because of the pace and the amount of material covered. This is another indication of the influence of time on the pedagogy of the accelerated instructional delivery model. During the second week the students waited until Friday night to begin participating in the threaded discussions on the homework assignments. They were pleading for help but none of them could explain the homework and Professor Algorwal did not participate. During week three there was a significant reduction in the number of postings in the threaded discussion area. The students either did not see the benefit of the threaded discussions or the fact that Professor Algorwal was not participating made them not care to participate either. The students never learned how to help one another using the threaded discussions. Since this is one of the major pedagogical tools of the BILS for the students, this is a disappointment. The students who did post were asking for help but no one was responding. By week five, there was essentially no activity in the threaded discussions.

When we were discussing the accelerated instructional delivery model during the interview, one of the major themes of Professor Algorwal's responses was time, or the lack of it,

when teaching using the accelerated model. Her responses reflect what I saw during my observations of her classroom. At one point she stated, "What I find in the accelerated model is that I just have time to skim the surface. I give them the theory, I work out a couple of examples, and then they are pretty much on their own." Later on in the interview Professor Algorwal said, "I definitely don't solicit any student participation and I don't want it. I do not appreciate any interruptions or questions because I have so much to cover in one class period…" These comments directly reflect the differences in her pedagogy between the standard and compressed instructional delivery models and the accelerated instructional delivery model that I observed in her classroom. She is aware that she is teaching differently in the accelerated classroom and she is aware of exactly what she does differently in the accelerated classroom when compared to her behavior in the standard and compressed classrooms. Professor Algorwal regrets that she has to teach this way in the accelerated classroom. This regret is illustrated in the following quote:

> On the other hand, in the accelerated model, again because I don't have the time, I'm not able to do that much. I'm not able to spend the amount of time I would like to with them and really show them how logical the flow of events is, how logical everything really is, how each set logically follows another (R. Algorwal, personal communication, July 9, 2004).

She really cares about her students and what they learn and it comes out clearly in this quote. This leads to the next major theme that came from the interview, the students.

Professor Algorwal is closely in touch with her students and their attitudes. And she takes personal pride in how her students succeed in her classroom and is disappointed when they don't succeed. This is all reflected in the interview when the discussion turned to students and

how they felt about the accelerated instructional delivery model. When asked what she thought the students preferred she replied,

> A lot of students complain that they really would prefer to take it in a standard session or a compressed session. But, because they have constraints, such as their work, etcetera, they have to take the accelerated sessions since we moved to this mode of delivery in the evenings and weekends. They really have a problem with this (R. Algorwal, personal communication, July 9, 2004).

This comment not only reflects the student preference as Professor Algorwal sees it, it also criticizes the institution for not providing the evening and weekend students alternative choices for instructional delivery. This comment also shows Professor Algorwal to be a strong student advocate. Later in the interview, two comments reinforce the fact that she is a strong student advocate. The first comment concerns the fact that the accelerated instructional delivery model places the burden for learning almost totally on the student.

> …the onus is strictly on the students [to learn] and a lot of them who come in with really poor academic preparation, they just drop out and there is nothing much I can do to help them because, you know a lot of times I offer them a lot of extra help. But the course, it's just so fast-paced, they can't keep up. And, once they fall behind, that's it (R. Algorwal, personal communication, July 9, 2004).

Professor Algorwal shows that she really cares about student success in this comment and regrets that some of her students are penalized by the accelerated instructional delivery model. The second comment of note concerns student preparation for College Algebra, particularly the preparation of older students who have been out of school for a while.

> …you occasionally have the student who hasn't been in touch with math for, say, the last 20 years and we let him into this accelerated class and they have absolutely no comfort. I mean, they're totally out of their comfort zone. There're undecided whether they should continue just after the first meeting (R. Algorwal, personal communication, July 9, 2004).

Again, this shows that Professor Algorwal is concerned for her students and critical of how the institution places them in her mathematics classes. Later, toward the end of the interview, she has one more comment about the students and who would be successful in an accelerated classroom.

> You know, accelerated model is really going to be successful if you have the right students in there. If you don't have the right students in there I don't think the teacher can do much because it's, they don't have the basics, I don't have time to go over the basics. So, you know, preparation, I think that is what is lacking in the students we take for accelerated classes (R. Algorwal, personal communication, July 9, 2004).

In this comment, Professor Algorwal accepts that there are students who can be successful learning mathematics in an accelerated classroom. She emphasizes that to be successful in the accelerated College Algebra class, students must be properly prepared because there is not enough time for the instructor to help them with the basics of mathematics in such a fast-paced course.

About half of an accelerated course is contained in the on-line component. Students are expected to be on line three hours per week in the accelerated College Algebra class. One particular facet of the on-line component that is designed to allow the students to collaborate and

to get help from their instructors is the threaded discussion area. When asked about using the threaded discussion area, Professor Algorwal had this to say,

> …they are there on the platform [BILS] discussing issues with each other and trying to sort their problems out and struggle through learning from each other. Even so, a lot of the times the material that I find on the BILS, I have to go over it in class because, either they are not able to understand it through the documents in doc-sharing [on BILS] or there is no one in the class [who does understand it] who can guide them through the process (R. Algorwal, personal communication, July 9, 2004).

What she is saying here is that unless there is someone in the class who grasps the concepts in the on-line component quickly, there is no one except the instructor who can help out. However, from reviewing the threaded discussion areas for this particular course section, I did not see any instances where Professor Algorwal made an attempt to help the students out on-line. Perhaps, if she had made better use of the threaded discussion areas, her students would have been more successful. However, one criticism of the BILS that comes up often is that there is no easy way to communicate mathematically in the threaded discussion areas. There is no way to write mathematical formulas other than by using pseudo code that looks like how formulas are written in computer programs. In pseudo code exponentiation is denoted by a caret (^) and multiplication is denoted by an asterisk (*). All formulas and equations must be written on a single line. The quadratic formula appears in pseudo code as: x = (- b +– sqrt(b^2 – 4ac))/(2a). Most of the students and their instructors are not familiar with this code because they have done no computer programming. This makes communicating in the threaded discussion areas difficult. There are other CMS platforms that do have this capability and perhaps one of these

should be investigated for use in the mathematics courses at Newbern University. Neither the instructor nor the students are adept with the BILS and this is shown in the following comment, "They're not comfortable with the on-line component. And, you know, I talked to them and asked them what was the main reason for them having problems with the on-line component and they said that it was all the typing they had to do." There was, however one part of the BILS that Professor Algorwal liked. That was the on-line testing. She was happy that she did not have to allocate time in the already fast-paced classroom to do formal assessments.

Professor Algorwal's attitude toward the accelerated instructional delivery model is negative and this negative attitude is illustrated by several comments taken from the interview. First she expressed her agreement with the student's opinion of the model, "I really agree with a lot of them [students] when I say that I don't think that this [accelerated] is a good model for math classes. It might work for something like English or Marketing, but I don't see it as being the best method for math." Later in the interview Professor Algorwal expressed her own opinion, "Is it a good teaching tool for math? I don't think it is a teaching tool. I don't think it can substitute for classroom instruction." Then, toward the end of the interview, she reveals one of the reasons she does not feel that the accelerated Instructional delivery model is a good tool for teaching mathematics, "So, it's just frustrating, because you know I'll start out with a class of six and sometimes end up with one student. Or I'll start out with three or four and then end up with maybe one again." Professor Algorwal is showing her frustration with her lack of success in teaching mathematics using the accelerated instructional delivery model. This lack of success using the model is influencing her attitude toward the model.

Professor Algorwal is a very caring and competent instructor of mathematics. She feels that her lack of success using the accelerated model is beyond her control. Two comments from

the interview show this. Both comments concern student placement in mathematics, which is done using university-wide placement criteria developed at the home office of Newbern University. In the first comment she says, "…I really would like to say we need to look at the quality of students we are letting into the accelerated program." This is a direct criticism of the placement standards. She feels that most of the students in her accelerated classes have no business being there because of their lack of preparation for college level mathematics. She goes on about two sentences later in the interview to say, "…if we put them in another class like put them in an intermediate algebra class before we put them in a College Algebra class because they had been out of school for 20 years I think they would have handled the accelerated a lot better than they did in this particular case." Thus, she feels that with proper preparation, most of the students could be successful.

The observations revealed that Professor Algorwal used a different teaching pattern when teaching in the accelerated instructional delivery model. There was no board work or clarifying questioning after the demonstration and seat work assignment. She taught as though the students all had sufficient prior knowledge of algebra to build upon in understanding the new concepts being introduced. Other evidence from the observations refutes this assumption.

A review of the threaded discussion areas in the on-line component of the course reveals that Professor Algorwal does not make sufficient use of the tools available, specifically the threaded discussion areas. She could have used the threaded discussions to coach the students and answer their questions, but there is no mathematics communication medium embedded in the BILS and Professor Algorwal was not aware of other methods to communicate mathematically on-line, such as the use of pseudo code.

The interview reinforced what was observed in the classroom. Professor Algorwal is aware of the differences in her pedagogy between the standard and compressed models on the one hand and the accelerated model on the other. She is also able to articulate clearly her reasons for these differences. The main reasons for differences in her opinion are lack of time and the BILS tool. During the interview she also expressed her concern for how students were assigned to the accelerated class sections. She feels that only a certain, well prepared, type of student can be successful in the accelerated mathematics courses. In general, she believes that the accelerated instructional delivery model is not a good model for mathematics instruction.

Brown

Professor Brown has taught using the accelerated instructional delivery model in the past but was not teaching a section of College Algebra using the accelerated model during the Spring 2004 term at Newbern. Thus I was not able to observe him in class using this model, but the subject was discussed in the interview based upon his past experiences.

Professor Brown's main contention with the accelerated instructional delivery model is the on-line component. When he first mentioned the accelerated model in the interview he had this to say:

> Now on the accelerated piece, it's all using… teaching the students to be familiar with the computer. So, that is the only intent, I'm constantly on the computer, perhaps twelve or fourteen hours in every two days. So I am probably spending about 40 hours per week on the computer because we've got the threaded discussions. Uh, we also are working with them because they have check problems. So we are working through those problems. So, it's a lot more time

> consuming working with the students one-on-one dealing with all of the tech support problems, dealing with them in the classroom, the pace is a lot faster because in an eight-week setting you are trying to cover 15 weeks of course work. (J. Brown, personal communication, September 14, 2004).

From this comment, I conclude that Professor Brown feels that the on-line component of the accelerated instructional delivery model is a burden on the instructor because he or she has to teach students how to use it. He or she also has to spend a lot of time each week monitoring the threaded discussion areas, which, to Professor Brown, is another burden. All of this, and his complaint about the fast pace of the class cause me to come to the conclusion that Professor Brown does not like the accelerated model. Later in the interview Professor Brown takes issue with the on-line component of the model again, "…with the accelerated, my [teaching] characteristics differ because then I have to use my computer skills to help them [students] deal with any computer problems on a day-to-day basis." Apparently his students had many problems using the computer to access the WebUniversity® CMS. Professor Algorwal, on the other hand, mentioned no problems accessing and using the CMS. Perhaps her students had more experience with the CMS since Professor Brown's experiences could have been during the first term that the WebUniversity® CMS was used for the accelerated instructional delivery model. Would Professor Brown's experience be different now that most students have experience with the on-line component of accelerated courses? Later in the interview, in Professor Brown's final comments on the accelerated instructional delivery model, he mentions the on-line component again.

> Well, I feel that with the accelerated I believe that my attitude is that there needs to be a preparation period for the students to make sure that they have all of their

> tech support and their computer problems that they have are ironed out before the session starts because I believe that my attitude is that I spend too much time going over tech support problems or computer problems or computer glitches and then consequently now I have to deal with those problems as I am instructing (J. Brown, personal communication, September 14, 2004).

To Professor Brown, the computer is a hindrance to his teaching. It causes him to have to deal with the students to solve problems he does not believe are his responsibility. He wishes that his students were already adept at the use of the CMS before he has to teach them College Algebra. As Newbern University deploys the use of the WebUniversity® CMS, almost all of the students who take College Algebra will have had experience with the CMS, either in another mathematics course or in a course in some other subject, such as English or history.

Students

Viktor Karoli

Viktor enrolled in the accelerated College Algebra course lacking sufficient preparation. He had recently taken a remedial mathematics course at a local community college but this course was below the level of intermediate algebra. His previous experience with mathematics at the College Algebra level was more than 30 years ago in Romania. He knew he was not properly prepared for the course and withdrew from the class in week five of the session. He had this to say concerning the class and Professor Algorwal:

> Ms. A was very patient and very good within her limits. She had to go on with the class because it is accelerated. But, she gave me all the leeway possible and explanation that she could, and was very helpful. But, I personally did know a way out of there to make it at that fast pace. If I had had preparation like

intermediate algebra, I'm sure I could keep up with it (V. Karoli, personal communication, June 29, 2004).

When Viktor was asked about the on-line component of the course he was critical that it lacked the instant response to questions that occurred in the classroom. He was very articulate in his complaint, "I think there are two things lacking on that on-line homework. Number 1: You don't have somebody that can…sometimes there are real silly things that blocks you from understanding the question, whatever, and you just need two words from somebody who knows this is what they are asking, actually." Viktor also missed the study group that he had been a member of at the local community college, "And, the cooperation between the other students would help a lot. I used to have a study group. Not all the time, but I had it. I had guys and girls in my classes at the community college do the homework with me actually after class and we did it together and it helped us a lot. So, that's not there on-line." The threaded discussion areas did not provide this for him on the real-time basis that he felt he needed. Viktor likes the accelerated instructional delivery model for the same reasons expressed by Mary James, they both perceive that the accelerated model will allow them to complete their degree programs in a shorter period than the standard or compressed models would.

Viktor's interview revealed several tools that are available on the WebUniversity® CMS that were not used effectively by Professor Algorwal. One that has already been discussed is the threaded discussion areas. Another tool that is available but not used at all is the chat room feature. This feature allows live communication with the students. The chat room is an excellent means for study groups to meet on a weekly basis, or more often, to collaborate and receive instantaneous feedback from each other. The instructor can sit in on these chat room meetings to provide guidance and answer any questions that the group cannot answer for themselves.

Mary James

Early in the interview Mary James describes herself as a hybrid student. She says that she uses the accelerated instructional delivery model courses for subjects she does not easily understand, such as mathematics, and uses the on-line instructional delivery model for everything else. She has this to say about why she takes mathematics using the accelerated model, "Well, for the mathematics courses, actually, I will take all of those accelerated, on campus. Because, I am a mathematical moron so I need that face-time." Later in the interview she amplifies her reasoning for taking mathematics using the accelerated model:

> …for subject matter that is not intuitive, it is perhaps better for myself and any other student who falls into this category to take certain classes, like the mathematics classes, in person where you have more real-time interaction. Because, you know, the adult learner, if you have, if you are working on a problem and you email the instructor and say, "I'm stuck." And he emails you back two hours later or the next day, you've already lost where you were. And to go back and try to pick that up again is like trying to look at a puzzle that you started six months ago and go, "what the heck was I doing then?" You get more feedback and the feedback just is better when doing it on campus versus doing it on-line (M. James, personal communication, July 14, 2004).

Ms. James was very vocal in both her criticism and praise of the accelerated instructional delivery model. She has quite a lot of experience using the WebUniversity® CMS since all of the on-line courses at Newbern are taught using it. This experience is reflected in her criticisms. Early in the interview she has this to say about the threaded discussion areas when I asked if she

participated in them, "Uh, I used that for my other classes, for mathematics classes, it doesn't appear to make a lot of sense." When I asked why she replied,

> Just because the mechanism, not everybody is fluent in xml or excel or knows how to use their text editor. And using them to do problems and to solve problems on-line is a bit difficult just because of the medium. It's good for peer relationships and students helping out other students. I'm stuck on problem 29. I got it to this point now what do I do? That's an excellent tool. But, as a teaching medium for, you know, college level algebra, I didn't find it to be all that helpful (M. James, personal communication, July 14, 2004).

She does see it as a good tool for student collaboration; she does not see how this collaboration is useful in instruction. That is interesting because most mathematics educators think student collaboration is an excellent learning tool. By default, this makes student collaboration a useful tool in instruction.

Later on in the interview she describes the differences in her learning experiences between the on-line courses and the accelerated courses this way:

> I would say that it is different, and it is different because, I have a mental and physical association with what I was taught. Whereas, on-line, I'm on-line for 98% of my job normally. So, for me, that's just an extension of that and it goes into my short-term memory and I remember it as long as I need it and then it's gone because it kind of exists in a vacuum. But here I have a physical focal point. I can regenerate things I have learned in that class, or things that we have talked about in that class, much longer. And so it's easier for me to actually take that and apply it somewhere (M. James, personal communication, July 14, 2004).

This passage reveals that Ms. James is aware of how she learns and the deficiencies in her learning that are a result of her choices of instructional models when she enrolls in classes. This is made clearer when she reveals her actual preference of instructional model a few sentences later in the conversation:

> If I wasn't in a hurry to do the things I need to do in order to further my career, which is why I'm doing the accelerated model, I probably would be doing the full, you know, fifteen-week on campus set of course work because, you know, you probably get a more in-depth education that way. And then it also has some networking benefits that you don't necessarily get in online (M. James, personal communication, July 14, 2004).

If Ms. James is a typical night and weekend student, which I have no reason to believe otherwise, this little passage from her interview speaks volumes about what educators are doing to make it easier for students to get degrees. The implication is that we are not giving them a good education. We are helping them to get the credentials to advance their careers, but at what cost to their learning? This is an ethical problem that cannot be easily solved.

Later in the interview I asked Ms. James, "Would your choice of delivery model be different for some other subject such as English literature or Psychology, and why?" She was very positive in her response,

> And it would, because, to me, those are intuitive topics and, no offense, but infinitely more interesting to me than mathematics. So, Actually, I just took Psychology and Sociology and Business law and Business Operations last term all on-line. And, they were, and you know, that material is more intuitive, therefore easier for me to grasp. And, I don't need that interaction, necessarily, with an

instructor to be able to grasp and comprehend and then apply (M James, personal communication, July 14, 2004).

Ms. James reveals herself as a mostly intuitive learner, or that some courses have content that is more intuitive to her than others, such as mathematics.

Ms. James is an intelligent person with definite opinions; so later in the interview I asked her what suggestions she had to improve the delivery of the accelerated courses. Her replies were very well thought out and helpful and related mostly to the WebUniversity® CMS. First, she said, "Well, the WebUniversity needs to actually work consistently, number one. It doesn't always work. I was in a class where WebUniversity wasn't set up for the first three weeks of class. So that was not very helpful." Unfortunately, during the time of the research, WebUniversity® was having growing pains because of the rapid expansion of course offerings, both accelerated and on-line, being offered by Newbern University, who is now their major customer. As a result, the platform was not very stable and tended to crash quite often. Also, Newbern itself was having some administrative difficulties assigning course shells to instructors in a timely manner. Most of these problems have been solved. Ms. James had praise for one part of the on-line component of the accelerated model. She genuinely liked the on-line testing, but did not like the on-line lectures in the accelerated model. This is what she had to say about them:

I like the on-line quiz delivery mechanism. I find that to be very helpful, easy to use. I personally like multiple choice because I know if I worked it one way and I didn't get the right answer, then I can work backwards from the answers and come to the same conclusion eventually. I don't think on-line lectures accomplish a lot for a mathematics class. Just because you can read the material all you want

> but if you don't have an interaction, it doesn't make any sense. And, doing problems on-line, as we discussed earlier, is a bit problematic just in terms of the formatting of the solutions and if you have to show the steps of all of your work, how do you communicate this? [Spiels off a long list of formulae]. It doesn't work real well when you are using a text editor (M. James, personal communication, July 14, 2004).

Her main point here is the lack of interaction with an instructor in the on-line lectures. These lectures are not much more than assigned readings, although some of them are really clever Power Point© presentations using good animations to help communicate the concepts. Later in this part of the interview, Ms. James brings up the communication problem that she mentioned above again,

> I suspect that for someone who's a CIS major, or someone who is a coder, that's [communicating mathematically on the computer] not a problem because I know that all of that can be done in HTML or in XML or in another language rather than just plain old text. But, from the last class, the people that I worked with had no idea, nor did I, how to really, how to communicate what we were doing mathematically using the keyboard (M. James, personal communication, July 14, 2004).

This is a real shortcoming of the WebUniversity® CMS. Other CMS systems have means for equation writing built in and are much easier to use for teaching mathematics. When I reminded her that documents could be attached to threaded discussion postings and that some word processing software had equation editing capability, she agreed that this could be a partial solution to the problem, "And that's easier, you know, doing an attachment and then attaching a

document to a threaded discussion. It's easier than trying to use that tiny little window and then post your solution. It's difficulty there." She was still critical of the CMS, but she was agreeable to my proposed solution.

My interview with Ms. James was the most informative student interview concerning the accelerated instructional delivery model. She is a very bright person and had very good opinions concerning herself and the instructional delivery model. Most of what she had to say was significant to the research.

Erica Castro

Ms. Castro has only had experience at Newbern University with the accelerated instructional delivery model. She did attend a community college in Texas where she earned her associates degree; so she has experience with the standard instructional delivery model at the college level to use for comparison. Early in her interview she expressed a preference for the accelerated model for learning mathematics,

> I like accelerated because you don't get bored with the topic, it's not an every day thing. And, you go, you do what you're supposed to do, and you wait until the next week to come back and do the same thing. And versus the standard, because it's an every day thing, I don't know, it's not a waste of time but you move a lot faster in the accelerated and that's what I like" (Castro, personal communication, June 23,2004).

She admits later on in the interview that the accelerated model is not the best choice for learning mathematics for everyone, "…it depends on the student too. If the student thinks they can't handle it, I don't think they should be in it. It's a little challenging, but, It's not impossible [for me]."

When asked, "If you were taking some other subject, say like English or history or science, would you still like the accelerated model? Would your choice be different?" she replied,

> Yes, my choice would definitely be different. I guess I'm not too interested in those other courses, or in those topics, so I know I won't be able to do it all myself. I would probably choose compressed for those topics because I need to come more than one day for those. Because,.. (softly) I can't think of the word,.. (normal voice) Because they are just not interesting to me (E. Castro, personal communication, June 23, 2004).

A few sentences later in the discussion she explained her preference for taking mathematics in the accelerated model and her reasoning for not wanting to take other subjects using the accelerated model:

> Yes, [I am interested in mathematics] and I can work on it by myself. That is, yes, I need the teacher that one day but then I can work on the homework by myself and at my own pace. You see what I mean? And, so, she just gives you all the homework for the week and then if I can do it all in one day, that's great. If not, I have different days to do it. And I know I can't teach myself but I at least know how to do math by myself and I won't know how to do English or the other, history. I can't teach myself history. So that is why I would prefer a longer session for those (E. Castro, personal communication, June 23, 2004).

This mirrors the reasoning Mary James used when choosing whether to take a subject on-line or using the accelerated model. Ms. Castro knows that for the courses she will have a more

difficult learning experience, she needs the extended face-to-face time that a compressed or standard instructional delivery model class will provide.

Ms. Castro had experience in a College Algebra class at the community college she attended in Texas so I was surprised that she had retaken College Algebra at Newbern. When I asked her if she found any difference in rigor between the two College Algebra courses she replied, "…no, it was the same difficulty as in Texas. The only difference was that we spent more time in Texas because it was a longer session. I mean, but it was the same difficulty. Actually, it was easier, because I already had the practice from Texas. I had already seen it once, I didn't struggle that much." Late in the interview, Ms. Castro revealed her real reason for taking the accelerated courses, "I like the accelerated because it is more convenient. I work from noon to six, and I don't have a babysitter for her (referring to her daughter who is on the floor). So, on Sundays, I don't work, my husband doesn't work, so he keeps her while I go to school. That's very convenient." So we see again that Newbern is making it easier for people to complete their degrees by making the courses convenient to take and Ms. Castro is taking advantage of this. I don't think Ms. Castro is aware of the issue brought up by Ms. James that her education may be suffering as a result.

Wendy Hall

Ms. Hall had a bad experience in an accelerated intermediate algebra class that she enrolled in when she first entered Newbern University. She is a weak mathematics student and the professor was not forthcoming with sufficient help to enable her to succeed in the course. As a result, she failed on her first attempt at intermediate algebra. She retook intermediate algebra in her second term using the compressed instructional delivery model with the same instructor and failed again. She then retook the course again in a standard instructional delivery model

classroom with a different instructor, Professor Algorwal, and thrived. At the time of the interview, when all of this information was obtained, she had just successfully completed College Algebra in a compressed instructional delivery model classroom with Professor Algorwal as her instructor.

Ms. Hall's main difficulty with taking mathematics using the accelerated instructional delivery model, aside from the instructor, was the pace. She admits to needing more time than others to grasp the mathematical concepts being presented, "my rough spot is only in math so it takes me a little bit longer to grasp it [than other subjects]." She expressed a preference for the standard instructional delivery model for mathematics but demonstrated in Professor Algorwal's compressed College Algebra class that she could succeed in the intense courses with the right instructor.

Blended Instructional Delivery System

Fortuitously, the Instructional Design Department at Newbern University conducted a survey of all instructors at Newbern who were using the WebUniversity® CMS during the Summer 2004 term. By this time Newbern had been using the WebUniversity® CMS for one year. A copy of the responses to the survey was requested and obtained through proper channels for use in this research. Both graduate and undergraduate faculty were surveyed and the response rate was about 60% for the survey. I excerpted five questions from the survey that I thought were significant to the research and performed an analysis on the responses.

The first question was, "In general, how have you used the WebUniversity® CMS in your most recent courses?" There were 43 respondents for this question. Most of the respondents had multiple uses for the CMS. Table 4-1 lists the responses and number of respondents to this question. One surprise shown in Table 4-1 is almost 10% of the respondents

admitted they did not use the WebUniversity® CMS at all. Also surprising is the highest usage of any feature of the WebUniversity® CMS was about 48%. This indicates these instructors are still becoming comfortable with the use of the WebUniversity® CMS and some of them were still resisting any usage at all.

Table 4-1:
Responses to "In general, how have you used the WebUniversity® CMS in your most recent courses?"

Response	Number of Respondents
No uses	4
Document sharing	16
Drop box	7
Email	10
On line assignments	7
Threaded Discussions	19
On line quizzes	11
On line grade book	15
Announcements	5
Chat room	4
Webliography	4
On line syllabus	6
On line lectures	1

The second question of interest was, "What aspects of the WebUniversity® CMS are most useful to you and why?" There were 40 responses to this question that varied from "no uses" to "everything." Table 4-2 lists the responses and number of respondents to this question. The threaded discussions and the on-line grade book were seen as most useful by the instructors even though neither of these tools attracted a majority of the responses.

Table 4-2:
Responses to "What aspects of the WebUniversity® CMS are most useful to you and why?"

Response	Number of Respondents
No uses	1
Document sharing	7
Drop box	5
Email	9
On line assignments	0
Threaded discussions	11
On line quizzes	6
On line grade book	15
Announcements	2
Chat room	1
Webliography	2
On line syllabus	3
On line lectures	1
Historical documentation	1
Single point of contact	2
Constant access to course materials for instructor and students	1
Everything	1

The third question was, "What aspects of the WebUniversity® CMS are not useful to you?" This question also had 40 responses. Table 4-3 lists the responses and number of respondents for the third question. For comparison purposes the responses from the second question were used for the tally. What is interesting about these responses is that eight respondents found the on-line quizzes not useful while, from question two, six respondents found these quizzes useful. When I looked at the actual language of the responses, those who found the on-line quizzes not useful were concerned about the integrity of the quiz results because they felt that the quizzes were not proctored and thus the students had too much of an opportunity to cheat on them. In fact, the final examination in all of the courses that use the WebUniversity® CMS is an in class, proctored exam. This should expose any cheating that went on during the quiz taking during the course. All that would have to be done is to make passing the final

Table 4-3:
Responses to "What aspects of the WebUniversity® CMS are not useful to you?"

Response	Number of Respondents
None	5
Document sharing	1
Drop box	1
Email	0
On line assignments	0
Threaded discussions	1
On line quizzes	8
On line grade book	3
Announcements	1
Chat room	4
Webliography	4
On line syllabus	0
On line lectures	1
Historical documentation	0
Single point of contact	0
Constant access to course materials for instructor and students	1
Virtual lab	1
All	1
White board	1
Inventory shells	2
Calendar	1
Groups	1

examination a criterion for passing the course. All of these instructors have the privilege of selecting how to assign grades in their courses, so this should not be a problem but is perceived as such.

The fourth question was, "How do your students react to the tool and what kind of feedback are you getting on the WebUniversity® CMS?" There were less, only 33, responses to this question which appeared late in the survey. Perhaps most of the respondents had become fatigued with the lengthy survey at this point. Table 4-4 lists the responses and number of respondents for question four.

Table 4-4:
Responses to "How do your students react to the tool and what kind of feedback are you getting on the WebUniversity® CMS?"

Response	Number of Respondents
Technical support is spotty	1
Navigation is difficult	2
Like	17
Redundant	1
Do not like virtual lab	1
Do not find useful	1
Do not like	8
Prefer face-to-face classes	1
Have difficulty using drop box	1

Significantly, 15 respondents indicated their students liked the WebUniversity® CMS, whereas eight respondents indicated their students did not like it. The instructors who indicated their students did not like the WebUniversity® CMS were vociferous in expressing this dislike. To quote one respondent, "Students seem to hate the on-line activities and view it as time wasting. This varies from course to course but by in large they absolutely hate it. Understand they don't want to spend more time in course, they just don't want to do this….." Another said, "Students do not like it. A number have said to me they almost feel they are taking an online course. Others have stated they felt the online assignments were "busywork." This was a minority of the respondents. The plurality said their students liked the CMS.

The fifth question was, "What kinds of improvements would you suggest in the WebUniversity® CMS to increase its effectiveness in your teaching?" This question had the least responses, only 25. These responses were thoughtful and many of the suggestions in these responses have been implemented. Table 4-5 lists the responses and number of respondents to the fifth question.

Table 4-5:
Responses to "What kinds of improvements would you suggest in the WebUniversity® CMS to increase its effectiveness in your teaching?"

Response	Number of Respondents
Provide access to internet-based interactive tools	1
Simplify the process for posting to the document sharing area	1
Fix the grade book	4
Provide better internal links	1
Provide more training on the use of the tool	3
Provide better technical support	1
Improve the examination builder	2
Do away with inventory shells and automatically roll course shells	6
Provide tracking to show email receipt	1
Make course shells available in more timely manner	1
Add instant messaging	1
Better prepare new students to use the BILS tools	1
None	1

The suggestion with the most responses has more to do with the administration of the CMS than with the use of the CMS. This is a very thoughtful suggestion and seems reasonable because instructors often make changes to their course shells during a session and in order to have these changes available during the next term, all of these changes need to be copied over to the instructor's inventory shell.

Summary

The results of the observations of Professor Algorwal and the interviews with both Professor Algorwal and Professor Brown indicate problems with the accelerated instructional delivery model that may or may not be growing pains associated with the deployment of a new instructional delivery model. The main growing pain seems to be the lack of experience in using the WebUniversity® CMS. Evidence was collected that showed Professor Algorwal was not using the threaded discussions as a teaching tool. As a witness to the deployment of the BILS, I can say there was no training given to the instructors in the pedagogy of teaching online using the WebUniversity® CMS. The only training given the instructors was how to navigate and

modify the course shells, and how to use the various components of the course shell from a technical point of view. As a result, instructors who are not experienced with the use of a computerized course management system, were at a loss early in the deployment of the BILS as to how to effectively use the WebUniversity® CMS as a part of their pedagogy. One symptom of this is the desire to cover all of the course topics in the classroom, which creates stress on the students and the instructor and often leads to leaving out topics the instructor feels are less important in order to cover all of the topics the instructor considers to be important. Comments from the interview with Professor Brown indicate resistance and resentment to using the WebUniversity® CMS because it takes up too much of what instructors see as their personal time. He does not feel it should be his responsibility to help the students fix technical problems with their home computers. The results of the survey of instructors using the CMS seem to confirm this. I do not believe this attitude is common to all of the instructors at Newbern University because Professor Algorwal shows concern for her students and a willingness to help them, even outside of the classroom and her office hours. She did, however, show a reluctance to use the WebUniversity® CMS by her lack of participation in the threaded discussions.

There are other problems, mostly technical, with the WebUniversity® CMS. One that is significant to mathematics instruction is the lack of a means to easily communicate mathematically. This is a major stumbling block to the use of the threaded discussions. Even communicating in pseudo code can be difficult because this code is hard to read once it is typed. For example a simple quadratic equation looks like this in pseudo code: 2x^2 + 3x –4 = 0. The first solution step to this problem using the quadratic formula looks like this:

x = (-3 + sqrt((-3)^2 – 4(2)(-4))/(2*2).

This does not look a bit like the quadratic formula when presented in a textbook. It is hard to read, and harder to type, and the students have difficulty understanding problems written this way.

Comments from the student interviews indicate they feel they would learn mathematics more easily in either a standard instructional delivery model classroom or a compressed instructional delivery model classroom because they would have more face-to-face time with the instructors. The reason most of them indicate for taking the accelerated classes is because of their work schedule or other personal reasons. They expressed dislike for the WebUniversity® CMS because of the lack of means for communicating mathematically.

The survey of instructors using the WebUniversity® CMS provided mixed results in relation to the research. This survey included graduate as well as undergraduate instructors and this may have influenced the responses. Most of the instructors reported things they liked about the CMS, four said there was nothing to like. There were some good suggestions for improvement in the survey responses. Overall the responses were positive although some were vociferously negative.

Outcomes Comparison

Three measures were used to compare learning outcomes between the three instructional delivery models. The first measure was based on a set of ten items embedded in the final examinations for each course section. The ten items were designed to cover the course objectives as stated in the curriculum guide for College Algebra used at Newbern University. The questions covered the following topics: number bases, equations involving radicals, application of linear equations, systems of linear equations, graphing quadratic equations, graphing rational equations, graphing using translations of basic functions, logarithmic

equations, exponential equations, and sequences. A copy of these test items appears in Appendix C.

The second measure was based on grade data for all of the sections of College Algebra that met during the Spring 2004 term at Newbern University. Average grades for each instructional delivery model were calculated and compared using a *t*-test of two means. The third measure, which is used at Newbern University, is called the WF rate. It is the proportion of students who either earn a grade of F or withdraw during a given term. The general idea is a lower WF rate implies a higher student retention rate. Since Newbern is a proprietary, for-profit institution, student retention is related to higher profits. The remainder of this section of the chapter is an analysis of each of these data types as applied to College Algebra.

Learning Outcomes Based on Embedded Test Items.

Each instructor submitted blind, ungraded copies of the embedded test item results. Each test copy was graded using the five point test rubric shown in Table 4-6.

Table 4-6:
Scoring Rubric for Embedded Test Items

Points	Description
0	Did not attempt problem or shows no knowledge of how to solve the problem
1	Shows some knowledge of how to solve the problem or makes some attempt to solve but does not complete
2	Shows knowledge of how to solve the problem but makes basic errors in computation that result in an incorrect solution
3	Shows knowledge of how to solve the problem but makes simple errors in computation that result in an incorrect solution
4	Shows complete knowledge of how to solve the problem and has the correct solution.

After the tests were scored, a test item analysis was performed to see how well each instructor covered the course objectives and average class grades were calculated for comparison purposes between the models. Only four of the five class sections that were a part of the research had the embedded test items submitted. Professor Brown did not submit the items for

his standard instructional delivery model class. Table 4-7 shows the class averages on the embedded test items.

Table 4-7:
Class Averages on Embedded Test Items (maximum Score = 40 points)

Class	Mean	n
Brown Compressed	21.333	3
Algorwal Compressed	17.500	5
Algorwal Standard	23.300	10
Algorwal Accelerated	24.600	5

The average class grades were compared pair-wise using a *t*-test of two means. The results of this comparison are shown below. The values in the table are p-values. The values are the probability of a type I error when the alternative hypothesis is the class averages for the classes in the column headings are greater than the class averages for the classes in the row headings.

Table 4-8:
p-values from the Pair-Wise *t*-test of Two Means

	Brown Compressed	Algorwal Compressed	Algorwal Standard	Algorwal Accelerated
Brown Compressed		.0309	.7280	.8304
Algorwal Compressed	.9691		.8888	.9673
Algorwal Standard	.2720	.1112		.6035
Algorwal Accelerated	.1696	.0327	.3965	

When the compressed instructional delivery model classes are compared head-to-head, Professor Brown's class section had a significantly higher class average ($p = 0.0309$). Professor Brown began this class with four students and at the end of the term all of the students were still in the

class. Professor Algorwal's class began with 12 students and 5 of them withdrew during the term. From the classroom observations, Professor Brown was able to give his students more personal attention during the term and this may account for the difference in the class scores on the embedded test items. When the models are compared head-to-head, the only significant difference is Professor Algorwal's accelerated class had a higher average than her compressed class ($p = .0327$). From Professor Algorwal's interview, the compressed class had only overnight to prepare for the final examination and Professor Algorwal expressed disappointment in the results of the examination. Some of the students she thought would earn a grade of A did so poorly that they earned a grade of B instead. This may also explain some of the difference between Professor Brown's compressed class and Professor Algorwal's compressed class.

The test item analysis ranked the ten problems from 1 to 10 with 1 being the most difficult for the students, and 10 being the easiest for the students. This was done class section by class section and also aggregated across the classes. In each of the four class sections, the problem involving number bases was the most difficult. In two of the class sections, no student even attempted the problem. The only class section where students attempted the problem and seemed to understand it was Professor Algorwal's standard instructional delivery model class. This may be related to the time constraints present in the compressed and accelerated class sections. Perhaps the instructor did not have time to cover number bases. In the aggregate, the easiest problem for the students involved systems of linear equations, which was a surprise because, in the experience of the researcher, students usually have problems with systems of equations. The remainder of the questions ranked close together in difficulty. A table of the item analysis appears in Appendix D.

Learning Outcomes Based on Course Grades

Grade data was collected for all of the sections of College Algebra that met during the Spring 2004 term at Newbern University. There were seven sections of College Algebra using the accelerated instructional delivery model, two sections using the compressed instructional delivery model and three sections using the standard instructional delivery model. The grade data was aggregated by instructional delivery model and then the grade point averages (GPAs) for the models were compared pair-wise using a *t*-test of two means. The GPAs by instructional delivery model are shown in Table 4-9.

Table 4-9:
GPAs by Instructional Delivery Model

Model	GPA	n
Accelerated	1.898	91
Compressed	1.813	11
Standard	0.829	73

The results of the comparisons are show Table 4-10 below. Again, the values in the table are *p*-values.

Table 4-10:
p-values for *t*-tests of GPAs for Models

	Accelerated	Compressed	Standard
Accelerated		.396	0
Compressed	.602		.003
Standard	1	.997	

The table shows significant differences in GPAs between the standard instructional delivery model and both the accelerated model ($p = 0$) and the compressed model ($p = .003$) with the accelerated and the compressed models having the greater GPAs. This coincides with the results reported by others in the literature for other academic subjects taught in an intensive

format. There was no significant difference shown for the GPAs between the accelerated and compressed models (p = .396).

Effectiveness Outcomes Based on WF Rates

The grade data also contained the number of students who withdrew from each class section. These rates were aggregated in a similar manner to how the GPA's were aggregated across the models. Table 4-11 shows the WF rates for Professor Algorwal's and Professor Browns classes along with the aggregate WF rates by instructional delivery model.

Table 4-11:
WF Rates by Model and Instructor

Professor and/or Model	n	WF	WF Rate
Algorwal Accelerated	6	2	0.333
Algorwal Compressed	12	6	0.500
Algorwal Standard	23	12	0.522
Brown Compressed	4	0	0
Brown Standard	59	36	0.610
Accelerated	118	41	0.347
Compressed	16	6	0.375
Standard	111	62	0.559

The WF rates for the accelerated instructional delivery model and the compressed instructional delivery model were very close, 0.347 versus 0.375. A z-test of two proportions shows no significant difference in the rates (p = .828). The WF rate for the standard instructional delivery model classes was somewhat higher, 0.559. This means almost 56% of the students in the standard instructional delivery model class sections either failed the class or withdrew. Unfortunately the Spring 2004 term was an anomaly for this statistic. The WF rate for College Algebra for the Spring 2004 term was about 20 percentage points greater than the rates for ether the Fall 2003 term or the Summer 2004 term and, when viewed graphically, shows a significant spike in this statistic. When z-tests of two proportions were performed comparing the models pair-wise, the WF rate of the standard model was significantly greater than the accelerated model

(p = .0007) and the compressed model (p = .0844). Because of the anomaly of the WF rates in the Spring 2004 term, these statistics are suspect and I will not draw any conclusions from them.

Summary

The outcomes data is reflective of the results of other studies in the literature concerning intensive instructional delivery models. The major difference is the inclusion of the hybrid accelerated instructional delivery model in this study. None of the literature in the review reported on hybrid models in an intensive instructional delivery context. All of the literature on hybrid models reported on the use of a CMS to augment standard courses. The outcomes data seems to claim the accelerated instructional delivery model is somewhat better for instructing College Algebra than the compressed instructional delivery model, and either of these models is better than the standard instructional delivery model.

Summary of Results

How do all of these results relate to the research questions? The first research question is, "What, if any, are the pedagogical differences for teaching mathematics among the three models, standard, compressed, and accelerated?" In Professor Algorwal's classes the main difference was between the standard and compressed models versus the accelerated model. These differences were all related to available instructional time. For the accelerated class section, Professor Algorwal shortened her normal instructional pattern by taking out board work and discouraging questions from the students, all in a effort to save enough time to cover the material. Additional evidence was brought out in Professor Algorwal's interview when she admitted to discouraging student questions in the accelerated class section. In Professor Brown's classes the pedagogical differences between the standard model class section and the compressed model class section were related to the extreme difference in class size. The compressed class,

which was the smaller, was conducted in the manner of a tutorial with ongoing personal feedback between the instructor and the students. This allowed Professor Brown to craft the instruction to the needs of the individual student, since informal assessment was a continuing process in this classroom. In the standard model classroom, which had almost 15 times the number of students in it, the instruction was more formal, hardly ever getting out of the lecture mode, and almost no informal assessment was observed. I did not learn anything about the differences in the models from the observations of Professor Brown's classes other than extreme differences in class size have a great effect on instructional style. In fact, I could have done the whole study using Professor Algorwal's classes and not had any difference in the outcome. The observations of Professor Algorwal's classes were informative. Instructional time is the major factor in the differences in pedagogy between the models. Professor Algorwal felt stressed by the lack of time in the accelerated model classroom. She changed her style of teaching to accommodate for this stress. She admitted to this difference in her interview.

The second research question is, "How does instructor satisfaction compare when teaching mathematics in each of the three instructional delivery models?" More than one time in the interview, Professor Algorwal expressed her dislike of the accelerated instructional delivery model. She felt it was not fair to the students. It caused them too much stress and she gave anecdotal evidence from her conversations with her students they did not like accelerated courses either. Theses concerns can also be related to available classroom instruction time. Professor Algorwal's main objection to the compressed instructional delivery model, as she had just experienced it, was to the scheduling of her class. After some questioning, she admitted she would prefer the compressed model if it were scheduled in four, two hour blocks. Professor Brown's preferences were again related to class size. In his experience, the compressed

instructional delivery model classes were smaller and the standard instructional delivery model classes were larger. He also did not like the accelerated model because he perceived the on-line component to be too much extra work, which was not worth the effort. The better lesson is gained from Professor Algorwal. She sees the advantage, both to the student and instructor, of the compressed model. Fewer classes at a time to worry about giving more time to concentrate on the subject during the eight-week session.

The third research question is, "What, if any, are the differences the student sees in learning mathematics among the three models?" From the interviews, particularly Viktor Karoli's, the learning experience in the accelerated model is not as good as the other models. The evidence in the interviews shows that, in order to thrive in the accelerated model, the student must be self-motivated, well prepared from previous academic experience, and also be an independent learner. There are very few students meeting all of these criteria. All of the students admit they would take mathematics in the standard or compressed format if they were not trying to complete their degrees in the shortest time possible.

The fourth research question is, "How does student satisfaction compare when learning mathematics in each of the three models?" Only one of the students, Mary James, was satisfied with the mathematics learning in the accelerated model. She was the student who was taking all of her courses either online or in the accelerated model. She admitted she would probably get a better education if she enrolled in the standard or compressed classes because she would have more time to transfer the knowledge to her long term memory.

The fifth research question is, "How do student mathematics learning outcomes differ among the three models?" From the evidence collected, the embedded test problem results, and

the class grades, there is a difference in learning outcomes favoring the compressed and accelerated instructional delivery models.

In retrospect, the data gathered regarding Professor Brown's classes was not relevant to the research. None of the differences in pedagogy or learning outcomes in his classes can be directly related to the differences in the instructional delivery models, the differences can only be related to the extreme difference in his class sizes. Whereas, in Professor Algorwal's classes the differences in pedagogy can be directly related to the time constraints caused by the differences in the models. Also, it appears from the interview with Professor Algorwal that the difference in learning outcomes between the accelerated and the compressed model classes can be related to the adverse scheduling of the compressed model class on consecutive days.

The sixth research question was, "What are the relative strengths and weaknesses of each model for teaching college mathematics at Newbern University?" Both the accelerated and the compressed instructional delivery models had significantly better learning outcomes as measured by the embedded test items and the aggregated GPAs than the standard instructional delivery model but neither of them stood significantly above the other if only Professor Algorwal's data is considered. What the data, both qualitative and quantitative imply is, there is no instructional delivery model that is right for every student. Each model has advantages and disadvantages for instructing mathematics. Professor Algorwal's interview indicates that the weaker students need the longitudinal time provided by the standard instructional delivery model to be successful. The student interviews show that, with the right instructor, some of the weaker students can be successful in classes that use the compressed instructional delivery model. This is exemplified by Ms. Hall's experience. Finally, the sufficiently prepared and motivated students can be successful in classes using the accelerated instructional delivery model. The accelerated model

has one advantage of interest to Newbern University, the reduced classroom seat-time per week allows for more efficient use of valuable space allowing for expansion of the night and weekend programs. The implications of these findings will be discussed in Chapter Five.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND IMPLICATIONS FOR FURTHER RESEARCH

Introduction

In this chapter I will summarize the results of the research and present conclusions made from these results. The summary of the results will be presented in order of instructional delivery model as presented in Chapter 4 and will conclude with a summary of the learning outcomes. The conclusions will follow and will include a paragraph on who should be interested in the results of this research. The chapter will conclude with implications for further research.

Summary

Standard Instructional Delivery Model

The standard instructional delivery model is used at nearly every institution of higher education in the United States. The model is the basis for assigning credit hours in most institutions; a three credit hour course meets three hours per week for 15 weeks. It is important for some students, particularly the less prepared and motivated students who need this time, particularly the longitudinal time to study and absorb the concepts and materials presented in a college mathematics course, to have the full fifteen weeks to learn. There are other students, particularly the better prepared students, who can be bored by the slow pace of the standard instructional delivery model and suffer the effects that usually

come with boredom such as inattention. At least one of the students interviewed was this type of student.

The research results show the less prepared students, or the students without recent mathematics experience in an academic setting often do better in a standard instructional delivery model setting. These are the students mentioned above who need this longitudinal time to absorb the concepts and develop the skills. This may not be important to an institution that can maintain high entrance requirements, such as the University of Georgia, but it is very important to other institutions which have an open admissions policy.

Compressed Instructional Delivery Model

Differences in pedagogy were observed between the compressed instructional delivery model and the standard instructional delivery model related to class scheduling and class size. For one of the instructors, the differences were related to available instruction time, which was affected by the class schedule, two four-hour blocks on consecutive days, Thursday and Friday. From class observations, students began to tire after about two and a half hours of instruction and were so tired and inattentive after three hours that any further instruction was senseless. This had the effect of losing two of eight of the available instructional hours per week. As a result, the pace of instruction had to be increased to compensate. This was done by not allowing as much time for student questions or for seatwork. For one instructor, the differences were related to class size. The compressed instructional delivery model class was significantly smaller, 4 students, than the standard instructional delivery model class, 59 students. This allowed the other instructor to conduct the compressed class in a more intimate and friendly atmosphere than the standard model class. This finding had no direct relation to any characteristic of the

compressed model; therefore the finding has no relevance to any of the research questions and will be ignored in the conclusions.

Intuitively, there should be no differences in pedagogy between the standard instructional delivery model and the compressed instructional delivery model because the face-to-face contact time is the same in both models. The scheduling of the compressed classes in four-hour blocks could perhaps have benefited from some changes in pedagogy such as using group work to break up the class time. This might have reduced the fatigue observed during the fourth hour in one of the class sections studied by giving the student the opportunity to move around in the classroom. For the students, who should be taking fewer classes at a time, there should be a definite advantage to taking mathematics in a compressed model classroom. They should be able to concentrate more effort on learning only two or three subjects instead of diluting their learning efforts across five or more subjects, as would be the case when taking all of their courses in standard instructional delivery model classrooms. Unfortunately, the results of this research show other factors, such as scheduling, can cause pedagogical differences to appear. None of the pedagogical differences between the standard and compressed models appear to be related to differences between the models themselves. The reduced student interaction and the elimination of board work by one professor was related to the effective loss of two hours of instruction time per week caused by scheduling the class in four-hour blocks and the resulting student fatigue and her failure to adjust her pedagogy for this. The more intimate classroom conduct of the other instructor was related to class size.

Both instructors felt the compressed instructional delivery model was a good model for teaching mathematics. One instructor expressed the opinion the compressed instructional delivery model was almost as good as the standard model and would have been better had the

scheduling of the compressed model class been in four, two-hour blocks instead of the two, four hour blocks the instructor experienced.

The students had little experience with the compressed instructional delivery model. The one student who was in the compressed model class expressed she would take a mathematics class using the compressed instructional delivery model only if the right instructor was teaching the class. This fits with the results reported by Scott; intensive courses can be as instructionally effective as traditional semester-length courses if certain instructional qualities were present. If the instructional qualities she identified were not present, however, then intensive courses were not as effective (Scott, 1995). Another student who took a compressed mathematics class at another institution, said she would prefer the standard or compressed model for all of her courses, but she was trying to complete her degree as soon as possible while working full-time and that was not possible taking compressed or standard courses so she was taking only online and accelerated classes.

Accelerated Instructional Delivery Model

The results of the observations of one of the professors and the interviews with both professors indicate problems with the accelerated instructional delivery model that may or may not be growing pains associated with the deployment of a new instructional delivery model. The main growing pain seems to be the lack of experience in using the WebUniversity® CMS. Evidence was collected that showed one professor was not using the threaded discussions as a teaching tool. As a witness to the deployment of the BILS, I can say there was no training given to the instructors in the pedagogy of teaching online using the WebUniversity® CMS. The only training given the instructors was how to navigate and modify the course shells, and how to use the various components of the course shell from a technical point of view. As a result,

instructors who are not experienced with the use of a computerized course management system, were at a loss early in the deployment of the BILS as to how to effectively use the WebUniversity® CMS as a part of their pedagogy. One symptom of this is the desire to cover all of the course topics in the classroom, which creates stress on the students and the instructor and often leads to leaving out topics the instructor feels are less important in order to cover all of the topics the instructor considers to be important. This parallels the results reported by Daniel (2000). Comments from the interview with one of the professors indicate resistance and resentment to using the WebUniversity® CMS because it takes up too much of what instructors see as their personal time. He does not feel it should be his responsibility to help the students fix technical problems with their home computers. The results of the survey of instructors using the CMS seem to confirm this. Harmon and Jones also reported this in their research of web-based instruction (Harmon & Jones, 2001). I do not believe this attitude is common to all of the instructors at Newbern University because the other professor showed concern for her students and a willingness to help them, even outside of the classroom and during her office hours. She did, however, show a reluctance to use the WebUniversity® CMS by her lack of participation in the threaded discussions.

There are other problems, mostly technical, with the WebUniversity® CMS. One that is significant to mathematics instruction is the lack of a means to easily communicate mathematically. This is a major stumbling block to the use of the threaded discussions. Review of the threaded discussion area of the online component of one instructor revealed that the threaded discussions ended after week five of the term. Comments from the interviews complaining about the lack of a convenient way to communicate mathematically indicate that perhaps this was a contributing cause. Even communicating in pseudo code can be difficult

because this code is hard to read once it is typed. For example a simple quadratic equations looks like this in pseudo code: 2x^2 + 3x – 4 = 0. The first solution step to this problem using the quadratic equation looks like this: x = (-3 + sqrt((-3)^2 – 4(2)(-4))/(2*2). This does not look a bit like the quadratic equation as presented in a textbook. It is hard to read, and harder to type, and the students have difficulty understanding problems written this way without decoding them by writing the equations out on paper. Often mistakes are made in coding or decoding and these only add to the frustration. This is a situation that is unique to mathematics education when using this CMS.

Another problem with the design of the accelerated College Algebra course as implemented at Newbern University is the original goal was to have an accelerated course which looked exactly like the standard instructional delivery model course for which it is a substitute. No attention was paid to the possible differences between face-to-face and online instruction as recommended by Alley and Jansak (2001). Not enough attention was given to possible technical problems. In the deployment of the BILS, the same technical problems that were observed by Harmon and Jones (2001) occurred regularly as reported in the survey of the instructors using the BILS at Newbern. To conclude, no attempt was made to provide instructors with training using the threaded discussion areas in a manner similar to that reported by Klemm (1998), or on the differences between the face-to-face environment and the online environment reported by Smith and his colleagues (2001).

Comments from the student interviews indicate they feel they would learn mathematics more easily in either a standard instructional delivery model classroom or a compressed instructional delivery model classroom because they would have more face-to-face time with the instructors. The reason most of them indicate for taking the accelerated classes is because of

their work schedule or other personal reasons. They expressed dislike for the WebUniversity® CMS because of the lack of means for communicating mathematically.

The survey of instructors using the WebUniversity® CMS provided mixed results in relation to the research. This survey included graduate as well as undergraduate instructors and this may have influenced the responses. Most of the instructors reported things they liked about the CMS, four said there was nothing to like. There were some good suggestions for improvement in the survey responses. Overall the responses were positive although some were vociferously negative. One question that could have been asked, and probably should have been asked in the survey is, "What deficiencies in your training to utilize the WebUniversity ® CMS as a part of your instruction in your course?" Perhaps if this question had been asked, the survey would have been more useful to this research.

Learning Outcomes

The outcomes data is reflective of the results of other studies in the literature concerning intensive instructional delivery models in terms of the embedded test item analysis and the GPA analysis. Intensive format courses are equally as effective or more effective than traditional format courses in learning outcomes. The major difference is the inclusion of the hybrid accelerated instructional delivery model in this study. None of the literature in the review reported on hybrid models in an intensive instructional delivery context. All of the literature on hybrid models reported on the use of a CMS to augment standard courses. The outcomes data seem to show the accelerated instructional delivery model is somewhat better for instructing College Algebra than the compressed instructional delivery model, and either of these models is better than the standard instructional delivery model. The WF rate data analysis was

inconclusive because of anomalies in that data related to unidentified confounding factors that occurred only in the Spring 2004 term.

Conclusions

There is an interesting conflict in the research results between the qualitative results and the quantitative results. If I were to make conclusions strictly based on the qualitative results I would say the preferred instructional model for mathematics instruction is the compressed model. If I were to make conclusions strictly based on the quantitative results I would the preferred instructional model for mathematics instruction is either the accelerated model or the compressed model because there was not a significant difference in outcomes as measured by either the embedded test items or the aggregate GPA's between these models. The data are collectively inconclusive and if someone were looking to find the best model for instructing College Algebra they would be disappointed. There are advantages and disadvantages to each instructional delivery model and no one of the three in this research can be said to be best based on the research results.

The qualitative data point out problems related to mathematics learning associated with the accelerated instructional delivery model. One of these problems concerns the lack of a convenient means to communicate mathematically using the WebUniversity® CMS. This resulted in difficulties using the threaded discussion component of the CMS for the purpose it was intended, to allow the students to collaborate on learning the new concepts presented on-line and to allow the instructor to monitor the threaded discussions and provide feedback to the students using the CMS. This is a major problem and should be addressed by Newbern University and the WebUniversity® support group as soon as possible. There are other problems mentioned in the survey of instructors using the WebUniversity® CMS needing to be

addressed, but the mathematics communication problem is the most important to this research and to the future success of using the accelerated instructional delivery model for teaching mathematics at Newbern University. Another problem pointed out in the research is the differences in classroom pedagogy resulting from the shortened face-to-face instructional time available when using the accelerated instructional delivery model. These pedagogical differences have the most adverse affect on the less prepared student. The differences are characterized as faster paced instruction in order to cover the material and an underlying assumption the student has the prerequisite knowledge to succeed at this pace. This is not true for all students who are in classrooms using the accelerated instructional model. Some students, will not be successful in an accelerated mathematics course because of personal difficulties with mathematics learning. One student did show she could be successful in a mathematics course using the compressed model and the right instructor.

Based on the research results, there is no best instructional delivery model for teaching mathematics at Newbern University. Each model has advantages and disadvantages. The standard instructional delivery model has the advantage of greater longitudinal time for the instruction. This time can be helpful to students with weaker mathematics backgrounds and those who have perceived difficulties learning mathematics related to math anxiety or some psychological affect related to earlier failed mathematics learning experiences. The disadvantage of the standard model to Newbern University is it inhibits efforts to utilize classroom space more efficiently and to reduce overall instructional costs. Another disadvantage of the standard model is use of the model limits access to instruction more difficult or perhaps impossible for the student who is working full-time and trying to go to school to better themselves professionally, financially or otherwise.

The research shows the compressed instructional delivery model has the advantage of better learning outcomes when compared to the standard model. The pedagogical differences between the compressed and standard models are minimal and, in this research, related only to scheduling differences and not to characteristics of the models. Most authors contribute the improvement in learning outcomes to the student being able to concentrate on only two or three courses at a time as compared to five or six courses at a time using the standard instructional delivery model (Daniel, 2000; Scott, 1993, 1995, 1996, 2003; Van Scyoc & Gleason, 1993). The disadvantage of the compressed model to Newbern University is the same as the disadvantage of the standard model. Since the compressed model uses the same classroom seat-time as the standard model, it does not allow for better utilization of limited classroom space.

The research shows that the accelerated instructional delivery model also had an advantage over the standard model in terms of learning outcomes. It also has the advantage of meeting Newbern University's desire to more efficiently utilize limited classroom space in order to serve a growing night and weekend student population. The research does show disadvantages for the accelerated model. One disadvantage is for a student to be successful in an accelerated model class, he or she must be well prepared and motivated to learn. This disadvantage could possibly be ameliorated by a redesign of the course taking into account the literature on instructional design discussed in Chapter 2. Additionally, providing faculty training based on the articles by Klemm (1998) and Smith and his colleagues (2001) concerning online pedagogy could bring the accelerated model within the reach of the less prepared and less motivated student.

One problem the qualitative data reveal concerning the accelerated instructional delivery model is the lack of training in online pedagogy provided to the instructors when the BILS was

adopted. One professor's poor use of the threaded discussion area in her accelerated College Algebra class is an example of this. The accelerated instructional delivery model was introduced at Newbern in part to better utilize the physical plant, particularly for the night and weekend programs, which are growing at a faster rate than the day programs. This pressure to better utilize the classroom space will not subside so efforts need to be made to make the accelerated instructional delivery model more successful for the weaker mathematics students. The tools are present in the WebUniversity® CMS to achieve this success, but only if these tools are used in a pedagogically correct manner. This could relieve the pressure in the face-to-face meetings in the classroom that results in the fast paced instruction with which the weaker students have difficulty. To do this requires that Newbern University provide more training for the instructors who are forced to use the accelerated instructional delivery model, specifically in the pedagogical use of the tools available on the WebUniversity® CMS.

This research should be of interest to anyone who is considering the use of alternative instructional delivery models for teaching mathematics and to anyone who is developing such models. If this research had been available when the compressed and accelerated instructional delivery models were introduced at Newbern University, problems discovered in the research and in the deployment of the models could have been avoided and the deployment would have been successful sooner. When developing a hybrid model for instructing mathematics a means for easily communicating mathematically is a necessity. This was, and is, lacking at Newbern. When training faculty to use the online tools for a hybrid instructional delivery model, include training on the pedagogical uses of those tools. And, when scheduling classes using a compressed instructional delivery model similar to the one described in this research, pay

attention to the length of the class periods and the school's holiday schedule. These were all problems uncovered in this research that affected both student and instructor satisfaction.

Limitations of the Research

The limited number of research subjects involved in the research makes such generalizations problematic. All of the conclusions in the research are based on only one of the instructors involved. The uneven enrollment between the standard and compressed classes of the other instructor was not foreseen in the research design and it rendered the data collected concerning that instructor irrelevant to the research. Administrative practices limited the opportunity to explore a test of the models. For example, the scheduling of the compressed classes in two four-hour blocks on successive days may have been less than ideal for implementing the compressed model. The inherent limitations of the WebUniversity ® CMS used in the accelerated model impacted on the implementation of the model. Lack of instructor training in pedagogy for online instructional delivery also can be seen as a limitation to providing a good test of the models. Finally, there is an inherent difference in student backgrounds between the students enrolled in each model. The older, more mature, working students must use the accelerated or online models because night and weekend classes are only offered using these models. Every effort was made on the part of the researcher to limit his biases in developing conclusions regarding the research results. However, the researcher had vested interest in the outcome of the research, so some bias may still linger.

Implications for Further Research

This research raises several questions concerning the use of alternative instructional delivery models for mathematics education. If we look at the remedial course offerings of community colleges and other institutions with open admissions criteria, we find that, for the

most part, there are only courses offered in mathematics and language arts. First, what unique characteristics of mathematics as a subject influenced the results of this research on alternative instructional delivery models? Are there parallels in the language arts to the characteristics of mathematics? This would be a very interesting research topic of interest to our colleagues in these institutions. Second, how can web-based course management systems be better adapted to teaching mathematics? This research should be of interest to both college level mathematics faculty and to the companies marketing these course management systems. And finally, what are the best pedagogical practices for teaching mathematics using a web-based course management system or using the compressed instructional delivery model and what professional development is needed for instructors to successfully deploy this pedagogy? Research in this area should also be of interest to both college level mathematics faculty and to the companies marketing course management systems.

This document offers an insight into how alternative instructional delivery models were introduced at Newbern University and to how two instructors and four students adapted to the use of these models. The research reported here documents differences in pedagogy resulting from this introduction and each instructional delivery model had qualities commending the model and qualities needing improvement. The research did not reveal one of the instructional delivery models studied was superior to the others for teaching mathematics at Newbern University.

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APPENDICES

APPENDIX A

INSTRUCTOR INTERVIEW QUESTIONS

1. At DeVry we use four different instructional models for course delivery; standard fifteen-week, compressed, accelerated, and online. Which of these instructional delivery models have you used to teach courses?

    a. Describe how your teaching methods differ for each instructional delivery model that you have used.

    b. To which characteristics of each instructional delivery model do you attribute your differences in teaching methods among the models? Why?

2. Reflect on your recent classroom experiences using each instructional delivery model and then relate to me your perceptions of student attitudes toward each of the models.

    a. What characteristics of each instructional delivery model do you think engender these attitudes and why?

3. Describe the differences in student learning outcomes you have experienced among the instructional delivery models and attribute these differences to the characteristics of the individual models

4. Again reflect on your recent classroom experiences using each instructional delivery model and then relate to me your attitudes toward each instructional delivery model and your reasoning for these attitudes.

5. You are an instructor of mathematics. Describe the unique challenges of teaching mathematics using each of the instructional delivery models. If you think mathematics is easier to instruct in one or more of these models describe how and why

APPENDIX B

STUDENT INTERVIEW QUESTIONS

1. At DeVry we use four different instructional delivery models for course delivery; standard fifteen-week, compressed, accelerated, and online. Which of these models have been used in mathematics courses you have taken at DeVry?

    a. Describe to me the differences in teaching methods your instructors used in each model.

2. How did your learning experiences differ among the instructional delivery models? What was it about the different models that you think made the learning experiences different?

3. Which instructional delivery model do you prefer for learning mathematics and why?

4. Would your choice of instructional delivery model be different for some other subject such as English literature or psychology? Why?

APPENDIX C

EMBEDDED TEST ITEMS

1. Show how to convert:

   a. 1011011_2 to a decimal number

   b. 189_{10} to a hexadecimal number

2. Solve for x: $\sqrt{x+3} = 3x-1$

3. A farmer raises corn and soybeans on 350 acres of land. Because of expected prices at harvest time, he thinks it would be wise to plant 100 more acres of corn than of soybeans. How many acres of each does he plant?

4. Solve by Gaussian Elimination, Gauss-Jordan Elimination or Cramer's Rule the following:

$$\begin{aligned} x + 2y - 3z &= -7 \\ 2x - y + 4z &= 11 \\ 4x + 3y - 4z &= -3 \end{aligned}$$

5. Graph the following quadratic function $f(x) = x^2 + 6x - 1$ and identify:

   1. all the intercepts (if any)
   2. axis of symmetry
   3. the vertex
   4. domain and range of this function

6. Sketch the graph of f(x) = $\dfrac{2x^2 + 3x}{3x^2 - 48}$ by showing
   a. All the asymptotes
   b. All the intercepts

7. Given: $f(x) = \sqrt{x}$, use translation and/or reflection to graph the following:

$$f(x) = \sqrt{x-2} + 1$$

8. Solve for x: $\ln x = \ln (2x-1) - \ln(x-2)$

9. Solve for x: $3^{2x-1} = 5^{x+2}$. Solve to 4 decimal places.

10. Find the ninth term of the arithmetic sequence whose first three term are -8, -5, -2, ….

APPENDIX D

Table B-1:
Test Item Analysis of Embedded Test Items

Topic	Mean Score (Range 0 to 4)	Rank of Difficulty (1 = most, 10 = least)
Number bases	0.651	1
Equations involving radicals	2.696	8
Applications of linear equations	2.609	5
Systems of equations	2.913	10
Graphing quadratic functions	2.652	6
Graphing rational functions	2.043	4
Graphing using translations	2.696	8
Logarithmic equations	1.174	2
Exponential equations	1.522	3
Sequences	2.652	6