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STUDENT ACADEMIC PERFORMANCE IN SKILLS-BASED TECHNOLOGY COURSES DELIVERED THROUGH DIFFERENT SCHEDULING FORMATS

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ABSTRACT

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STUDENT ACADEMIC PERFORMANCE IN SKILLS-BASED TECHNOLOGY COURSES DELIVERED THROUGH DIFFERENT SCHEDULING FORMATS

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This descriptive study investigated student academic performance in skills-based word processing courses taught in two different scheduling formats at one small rural western United States university over the period of several years. One scheduling format followed a more traditional approach where courses were taken at the same time as at least one other course and in a time frame more resembling a typical semester. This distributed practice model, or cohort approach, required a prerequisite beginning level course or appropriate substitute course before enrolling in an advanced word processing course, thus spreading the instructional time over a longer timeframe. The other scheduling format allowed students to take only one course at a time, thus a massed practice model, in a compressed time format that presented the contents of the entire course in 18 instructional days. Student academic performance was measured by a subset of equivalent posttest questions that were common to both scheduling formats. Retention performance during the cohort approach was measured by a subset of equivalent questions common to the beginning and advanced cohort courses. The entire population of word processing students at this university was studied and thus there is no generalizability from this study to another population. Participants self-selected into groups by enrolling in course sections. Simple means were used to compute descriptive and comparative statistics. The distributed practice cohort group out-performed the massed practice group by an experimentally important five percent on the posttest. Results from the retention portion of the study indicate additional research is needed.

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TABLE of CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION TO THE STUDY

A small rural undergraduate campus in the western United States has embarked upon a pedagogical journey refocusing learning and dedicating itself to immersion and experiential learning (IE/L) within a block scheduling model that the university has labeled *Experience One* (X1). A potentially important research study emerged: Does the Experience One learning model provide an environment for improved student academic performance in skills-based word processing courses delivered through an immersion and experiential learning block model as compared to an extended time cohort educational approach? For the purpose of this study the *Experience One* learning model, or X1, will be referred to as the block or block scheduling.

The Setting

This study was conducted at a small rural undergraduate university located in the western United States. The university's mission is to

> provide innovative interdisciplinary education through experiential learning that combines theory and practice. [The university] serves citizens of all ages with its academic, community-service and lifelong-learning programs. As part of the global community, [the university] encourages diversity, international awareness, environmental responsibility and mastery of technology as a gateway to the world. ([University] Mission Statement, 2008, ¶. 1).

Face-to-face traditional semester lecture-based learning models have been the norm in higher education for hundreds of years. Near the end of the 19th century some educators, e.g., Chauncey Wright and John Dewey, started asking such questions as *how do children learn best?* and *how can teachers teach best?* Throughout the 20th century experiments took place using a variety of pedagogical philosophies and delivery methodologies.

In 2001, the university received a grant from the Fund for the Improvement of Postsecondary Education (FIPSE) organization to study block scheduling entitled *Experience One* (X1). At the beginning of the 2005-2006 academic year the university implemented the block scheduling model campus-wide. Prior to the campus-wide implementation, each department was given a one-year timeframe to redesign their curriculum to better align with block scheduling. Most disciplines changed every course they offered making them fit into the four-credit block model. Although many Business & Technology Department (B&T) courses were converted to the four credit format, the majority of Bachelor of Science in Business core courses were kept at the three-credit level in order to maintain transferability for incoming and outgoing transfer students, to better align with national business education models, and to provide a four-day week (Monday – Thursday), thus making the degree program more attractive to student athletes.

Technology Course Core

In a similar fashion to the Business core, computer science courses (COMS) that were part of the Business core were not initially developed to fit the block model. These COMS courses were developed to be taken in parallel with regularly scheduled block courses in order to meet core credit limitations and scheduling requirements. For the purpose of this study, only the word processing courses are discussed.

Word Processing Course Development

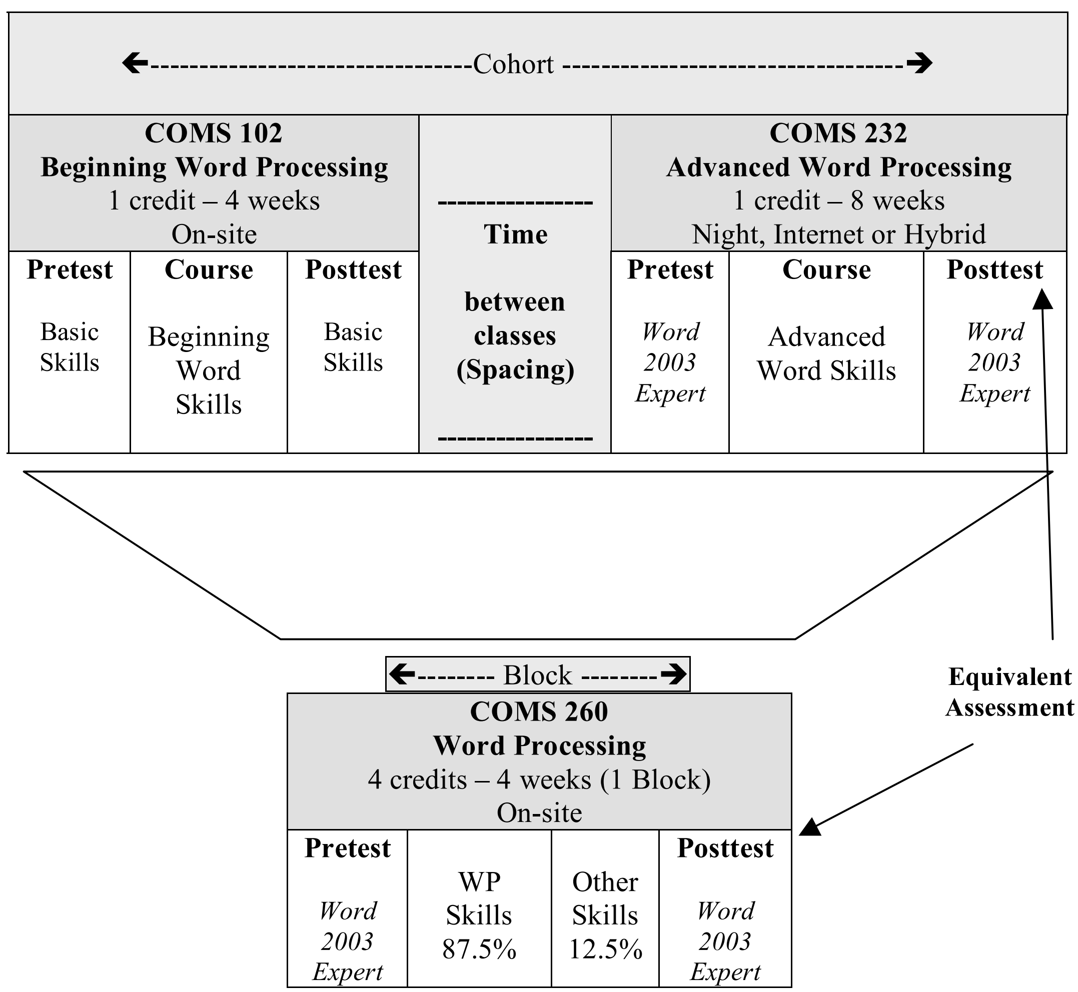
In order to meet constraints, B&T used a cohort educational approach in the development of a beginning/advanced course model for the word processing curriculum. A distributed practice model was used in developing the cohort where beginning concepts and skills were taught in the introductory course COMS 102, Beginning Word Processing. Advanced Word Processing, COMS 232, focused on teaching advanced concepts and skills. As the first class in the cohort, COMS 102 was typically taught in a one credit one block format and used a pretest/posttest methodology to assess student academic performance. The course scheduling was designed so that students could take COMS 102 in addition to another three- or four-credit block course at the same time. The second course in the cohort, COMS 232, was typically taught in a one credit two block online or hybrid format employing a distributed practice methodology that provided spacing between assignments. A pretest/posttest assessment methodology was also used in COMS 232 and focused on teaching advanced word processing skills that aligned with *Word 2003 Expert Microsoft Office Specialist* (MOS) competencies. The COMS 102/232 cohort totaled two credits.

Within the cohort model, spacing, the time between when the beginning and advanced courses were taken, was important when considering student academic performance in the advanced course. For this study, the COMS 102/232 cohort and block-based COMS 260 Word Processing will be referred to as Core Word Processing Courses (CWPC).

During the summer prior to the 2007-2008 academic year, B&T Computer Science instructors redesigned the cohort word processing curriculum changing the format from two one-credit cohort courses into one four-credit block course titled Word Processing (COMS 260). This course employs a massed practice methodology where learning occurs in a compressed course timeframe. The pretest/posttest assessment structure remained the primary assessment instrument in Word Processing and also aligned with *Word 2003 Expert Microsoft Office Specialist* (MOS) competencies (see Table 1). For a complete MOS competency outline see Appendix A.

Table 1.

Word 2003 Expert MOS Competency Attainment Path



The structure change enabled COMS 260 Word Processing to better fit the block model. Advantages of the redesign were four–fold:

- Students could focus on a single course rather than on two courses during a one-block timeframe (e.g., Advanced Word Processing and Business Communications).
- Faculty in-class time and class preparation became more manageable because faculty no longer had to prepare for and teach Beginning or Advanced Word Processing in addition to a four-credit block course.
- Redesigning the courses resulted in easier and improved course scheduling for the Registrar. This resulted in fewer room and time conflicts between courses.
- The redesign resulted in only minor curricular changes.

This study focused on comparing student academic performance in word processing skills-based technology courses that are delivered using a distributed practice extended time cohort model that contains elements of spacing versus a massed practice block-based model where the courses from within each model have similar learning objectives and performance measured by questions common to both the cohort and block-based pre/posttest. Findings from this study will assist the university faculty in determining the optimal scheduling format that will ideally improve student academic performance in regard to posttest scores in skills-based word processing courses.

Statement of the Problem

Creswell (1998) stated the problem statement should provide the rationale for conducting a study. What is the source of the problem? Does the research fill a void in existing literature? Have any associations or correlations been discovered in the study? Has there been an increased understanding of the issue as a result of the research?

Student academic performance comparing cohort and block courses at the undergraduate level has been studied very little. The university's decision to adopt *Experience One* campus-wide was based on a minimal data set, however, additional factors such as marketing niches were included in the decision. The university researched other block universities but found limited quantitative and qualitative data. The primary source of quantitative data was gained through the three year FIPSE pilot project the university conducted internally.

Currently there is limited quantitative data both internally and in the literature regarding student academic performance in word processing courses comparing an extended time cohort format and a block format. More extensive data needs to be gathered in order for the university to better understand the correlation, if one exists, between the course format (cohort versus block) and the impact distributed versus massed practice and the spacing effect has on student academic performance.

Purpose of the Study

Over the last seven years the university has made a significant investment in researching, piloting, and implementing the block-scheduling model. The financial and human resources that have gone into the transition have been immense. There were several reasons for adopting and implementing block scheduling. Loveless and Holmes

(1968), Sigurdson (1981), (O'Neil, 1995), Marshak (1998), White (1995), Barr and Tagg (1995), Casey and Howson (1993) believe that from an educational perspective block scheduling seems to offer pedagogy more conducive to learning. From a business perspective, block scheduling creates a market niche whereby the university gains a competitive advantage over peer institutions. The purpose of this study was to determine whether or not the format, (a) a cohort model employing distributed practice and spacing or (b) a block model utilizing massed practice methodologies, resulted in a difference in academic performance of students as measured by pre- and posttests.

It was important to be aware of the advantages and disadvantages of both the extended time tier-based cohort format and block-based scheduling format including the impact the spacing effect had on student academic performance. By understanding which format, cohort or block-based, had the highest student academic performance B&T computer science instructors would be better able to plan and schedule core word processing technology courses in a manner in which students had the greatest opportunity for success.

Research Questions

The research questions that guided this study were:

1. Was there a difference in student academic performance between cohort and block educational environments?
2. Did the difference in time between taking cohort classes, introductory and advanced word processing courses, have an impact on student academic performance?

Significance of the Study

Those interested in instructional delivery approaches and academic achievement will benefit from this study. Universities considering conversion from semester-based courses to block scheduling will be interested in this research. Universities also will gain insight into the spacing effect as related to the time between cohort courses as well as the effect the length of the course has on knowledge retention and the development of technical skills. Prospective students will find this study valuable in determining the best fit between type of education and individual learning styles.

Universities can gain an understanding of student achievement based upon various scheduling models that can assist the university in long-term strategic planning. For instance, a university researching the block model will have access to descriptive data that could help inform whether or not a transition to a block model is in its best interest.

The prospective student will be able to compare advantages and disadvantages associated between extended time cohort courses and courses delivered through the block scheduling model. Many students believe they can best benefit from an immersion and experiential learning (IE/L) environment where the learning approach is immersion based hands-on face-to-face while others are interested in the more traditional approach offered by an extended time course model. The findings of this study will provide empirical evidence determining whether an extended time cohort or block-based format demonstrates better student academic performance in skills-based word processing courses where learning objectives are similar and measured by questions common to both the cohort and block pre- and posttest.

Limitations

Creswell (1998) states limitations identify potential weaknesses of the study. The research in this study was confined to freshmen through senior undergraduate students who attended, or are still attending, the university between the 2005-2006 and 2007-2008 academic years and were enrolled in at least one of the following skills-based word processing technology courses: COMS 102, COMS 232, or COMS 260. There were several limitations to this study including past student performance, credit hour comparison, course instructor, and student academic load. Additionally the findings of this study can be open to other interpretations.

Past Student Performance

Krank (2005) found that student grade point average (GPA) is an indicator of academic success. The Fund for the Improvement of Postsecondary Education (FIPSE) project provided a mechanism to introduce block scheduling at the university. Statistics gathered from this project found the majority of the university's students were under prepared for college level work resulting in a probable lower GPA (Krank, 2005). Because the majority of the university's students were under prepared for college level work, they may not synthesize knowledge and skills resulting in academic underachievement regardless of cohort or block format.

Credit Hour Comparison

Table 1 shows the discrepancy in the credit hours, duration of the instruction, and time between taking successive classes between the cohort and block formats. The cohort totaled two credits while the block-based course totaled four credits resulting in a two credit differential in credit hours. Obviously students in the block format had more in-class time to synthesize the knowledge and skills as compared to the two one-credit courses but far less out-of-class time than the block-based course. The out-of-class time difference was a severe limitation to the study.

Course Instructor

As is normal within the academic environment, multiple sections of a core course were often taught by several different faculty members. Although ideally the same course would be taught by the same instructor, the educational environment was not typically ideal. This limitation was minimized due to the fact that a minimal number of instructors (four) had been assigned to teach the CWPC studied in this research. Four instructors were assigned to teach the cohort and block word processing courses. The researcher was one of the three instructors assigned to teach the cohort Beginning Word Processing course. The cohort Advanced Word Processing and the Block Word Processing courses were taught by the other instructors.

Student Academic Load

The cohort structure was initially developed with the understanding that students would be taking more than one class at a time. As a result the student academic load was considerably greater while students were taking classes within the cohort format. For instance typically students were taking the one-credit beginning word processing course at the same time they were taking another three- or four-credit block course. Primarily, as related to this study, this problem not only increased student workload but also did not align with block scheduling pedagogy where students are intended to focus on only one class at a time. Restructuring the cohort enabled B&T to offer four-credit courses that fit into the block model and aligned with block scheduling pedagogy. Block students took only one technology course per block which enabled them to focus on one course at a time and maintain a reasonable workload.

Delimitations

Creswell (1998) suggested using delimitations to narrow the scope of the study. This study was delimited by choosing participants who were freshmen through senior undergraduate students who attended the university between the 2005-2006 and 2007-2008 academic years and were enrolled in at least one of the following skills-based word processing courses: COMS 102, COMS 232, or COMS 260. This study also was delimited by evaluating and analyzing only the questions that were common to both the COMS 232 and COMS 260 pre- and posttest.

Definition of Terms

Advanced placement – Refers to students who were allowed to enroll in the cohort's advanced word processing course without taking the prerequisite beginning word processing course.

Advanced Pretest – Thirty-six questions of the 50 question cohort/block pre- and posttest the researcher identified as most likely not to have been learned or reinforced in course work outside the cohort. These questions covered advanced topics like recording macros and tracking changes.

Block Scheduling – Classes exist in a contiguous, several-hour time frame.

Block-based – See block scheduling.

Cohort - Two classes where a prerequisite course is taught prior to the advanced course. The prerequisite course usually teaches fundamental knowledge and/or skills required for success in the advanced course.

COMS 102 – First cohort course, Beginning Word Processing (one credit).

COMS 232 – Last cohort course, Advanced Word Processing (one credit).

COMS 260 – Block course, Word Processing (four credits).

Constructivism –Constructivist theory views “learning as an interpretive, recursive, building process by active learners interacting with the physical and social world” (Fosnot, 1996, p. 30).

Core Word Processing Courses (CWPC) – Word processing courses (COMS 102, COMS 232, and COMS 260).

Course Delivery – The format in which the course is taught such as immersion, hybrid, online, block, or face-to-face.

Credit - One credit (credit hour) equals fifteen hours (50 minute hour) of course time.

Credit hour – The Carnegie Unit and the Credit Hour are time-based references used by the American educational system to measure educational attainment. The Credit Hour is approximately 15 hours of class or contact time. A Credit Hour is the equivalent of one-hour (50 minutes) of seat (in-class) time for one student per week over the course of a semester, usually 14 to 16 weeks.

Critical thinking – “Meta-cognitive processes that stress an attitude of suspended judgment, incorporate logical inquiry, and leads to an evaluative decision or action. Critical thinking refers to a way of reasoning that is sensitive to context, demands adequate support for one’s beliefs, and displays an unwillingness to be persuaded unless the support is forthcoming and includes both problem solving and decision-making” (Krank, 2005, p. 9).

Cutoff point - A designated limit or point of termination between pass and fail.

Dependent variable – Variables that depend on the independent variables; they are the outcomes or results of the influence of the independent variables (Creswell, 2003, p. 94).

Descriptive research - Borg and Gall (1983) state the goal of descriptive research is to characterize a sample of students, teachers and so forth on one or more variables.

Distributed Practice (DP) – Used in courses offered longer than the 18 day one block model. There were typically at least two days or more between lessons. Distributed practice in cohort classes had a time interval between the beginning and advanced course and used spacing practice methodologies.

Ease of Learning (EOL) – "Judgments occur in advance of acquisition, are largely inferential, and pertain to items that have not been learned. These judgments are predictions about what will be easy/difficult to learn, either in terms of which items will be easiest or in terms of which strategies will make learning easiest" (Nelson & Narens, 1990, p. 130).

Educational Advantage – The expertise a student has gained through learning strategies providing that student with a competitive advantage over peers who did not participate in the specific learning strategy.

Experiential Education – A method of education where the student becomes directly involved in the learning process.

Experience One (X1) – The coined name of the university's pilot project that resulted in implementation of the block scheduling model.

Experiential Learning– Learning through direct involvement with the subject.

External Validity – Generalizability of the study to the population (Glass & Smith, 1987).

Face-to-face (F2F) - Such as in a face-to-face lecture where students and professor are in the same room.

Feeling of Knowing (FOK) – “Judgments occur during or after acquisition (e.g., during a retention session) and are judgments about whether a given currently non-recallable item is known and/or will be remembered on a subsequent retention test” (Nelson & Narens, 1990, p. 130).

Format – Course schedule tier-based and block-based classes are delivered in.

General Education (GE) – Introductory courses meant to provide students with a general foundation of liberal studies.

Hybrid – Course where some percentage of the class is taught on-site face-to-face and the remaining percentage of the course is taught on the Internet.

Immersion Scheduling – Scheduling model where students are immersed in a subject. Students focus on that subject for a several hour contiguous block of time each day.

Immersion scheduling and Experiential Learning (IE/L) - Students learn through a hands-on, or experiential, methodology that exists in a contiguous several hour time frame.

Independent variable – “Variables that (probably) cause, influence, or affect outcomes. They are also called treatment, manipulated, antecedent, or predictor variables” (Creswell, 2003, p. 94)

Institutional Review Board (IRB) – Board governing the procedures used when researching human participants. Studies involving human participants must be approved by the IRB (University of Montana, 2004) .

Internal Validity – The relative absence of reasonable alternative explanations (Glass & Smith, 1987).

Judgments of Learning (JOL) – "Occur during or after acquisition and are predictions about future test performance on currently recallable items" (Nelson & Narens, 1990, p. 130).

Learning objectives – The cognitive skills learners should master by the end of a lesson, series of lessons or course.

Lecture-based learning – Learning model where the professors *tell* students the information.

Massing (massed practice) – "The learner studies a particular to-be-learned item for a certain period of time with short rest periods, or lags, between study trials" (Son, 2004, p. 601). Typically lessons were separated by one day or less.

Mediators – Encoding strategies used by learners to retain information.

Montana University System (MUS) – The system of Universities within Montana.

Microsoft Office Specialist (MOS) – globally recognized standard for validating expertise with the Microsoft Office suite of business productivity programs.

Outside the block model – courses that are not scheduled in a block format. The block format consists of classes that are typically scheduled in an 18 contiguous day (excluding weekends) four-credit course.

Pedagogy – 1) the art or science of teaching; education; instructional methods, 2) the principles and methods of instruction (http://dictionary.reference.com/browse/pedagogy).

Pilot Project – Activity planned as a test or trial.

Pretest / Posttest – Exams given as part of a research methodology in which participants are given a pretest followed by a treatment, and then the participants are retested using a posttest.

Retention - An ability to recall or recognize what has been learned or experienced; memory.

Retention posttest – A subset of questions found on the cohort's advanced word processing courses pretest. The retention pre- and posttest contain equivalent questions.

Retention pretest - A subset of questions found on the cohort's beginning word processing courses posttest. The retention pre- and posttest contain equivalent questions.

Skills Assessment Manager (SAM) – Software solution developed by Thomson Course Technology allowing students to train using interactive text, guided simulations, hands-on practice, and challenge assessments emulating real-world *MS Office* and *Windows* skills.

Skills-based technology courses – Courses whose learning objectives are focused on teaching the skills associated with using computer applications such as word processing and spreadsheets.

Spacing effect – The concept of learners needing to see things over time to retain knowledge and skills.

Spacing (spacing practice) - "studying to-be-learned item over several repetitions with longer lags between [the repetitions]" (Son, 2004, p. 601).

Spiraling – Learning strategy where concepts are introduced and reintroduced multiple times at varying levels of difficulty and perspectives throughout the curriculum.

String Courses – Courses that fall outside of the regular block scheduling time frame.

Student academic performance – Gain in knowledge and skills as measured by a pretest / posttest design.

Student pass percentage– Percentage of students passing the posttest on their first attempt.

Technology skill set / skill set – Technology skills associated with a specific application such as *Microsoft Word*.

Traditional educational approach – Course structure where courses are taught in a semester scheduling format.

Word 2003 Expert MOS Certification Exam – A globally recognized standard for validating expertise in *Microsoft Word* 2003.

Word posttest common questions – Questions that are common to both the COMS 232 and COMS 260 pre/posttest. Thirty-four of the fifty questions (68%) asked on the COMS 232 and COMS 260 pre/posttest are the same.

Word Processing Courses (WP) – Word processing courses (COMS 102, COMS 232 and COMS 260).

Organization of the Study

This study is comprised of five chapters. Chapter 1 is the introductory chapter containing the purpose of the study, the research question, the significance of the study, limitations, delimitations, and definition of terms. Chapter 2 contains the review of related literature. Chapter 3 contains a description of the study, the population, the sampling method, the instrumentation, the procedures, the methods of data collection, and the methods of data analysis. Chapter 4 is a description of the data obtained, discusses how the data were prepared for analysis, and presents the analysis of data. Chapter 5 presents the summary, conclusions, implications, and recommendations for further study based on the analysis of data.

CHAPTER II

LITERATURE REVIEW

This chapter provides a review of the literature presenting an overview of the last two centuries of educational pedagogy in America, the historical adoption of block scheduling over the last 50 years including *Experience One* implementation at a rural university in the Western United States, the migration to block-based scheduling for the core word processing courses at the same university, the role prerequisites play in learning as pertain to the university's cohort model, and metamemory and cognitive processes in learning. The reader is introduced to a brief history of education as it relates to traditional and constructivist pedagogy including the philosophy of some of the more prominent historical figures. Literature focusing on the implementation of block scheduling over the last 50 years in both secondary schools and universities will be reviewed. The implementation and research findings of *Experience One* at the university will be explored. Distributed and massed practice including the spacing effect and their roles in the synthesis of information are examined. Research findings from several studies conducted by Bahrick (1979), Bahrick and Phelps (1987), Donovan and Radosevich (1999), and Bahrick and Hall (2005) are presented to develop a level of understanding about how distributed and massed practice learning methodologies impact long-term performance retention. Research findings from studies at San Francisco State University and a consortium of universities including the University of California, Davis, the University of Kentucky, and the University of Texas, Austin are shared to develop a level of understanding about student academic performance in the prerequisite based cohort approach. A majority of the literature focusing on short-term memory retention and mastery learning as well as selected literature regarding high school block implementations from the 1960s through the 1990s were not relevant to this study and thus not reviewed.

Creswell (1994) states the literature should be selected based upon the following criteria: "to present results of similar studies, to relate the present study to the ongoing dialogue in the literature, and to provide a framework for comparing the results of the study with other studies" (p. 37). The literature review provides for greater understanding of the pedagogical relations and accompanying structural arrangements between scheduling format and student academic performance.

History

Three Centuries of Education in America

The educational system in America has changed and improved substantially since the turn of the 19th century. The following sections assist the reader in understanding that the early educational system was a very lecture and memorization oriented model but that by the end of the 19th century alternative styles of education were being experimented with, notably by John Dewey. That experimentation was continued from the 1960s through the 1990s with various alternative educational formats such as block scheduling. By becoming familiar with the historical development of traditional and alternative pedagogy, the reader begins to develop a foundation of understanding for learning approaches in 2008.

The Protestant School System: Pre-Dewey

The pre-revolutionary Colonial school system prevailed into the early 19th century. In 1790 Noah Webster stated “There is one general practice in schools which I censure with diffidence, not because I doubt the propriety of the censure, but because it is opposed to deep-rooted prejudices: this practice is the use of the *Bible* as a schoolbook. There are two reasons why this practice has so generally prevailed: the first is that families in the country are not generally supplied with any other book; the second, an opinion that the reading of the scriptures will impress upon the minds of youth the important truths of religion and morality. The first may be easily removed, and the purpose of the last is counteracted by the practice itself” (Webster, 1790, p. 37). Although Webster's words are progressive, the *Bible's* role in education remained strong in the Protestant based educational system of early America.

Fraser (2001) states “the pattern of public schooling we know today – tax supported, free, and essentially compulsory – emerged in the United States during the four decades prior to the Civil War” (p. 48). The school system of today is very similar to the common school movement of the early 19th century including the traditional lecture-based delivery method that has been commonly found in education for the last 200 years.

In the mid 1870s, debate began regarding teaching pedagogy. In 1873, Isaac Todhunter (1820-1884), a conservative mathematics lecturer at St. John’s College in Cambridge, wrote an article titled *The Conflict of Studies, and Other Essays on Subjects Connected with Education.* This article discusses and accepts the common pedagogy of the day that was based, to a great extent, on lecture and memorization. Within this article, Todhunter asks that teachers join him in being resigned “to the fact that education is for the most part directed to training pupils for examinations" (as cited in Privitello, 2005, p. 630). Todhunter points out that because of the "character of examinations, … over cultivation and over appreciation of memory … can hardly be helped, and that because of time limits, again, in examinations the 'accuracy and beauty' of what is well stored in memory is more valuable than a candidates 'inventive power and genius'" (p. 629). Todhunter, like most educators of his day, believed memorization and examinations are more important than developing problem solving and critical thinking skills. Dewey (1897) acknowledged that educational pedagogy of the late nineteenth century was simple memorization. Dewey stated that "we are told that the psychological definition of education is barren and formal – that it gives us only the idea of a development of all the mental powers without giving us any idea of the use to which these powers are put" (Dewey, 1897, p. 5).

Chauncey Wright (1830-1875), an educational innovator of the 19th century, disagreed with Todhunter. In 1875, Wright wrote *The Conflict of Studies* disagreeing with Todhunter's position. Within this article Wright proposed a differing educational pedagogy that was not accepted by the educational mainstream of the day (Privitello, 2005). Wright believed the best education should go beyond mere memorization. He suggests that "the student be freed from the mere exercise of 'simple memory' by working with the 'direct effect of illustrations'" (as cited in Privitello, 2005, p. 630). Wright also believed "experience is what makes the imagination work more steadily towards the truth." (as cited in Privitello, 2005, p. 630). Wright's focus was on developing problem solving and critical thinking skills. Wright's educational pedagogy was juxtaposed to the generally accepted educational philosophies of his day.

Although not a colleague of Wright's, John Dewey began experimenting with differing educational pedagogy in the late 19th century. Dewey's work focused on experiential learning and, although not accepted at the time, has changed the face of education over the last century.

Experiential Education - Dewey

John Dewey (1859 – 1952) believed developing real-life problem solving skills was essential to the intellectual development of children and that education should guide the student in tracking and tackling these problems (Dewey, 1897). The main themes in Dewey's education philosophy were:

1. Students do all the work, the teacher's role becomes more that of a facilitator.
2. Students are encouraged to ask each other questions, to object and correct aloud, and to think for themselves.
3. Experimenting, role playing, and constructive activities are used to show students problems and possible solutions providing a basic understanding and connection to previous experiences before students see the concept in print.
4. "Education must be conceived as a continuing reconstruction of experiences" (p. 13).

Dewey's approaches to pedagogy, constructivism, progressive education, aesthetics and religion remain prominent today. Dewey shaped the American progressive education movement that was prevalent through the first half of the 20th century. Even after a century, Dewey's pedagogical philosophies have significant influence in today's educational environment and serves as a model for today's and tomorrow's teachers.

Pedagogical Experimentation after Dewey

During the mid and late 20^{th} century, educators started to believe that not all classes were the same and as such needed more flexible class scheduling in order to be taught most thoroughly and efficiently. Time blocks beyond the regular 50 minute class allowed for the use of various teaching strategies that were not possible during the regular one hour class (O'Neil, 1995). Educators began experimenting with various alternative educational methodologies, primarily block scheduling.

The Block appears to benefit students of all abilities and personalities. For instance the traditional lecture-based learning model does not create an environment of participation for all students. Often, the lecture-based learning model allows for participation from outgoing students but ignores those students who are typically quiet. The Block benefits those quiet students by engaging them through an active classroom. Typically, outgoing students initiate group activity in a focused and teacher supervised approach. White (1995) found that quiet children who are not usually engaged by a teacher will be engaged by outgoing peers. Barr and Tagg (1995) discuss the quality of student–teacher interaction within the block scheduling model. The additional time students spend face-to-face with the instructor fosters a personal learning environment where students participate in their education through the assistance of not just a teacher, but a teacher who becomes a mentor. The pedagogy that one must use in a block scheduling environment shifts the learning environment away from a lecture-based system where the student is the recipient of the knowledge to an environment where the student becomes an active participant in their own education.

The high school and university block implementations varied with each having its own advantages and disadvantages. The university model attempts to improve student learning using an approach where students can immerse themselves in one subject at a time through creative, hands-on learning strategies (Colorado College, 2007a).

Secondary Education in the 1970s.

The late 1960s and 1970s brought about increased experimentation with educational pedagogy and scheduling. O'Neil (1995) states that during this time as many as 15 percent of junior and senior high schools experimented with some form of block scheduling. The block scheduling model adopted in the 1970s in junior and senior high schools were primarily 4X4 models where students would take four 90 minute classes each day. Usually, classes were scheduled daily, however, sometimes an every-other day strategy was used. The premise behind the adoption of block scheduling in junior and senior high schools in the 1970s was that educators believed that not all classes were the same and as such needed more flexible class scheduling in order to be taught most thoroughly and efficiently. The block scheduling model allowed flexible time for lectures, small group study, labs, and individual help sessions. Block scheduling at the junior and senior high school level in the 1970s ultimately failed. First, the curriculum had been designed so that students were spending large amounts of time doing independent studies. Due to faculty resource issues, many of these independent studies were not well supervised which lead to disciplinary problems. Second, teachers in schools using block scheduling often did not receive sufficient training in how to implement various instructional strategies that were necessary to make an experiential classroom a success. Block scheduling became such an administrative nightmare that most junior and senior high schools went back to the traditional 50-minute class scheduling model (O’Neil, 1995).

Loveless and Holmes (1968) studied block scheduling. They surveyed business and office practice teachers opinions in Utah high schools. Loveless and Holmes found teachers generally agreed that the two-period (90 minutes) block format was more advantageous for student learning than the one-period (50 minute) format. Respondents believed that within the two-period block model (a) more material can be taught, (b) related subject correlation is better, (c) more flexibility is permitted, (d) student achievement is higher, (e) individualized instruction is better, (f) vocational counseling is improved, and (g) more usable working time is provided. Loveless and Holmes found the limited disadvantage the two-period format presented was scheduling problems.

Van Mondfrans, Schott, and French (1972) conducted a study of whether the effects of block scheduling on student achievement and attitudes are more advantageous than traditional scheduling. The block and traditional scheduling treatment included three required courses, one from each high school grade level. Each block class contained between 19 – 110 students and was taught over a 140 minute timeframe. Each traditional class contained 30-35 students for 40 minutes each day. Data for analysis included the scores on objective, teacher-made tests covering the material taught in the instructional units and the ratings filled out by students on their interest and attitudes toward learning in each model. The study concluded that the two treatments, traditional and block, did not differentially affect the test results or student ratings. Issues remaining upon the conclusion of this study were the ability and difficulty the teacher had in handling the flexibility in time and group size, the importance of time and group size flexibility, and the need for maturity on the part of the learner.

Sigurdson (1981) researched the Edith Rogers Junior High School (Edmonton, Alberta, Canada) implementation of the Block Plan. The Edith Rogers Junior High School model consisted of a homeroom period plus periods for four academic core subjects. The main features of the Block Plan included flexible scheduling, joint planning, special attention given to the teacher's role in student counseling and reading, use of community resources, integrating subject areas, and the use of a differentiated support option for remedial coursework. The Block Plan at Edith Rogers Junior High School was designed to be especially effective in overcoming problems that students encounter in making the transition from elementary school to a large junior high school. The program was monitored on two levels: (a) product, concerning student attendance, attitudes, and achievement; and (b) process, the teachers' reactions to the program as it was being implemented. Overall the results were positive for attendance, attitude, and most achievement measures, however, the study found weaknesses in block implementation such as difficulties in joint planning and differentiated support options for remedial course work (Sigurdson, 1981). Although the overall results were positive, Sigurdson noted that the data was unable to show which aspects of the Edith Roger's Block Plan contributed to the success of the program.

Secondary Education in the 1990s.

The 1990s brought block scheduling back into high schools. In 1990 Virginia had fewer than five schools using variations of the 4X4 Block format. Four years later 133 of the state's 290 high schools (46 percent) had adopted some form of block scheduling

(O'Neil, 1995). A 90-minute class in a 4X4 model enables teachers to use additional instructional strategies that a 50-minute class does not allow (O'Neil, 1995). Many schools saw daily attendance, the percentage of students making the honor roll, and the number of students going on to four-year colleges increase after Block implementation. They also saw the failure rate decrease after Block implementation (O'Neil, 1995). Supporters of the 1990s high school block movement believe adopting a 4X4 plan created an environment where teachers could use cooperative learning, hands-on projects, and other learning strategies encouraging student involvement resulting in increased innovation and learning in the classroom.

Marshak (1998) reports that ten high schools in the Seattle area researched Block scheduling focusing on effective teaching and learning in block periods of 80 minutes or more. The school districts' implementation of the block scheduling model culminated in a successful experiential based learning environment. Weingarten (2005) states that the block scheduling model provides an advantage for students by infusing a cooperative learning environment into the classroom that changes the dynamics of the group.

The block scheduling model fosters a learning environment conducive to developing critical thinking skills. Huber and Moore (2001) believe that the block scheduling format is conducive toward developing full inquiry-based scientific instruction. Casey and Howson (1993) stated that with well-designed courses, the block scheduling model creates an authentic learning environment in which students are given the opportunity to use their reasoning skills to solve problems based on their interests. Dewey (1897) supported this approach and believed that students learned better if the learning experiences were based upon their interests. Supporters of this approach, the problem-centered approach, believe acquiring knowledge becomes more meaningful to the student when they investigate and examine rather than simply listen to a lecture (Gordon, 1998).

Bowman (1998) found no concrete research that demonstrated block scheduling is a more effective learning model than any other model. He observed additional levels of stress for teachers within the block-scheduling model from the required engaging activities teachers developed in addition to increased homework of students.

*Block Scheduling in Undergraduate Education from the 196*0s *through Today*

In the 1970s, colleges experimented with block scheduling. Colorado College, a private, four-year liberal arts college about the same size as the university in this study began a unique program called the Block Plan (Colorado College, 2007b). In the 60s and 70s Colorado College professors implemented the Block Plan. In 1968, Colorado College faculty believed that students and faculty were being pulled in too many directions minimizing the time students could focus on each of their class subjects. Colorado College faculty believed not enough time on task and a lack of focus lead to a poor understanding of the topic. Students complained that the 50-minute class time was too short, just when discussion was becoming interesting class was over. Secondly, because students were taking four or five classes at a time in the semester system they felt they were spending too much time on organizing and prioritizing assignments that they did not have ample opportunity to work on any one subject long enough to learn the content (Colorado College, 2007a).

Even though the 1970s block scheduling model failed at the high school level, Colorado College remained successful with the Block Plan, which is a Colorado College cornerstone (Colorado College, 2007c). The average class size at Colorado College is 16, but all classes are limited to no more than 25 students (Colorado College, 2007b). The goal of this model is to create flexible classes where students can immerse themselves in a subject through a creative, hands-on learning approach (Colorado College, 2007c). Colorado College's Block Plan provides, due to its' flexible one class at a time schedule, an excellent opportunity for field study. Professors can hold classes off campus for days, weeks or an entire 3 ½ week block without the competition from other class obligations as would be seen in the traditional semester format. In order to make the Block Plan more successful, Colorado College has developed an orientation program focused on introducing students to the expectations of block scheduling.

Private and public universities and colleges have adopted the block scheduling model. Private universities include Cornell College, Tusculum, and the Hofstra University New College. The Hofstra University New College Block schedule is similar to Colorado College, but uses a 4-day week with classes that are 3 ½ hours each day (Hofstra, 2008) and leads to a student tailored Bachelor of Arts degree in Humanities, Social Sciences, Natural Sciences, or Creative Arts. The only public university to adopt the block scheduling model is the university in this study. The university's adoption follows the Colorado College model but includes string courses, i.e., courses following outside of the regular block scheduling, allowing more scheduling flexibility for those courses that may not fit well into the block scheduling model.

Block scheduling allows experiential learning to take place in a contiguous segment of time. Schiering and Honigsfeld (2002) state how a student's training must include a hands-on, or experiential, component in order for the educational experience to be considered successful. Furner (1998) found block scheduling exhibited improved attendance, grades, stream-lined workdays with fewer administrative tasks, and a more focused learning environment.

The Implementation of Block Scheduling at the University

The immersion and experiential learning (IE/L) model, also referred to as the Block model, was initially developed at the university level by Colorado College in the late 1960s. The Block model is only used in a handful of small private universities nationwide, but was adopted for the first time by a public institution in 2001, first as a pilot project, and then implemented campus-wide in 2005. The studied university's model is similar to the Colorado College block model. In the university's model, students take only one four-credit, 18 contiguous day course (excluding weekends) for three hours per day. This transformation placed an experiential educational pedagogy at the university enhancing student learning through a hands-on learning environment.

Development of Experience One (X1)

At the beginning of the 2005-2006 academic year, the university implemented a campus-wide block scheduling model based on the Colorado College block scheduling model. In this model, students typically take one four-credit course for an 18 contiguous day period (excluding weekends). When this course is completed students will take another four-credit course during the next Block. Each Block is four weeks in length with class periods usually consisting of a contiguous three-hours. Students typically take only one class in each block although there are exceptions due to the curricular requirements of various degree programs. String courses are available outside of the regular course schedule that meet degree requirements in specific disciplines, curricular requirements, or provide community service. These classes are typically one, two, or three credits and meet early morning, noon, or evenings.

The university adopted this block scheduling model known as Experience One (X1) for a variety of reasons.

- Student focus – Focusing on one subject in a one-class-at-a-time format better provides uninterrupted learning opportunities allowing the student to become immersed in that single subject. The student is completely involved only in one class for a consecutive 18-day timeframe.
- Experiential learning: Learn by doing - theory and practice are balanced creating a classroom filled with active learning through participation.
- Field experiences – Within the block scheduling model, there is a greater opportunity for quality field experiences. This enables the student to experience what a professional does and provides an opportunity to gain insight and experience for future career possibilities.
- Class size – A key to successful experiential learning is to limit the class size allowing more teacher / student and student / student interaction.
- Professor / student interaction – Between a combination of small class sizes, subject immersion, and interactive learning between the professor and student, the professor has an opportunity to become not just a teacher, but a mentor to every student in his or her classroom.
- Student retention – Student retention rates may improve if students like the block scheduling format and stay at the university throughout their college career.

- Student performance and achievement – Because most students learn more through an experiential pedagogy, they will attain a greater understanding of the subject area and thus improve student performance.
- Niche market – The studied university is the only public university in the United States offering an immersion scheduling model in the Colorado College format ((Experience One, n.d., ¶ 1-10).

The university, through the financial support of a 3-year grant from the Fund for the Improvement of Postsecondary Education (FIPSE), developed a pilot project during the 2002-2003 academic year. Table 2 provides an overview of the first five years of the Experience One project.

Table 2.

Experience One (X1) Project Overview

Year 1: 2001-2002	Planning, development, curricular changes
Year 2: 2002-2003	1st group of approximately 75 freshmen students selected and participating in Block General Education courses
Year 3: 2003-2004	2nd group of approximately 75 freshmen students selected and participating in Block General Education courses
Year 4: 2004-2005	Extension of FIPSE Project – All Freshmen in block scheduling
Year 5: 2005-2006	Campus-wide adoption of Block Scheduling

In Year 1 of the X1 project, a new general education curricular core and new course schedule was developed. Additionally general education faculty were trained regarding block scheduling and the general educational pedagogies surrounding experiential learning.

The selection criteria for faculty participating in this project was fairly liberal. Departments identified faculty who were interested and willing to make the commitment to block scheduling. Faculty were then selected on the following criteria (Mock, 2001):

- Experience teaching general education curriculum.
- Interest in developing course curriculum that maximized experiential education.
- Ability to teach more than one general education course.
- Tenured or tenure-track.
- Faculty already doing experiential learning in their classroom were preferred.
- Faculty that were willing to accept the pilot project evaluation process.

The University provided special block workshops assisting the faculty transition to block scheduling. Selected faculty also had the opportunity to travel to Colorado College located in Colorado Springs to observe the learning environment block scheduling offered.

Traditionally, faculty at the university taught 12 credits per semester. Usually, the 12 credits consisted of four three-credit courses. This was considered a full load. In the original block scheduling concept, it was envisioned that each faculty member would teach three four-credit courses each semester. That enables faculty one block per semester for professional development opportunities. Prior to block scheduling, faculty were limited to semester or year-long sabbaticals and participated in professional development while teaching.

Pilot Project and Research Findings

During the first year of the block scheduling pilot project (2001-2002 academic year), general education courses were converted from the traditional three-credit course to four-credit courses. The university general education faculty made curricular and credit changes to eight courses within the general education curriculum. These changes included consolidating several general education courses within the same discipline into one four-credit course thus decreasing the number of general education course offerings. Within the curricular structure, experimental, transitional courses were developed.

The new general education structure enabled students to take eight four-credit courses totaling 32 credits during one academic year. The total number of general education credits required to fulfill the University System general education core requirement is 30 to 32 credits. As a result of block scheduling, students were able to take the required 30 to 32 general education credits within a one-academic-year timeframe, thus allowing students to pursue their specific degree choices in their second, third, and fourth years. The entire general education core has been revised since the initial year of the project following the four credit format.

Block courses were taught for the first time during academic year 2002-2003 (Project Year Two). The first group of freshmen entering the block scheduling project consisted of 73 students. The freshmen participating in the pilot project were placed into cohort groups through a voluntary first-come, first-serve methodology. The remaining 53 incoming freshman were placed into traditional semester courses.

The first year (blocks 1 through 8) students were randomly placed into three groups consisting of about 25 students each. Each group was then placed into a cohort of general education courses (see Table 3.). This was repeated for the first semester (block 1 through 4) of the second year. The second semester of the second year (blocks 5 through 8) students were placed into groups that followed either prescribed curricular tracks

Table 3.

X1 General Education Course Rotations

– Academic Year 2002-2003			
	Group 1	**Group 2**	**Group 3**
Fall Semester			
Block 1	Geology	History	Fine Arts
Block 2	English	Geology	History
Block 3	Fine Arts	English	Geology
Block 4	History	Fine Arts	English
Spring Semester	Each course during the Spring semester was tailored to meet a prescribed curricular track relating to each groups' educational goals.		
	Elementary Education Majors	Liberal Arts Majors	Math / Science Majors
Block 5	English (Writing)	Math	Sociology
Block 6	Sociology	Biology	English (Writing)
Block 7	Biology	Sociology	Math
Block 8	Math	English (Writing)	Biology

or placement based upon Math ACT/SAT scores. For instance, during Block 8 (second semester), Group 1 students were enrolled in Math 115. This track contained 26 students and was primarily for Elementary Education majors. In Block 5, Group 2 students were enrolled in Math 104 that was primarily for Liberal Arts majors. Similarly, during Block 7, Group 3 students enrolled in Math 110 Probability and Linear Math. These students were math and science majors.

The 2003-2004 academic year was the third full year of the pilot project, the second course year, and the last year of the original FIPSE grant. The Fall 2003 course schedule followed a similar sequence to Fall 2002 by placing students in the cohorts that corresponded to their declared major. A new group of approximately 75 freshmen volunteered to participate in Block courses. As in the previous academic year, these students were separated into three groups and placed into the same general education cohort. The students who had been enrolled in Block courses the previous year were placed into traditional semester courses.

Krank (2005) compared traditional age freshman using five assessments of academic achievement; Group Embedded Figures Test (GEFT), Cornell Critical Thinking Test Level Z (CCTT-Z), Student Descriptive Questionnaire III (SDQ-III), American College Test Composite (ACT), and high school grade point average (HSGPA).

The Group Embedded Figures Test (GEFT) is a measure of cognitive styles. The Cornell Critical Thinking Test Level Z (CCTT-Z) is based on the conceptualization of critical thinking as the ongoing process of the evaluation of a stream of incoming information while deciding what to believe or what to do. The Student Descriptive Questionnaire III (SDQ-III) is based on the conceptualization of self-concept as a multifaceted, hierarchical construct. The GEFT, CCTT-Z, SDQ-III, ACT, and HSGPA are established indicators of academic success for higher education students (Krank, 2005).

Students were reported as below-average, average, and above-average based upon the predictor scores of the GEFT, CCTT-Z, SDQ-III, ACT, and HSGPA. Students were classified based upon the following definitions:

Below average – students scoring one-half standard deviation below the mean on a majority of the predictor scores.

Average – students scoring between one-half standard deviation below and one-half standard deviation above the mean on a majority of the predictor scores.

> Above average – students scoring above one-half standard deviation above the mean on a majority of the predictor scores. (Krank, 2005, p. 12)

Fall Semester 2002 (second project year, first course year)

- Based on assessment results, students in the FIPSE project cohort were a virtual match for the typical university Freshman class.
- First semester grades for students participating in the FIPSE project and the traditional program were equivalent.
- Fall to spring semester dropout rates for students participating in the FIPSE project were one-half the historic dropout rate at the university.
- Within the traditional, lecture-based program significantly more at-risk under-prepared students failed to finish fall semester or enroll in spring semester than average or above-average well-prepared students.
- Within the FIPSE program, dropouts were more evenly distributed across below-average, average, and above-average categories.

Spring Semester 2003 (second project year, first course year)

- For all students finishing spring semester, there were significant differences among general education course grade point average by group (below-average, average, and above-average). Students in both traditional and the X1 cohort showed the same trend.
- Students in the pilot project scored higher on assessments of academic self-concept at the end of spring semester when compared to the students in the traditional, lecture-based academic program.

- Students in the pilot project earned a higher average grade point average in the general education program classes at the end of spring semester when compared to the students in the traditional, lecture-based academic program.
- Student evaluations of their professor's performance in the traditional, lecture-based courses and the pilot project courses were numerically equivalent.
- Student comments regarding the X1 courses indicated positive experiences in terms of using blocks of time and experiential learning.
- Faculty reported superior performance by the pilot project students when compared to previous students in the traditional program in both quantitative and qualitative terms.

Fall Semester 2003 (third project year, second course year)

- The spring to fall retention rate was far superior for the pilot project when compared to the traditional university fall to spring retention rate similar to the improved fall to spring retention rate from the 2002-2003 academic year.
- Unlike previous years, the university's fall 2003 first-time, traditional-age students were better prepared for college level work. Though above-average students were still rare, fewer were below-average than during previous years.
- Fall grades for students participating in the pilot project and the traditional program were equivalent.
- Students in the traditional program gave their instructors more favorable ratings than students in the Block program.
- Unlike the first course year (second project year) of the program, during the second course year, substantially more at-risk, under-prepared students in the

project failed to finish fall semester or enroll in spring semester than average or above-average students.

Spring Semester 2004 (third project year, second course year)

- Fall to spring semester dropout rates for students participating in the second course year of the pilot project were the equivalent of the historic dropout rate for the university.
- For pilot project students finishing spring semester, there were significant differences among general education course grade point average by group (below-average, average, and above-average). Students described as below-average based on the five assessments finished the year with lower grades than the other two groups.
- Students in the pilot project and traditional program earned equivalent grade point averages in the general education program classes at the end of spring semester.
- Assessment of critical thinking and academic self-concept produced equivalent scores for students in the pilot project and traditional program at the end of spring semester.
- Student evaluations of their professors' performance in the traditional, lecture-based courses were generally superior to the pilot project courses evaluated.
- On the student evaluation section intended to assess the immersion and experiential nature of the courses, the evaluations were equivalent.
- Student comments regarding the Block courses indicated mixed experiences in terms of using blocks of time. Reports of long lecture sessions were common.

- Generally, Block students appeared to be surprised that out-of-class work often required as many hours of their time as in-class sessions.
- Overall, faculty reported inferior preparedness, performance, and affect by the 2003-2004 pilot project students compared to previous students.

Pilot Project Extension and Research Findings

In year 4, academic year 2004-2005, the university asked FIPSE for a one year extension of the project to further study block scheduling. During year 4, all incoming freshman were placed into Block General Education cohorts. The following are some of the significant findings from year 4 of the X1 project (Mock, 2005).

Fall Semester 2004 – all freshman - (fourth project year – project extension, third course year)

- The spring to fall retention rate was superior for the pilot project when compared to the traditional university fall to spring retention rate.
- Due to changes in recruiting and marketing strategies, the university's fall 2004 first-time, traditional-age students were less prepared for college level work than the typical under-prepared cohort. Above-average students were still rare and below-average students comprised 60% of the cohort.
- Fall grades for students participating in the pilot project and the traditional program were equivalent.
- With the exception of the items specific to experiential learning and use of blocks of time, course evaluations for Block and traditional program were equivalent.

Spring Semester 2005 – all freshman - (fourth project year –third course year)

- The fall to spring retention rate was superior for the pilot project when compared to the traditional university fall to spring retention rate.
- For pilot project students finishing spring semester, there were significant differences among general education course grade point average by group (below-average, average, and above-average) with those categorized as above-average receiving higher grades than students categorized as below-average or average.
- Assessments at the end of spring semester of critical thinking produced equivalent scores for students in the pilot project and traditional program.
- Assessments at the end of spring semester of academic self-concept produced superior scores for students in the pilot project when compared to the traditional program.
- With the exception of the items specific to experiential learning and use of blocks of time, course evaluations for Block and traditional programs were equivalent.
- Overall, faculty reported superior performance for the 2004-2005 pilot project students when compared to previous students enrolled in their classes.

Based upon the benefits block scheduling would bring to students at the university, the administration and a majority of faculty voted to adopt the block scheduling model campus-wide in January 2005, a full semester before the pilot project extension was to be finished. Throughout the spring semester of 2005, the curriculum in the majority of university courses were revised to four credits with an experiential focus. The full implementation of Experience One across campus took place in the 2005-2006 academic year.

Cohort Course Development

Business & Technology (B&T) Computer Science (CS) instructors at the rural western United States university designed a cohort for the word processing curriculum creating a prerequisite course structure. In this model, the beginning course developed the concept and skills necessary for success in the advanced course. The cohort model for word processing courses was implemented at the same time the block scheduling model was adopted at the university.

Adamson, Rovick, Michael, Modell, Bruce, Horwitz, Richardson, Silverthorn, and Whitescarver (1999) stated that teachers establish prerequisites that students must meet before they are permitted to enter more advanced courses. It is expected that having these prerequisites will provide students with the knowledge and skills they will need to successfully learn the advanced course content. Bloom (1982) believes cognitive entry behaviors or prerequisites account for up to 50% of the variance over subsequent learning tasks. Faux (2006) believes in the breadth-first approach, an approach that focuses on basic concepts, spiraling, spacing, and pedagogical constructivist theories, to build a solid curricular foundation for future learning. Spiraling is a learning strategy where the curriculum refers to topic areas multiple times at different levels of difficulty and from different perspectives and has some mastery learning elements. Spacing refers to the concept of learners needing to see things over time to retain knowledge and skills (Faux, 2006). Cognitive processes play a role in spacing when determining optimal learning time. According to constructivist pedagogy, understanding comes from what one has experienced. It is critical that a solid foundation be built in beginning courses in order to provide the necessary experiences for students to be successful in advanced courses (Faux, 2006).

Birch (1995) prefers the building block or pyramid approach where every concept is presented from the bottom up. Birch believes building conceptual knowledge and skills from the bottom up is important for two reasons. First, he discusses the importance of making the student begin the thinking process for a course at the lowest level. This establishes a common body of knowledge from which the student can build. Additionally, using a building block approach, advanced material is not presented until a proper foundation has first been established. As a result, students will have more confidence in their knowledge and abilities and be less anxious when taking a high-level technical course (Birch, 1995).

San Francisco State University Remedial Course

The following research serves to reinforce the importance of the prerequisite in curriculum. In the mid 1990s, San Francisco State University (SFSU) revised their accounting program refocusing teaching away from a preparer's perspective to a user's perspective. SFSU believed this curricular shift would create more interest in taking the courses by being more relevant, not only to accounting majors, but also to non-accounting majors (Huang, O'Shaughnessy, & Wagner, 2005). One of the issues surrounding curriculum alteration was that the change de-emphasized the accounting cycle and double-entry bookkeeping, critical components for the tax preparer.

In SFSU's program, all Business majors including accounting majors are required to take Principles of Financial Accounting, ACCT 100. After this course, accounting majors would take ACCT 101, Managerial Accounting. The next course in the sequence, ACCT 301, Intermediate Accounting was changed such that instead of focusing on the perspective of an accounting preparer, the course focused on the perspective of the user of accounting. This change led SFSU to drop critical accounting cycle and double-entry bookkeeping content out of the ACCT 301 curriculum. SFSU found that without this basic accounting cycle and double-entry bookkeeping content ACCT 301 students suffered academically. As a result SFSU faculty developed a one credit remedial course titled ACCT 102 that taught basic accounting cycle and double-entry bookkeeping concepts and skills. Even though not a prerequisite course, ACCT 102 served in that capacity because most ACCT 301 students had to either pass an accounting pretest or pass ACCT 102 in order to enroll in ACCT 301. There were exceptions to this policy. Interestingly, some students were allowed by faculty to take ACCT 102 at the same time as they took ACCT 301. Faculty allowed some students, those with more initial accounting skills, to take ACCT 301 without having taken ACCT 102 at all. Because ACCT 102 was not technically a required prerequisite, SFSU allowed students to fail either the pretest or ACCT 102 and still take ACCT 301.

Huang, O'Shaughnessy and Wagner (2005) devised a pretest that consisted of 30 multiple-choice questions covering the accounting cycle and double-entry bookkeeping. The pretest had a passing cutoff point of 70%. They found that students who took ACCT 301 and ACCT 102 at the same time performed the best and received and an average grade of 2.89 in ACCT 301 (see Table 4.). For those students who either passed the pretest or took ACCT 102 prior to ACCT 301 performed well in ACCT 301 with an average grade of 2.6. The third group, those students who did not pass the pretest or ACCT 102 performed below average in ACCT 301. The fourth group, those students who did not take the pretest or ACCT 102 prior to ACCT 301 performed slightly above an average level with an average grade of 2.23. Although the research doesn't state it is assumed that the faculty who enrolled these students into ACCT 301 felt they had a sufficient background in double-entry bookkeeping and the accounting cycle to be successful in ACCT 301.

Table 4.

Breakdown of ACCT 301 Grades and Pretest/ACCT 102 Status (San Francisco State University)

Group # and Student Category		*N*	Average Grade
1.	Students who took ACCT 301 and ACCT 102 Concurrently	108	2.89
2.	Students who passed the pretest/ACCT 102 prior to ACCT 301	491	2.6
3.	Students who did not pass the pretest /ACCT 102 prior to ACCT 301	58	1.93
4.	Students who did not take the pretest/ACCT 102 prior to ACCT 301	427	2.23
	Total	1084	

Huang, O'Shaughnessy and Wagner (2005) found students who successfully build a solid knowledge and skill-set base prior to taking an advanced course academically perform better than students who have not mastered fundamental concepts. Students who passed the pretest or ACCT 102 prior to taking ACCT 301 performed significantly better in ACCT 301 than those students who failed either the pretest or ACCT 102.

Respiratory Physiology Prerequisite Courses

In the late 1990s, 11 institutions nationwide identified concepts that were agreed to be essential prerequisites for learning respiratory physiology (Adamson et al, 1999). Adamson, et al. wanted to learn if faculty assumptions were accurate regarding the amount of knowledge students retained from courses that were prerequisites of the respiratory physiology class. A by-product of this research was learning if students retained more fact-based (memorization) knowledge or application-based (problem solving abilities requiring higher order mental processing) skills through the completion of the prerequisite to respiratory physiology courses. Some of the more notable institutions that participated in this collective partnership were the University of California, Davis, the University of Kentucky, and the University of Texas, Austin (Adamson, et al., 1999).

Based on the agreed upon concepts, Adamson, et al. (1999) developed two sets of multiple-choice questions, fact-based and application-based. The fact-based questions tested recall of factual knowledge, i.e., memorization. The application-based question required that knowledge be manipulated in some way to answer the question, i.e., problem-solving. Professors at each of the 11 participating universities reviewed the fact-based and application-based questions submitting acceptable revisions to the researcher. The instructors from the seven studied courses selected five fact-based and five application-based questions to form seven unique ten question prerequisite exams (Adamson et al., 1999). Students from seven courses ranging from 30 to 275 students per class (801 total) took the prerequisite exam at the beginning of the respiratory physiology course.

Student Performance.

The mean score on fact-based questions was 65.3% with a standard deviation of 9.3. The mean score on the application-based questions was 45.5% with a standard deviation of 10.2. The difference was statistically significant indicating that students do less well on questions that require higher order mental processing (problem solving) skills than on questions that require simple recall (memorization) (Adamson et al., 1999). They found students' memorization of prerequisite information was far superior to the problem solving skills they had gained through their prerequisite courses.

Instructor Assumptions.

Prior to the prerequisite exam, faculty were asked to predict how well students would score on the fact-based and application-based questions. Each instructor predicted a mean score for both fact-based and application-based questions. These scores were then averaged. Faculty believed students would receive a mean of 62.7% on the fact-based questions when in actuality they received a mean of 65.3%. Faculty believed students would receive a 58.2% on the application-based questions when in actuality they received a mean of 45.5%. Adamson et al. (1999) found instructors underestimated the amount of memorization students could recall from prerequisite courses. Most importantly instructors greatly overestimated, by nearly 13%, the students' ability to answer questions that require higher order mental processing skills (Adamson et al., 1999).

Metacognitive Processing in Distributed/Massed Practice

Cognitive Processes in Learning

The block model employs a massed practice methodology where students learn in a compressed timeframe. In the cohort model, a distributed practice methodology is employed where student learning is distributed over a longer period of time. Literature was reviewed to understand the importance of metamemory and metacognitive processing and their impact on learning, retention, and synthesis of knowledge specifically as observed from a time related, or spatial, orientation. The review of the literature also focused on the role the spacing effect plays in distributed practice and how performance differs between distributed, spacing, and mass practice methodologies.

Metamemory

Metamemory refers to an individual's awareness of and knowledge about his own memory systems and the strategies that will help him retain the most information possible. There are three components of metamemory; (a) awareness of different memory strategies, (b) knowledge of which strategy to use for a particular memory task, and (c) knowledge of how to use a given memory strategy most effectively. Bruner (1987) stated reflection implies a reflecting agent (reflection is synonymous with retention in this context); metacognition requires a master routine that knows how and when to break away from straight processing to corrective processing procedures. Metamemory provides that master routine required by higher order thinking skills through metacognitive processing.

A brief metacognitive processing overview is therefore necessary to provide insight into how individuals process information and make choices. In short metacognitive processes help to enhance learning by logically organizing, or guiding, the thinking process. Regarding long-term retention one needs to be aware of how encoding strategies and / or metamemory judgments are consciously or subconsciously determined. The following theoretical framework was developed through metamemory research but advanced by Nelson and Narens (1990).

The theoretical framework Nelson and Narens (1990) developed was a three-level architecture for metacognition that supports introspective capabilities and self-awareness. Nelson and Narens defined three abstract principles of metacognition (see Figure 1):

- Principle 1: The cognitive processes are split into two or more specifically interrelated levels, the meta-level and object-level (p. 125).
- Principle 2: The meta-level contains a dynamic model (e.g., a mental simulation) of the object-level (the meta-level determines how the object-level should act) (p. 126).
- Principle 3: There are two dominance relations, called ’control’ and ’monitoring,’ which are defined in terms of the direction of the flow of information between the meta-level and the object-level (p. 127).

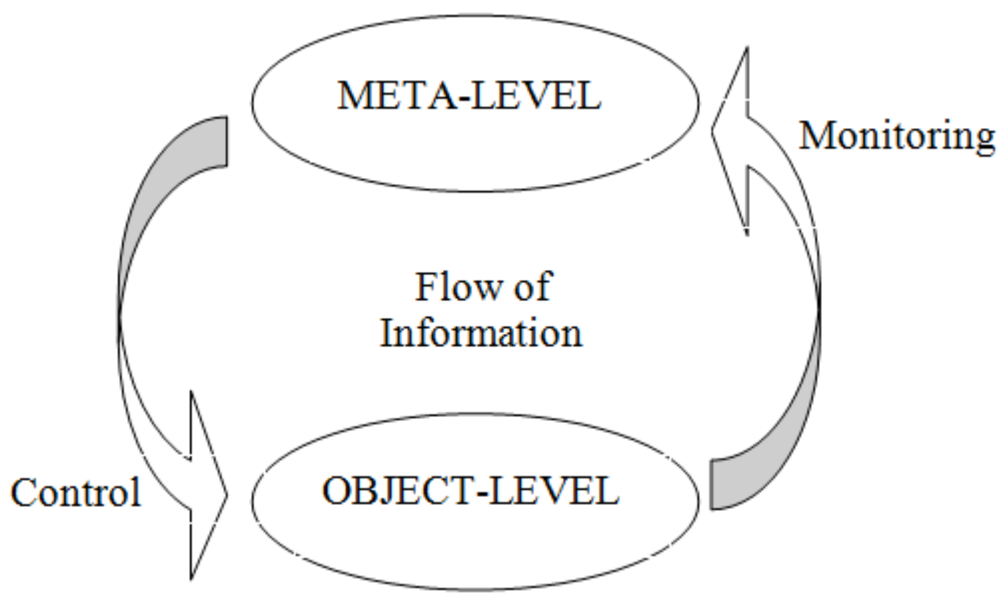


Figure 1. Theoretical mechanism consisting of the meta-level and object-level and the information flow between the two levels as identified by Nelson and Narens (1990, p. 126).

In the control process the meta-level modifies the object-level. This process is analogous to speaking into a telephone handset. The control process puts the object-level into one of three states: (a) to initiate an action, (b) continue an action, or (c) terminate an action. The object-level listens (to the meta-levels phone call), processes (reacts), and then informs the meta-level what state it is in. If, based upon new data, a state change needs to take place the meta-level will then tell the object-level to make that change. The object-level will then update the meta-level regarding the state change. The object-level provides information (choices) to the meta-level and the meta-level makes the decision. In short the meta-level has an overall picture of what should be happening. The object-level does what the meta-level tells it to do. This process constructs introspective behaviors. Nelson and Narens (1990) stated introspection can be examined as a type of behavior so as to characterize both its correlations with some objective behavior (e.g., likelihood of being correct on a subsequent test) and its distortions.

Nelson and Narens (1990) describe three learning judgments that involve metacognitive introspection. Each learning judgment is instrumental in learning and retaining information. First, ease-of-learning judgments (EOL) occur in advance of acquisition, are largely inferential, and pertain to items that have not been learned. These judgments are predictions about what will be easy or difficult to learn, either in terms of which items will be easiest or in terms of which strategies will make learning easiest (1990). Feeling of Knowing (FOK) judgments occur during or after acquisition (e.g., during a retention session) and are judgments about whether a given currently non-recallable item is known and/or will be remembered on a subsequent retention test (1990). Finally judgments of learning (JOL) occur during or after acquisition and are predictions about future test performance on currently recallable items (1990).

Figure 2 identifies the metacognitive processes determining, for example, a test question's difficulty and the decisions associated with its processing. The beginning

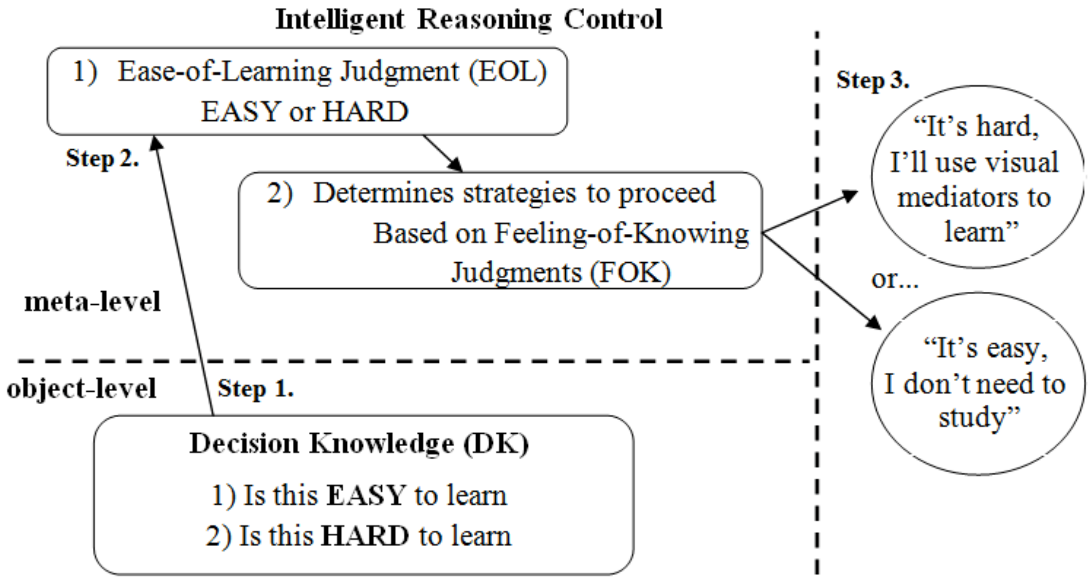


Figure 2. Introspective metacognitive ease-of-learning judgment decision process.

of this process takes place at the object-level. A decision pool is generated–easy or hard to learn–and those choices are sent to the meta-level. At the meta-level, an ease-of-learning judgment (EOL) is determined based on various factors such as understanding of information, and relationship to other known information. Based on the feeling-of-knowing judgment (FOK), a processing strategy is selected, in this example either use visual mediators or not to study.

Figure 3 provides a more complete and comprehensive understanding of how learning judgments are used during acquisition, retention and retrieval phases in relation to meta- and object-level monitor and control sequences. Metamemory, metacognitive processing, and EOL, FOK, and JOL judgments play an integral role in the learning process and are directly linked to all research studying performance retention.

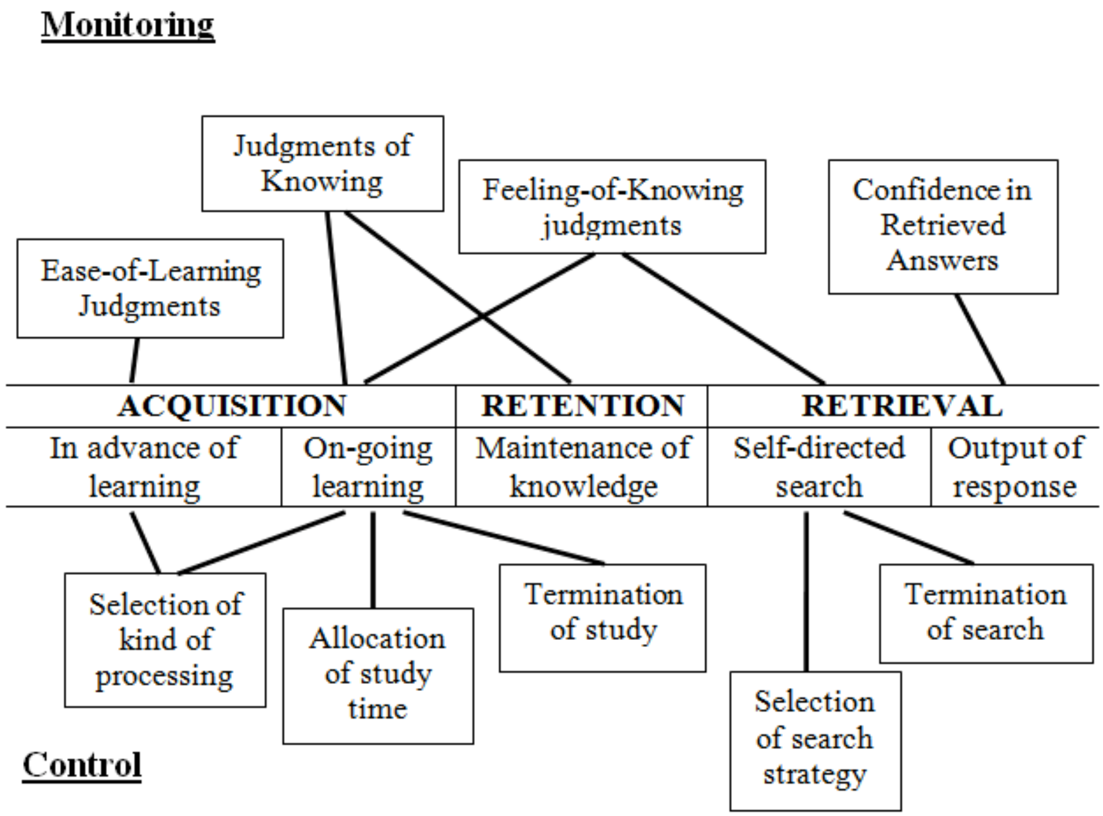


Figure 3. Main stages in the theoretical memory framework as identified by Nelson and Narens (1990, p. 129).

Distributed, Spaced, and Massed Practice and the Spacing Effect

Distributed practice, massed practice, spacing practice and the spacing effect are important when understanding and identifying methodologies where students learn best. Son (2004) states studying an item over several repetitions with lags (space) between them has been known as spacing. Donovan and Radosevich (1999) define spacing practice or distributed practice as those conditions in which subjects received practice sessions separated by a time interval. The COMS 102/232 cohort is an example of one type of distributed practice model with elements of spacing, the concept of learners needing to see things over time to retain knowledge and skills. Donovan and Radosevich define massed practice as a condition in which subjects received continuous practice on the task with no between training interval. Son (2004) more liberally defines mass practice by stating a learner studies a particular item for a certain period of time with short rest periods, or lags, between study trials. This definition of mass practice is more applicable to the methodologies employed in the COMS 260 Word Processing block course.

Hermann Ebbinghaus (1850-1909) was one of the first psychologists to research memory as it relates to the spacing effect and retention performance. In the early 1880s Ebbinghaus developed the nonsense syllables methodology for use in memory work (Shakow, 1930). Ebbinghaus assumed that the process of committing something to memory involved the formation of new associations and that these associations would be strengthened through repetition. Ebbinghaus learned that forgetting occurred most rapidly soon after the end of practice, but the rate of forgetting slowed over time. Ebbinghaus labeled this curve the Forgetting Curve. In his experiments, Ebbinghaus used two types of recall: (a) free recall – recall items in a list without regard for order and, (b) serial recall – recall items in a list in the order they were studied. Ebbinghaus also studied the over-learning effect. The over-learning effect refers to the amount of study time beyond optimal performance. For instance if a student studies for two hours and receives a 100% on an exam, any study time past two hours would be over-learning (Shakow, 1930).

The majority of the research shows that performance improves when practice is distributed rather than massed (Bahrick, Bahrick, Bahrick, & Bahrick, 1993; Bahrick & Hall, 2005; Bahrick & Phelps, 1987; Glenberg, 1977; Zechmeister & Shaughnessy, 1980). Additionally, Son (2004) states that it has been found by numerous authors referencing numerous studies that spacing leads to higher performance than does massing, particularly under conditions in which the delay between study and test is long rather than short. Glenberg (1977) reinforces these findings. Glenberg found that items given massed presentations are recalled less often than items whose presentations are distributed.

Early spacing effect research showed that students learned more quickly given shorter practice sessions with longer time (spacing) in between the practice sessions. Meta-analytic reviews conducted by Donovan and Radosevich (1999) and Lee and Genovese (1988) substantiate that retention is improved by distributed practice with spacing rather than by massed practice.

Glenberg (1977) suggests spacing effectiveness, or how well items are retained, is related to encoding strategies and discusses that free-recall (retention) is dependent on the conditions of retrieval. Glenberg (1977) believed that an item repeated or reinforced after a long space of time becomes associated with more varying types of information. The more ways, or routes, to retrieve an item results in better recall providing advantages in retention of the item. Zechmeister and Shaughnessy (1980) suggest spacing effectiveness is related to how participants distribute their study resources in regard to metamemory judgments.

Bahrick and Hall (2005) investigated how learners encode information. Students use a variety of encoding strategies in associative learning to successfully retain information. Bahrick and Hall used three primary encoding strategies, also termed mediators: (a) repetition, (b) verbal elaboration by means of a word or sentence, and (c) visual elaboration by means of a visual image. Bahrick and Hall (2005) believe that encoding strategies vary in effectiveness; some strategies benefit short-term retention where other strategies benefit long-term retention. Students can only learn which strategies work best for them through trial and error. A trial and error methodology can only be employed if there is a sufficient timeframe for learning. Bahrick and Hall state the reason retention is better through distributed practice using spacing as compared to massed practice methodologies is that learners have more time to evaluate and employ the encoding strategies that work best for them. There is not enough time using massed practice methodologies for students to learn the best encoding strategies for the given information, therefore, they choose simple repetition.

Nelson and Leonesio (1988) found students distribute their study time based on metamemory judgments as described by Nelson and Narens (1990). Metamemory judgments can be correlated to accuracy and speed of learning. Nelson and Leonesio found that primarily ease of learning judgments (EOL) and, to a lesser extent, feeling of knowing judgments (FOK) are reliably related to study time and performance. A learners' EOL and FOK will be determined based upon their comfort level with to-be-learned information and study time is allocated accordingly; less time is spent studying easy information where more time is spent learning more difficult information. Underwood (1966) showed EOL is predictive of subsequent learning. A students' belief about information difficulty, based upon subsequent learning, had a significant predictive value for free-recall learning during experimenter-paced trials.

These findings were verified in studies conducted by Lippman and Kintz (1968) and Nelson and Leonesio (1987). Hart (1965) conducted some of the first feeling-of-knowing (FOK) research establishing the significant predictive validity for recognition performance. If a learner has a low FOK they will review that item. If the FOK is high the learner will continue on to the next item. This research was verified and extended by more recent FOK research conducted by Nelson, Gerler, and Narens (1984).

Nelson and Leonesio (1988) found judgments of learning might be relevant to spacing when predicting the amount of time learners dedicate to studying. Nelson and Leonesio suggest that when learners reach a certain personal learning threshold for an item they will move on to the next item even though mastery may not have been attained. The resulting condition, if the item has remained unlearned, will result in lower performance on retention tests.

Since the mid 1970s, research has primarily focused on tests of immediate retention with intervals of only a few seconds between repeated presentations of content (Bahrick & Hall, 2005). Although a few exceptions exist, most studies reported on spacing of more than one day.

Long-term Performance Retention

Literature focusing on widely spaced long-term retention is minimal in comparison to research studies focusing on retention with short-term spacing intervals. Individual experiments conducted by Bahrick (1979), Bahrick and Phelps (1987), and Bahrick and Hall (2005) as well as a meta-analytic review by Donovan and Radosevich (1999) were reviewed to provide a framework for understanding the distributed and massed practice paradigm.

Donovan and Radosevich (1999) found 63 studies that matched their criteria: the study had to (a) contain massed and spaced elements, (b) involve the acquisition of knowledge or skill, and (c) be generalizable. The meta-analytic review by Donovan and Radosevich focused on several components including methodological rigor, task type, acquisition performance, retention performance, and time interval.

Table 5.

Effect Size from Cluster Analysis on Learning Tasks by Donovan and Radosevich (1999)

Task Cluster #	Effect Size	Mental Requirements	Overall Complexity	Physical Requirements	Tasks Include
TC 1	0.97	Low	Low	High	Typing, ball toss, ladder climbing
TC 2	0.42	Low	Average	High	Free recall, foreign language, classroom lecture, **word processing**, verbal discrimination
TC 3	0.11	Low	High	High	Gymnastic skills, balancing task
TC 4	0.07	High	High	High	Airplane control simulation, hand movement memorization, puzzle box task, music memorization and performance

Table 5 shows several clustering categories Donovan and Radosevich (1999) developed to study task type. Task cluster 2 (TC2) analyzed word processing skills, the skill-set studied within this research. Donovan and Radosevich found that task type appears to play an important role in studying the relationship between massed and spaced practice conditions. For instance, Task cluster 1 (TC1) is low in complexity and mental requirements but high in physical requirements (psychomotor) and has an effect size of 0.97 showing a strong effect for the superiority of spaced practice. Task cluster 2 (TC2) had an effect size of 0.42 which Donovan and Radosevich consider a medium effect size. This implies that there is a moderate positive correlation between spacing practice and learning and retaining word processing skills. Task cluster 3 and 4 will be ignored in this literature review but are relevant to other studies and included to share the full range of the table.

Donovan and Radosevich (1999) state that the distribution of practice effects is limited to relatively simple tasks such as TC1 and TC2 (high in physical requirements but no more than average in overall complexity). Donovan and Radosevich found simple tasks, especially when using very brief rest periods, had larger effect sizes. Donovan and Radosevich believe the optimal interval between learning sessions appears to be partially a function of the type of task being learned. For more complex tasks, Donovan and Radosevich state that longer rest periods appeared to be more beneficial for learning.

Bahrick (1979) and Bahrick, Bahrick, Bahrick, and Bahrick (1993) conducted research focusing on very long-term memory for foreign language retention. Both studies used training sessions with alternating study and test trials combined with a drop-out procedure so that words correctly recalled on a test trial were no longer studied on subsequent trials (Bahrick & Hall, 2005). Bahrick (1979) studied retention for English-Spanish word pairs taught over six training sessions with inter-session timeframes of zero days, one day, and 30 days. All word pairs were trained in Session 1. Each subsequent session started with a retention test assessing word pair retention based upon the previous session's training. Interestingly, on a per session basis massed and one-day participants retained more as a percentage throughout the first six sessions than did the 30-day participants (see Figure 4). However in session seven, when each group was tested after a 30-day interval, the massed and one-day participant retention dropped off considerably where as participants who had been training in the 30-day interval continued to show significant improvement.

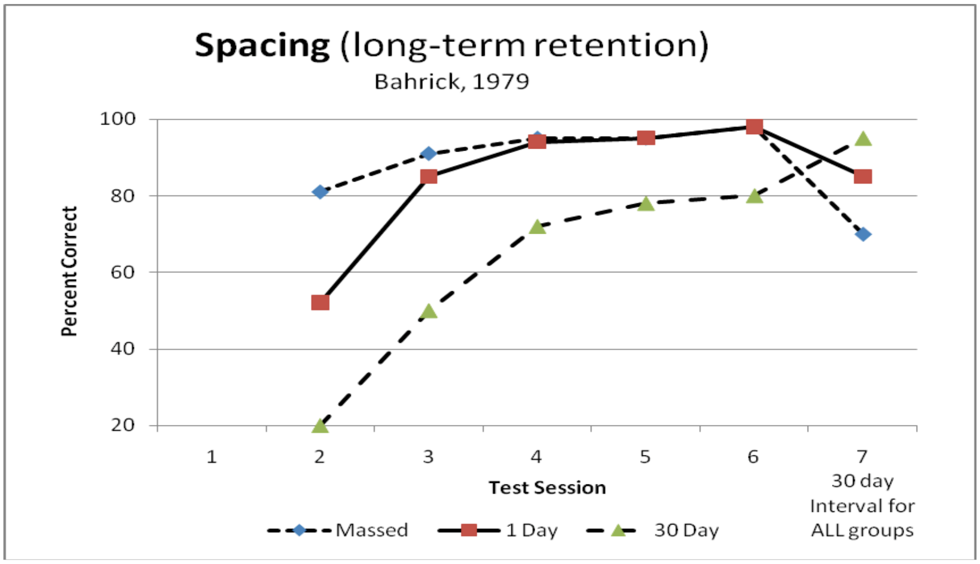


Figure 4. Word-pair retention over time.

Eight years after Bahrick (1979) first conducted his research, Bahrick and Phelps (1987) conducted a follow-up study using the same participants (participant mortality was not reported). They found the 30-day participants still recalled 15% of the original word pairs from the 1979 study. This compares to 8% recall for the one-day group and a 6% recall for the massed group.

Bahrick and Hall (2005) found the longer the between session spacing interval the more training sessions it took for full understanding. When there was longer time between training intervals participants retained more information and remembered it longer. Hence Bahrick and Hall found more time between spacing leads to improved performance retention. The researchers concede that due to the design of the research 30-day participants might be at an advantage. The design of the study was such that when participants had succeeded in retaining a word pair that word pair was thrown out of the word pair pool. The 30-day participants had fewer word pairs thrown out of the pool throughout the first six sessions. This resulted in the 30-day group having seen the word pairs more often than either of the other test groups. This possible advantage may have lead to improved retention on the 7th exam session (see Figure 4).

Bahrick and Hall (2005) conducted several studies regarding long-term retention. The first experiment had 41 participants and followed a similar format to the 1979 Bahrick study. Rather than English-Spanish word pairs, the 2005 study used English-Swahili word pairs. Three groups were developed: zero-day (massed practice), one-day, and 14-day. The total study time for the zero-day group was 15 days, the one-day group's study lasted 18 days, and the 14-day group's study lasted 57 days. An additional component Bahrick and Hall introduced into this study was how students used encoding strategies (mediators). In addition to the test itself, students were surveyed on which encoding strategies they used to remember the word pairs: (a) repetition, (b) verbal elaboration by means of a describing word or sentence, (c) visual elaboration by means of a mental image, or (d) some other method.

Very similar to the Bahrick (1979) findings, the massed and one-day groups performed better until the session 5 retention exam that occurred at the 14 day interval. The 14-day group started out poorly but performed better than either the massed or one-day group on the 14 day retention test (see Figure 5).

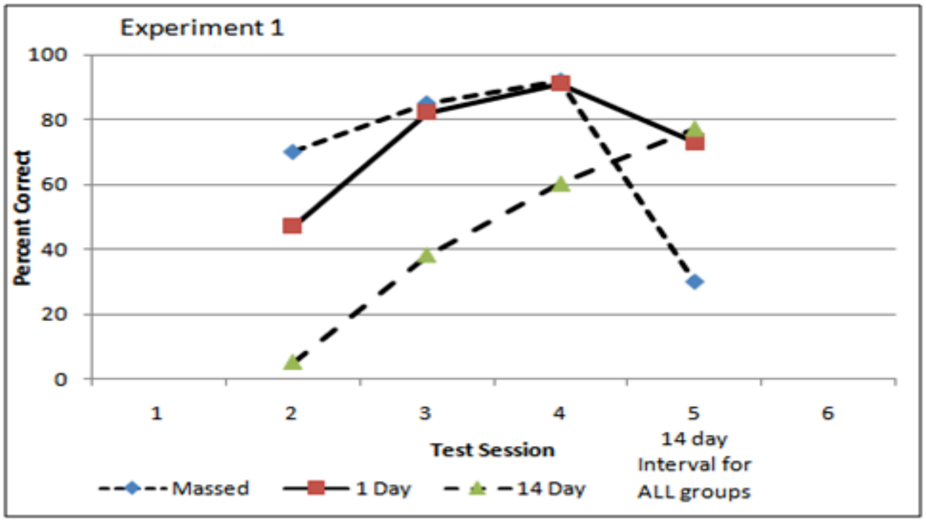


Figure 5. Memory retention (Bahrick & Hall, 2005, p. 570).

Participants use of mediators helps to understand the retention performance on the study. Figure 6 displays the frequency each group used the mediator repetition to study

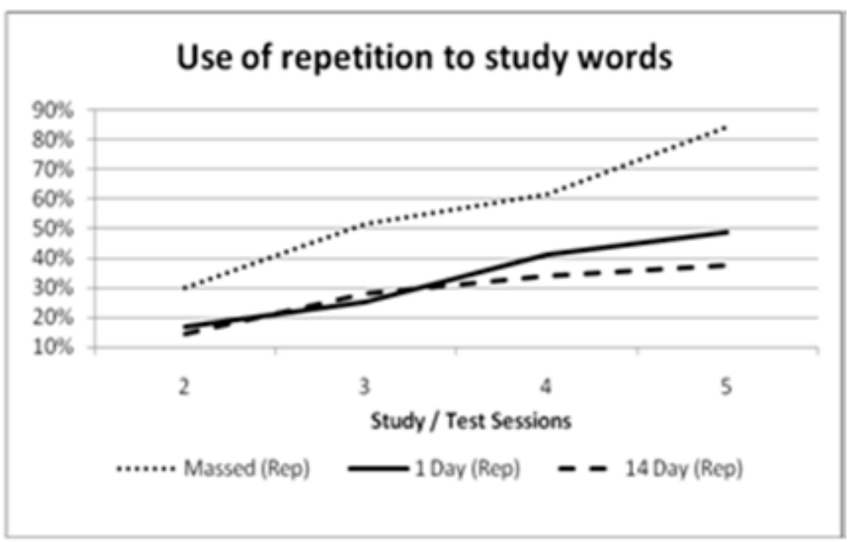


Figure 6. Use of repetition to study words.

words. Figure 7 shows the frequency each group used mediators other than repetition to study words. The massed group increasingly used repetition encoding strategies throughout the five session study trials. Recall the first session was only used for training. By the 5th session the one-day group was using repetition and audio/visual mediators almost evenly. The 14-day group clearly made extensive use of audio/visual mediators over repetition (see Figure 6 and 7).

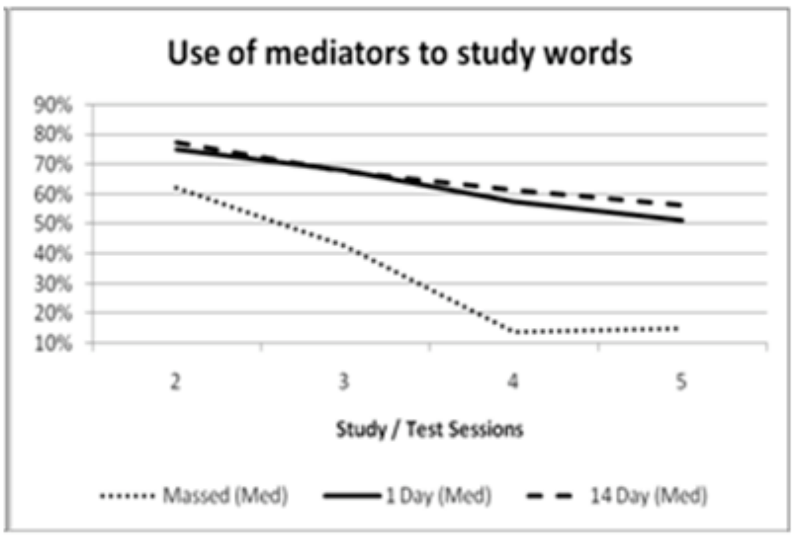


Figure 7. Use of mediators other than repetition to study words.

Bahrick (1979) believes that widely spaced practice sessions are advantageous to long-term retention. He believes students, if given time, will identify and use the encoding strategies that work best for them given the specific type of information they are to learn and retain. If an encoding strategy doesn't work the student fails to remember then they will try a new one that will enable them to remember. This study suggests that, for the most part, students in a mass practice environment will resort to simple repetition (memorization) rather than using audio/visual mediators as a way to learn and retain information. Figure 6 shows that in session 1 massed students used repetition to learn words about 30% of the time. Figure 7 shows massed students used mediators other than repetition about 62% of the time in session 1 (Figure 7). By the time massed students reach session 5 they are now using repetition to learn 85% of the time and mediators other than repetition 15% of the time. The one-day and 14-day groups initially used repetition and non-repetition mediators nearly evenly. On the 5th session the one-day group still used repetition and non-repetition mediators about evenly to learn word pairs. However on the 5th day the 14-day group used repetition only about 38% of the time and non-repetition mediators about 58% of the time. As shown in Table 6, the encoding strategies used by the massed group were minimally effective resulting in poor final recall at 30%.

Table 6.

Study Exposure and use of Mediators Resulting in Final Recall

	Study Exposures	Percent mediators in session 1	Percent mediator additions	Final recall
Massed	3.97	62.14%	2.32%	30.18%
1-day	4.08	75%	4.81%	73.46%
14-day	5.45	77.22%	10.54%	77.32%

It appears the encoding strategies for the one-day and 14-day groups were more successfully utilized, 73% and 77% respectively, than for the massed group. However, as in the study of Bahrick (1979), the initial poor performance of the 14-day group lead to increased word pair study exposure that may have resulted in improved final recall performance. If the massed and one-day study exposure times are analyzed this argument seems negligible. The massed and one-day group have virtually the same number of study exposures per word pair (3.97 to 4.08 respectively) yet the one-day group far outperformed the massed group on final recall (73% to 30% respectively).

In a second experiment conducted by Bahrick and Hall (2005), they again used Swahili-English word pairs and grouped them into easy and difficult categories. This experiment used massed and one-day groupings but used three to four day intervals between sessions rather than 14 day intervals. Intervals spaced three to four days apart were used to avoid scheduling sessions on weekends. Participants were given five training sessions with the first session used only for training. The sixth exam session was given seven days after the specific groups last training session.

Bahrick and Hall (2005) replicated their first 2005 experiment and confirmed the findings from Bahrick (1979). On both easy and difficult items, the massed group performed at a higher rate than did the one-day or three- to four-day groups through the first five lessons (see Figures 8 and 9). However, similar to previous studies, the massed groups retention on the session 6 retention exam decreased significantly at 40% on easy word pairs and nearly 50% on difficult word pairs. Similar to the previous studies' 14-day group the 3- to 4-day group's performance continued to improve throughout the study. However the one-day group retained more word pairs than did the three- to four-day group throughout the study even though their retention performance did not change during the seven day retention interval between session 5 and the final retention test in session 6. Based on the 1979 Bahrick experiment and their own 2005 findings, Bahrick and Hall (2005) suggest that the differential effect between the one day and three-four day spacing conditions become more pronounced the longer the final retention interval is

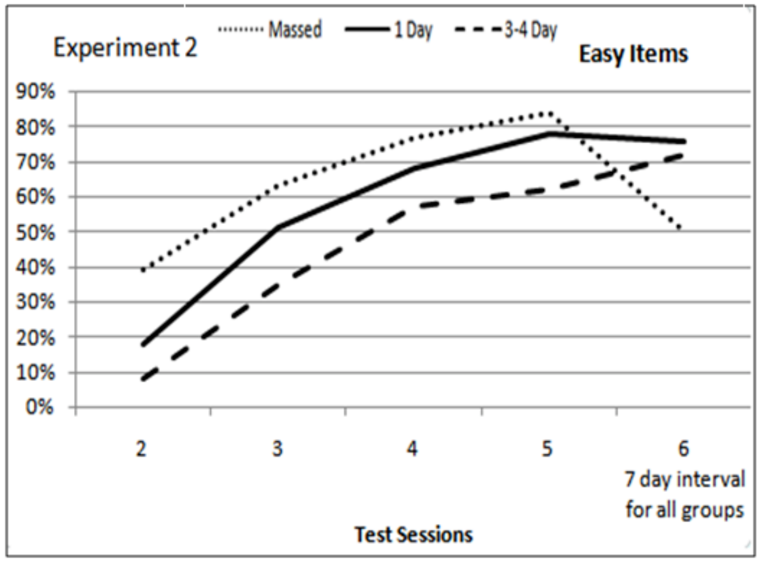


Figure 8. Findings from easy items (Bahrick & Hall, 2005, p. 573).

between session 5 and 6. The longer the retention interval, the more likely one-day participants will remember less than three- to four-day participants.

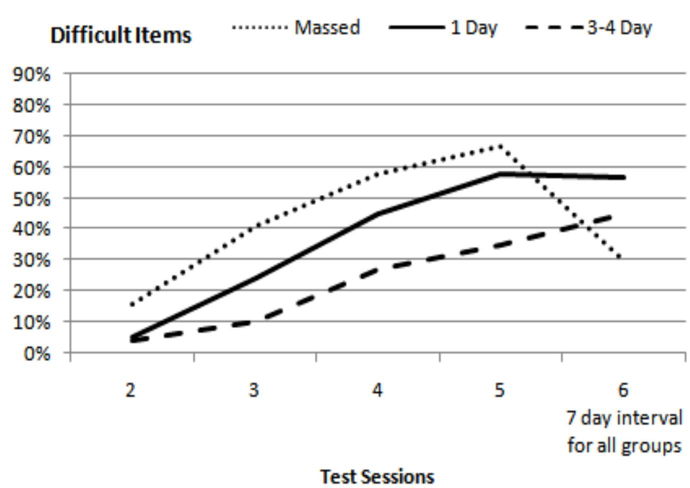


Figure 9. Findings from difficult items (Bahrick & Hall, 2005, p. 573).

Chapter Summary

Over the last two centuries various pedagogical learning models have been brought forward by pioneers in the field of education. Wright proposed alternative educational pedagogy in the mid 19th century. Dewey founded the Chicago University Laboratory School in the late 19th century and many others have proposed alternative educational learning models throughout the 20th century. By becoming familiar with the historical development of traditional and alternative pedagogy, the reader begins to develop a foundation of understanding for learning approaches in 2008.

Block scheduling is one such alternative model. Block scheduling at the rural western United States university under study provides experiential learning in a three hour per day 18 contiguous day (excluding weekends) timeframe. Experiential learning in this model is intended to be hands-on and real life.

The adoption of block scheduling within the school system has been generally successful. For instance, in the 1990s ten Seattle area high schools conducted research and then adopted an 80-minute block-scheduling model (Marshak, 1998). The block-scheduling model infuses a cooperative learning environment into the classroom that changes the dynamics of the group (Weingarten, 2005) and creates an environment conducive toward developing real-life problem solving and critical thinking skills. Supporters of this approach believe acquiring knowledge becomes more meaningful to the student when they investigate and examine rather than simply listen to a lecture (Gordon, 1998). Block scheduling also increases the quality of student–teacher interaction in the classroom. The additional time students spend face-to-face with the instructor fosters a positive and personal learning environment. The teacher does not just teach; she becomes a mentor. In this environment, the student is not just the recipient of knowledge; he becomes an active participant in his own learning. This learning paradigm creates conditions in the classroom that helps students learn for themselves (Barr & Tagg, 1995) and is conducive to developing critical thinking skills. Loveless and Holmes (1968) conducted an opinion survey targeting Business and Office Practice Teachers in Utah high schools. They found teachers generally agreed that the two-period (90 minutes) block format was more advantageous for student learning than the one-period (50 minute) format. Respondents believed that within the two-period block model (a) more material can be taught, (b) related subject correlation is better, (c) more flexibility is permitted, (d) student achievement is higher, (e) individualized instruction is better, (f) vocational counseling is improved, and (g) more usable working time is provided (Loveless & Holmes, 1968).

Bowman (1998) found little concrete evidence demonstrating block scheduling is a more effective learning model than any other. Bowman's research found the levels of student learning were unchanged by block scheduling. As an additional disadvantage, block scheduling added to the workload of educators and the homework of students.

Van Mondfrans, Schott, and French (1972) conducted a study on the effects of block scheduling versus traditional scheduling on student achievement and attitudes.. They concluded that the two treatments, block and traditional, did not differentially affect the test results or student ratings between block and traditional scheduling models.

Krank (2005) reported on the rural western United States university implementation of an experiential learning model that is facilitated by block scheduling. Analysis of the initial pilot project data finds, as a general rule, experiential learning in a block format yields nearly identical student course evaluations as compared to traditional face-to-face courses, has improved student retention, and improved student self-concept

The review of the literature focusing on prerequisite courses finds that although not prevalent, there have been a few studies conducted attempting to quantify the importance of the prerequisite. Some studies have shown prerequisite courses are valuable in constructing new knowledge required for the advanced course where others find the prerequisites importance negligible.

The role metamemory, metacognitive processing, and how ease-of-learning, feeling-of-knowing, and judgments of learning contribute to the learning process and how they are directly linked to performance retention was discussed. It appears students retain more information when they are given time to learn which encoding strategies or mediators work best for them given the kind of information they are studying.

The majority of the research shows that performance improves when practice is distributed rather than massed (Bahrick, Bahrick, Bahrick, & Bahrick, 1993; Bahrick & Hall, 2005; Bahrick & Phelps, 1987; Glenberg, 1977; Zechmeister & Shaughnessy, 1980). Donovan and Radosevich (1999) found in a meta-analysis that certain tasks such as psychomotor, foreign languages, and word processing were positively impacted by spacing practice. Bahrick (1979) found longer time intervals between training sessions resulted in improved long-term performance retention. Bahrick and Phelps (1987) followed up Bahrick (1979) by looking at three groups' retention. The 30-day group participants still retained 15% of the information they had learned earlier, while the one-day group recalled 8% and the massed group recalled only 6% of the original information. In two long-term performance retention experiments conducted by Bahrick and Hall (2005), long-term retention continued to improve for the spaced group on performance retention exams 14 days and 7 days after the last training session although the number of study exposures may have impacted their findings. Although there are minimal recent studies, the literature suggests the practice of spacing has a positive impact on retention performance.

Strengths and weaknesses in both block scheduling and cohort course structure were reviewed. Although university Business & Technology Computer Science instructors converted the word processing curriculum from the cohort approach to the block-based scheduling model, debate continues regarding how best to offer skills-based word processing curriculum at the university. The results of this research may provide valuable insight into the best scheduling and instructional strategies that will give the student the best learning experience. Chapter III presents the research design and methodologies.

CHAPTER III

RESEARCH METHODOLOGY

The purpose of this study was to explore the relationship between student academic performance and the course delivery format, cohort or block, and how the spacing effect impacted retention performance. This chapter describes the research design, population, instrumentation, data collection methods, and methods of analysis used in the study. The research questions that guided this study were:

1. Was there a difference in student academic performance between block and cohort educational environments?
2. Did the difference in time between taking an introductory and advanced word processing course have an impact on student academic retention performance?

Research Design

Descriptive statistics were computed and used to analyze research data. Simple means were reported. Borg and Gall (1983) state the goal of descriptive research is to characterize a group of students, teachers, and so forth on one or more variables.

Research question 1 addressed scheduling format and academic performance. Because this study was ex-post facto, students had self-selected scheduling formats, the independent variable, and no random selection of participants nor random assignment of scheduling format was necessary. This controlled for researcher bias and the Hawthorne effect. Research question 2 addressed the time in-between two sequential courses. This time in-between was the independent variable. Participants had self-selected when to take the two courses.

Population

The population of this study was the entire population of students at the rural western United States university who took COMS 102 and COMS 232 (cohort) and COMS 260 (block) between and including 2005-2006 and 2007-2008 academic years. There were 47 students in the cohort and 40 students in the block over this time. No sample was employed; all students were included in this ex-post facto study.

Instrumentation / Process

One goal of the study was to investigate student academic performance based upon scheduling model in core word processing courses as measured by questions common to both the cohort's advanced word processing course and block word processing course posttest. As shown in Figure 10, the cohort's beginning word processing course had a separate pre- and posttest that assessed basic word processing

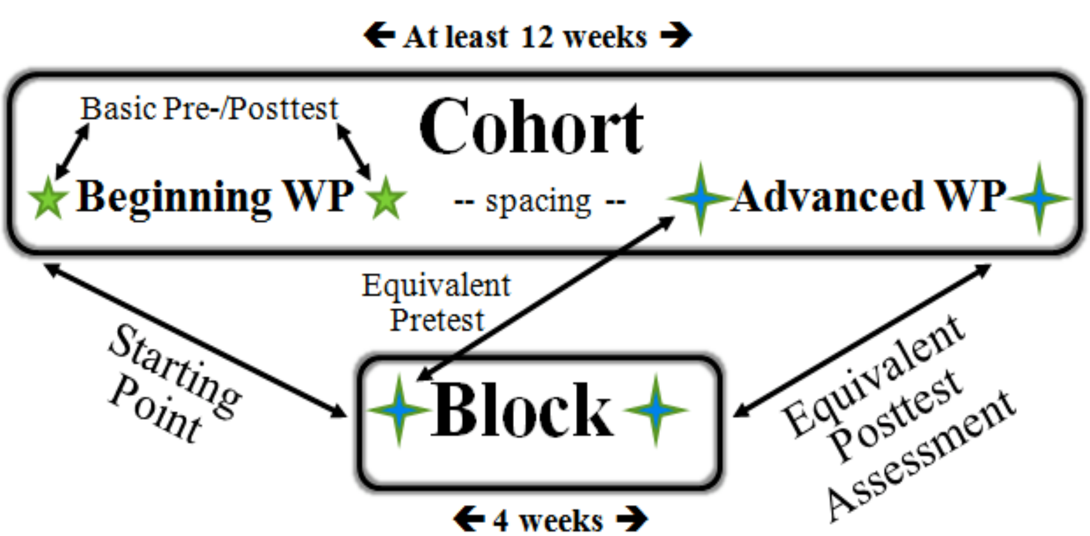


Figure 10. Cohort and block assessments.

skills. The pre- and posttest in the cohort's beginning course had six questions in common with the advanced cohort's pre- and posttest and two questions in common with the block's pretest. Although the curricular starting point was the same for both the cohort and block groups there were not enough questions common to both the beginning cohort course's and block course's pretest to determine if students in both formats began at an equivalent starting point. The cohort's advanced word processing course and the block word processing course had equivalent assessments. Both cohort and block formats had equivalent endpoint assessments. For the purpose of this study, posttest questions that are common to the cohort's advanced word processing course and block word processing course will be defined as the posttest. Posttest questions included tasks covering a variety of advanced skill sets and tasks (see Table 7).

Table 7.

Examples of Posttest Questions

Skill Set	Task
Format Documents	• Rotate and align text in a table cell
Customize *MS Word*	• Remove the document map button from the standard toolbar • Edit and save macros
Use Mail Merge	• Merge a document with a data file, insert fields, and then print all the letters.
Use Workgroup Collaboration	• Format a web page with a specific theme. • Compare and merge different versions of the same document.

Together, the beginning and advanced cohort courses totaled two credits while the block course totaled four credits. At first glance, it appeared the comparison of the two formats would be unequal. Upon closer examination, the student workload in each format was not too dissimilar. Due to degree program credit limitations and an expectation that students achieve a high skill level in word processing, computer science instructors placed approximately one and one-half times the content for a normal one credit course into each cohort course. This resulted in the cohort totaling an estimated three credits. When computer science instructors designed the block word processing course, it was determined extra content in addition to the same word processing skills learned in the cohort structure were needed. This resulted in word processing curriculum estimated at about three and one-half credits. Because voice recognition is an important skill in both business and education, it was added to the block word processing courses curriculum. This addition enabled the block word processing curriculum to total four credits. Therefore, students enrolled in the cohort for two credits actually did very comparable work in word processing to those enrolled in the block for four credits.

Participants were assigned a random identification number with the researcher maintaining the key. Course Technology's Skills Assessment Manager (SAM) provided the pre- and posttest assessment instrument for all exams within the core word processing courses. Exams developed in SAM enable the instructor to create and schedule trainings, deliver password protected exams, create a variety of group or individualized reports, archive complete courses, and test *Microsoft Word 2003* Expert Microsoft Office Specialist (MOS) competencies (see Appendix B). The pretest and posttest for both scheduling formats were developed using SAM and contained advanced word processing learning objectives that aligned with nationally recognized *Microsoft Office Specialist certification* competencies. All of the pre- and posttest questions were application-based, none were recall. Because learning objectives in the cohort and block formats aligned with *Microsoft Word 2003* Expert Competencies the majority of pre- and posttest questions were common to both formats. The pretest and posttest instrument was delivered using SAM via the Internet.

Retention performance in research question 2 compared student performance on six questions that were common to the cohort's beginning course posttest and the advanced course pretest (see Figure 11). For the purpose of this study, the term retention

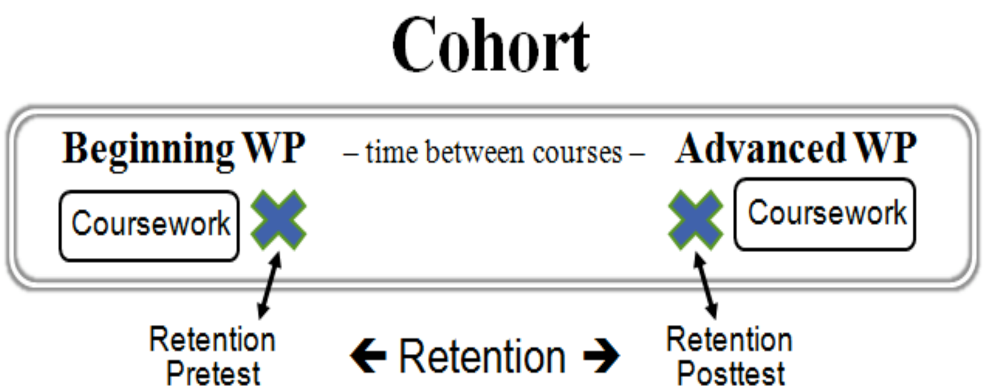


Figure 11. Retention assessments.

pretest was used to identify common questions in the beginning course posttest and retention posttest was used to identify common questions from the advanced word processing course pretest. The retention pretest and posttest questions included tasks covering a variety of beginning skill sets and tasks (see Table 8).

The pretest and posttest used in the cohort's beginning word processing course and the advanced word processing course was developed, administered, and delivered via the Internet using SAM. The posttest for the cohort's beginning word processing course was taken at the end of the course. The pretest for the cohort's advanced word processing course was taken at the beginning of the course.

Table 8.

Examples of Retention Pre- and Posttest Questions

Skill Set	Task
Format Documents	• Sort table data
Customize *MS Word*	• Track changes

In research question 1, the independent variable was the scheduling format–cohort or block. The dependent variable, as defined by Creswell, is the variable that depends upon the independent variable. In research question 1, the dependent variable was student academic performance as determined by the cohort and block posttest. In research question 2, the independent variable was the amount of time between beginning and advanced cohort courses. The dependent variable was student academic performance on the advanced cohort pretest.

Data Collection

Prior to beginning the study, the Institutional Review Board of the university system and the core word processing course supervisor approved the study.

All scores for cohort and block courses including individual student performance were recorded and archived in the Thomson Course Technologies SAM database. The researcher accessed the archived SAM data and recorded student performance on each of the questions that were common to both the cohort and block pretests and posttests.

In research question 2, the time between the cohort's beginning and advanced word processing course was the independent variable. Due to the nature of the flexible scheduling in the cohort approach it was possible for students to take the beginning course and advanced course in a variety of timeframes including back-to-back, within the same semester or academic year, or in different academic years. When collecting data comparing spacing in research question 2, the SAM database was accessed and the date the beginning course's posttest was taken was recorded. In order to determine the ending point, the advanced course's pretest date was recorded. The number of weeks between cohort courses was calculated and recorded.

Data Analysis

Simple means were computed on the research question 1 population to provide descriptive and comparative data. Because descriptive and comparative data were analyzed on the entire population, the *p*-value was not reported and results are not generalizable. Experimental importance was based on the percentage between posttest mean scores. The literature provided no hard and fast rules for determining experimental importance. In this study, this researcher believed a five percent or greater difference in mean scores between treatment A and treatment B was important. Such a difference would compel this researcher to consider the possibility that one treatment might be better than another, or at least to conclude further research was needed. Daniel (1977) states practical significance refers to the scientific or practical importance of conditions that exist in populations. The following example explains this concept. The mean for treatment A may be four percent higher than the mean for treatment B. However, treatment A may need several teachers and expensive equipment to implement whereas treatment B does not. Even though treatment A may show statistical significance, treatment B is practically significant because treatment means are not too dissimilar and the treatment is much less expensive. Even though means between two groups may be experimentally important, the determination as to practical significance is more complex and can only be determined by the researcher. As Daniel stated, “Whether or not the magnitude of the difference between *Mu* of *A* and *Mu* of *B* is of any practical importance is a question that cannot be answered by the statistical test. This is a question that only the researcher can answer after consideration of non-statistical information” (1977, p. 425). Experimental importance and practical significance were reported. Simple means were also computed on the populations in research question 2 to determine descriptive and comparative statistics. Because descriptive and comparative data were analyzed on the entire population, the *p*-value was not reported and results were not generalizable. Experimental importance and practical significance were reported in Chapter Four.

A second goal of this study was to determine if the amount of time in-between beginning and advanced cohort classes has any effect on retention performance. The researcher categorized students by the number of weeks between taking the beginning and advanced cohort classes with each 16 week period equaling one semester. In order to provide a comparison to the traditional model, three timeframe categories were developed, each based on a 16-week timeframe. In the first category, category A, the beginning course was within one semester of the advanced course. Category B had one semester between beginning and advanced courses. There were two semesters between beginning and advanced courses in category C. For research question 2, the retention pretest and posttest is composed of six questions. On a 100-point scale, each question is valued at 16.7% of the total score. Although, given the timeframes of previous and current studies, it was impossible to correlate retention performance between the research Bahrick (1979) and others conducted over the last three decades to this study, one could still identify consistent retention patterns. In the distributed and massed practice research previously discussed, distributed practice performance reached a peak and then slowly decreased over a period of time. Remaining consistent with prior research, this researcher expected students who took the cohort within 16 weeks of the beginning course (category A) to have a 0% retention loss, those students who took both classes of the cohort more than 16 weeks but less than 32 weeks apart (category B) to have a one question or 16.7% retention loss, and those students who took the cohort more than 32 weeks but less than 48 weeks apart (category C) to have a two question or 33.4% retention loss. Once again, the researcher believed a five percent or greater difference in expected mean scores between groups–within the same 16 weeks, 17 to 32 weeks apart, and 33 to 48 weeks apart–was important.

Chapter Summary

Chapter Three presented the methodology and procedures that were used in this study. The descriptive approach to studying student academic performance and the course delivery format was employed in this study. Students self-selected into groups by enrolling in either the cohort or block course. The method of data collection was explained. Results are discussed in Chapter Four.

CHAPTER IV

ANALYSIS OF DATA

This study explored the relationship between student academic performance and course delivery format, cohort or block. This study also investigated the impact spacing had on performance retention.

The research questions that guided this study were:

1. Was there a difference in student academic performance between block and cohort educational environments?
2. Did the difference in time between taking an introductory and advanced word processing course have an impact on student academic retention performance?

Research question 1 explored the relationship between the scheduling format, cohort and block, and student academic performance. The cohort format was utilized during the first two academic years after block scheduling was implemented at the university. In the cohort approach, students took a beginning word processing course followed by an advanced word processing course with some amount of time in between. The time in-between the two courses was referred to as spacing in this study. Upon completion of the cohort's advanced word processing course, a posttest was given testing learning objectives based on *Microsoft Office Specialist 2003 Word Expert* competencies. In the block approach, three-hour classes were held daily for 18 contiguous days excluding weekends. Computer Science instructors changed the scheduling format for word processing courses from cohort to block two academic years after block scheduling was implemented at the university primarily to make the word processing curriculum align with the block model. As in the cohort model, the performance measure for the word processing course's posttest in the block approach was based upon *Microsoft Office Specialist 2003 Word Expert* competencies.

Students typically took the cohort or block word processing courses during their sophomore or junior year. Most cohort students would have entered college during the 2003-2004 and 2005-2006 academic years. Block students would have entered college during the 2005-2006 and 2006-2007 academic years. Table 9 shows that over the three year *Experience One* pilot project each entering freshman group had performed about the same on the American College Test Composite (ACT) and High School Grade Point Average (HSGPA) (Krank, 2005). Some of the cohort students may have entered the university as freshmen in Fall 2003. It is reasonable to assume the ACT and HSGPA performance level for cohort and block students entering the university after the pilot project completed was about the same as those whose ACT and HSGPA statistics have been reported in Table 9.

Table 9.

Entering Freshman ACT and HSGPA Scores during Experience One Pilot Project

		ACT		HSGPA	
		mean	standard deviation	mean	standard deviation
Fall 2002	Traditional	19.25	3.59	3.08	.52
	Block (IE/L)	19.72	3.41	3.15	.53
Fall 2003	Traditional	19.3	3.63	3.02	.55
	Block	19.66	3.93	3.11	.47
Fall 2004	Traditional	* N/A	* N/A	* N/A	* N/A
	Block	19.04	* N/A	* N/A	* N/A

* Information was not reported in Krank, 2005.

The posttest for the cohort and block word processing course formats was developed using Skill Assessment Manager (SAM) developed by Thomson Course Technology. SAM is an Internet-based software solution that allows students to train using interactive text, guided simulations, hands-on practice, and challenge assessments emulating real-world *MS Office* and *Windows* skills. The researcher analyzed the posttest from the cohort's advanced word processing course and the block's word processing course in order to determine the number of questions the cohort and block posttest had in common. Thirty-four out of 50 questions were equivalent between the two scheduling formats (see Appendix C). In research question 1, all references to posttest performance was based on the 34 questions each scheduling format had in common. The posttest was given at the end of the advanced word processing and block courses and is the performance measure in this study.

Research question 2 focused on retention performance within the cohort model based upon the beginning courses posttest, Point A, and the advanced courses pretest, Point B (see Table 10.).

Table 10.

Retention Measure

Point A ← **Retention** → Point B

COMS 102 1 credit – 4 weeks On-site				**COMS 232** 1 credit – 8 weeks Night, Internet or Hybrid		
Pretest Basic Skills	**Course** Beginning Word Skills	**Posttest** Basic Skills	**Time (Spacing) between classes**	**Pretest** Word 2003 Expert	**Course** Advanced Word Skills	**Posttest** Word 2003 Expert

Time between classes was determined by the number of weeks between the beginning and advanced courses. Table 11 shows the category associated with the number of weeks between classes.

Table 11.

Spacing Correlation

Number of Weeks	Spacing Category	Description
0 – 16	A	Beginning and advanced courses were taken within the same semester.
17 – 32	B	One semester between beginning and advanced courses.
33 - 48	C	Two semesters between beginning and advanced courses.

The pretest and posttest in the beginning word processing course aligned with *Microsoft Office Specialist 2003 Word Expert* competencies and tested only beginning skills and concepts. The courses posttest and pretest were developed and administered using SAM. The researcher found six questions that were common to the cohort's beginning word processing course posttest and the pretest from the cohort's advanced word processing course. For the purpose of this study, the retention pretest and posttest referenced the six questions that are the same from the beginning course posttest and the advanced course pretest. Retention pretest and posttest questions included tasks covering a variety of beginning skill sets and tasks (see Table 8).

After analyzing the data in preparation to answer research question 2, it was found that 23 of the 47 student cohort group took both the beginning and advanced course. The balance of the cohort students did not take the beginning word processing course. In some instances, the advanced cohort course prerequisite had been waived and advanced placement had been given. There were several reasons for advanced placement: (a) students transferred into the university meeting the prerequisite through previous university coursework, (b) students transferred high school Technology Preparation credits into the university which met the prerequisite, or (c) students had taken coursework prior to the campus-wide implementation of X1 that substituted for the prerequisite. In addition, it was found that two students took a slightly different version of the beginning pre- and posttest which resulted in their removal from the study. The final population for research question 2 was 21 students.

Results

Research Question 1

Research question 1: Was there a difference in student academic performance between block and cohort educational environments?

The cohort group consisted of 47 students and the block group consisted of 40 students. The cohort/block population consisted of University freshmen through senior undergraduate students who attended the university between the 2005-2006 and 2007-2008 academic years and were enrolled in either cohort classes or the block course. The cohort students had a gender breakdown of 60% female and 40% male. The block students had a gender breakdown of 25% female and 75% male. Simple means were conducted on the research question 1 population to provide descriptive and comparative data. Because population means were computed the p-value was not reported and findings were not generalizable. Standard deviations were not reported because posttest scores were negatively skewed thus not normally distributed.

All scores for the cohort and block were recorded and archived in the Thomson Course Technologies SAM database. The researcher accessed the archived SAM data and recorded student performance on each of the 34 questions that were common to the cohort's advanced word processing course and the block word processing courses posttests. Individual common question performance by student is summarized in Appendix D.

Table 12 contains the descriptive and comparative statistics used to evaluate posttest performance in cohort and block courses. The cohort's mean posttest score was

Table 12.

Research Question 1 Descriptive Statistics for Cohort and Block Posttest Performance

		Min.	Max.	Mean
Posttest				
Cohort	47	53%	100%	84%
Block	40	35%	94%	79%

5% higher than the block's posttest mean score. Because the researcher defined experimental importance in research question 1 to be five percent, cohort/block posttest results were considered to be experimentally important. The curriculum change from cohort to block was meant to allow students to focus on one class at a time, thus assuming an improvement in performance. Students actually performed better when they were taking two classes at a time with the word processing course being in a distributed format, thus practical significance was found.

Table 13 contains the descriptive and comparative statistics used to evaluate posttest performance in cohort and block courses by gender. In the cohort format, both female and male students performed about the same on the posttest. Female and male students again performed about the same in the block format. Females performed at about the same level in the cohort and block groups. The only experimentally important finding is the gender breakdown by male. Cohort males performed better than block males by six percent.

Table 13.

Research Question 1 Descriptive Statistics for Cohort and Block Posttest Performance by Gender

	N	Gender %	Min.	Max.	Mean
Cohort					
Female	28	60%	53%	100%	84%
Male	19	40%	62%	97%	85%
Block					
Female	10	25%	62%	94%	81%
Male	30	75%	35%	94%	79%
Female					
Cohort	28	60%	53%	100%	84%
Block	10	25%	62%	94%	81%
Male					
Cohort	19	40%	62%	97%	85%
Block	30	75%	35%	94%	79%

Research Question 2

Research question 2: Did the difference in time between taking an introductory and advanced word processing course have an impact on student academic performance?

The cohort population consisted of University freshmen through senior undergraduate students who attended the university between the 2005-2006 and 2006-

2007 academic years and were enrolled in both cohort classes. After analyzing the data, it was found 23 students took both the beginning and advanced cohort classes. It was further found that two students took a beginning course pretest and posttest that was not identical to the other 21 students. This resulted in a net cohort group of 21 students. Important differences in performance based on gender were not found; therefore, results for gender differences were not reported. Individual retention pre- and posttest performance by student is summarized in Appendix E.

Simple means were computed for the population studied in research question 2 to determine descriptive and comparative statistics. Experimental importance has been defined as any score falling within five percent of the expected value. The researcher defined the expected retention loss to be 0% in category A, 17% retention loss in category B, and 34% retention loss in category C.

Table 14 contains the retention pre- and posttest mean scores and the difference in those mean scores for the cohort model. In the category A retention pretest, students

Table 14.

Means for Spacing Categories.

Category	N	Retention pretest mean	Retention posttest mean	Loss / Gain
A. Beginning course was within one semester of the advanced course.	8	94%	60%	-34%
B. One semester between beginning and advanced courses.	2	75.0%	34%	-41%
C. Two Semesters between beginning and advanced courses.	11	85%	49%	-36%

performed better than did the category B or C students. The category A pretest student mean was 94%, while the category B and C pretest means were 75% and 85% respectively. The category A, B, and C retention posttest means were 60%, 34%, and 49% respectively. Even though category A students performed considerably better than category B or C students on the retention posttest, the net retention loss was approximately similar among all categories.

Students retained less than expected in categories A and B. In category C, students performed about as expected with a retention loss of 36%, slightly more than the anticipated 34%. Bahrick and Phelps (1987) long-term retention findings seemed similar to the retention performance observed in category C, but not in category A or B. As the researcher has defined, and as stated in the literature, retention performance should decrease over time. In this retention study, more than five percent above or below the expected value would be considered not experimentally important. Category A and B students fell more than five percent outside of the norms expected for retention performance, thus resulting in no experimental importance. Category C students were within five percent of the expected norms for retention performance. In this study however, with the limitation of only six questions, it appears the time between taking an introductory and advanced word processing course has very little impact on student academic performance; students on average did not successfully answer one-third of the questions irregardless of the time between tests. Overall, these findings may simply be an anomaly due to the limited number of participants studied.

Chapter Summary

The results of the data collected were presented in Chapter 4 with accompanying analysis. In research question 1, simple means were computed. The *p*-value was not reported and findings were not generalizable. Experimental importance at the five percent level was found between the cohort and block groups. Practical significance was also found between cohort and block groups.

When analyzing the data in research question 2, the researcher discovered that only 23 of the original 47 cohort students took both cohort courses. When analyzing the retention pretest and posttest performance, it was discovered two of the 23 students had taken a slightly different version of the retention pre- and posttest and required their removal from the study.

In research question 2, simple means were computed to determine if spacing, the time between beginning and advanced cohort courses, impacted student academic performance on the six question retention pre- and posttest. Experimental importance was found for those students who took the second course in the cohort between 33 and 48 weeks.

Chapter Five presents an analysis of the results of the study highlighted in this chapter, provides a summary of the study, and presents the specific findings associated with each research question. Chapter Five also presents recommendations for further study and practice.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study was conducted to explore the relationships between scheduling format–cohort and block–and student academic performance as measured by posttest questions. This study also explored retention performance based upon the time between beginning and advanced cohort word processing courses. Chapter Five provides a summary of findings from the study and conclusions and recommendations for further study and practice.

Summary of the Study

A small rural undergraduate campus in the western United States has embarked upon a pedagogical journey refocusing learning and dedicating itself to immersion and experiential learning within a block scheduling model that the university has labeled *Experience One* (X1). This study began to investigate whether the Experience One learning model provided an environment for improved student academic performance in skills-based word processing courses delivered through a massed block approach as compared to a distributed cohort approach by describing the results of student's posttest performance in each learning environment.

A review of the literature presents a brief historical, pedagogical background of education in the United States over the last three centuries. Early education in America had been traditionally lecture-based until educational innovators such as Wright

(Privitello, 2005) and Dewey (Dewey, 1897) started experimenting with and advocating a more experiential approach to education.

Experimenting with scheduling formats peaked in the 1960s and 1970s as many high schools (O'Neil, 1995) and one university developed and adopted block scheduling models. The premise behind the adoption of block scheduling in junior and senior high schools in the 1970s was that educators believed the block offered more flexible class scheduling allowing for improved lectures, small group study, labs, and individual help sessions (O'Neil, 1995). The 1970s block scheduling model ultimately failed. The 1990s showed a renewed interest in the block scheduling model with the junior and senior high schools that implemented the 4X4 block model remaining successful.

The block model was initially developed in 1970 and adopted at the university level by Colorado College (Colorado College, 2007a). Since that time, only a handful of universities, primarily private, have adopted the block scheduling format. The university studied is the only public university to have adopted the block scheduling model. A pilot project was conducted to determine if a conversion to the block scheduling model would be beneficial to the university. Over a 3-year pilot project, Krank (2005) collected data comparing pilot project students to traditional freshmen. The following common themes were found:

- Grades were usually equivalent between pilot and traditional delivery formats.
- Student evaluations of professor's performance were about the same.
- Pilot retention rates were higher than traditional peer's retention rates.
- Pilot dropout rates were less than the historic dropout rates.
- Pilot students scored higher on assessments of academic self-concept.

Research focusing on retention performance was important in this study. There is an abundance of short-term retention performance research available but the free recall retention timeframe is consistently not more than 15 minutes in any of the literature. There are only a small number of long-term retention performance studies in the literature primarily conducted by Bahrick (1979) over the last three decades (cf. Bahrick, Bahrick, Bahrick, & Bahrick, 1993; Bahrick & Hall, 2005; Bahrick & Phelps, 1987; Donovan & Radosevich, 1999). Individuals seem to retain more information if instruction is spaced over several days or longer rather than learned in a massed practice model. In a massed practice environment, individuals do not have time to encode information in ways that enable them to learn according to their preferred style. Bahrick and Hall (2005) found students learning in a massed practice environment tended to use repetition as their primary mediator, where as, when learning in a more widely spaced timeframe, a student can learn which mediators–repetition, verbal, or visual elaboration–work best to retain specific information.

Summary of the Findings

Research Question 1

Was there a difference in student academic performance between block and cohort educational environments?

Yes, experimental importance at the five percent level was found between cohort and block group students. Cohort students outperformed block students on the posttest by five percent. Practical significance was also found between the cohort and block students. The curriculum change from cohort to block was meant to allow students to focus on one class at a time, thus assuming an improvement in performance. Students actually performed better when they were taking two classes at a time with the word processing course being in a distributed format.

Research Question 2

Did the difference in time between taking an introductory and advanced word processing course have an impact on student academic performance?

Maybe. Those students who delayed taking the second course of the word processing pair of courses for at least 32-48 weeks retained content knowledge as expected, while those taking the second course immediately after the first or within less than 32 weeks retained basically the same information as those who delayed at least 32-48 weeks. Further study is necessary.

Conclusions

This study provided an initial examination of the relationship between scheduling format–cohort and block–and student academic performance as measured by a common posttest. This study also explored retention performance based upon the time between beginning and advanced cohort word processing courses.

Research Question 1 Conclusions

Research question 1 investigated student academic performance based upon scheduling format–cohort and block. The cohort model used a distributed practice approach where skills were learned and reinforced over time. The block model used a massed practice approach where skills were learned daily within a course timeframe of 18 consecutive instructional days. The majority of the previous research shows that performance improves when practice is distributed rather than massed (Bahrick, Bahrick, Bahrick, & Bahrick, 1993; Bahrick & Hall, 2005; Bahrick & Phelps, 1987; Glenberg, 1977; Zechmeister & Shaughnessy, 1980). Son (2004) found numerous authors referencing numerous studies that spacing leads to higher performance than does massing, particularly under conditions in which the delay between study and test is long rather than short. Glenberg (1977) found that items given massed presentations are recalled less often than items whose presentations are distributed.

The conclusion that can be drawn is that the distributed practice approach seems to be more conducive to student academic performance than the massed practice approach. In this study, students in a distributed environment had a longer timeframe to learn concepts and skills resulting in better performance as compared to students in a massed environment where the timeframe was compressed.

Performance by gender was analyzed to determine if females or males performed better in one format or the other–cohort or block–thereby affecting overall results. Table 13 shows that posttest performance based on gender was about the same in almost every category. In the cohort group, female and male students performed about the same at 84% and 85% respectively. Even though there was a wide gender disparity in the block group between female (25%) and male (75%) students, both genders performed about the same on the posttest at 81% and 79% respectively. Female students in both the cohort and block groups performed at about the same level at 84% and 81% respectively. The only experimentally important difference was between cohort and block male students. The mean score for cohort males was 85%. For block males the mean score was 79%. Although cohort males outperformed block males overall, there was little difference between male and female mean scores on the cohort and block posttest. The conclusion drawn from this data is that it appears gender had minimal impact on performance between the cohort and block groups.

In the cohort/block analysis, it appears the distributed practice model is more conducive to student learning than the massed practice model. Gender played only a minimal role in performance on the cohort and block posttest. Additional studies should be performed comparing performance between distributed and massed practice learning models.

Research Question 2 Conclusions

Research question 2 asked, *did the difference in time between taking an introductory and advanced word processing course have an impact on student academic performance?* Students tended to forget about the same amount whether they took the beginning and advanced cohort courses within the first 16 weeks (category A) or 32 to 48 weeks later (category C). Very interestingly, students retained far less than expected in categories A and B. Students performed about as expected in category C (see Table 15). In this study, it can be concluded that the time between taking an introductory and advanced word processing course has some impact on student academic performance. Retention performance studies by Bahrick (1979) and Bahrick and Phelps (1987) show an increasing decline in retention as the time after the final lesson of the study increases. In this study, students retained about the same amount whether the timeframe was short or long between cohort courses. Those students who delayed taking the second course of the cohort for at least 32-48 weeks retained content knowledge as expected, while those taking the second course immediately after the first or within less than 32 weeks retained basically the same information as those who delayed at least 32-48 weeks.

Implications

Overall, the results of this study have implications for educational researchers and practitioners interested in learning more about student academic performance in distributed practice and massed practice experientially based learning environments. This study produced a variety of findings and provides insight into the issues faced by the university in its adoption of *Experience One*.

Results and implications of this study include:

- The performance of cohort students was five percent higher than block students. Those students learning in a massed practice environment performed at a level five percent less than those students learning in a distributed practice environment.
- It is important to identify which factors, if any, beyond scheduling format, contributed to the performance in the cohort group.
- Part of the philosophy behind block-scheduling is that students can direct all of their energies into one class at one time. Students in the cohort format were taking at least two classes at the same time yet outperformed the block students. Cohort students may have had word processing skills reinforced in the other course they were taking which may have resulted in higher posttest performance. Perhaps if instructors in block courses used learning strategies such as combining complimenting courses, e.g., Business Communications and Word Processing, and applied practical experiential learning content block students may have performed better on the posttest. A well-designed

inter-disciplinary unit may improve overall word processing performance and retention in the block format.

- The research was mostly inconclusive regarding spacing. Several shortcomings should be addressed in future research. One, a large enough sample is required such that when investigating time in-between, each subcategory has a minimum of 30 participants. Two, a survey of students to learn what possible use of word processing they made in the time between cohort classes.

Limitations of the Research

The discussion of limitations surrounding massed versus distributed practice is complex. Due to the limitations of the implementation of the research, additional studies are needed. This research will add to the body of professional knowledge about massed, distributed, and spaced practice and their effect on performance and performance retention. This study provides some insight into how the educational community might use this knowledge to create academic strategies and opportunities that improve student academic performance.

The reader should consider the following limitations. First, the study was limited to university freshmen through senior students who attended the university between the 2005-2006 and 2007-2008 academic years. The first part of this study concentrated on those students who self-selected into one of the cohort's word processing courses or the block word processing course and focused on student academic performance on the posttest. The second part of this study concentrated on those students who self-selected into the cohort's beginning and advanced word processing courses and focused on student retention performance.

Krank (2005) found that student grade point average (GPA) is an indicator of academic success. Statistics gathered from the Fund for the Improvement of Postsecondary Education (FIPSE) project found the majority of the university's students were under prepared for college level work resulting in a probable lower GPA. Because the majority of the university's students were under prepared for college level work, they may not have synthesized knowledge and skills resulting in academic underachievement regardless of cohort or block format.

Each section of the cohort's beginning and advanced courses and the block course did not have the same instructor. As a result, teaching methodologies may have been different in each course resulting in inconsistencies between studied courses. A student's academic load has an impact on performance in each course. The cohort was designed to be taught in parallel with other courses. That other course may have been a very difficult core course requiring a great deal of time and effort to complete which may have resulted in poor performance in one or both courses. If the other course was easy the student may have performed well in both courses. The block was designed so that students would only take one course at a time reducing overall academic load and allowing students to focus on one specific course.

Although limited literature was found regarding distributed, spaced or massed practice, findings from several relevant studies were reported. Similar studies were not found when researching universities that use the block format. Gall, Gall, and Borg (2003) suggest, "there should be at least 15 participants in each group compared" (p.

176), but the general rule of thumb states a sample should contain 30 participants. A severe limitation of this study was the relatively few students enrolled in the courses researched in research question 2. The population size decreased after it was discovered that less than one-half of the original group actually took both beginning and advanced cohort courses. This discovery led to very small spacing categories that ranged from two to 11 students.

The findings of this study were limited to and based upon an examination of student data accessed through Course Technologies Student Assessment Manager (SAM). Only existing data was accessed in this *ex post facto* study. Cohort students were not surveyed regarding the amount of practice/experience devoted to using *Microsoft Word 2003* in the time between administration of the retention pre and post tests.

There was a discrepancy in the credit hours between the cohort and block formats, however, this was addressed. The cohort totaled two credits while the block-based course totaled four credits resulting in a two credit differential in credit hours. Even though students in the block format had more in-class time to synthesize word processing knowledge and skills, the cohort group out-performed the block group by five percent. Initially considered a potential limitation to this study, the credit disparity between cohort and block courses did not result in a limitation to this study.

Recommendations for Further Study

Additional research is needed in massed (block) and distributed practice learning models in order to determine which model is most beneficial to student academic performance. A new study should be conducted including students from a variety of colleges that have implemented similar scheduling formats. Although there have been a few distributed versus massed studies that have researched performance and long-term retention performance, those studies typically have had a foreign language emphasis, not a technology skills focus. Examining the relationship and role scheduling formats and pedagogical philosophies play in performance and retention as measured through a pre- and posttest experimental design will assist the university, both faculty/administration and students, in developing curriculum that is most beneficial to student success. Findings should be made available to the university, to other universities researching the block-scheduling model for possible adoption, and to students interested in attending a university with a block-scheduling model.

It would be important to analyze, if possible, additional influences and determine what role they played on student academic performance in both scheduling formats. Several additional studies should be undertaken to identify and better understand (a) which format did students retain more information in and for how long, and (b) the impact of parallel reinforcement.

Format and Retention

Long-term retention of skills beyond the end of the class should be investigated. Participants from each format could be identified and retested at one, three, and five-year intervals. Some participants may be using word processing extensively either at school or work while others may not have had additional reinforcement. Participants could be surveyed and categorized according to their word processing skills and then evaluated against peer categories.

Parallel Reinforcement

A study to teach a word processing course in parallel with a complimentary block course (e.g., Business Communications) using a pretest/posttest assessment of word processing skills should be developed. A comparison of the results from this cohort of courses to a block word processing course would demonstrate in a more controlled environment differences in learning formats. Curriculum could be developed where word processing skills would be taught in parallel with, for instance, a business communications course. In this example, various performance measures in the block course could be compared to those same performance measures from the word component of the newly designed curriculum.

Summary

This chapter presented a summary of the following: the purpose and methods of the study, findings, implications and limitations, and recommendations for future research. The study revealed that students in a distributed practice format out-performed students in a massed practice format. In addition, this study found that regardless of the spacing or time between cohort classes–zero to 16 weeks, 17 to 32 weeks, or 33 to 48 weeks–students retained about the same amount. This study established preliminary findings that may assist researchers and practitioners in addressing future questions regarding the relationship between course scheduling format and student academic performance.

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Appendix A

MOS Competency Outline

Appendix A

MOS Competency Outline

Competency Category	Competency	COMS 102	COMS Cohort	COMS Block
W2003.0 Get Started with Word				
	Start Word			
	Open a document			
	Open a new document window			
	Use Word Help			
	Close a document and exit Word			
	Use the Smart Tag action button			
W2003.1 Insert and Modify Text				
	Insert text			
	Cut and paste text			
	Copy and paste text			
	Use Paste Special			
	Move text			
	Find and replace text			
	Use AutoCorrect			
	Insert symbols			
	Using Word Wrap			
	Click and Type			
	Autoformat text as you type			
	Display formatting marks			
	Move to a specific location in a document			
	Select text			
	Use Undo and Redo buttons			
	Insert a symbol automatically			
	Use the Paste Options button			
	Collect and paste using the clipboard task pane			
	Insert a date with AutoComplete			
	Create an AutoText entry		X	
	Zoom page width			
	Insert hidden text			
	Use Reading layout and other views			
	Adjust line spacing			
	Change font size			
	Change font			
	Italicize text			
	Check spelling			
	Use the Thesaurus			
	Check grammar			
	Apply the superscript font effect			
	Highlight text	X		
	Bold text			

	Use Format Painter			
	Insert a date			
	Insert a date field			
	Apply a character style			
	Create a watermark			X
	Check Spelling and Grammar as You Type			
	Select a line			
	Underline a word			
	Delete selected text from document			
	Count words			
	Recount words			
	Select nonadjacent text			
	Change color of text			
	Insert an AutoText entry	X		
	Cut text			
W2003.2 Create and Modify Paragraphs				
	Apply a paragraph border	X		
	Apply shading to paragraphs	X		
	Indent paragraphs			
	Center a paragraph			
	Add a page border			
	Set Decimal tabs			
	Modify tabs			
	Add bullets	X		
	Add numbering	X		
	Create an outline	X		
	Hyphenate a document			
	Apply paragraph styles			
	Right-align a paragraph			
	First-line indent paragraph			
	Create a hanging indent			
	Apply a paragraph border different from the default	X		
	Justify a paragraph			
W2003.3 Format Documents				
	Create a document header	X		
	Modify a document footer	X		
	Apply columns	X		
	Modify text alignment in columns	X		
	Revise column layout			
	Insert page breaks		X	X
	Insert page numbers			
	Modify page margins			
	Change the page orientation			

	Create tables	X		
	Apply AutoFormats to tables	X		
	Modify table borders	X		
	Insert rows in a table	X		X
	Delete table columns	X		
	Modify cell formats	X		X
	Enter data into a Word table	X		
	Sort table data	X	X	X
	Use print preview			
	Print documents			
	Print envelopes	X		
	Print labels	X		
	Print using Reading Mode			
	Create document background colors and fill effects		X	
	Modify document background colors and fill effects		X	
	Print a draft			
	Switch from insert to overtype mode			
	Apply formatting using shortcut keys			
	Use the Research task pane	X		
	Zoom text width			
	Clear formatting			
	Insert a next page section break		X	X
	Insert Word document into open document			
	Delete a page break		X	X
	Create a header different from previous section header	X	X	
	Change page number format			
	Rotate text in a table cell		X	
	Insert a drawing canvas			
	Edit a date field			
	Insert an If field			
	Format a letter as a drop cap			
	Insert a column break	X		
	Split the window			
	Turn off the drawing grid			
	Hide white space			
	Arrange all open Word documents on the screen			
W2003.4 Manage Documents				
	Create folders for document storage			
	Rename folders			
	Create a document from a template	X		X
	Save a document			
	Use Save As			
	Modify workgroup template location			

W2003.5 Work with Graphics				
	Insert Clip Art			
	Resize a graphic	X		
	Create a text box			
	Create WordArt			
	Create charts			X
	Modify charts			
	Create diagrams	X		
	Modify diagrams	X		
	Add picture bullets to a list			
	Insert a symbol			
	Flip a graphic			X
W2003.6 Workgroup Collaboration				
	Compare and merge documents	X	X	
	Insert comments	X		
	Delete comments	X		
	Preview documents as web pages			
	Save documents as web pages			X
	Switch from one open Word document to another			
	View HTML source associated with a Web page			
	Edit a comment	X		
	Change reviewer information		X	X
	Print an outline			
W2003e.1 Customizing Paragraphs				
	Control Pagination		X	X
	Set line breaks			
	Modify default font		X	
	Customize document properties		X	X
W2003e.2 Formatting Documents				
	Format Sections			
	Verify paragraph formats			
	Clear formats			
	Use Page Setup options to format sections			
	Change character styles			
	Create paragraph styles			
	Change paragraph styles			

	Mark an index entry		X	X
	Insert a table of contents		X	X
	Insert a table of figures		X	X
	Update an index		X	X
	Build an index		X	X
	Insert cross references		X	X
	Create footnotes		X	X
	Format footnotes		X	X
	Edit footnotes		X	X
	Create master documents with three or more subdocuments		X	X
	Use bookmarks		X	X
	Use Document Map for document navigation			X
	Review and modify document summary			
	Summarize relevant content using automated tools (e.g. AutoSummarize)		X	
	Analyzing content readability using automated tools (e.g. Readability Statistics)			
	Save a form as a template		X	
	Insert a text form field		X	X
	Insert a Checkbox		X	X
	Protect forms		X	X
	Specify text form field options			
	Insert a drop-down form field			X
	Specify drop-down form field options			
	Add help text to form fields		X	
	Change line color of drawing object			
	Add a shadow to a drawing object			
	Add a 3-D effect to a drawing object			
	Adding a caption to a figure		X	X
	Apply a password to a document			X
	Create alternating headers			
	Go to a bookmark		X	
	Set a gutter margin			
	Open a master document			

W2003e.3 Customizing Tables				
	Use object linking to display Excel worksheet data as a Word table			
	Use object linking to display Excel worksheet data as a worksheet object			
	Modify table formats by merging table cells		X	X
	Advanced Text Wrapping using Tables			
	Insert frames			X
	Modify frames			X
W2003e.4 Creating and Modifying Graphics				
	Insert graphics in documents	X		
	Modify graphics	X		X
	Crop and rotate graphics		X	
	Control image contrast and brightness		X	X
	Create and revise charts using Excel or Access data		X	
	Use advanced text wrapping			X
	Use advanced layout options with graphics			
W2003e.5 Customizing Word				
	Create a macro		X	X
	Edit a macro using the Visual Basic Editor		X	X
	Run a macro		X	X
	Remove buttons from a toolbar		X	X
	Rename a macro		X	X
W2003e.6 Workgroup Collaboration				
	Track changes	X	X	X
	Review changes by type	X		
	Respond to proposed changes	X	X	
	Use new tracking features	X		
	Insert hyperlinks	X	X	
	Modify hyperlinks			
	E-mail Word documents			
	Convert a hyperlink to regular text			
	Display the Web page associated with a hyperlink			
	Create a new Web page using a Blank Template			

	Format a Web page with themes		X	X
	Display your Web pages in a browser			
	Open web pages in Word			
	Create versions of documents		X	X
	Set document protection			X
	Protect documents and give permissions			
	Collaborate with others			
	Convert documents to different formats for transportability			
	Use digital signatures to authenticate documents		X	X
	Link and embed an object in a document			
	Send an outline to PowerPoint			
	Unprotect a document			
W2003e.7 Using Mail Merge				
	Complete an entire mail merge process for form letters		X	X
	Use a Template to Create a Mail Merge Letter			
	Complete an entire mail merge process for mailing labels		X	X
	Complete a mail merge using Outlook information as the data source			

Appendix B

SAM Certification Statement

Appendix B

SAM Certification Statement

THOMSON COURSE TECHNOLOGY™

Certification Statement

Access 2003 Statistics

- Review ID 7462, Completed May 27, 2004
- 100% of Expert & Specialist exam objectives met in SAM 2003 Assessment & Training
- This course provides you with an accurate table of contents, task overviews to help you understand the purpose and relevance of the task, and it gives you a step-by-step, simple-to-more complex approach to the performance exercises. The exam objectives correlate very nicely to the task titles.

Excel 2003 Statistics

- Review ID 7460, Completed July 13, 2004
- 100% of Expert & Specialist exam objectives met in SAM 2003 Assessment & Training
- This course provides a flexible, convenient, online preparation so learners can successfully complete the Microsoft Excel Expert 2003 exam. The number of quality exercises available in each module is wonderful.

Word 2003 Statistics

- Review ID 7457, Completed July 13, 2004
- 98% of Expert & Specialist exam objectives met in SAM 2003 Assessment & Training
- This course is performance exercise intensive, giving learners many useful opportunities to prepare for the exam. This course provides learners with a vast number of practice opportunities in *Microsoft Word* 2003 to help learn the skills be become properly certified.

PowerPoint 2003 Statistics

Review ID 7461, Completed May 10, 2004
83% of Expert exam objectives met in SAM 2003 Assessment & Training
This course provides a flexible, convenient, online preparation so learners can successfully complete the Microsoft PowerPoint 2003 exam. The table of contents and task overviews help learners understand the purpose and relevance of the task and it gives

breath of simple-to-complex variety in the performance exercises. The exam objectives correlate very nicely to the task titles.

About Course Technology

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About ProCert Labs

ProCert Labs provides objective and reliable courseware product testing against published exam objectives and instructional design criteria. A passing mark from ProCert Labs assures customers that the course will help them achieve professional certification in an effective manner. Products which achieve 85% or more of the MOS (Microsoft Office Specialist) exam criteria will be able to use both the ProCert Labs Tested logo as well as the Microsoft Office Specialist Approved Courseware logo, under Microsoft's strict guidelines.

Appendix C

Cohort/Block Pre- and Posttest Question Correlation

Appendix C

Cohort/Block Pre- and Posttest Question Correlation

Cohort (102 & 232) / Block (260)
Question Correlation Chart

Analyzed Research Question	Cohort's Beginning Word Processing Course (COMS 102) Reference Number	Cohort's Advanced Word Processing Course (COMS 232) Reference Number	Block Word Processing Course (COMS 260) Reference Number
C-1		232-2	260-2
C-2	102-20	232-3	260-5
C-3		232-6	260-6
C-4		232-7	260-7
C-5	102-24	232-8	
C-6	102-30	232-10	
C-7		232-11	260-12
C-8		232-12	260-13
C-9		232-14	260-14
C-10		232-15	260-15
C-11		232-16	260-16
C-12		232-17	260-17
C-13		232-18	260-18
C-14		232-19	260-19
C-15		232-20	260-20
C-16		232-21	260-21
C-17		232-22	260-22
C-18		232-23	260-23
C-19		232-25	260-25
C-20		232-28	260-27
C-21		232-29	260-28
C-22		232-30	260-29
C-23		232-32	260-31
C-24		232-34	260-33
C-25		232-36	260-37
C-26		232-38	260-39
C-27		232-39	260-40
C-28		232-40	260-41
C-29		232-41	260-42
C-30		232-42	260-43
C-31	102-36	232-43	260-44
C-32	102-38	232-44	
C-33	102-40	232-45	
C-34		232-46	260-45
C-35		232-47	260-46
C-36		232-48	260-48
C-37		232-49	260-49
C-38		232-50	260-50

Appendix D

Research Question 1 Cohort and Block Posttest Data

Appendix D

Research Question 1 Cohort and Block Posttest Data

Cohort		Block		Cohort		Block	
Student	Posttest	Student	Posttest	Student	Posttest	Student	Posttest
S01	67.65%	S55	67.65%	S30	88.24%	S85	61.76%
S02	91.18%	S56	85.29%	S31	94.12%	S86	79.41%
S03	85.29%	S57	73.53%	S32	85.29%	S87	91.18%
S04	70.59%	S58	94.12%	S33	97.06%	S88	76.47%
S05	70.59%	S59	94.12%	S34	85.29%	S89	82.35%
S06	52.94%	S60	85.29%	S35	97.06%	S90	88.24%
S07	91.18%	S61	85.29%	S36	88.24%	S91	73.53%
S08	79.41%	S62	61.76%	S37	97.06%	S92	73.53%
S09	70.59%	S63	94.12%	S38	88.24%	S93	61.76%
S10	88.24%	S64	79.41%	S39	88.24%	S94	88.24%
S11	82.35%	S65	88.24%	S40	61.76%	S95	88.24%
S12	94.12%	S66	85.29%	S41	94.12%		
S13	70.59%	S67	76.47%	S42	97.06%		
S14	76.47%	S68	82.35%	S43	64.71%		
S15	94.12%	S70	82.35%	S44	76.47%		
S16	94.12%	S71	76.47%	S45	76.47%		
S17	91.18%	S72	82.35%	S46	82.35%		
S18	94.12%	S73	82.35%	S47	64.71%		
S19	73.53%	S74	82.35%				
S20	85.29%	S75	35.29%				
S21	97.06%	S76	64.71%				
S22	64.71%	S77	94.12%				
S23	79.41%	S78	76.47%				
S24	85.29%	S79	85.29%				
S25	100.00%	S80	73.53%				
S26	82.35%	S81	82.35%				
S27	94.12%	S82	76.47%				
S28	97.06%	S83	73.53%				
S29	94.12%	S84	82.35%				

Appendix E

Research Question 2 Retention Pre- and Posttest Data

Appendix E

Research Question 2 Retention Pre- and Posttest Data

Student Number	Gender	Beg. Course posttest	Adv. Course pretest	Blocks apart	Difference	# of Weeks
Category A – 0 to 16 weeks						
S01	M	100%	17%	0	83%	0
S25	F	100%	83%	0	17%	0
S44	F	100%	83%	1	17%	4
S47	M	67%	50%	2	17%	8
S28	F	100%	83%	3	17%	12
S33	M	100%	50%	3	50%	12
S35	M	83%	17%	3	67%	12
S37	F	100%	100%	3	0%	12
Category B – 17 to 32 weeks						
S26	F	50%	50%	5	0%	20
S11	F	100%	17%	7	83%	28
Category C – 33 to 44 weeks						
S08	F	100%	50%	8	50%	32
S09	F	67%	67%	8	0%	32
S17	F	100%	67%	8	33%	32
S21	F	100%	67%	8	33%	32
S22	F	67%	33%	8	33%	32
S23	M	83%	67%	8	17%	32
S32	F	100%	50%	10	50%	40
S36	M	67%	67%	10	0%	40
S40	M	100%	33%	10	67%	40
S43	F	67%	0%	10	67%	40
S46	M	83%	33%	10	50%	40