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Evaluating the Spacing Effect Theory on the Instructional Effectiveness of Semester-Length versus Quarter-Length Introductory Computer Literacy Courses in Institutions of Higher Learning

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Evaluating the Spacing Effect Theory on the Instructional
Effectiveness of Semester Versus Quarter-Length
Introductory Computer Literacy Courses in
Institutions of Higher Learning

by
Emelda S. Ntinglet

An Applied Dissertation Submitted to the
Abraham S. Fischler School of Education
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Education

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Approval

This applied dissertation was submitted by Emelda S. Ntinglet under the direction of the persons listed below. It was submitted to the Abraham S. Fischler School of Education and Human Services and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Nova Southeastern University.

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I have read the Code of Student Conduct and Academic Responsibility as described in the *Student Handbook* of Nova Southeastern University. This applied dissertation represents my original work, except where I have acknowledged the ideas, words, or material of other authors.

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Abstract

Evaluating the Spacing Effect Theory on the Instructional Effectiveness of Semester-Length Versus Quarter-Length Introductory Computer Literacy Courses in Institutions of Higher Learning. Emelda S. Ntinglet 2013: Applied Dissertation, Nova Southeastern University, Abraham S. Fischler School of Education and Human Services. ERIC Descriptors: Community Colleges, Spacing Effect, Retention, Scheduling, Higher Education, Instructional Effectiveness, Quarter System, Semester System

This mixed research study evaluated the spacing effect theory on the academic performances of students enrolled in introductory level Computer Literacy courses by comparing course grades and mock IC3 certification exam scores in semester-length and quarter-length courses at Prince Georges Community College. The study was ingrained on the spacing effect theory which posits that mammals will tend to recall material learned over time (spaced presentation) than material concepts learned over shorter periods (massed presentation).

A *t* test analysis revealed that students in the quarter-length formats had significantly higher grades than those in the semester format but the analysis presented no significant difference on their mock IC3 scores. A Pearson correlation conducted also revealed no significant relationship among students' course grades and their mock IC3 scores overall or by format (semester vs. intensive).

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Chapter 1: Introduction

In a turbulent economy with skyrocketing demand of basic computer skills in average to upper job levels, institutions of higher learning are utilizing flexible pedagogical approaches to disseminate educational content to students in quest of these skills. The two formats universally adopted by most institutions are the semester-length (spaced presentation) and quarter-length (mass presentation) formats. These teaching formats are adopted based on student demand for flexible course schedules.

Chapter 1 begins with a review of the problem statement, background of the problem and the significance of the study to education. Chapter 1 also includes the purpose of the dissertation research, the research questions, and a discussion of the theoretical framework. The chapter concludes with a discussion of important definitions, research assumptions (hypothesis), scope of the study, limitations and delimitations of the topic.

This study expanded upon the spacing effect theory. The study evaluated the effectiveness of both teaching formats through the use of course grades and mock IC3 Certification scores earned by students after completing a semester- versus a quarter-length Computer Literacy course.

A benchmark to determining a student's level of

understanding of instructional material is through their course grade. Seamon (2004) contended that "one of the biggest stumbling blocks to validity is the use of course grades as an indicator of the difference in the students' understanding and retention of instructional material between intensive and semester-length classes" (p. 8). Institutions of higher learning utilize course grades as a medium of assessment and evaluation of student understanding and retention of instructional material.

Comparing the grades of a quarter-length course with those of a semester-length course may not be an appropriate medium for comparing instructional effectiveness of the two formats. Thus, Seamon (2004) presented two scenarios. In one scenario, a student earned an 'A' grade in a semester-length course after the instructor's assessment based on the teaching strategies specifically designed for this format. In the second scenario, another student earned the same grade from a quarter-length similar course measured by guidelines tailored specifically for quarter-length academic environment. Based on these results, Seamon believed it was unjustified to speculate that both grades were a representation of similar levels of learning and retention.

Similar outcomes from both learning formats do not

necessarily mean equal levels of retention in the short and long term. With Seamon's assertion, further empirical studies are needed to corroborate the impact of dissimilar course formats within the contextual framework of the spacing phenomena.

According to Williams (2002), course grades were used as a benchmark for comparing instructional effectiveness of a 2002 study. The study compared intensive weekend and summer five-week courses with regular semester-length classes. In that study, data was collected over a period of three years from a total of 543 graduate students. Collected data was primarily student test scores. The outcome of that study indicated higher student scores and better grades for intensive courses.

Statement of the Problem

Anecdotal reports of continuous disparity in student grades after completing a quarter-length versus semester-length computer course aroused heightened interest levels amidst faculty and administrators regarding the teaching modalities employed in both formats. The fundamental problem and a basis to this study is that the quarter-length students were outperforming their semester-length counterparts after completing the same course at Prince Georges Community College.

Course formats based on length of instruction.

Institutions of higher learning use multiple course presentation formats to meet the needs of students coming from different backgrounds, and with diverse learning goals and timelines. Prince George's Community College provides non-credit refresher and college credit level courses to a diverse population of students ranging from ages 19 through 70. A majority of the student population were employed, thereby embracing the luxury of the flexibility in the training formats (intensive and semester length) the institution offers. Course lengths range from as short as one day refresher course sessions to 15-week long semesters sessions.

The research problem. Instructors and institutional administrators have a heightened interest in understanding whether course length has a direct relationship with course grades at the College. This concern had been elicited by higher student performances for intersession and summer (quarter-length) Computer Literacy (CIS 1010) courses as compared to grades for similar courses taken during semester-length 15-week session.

According to anecdotal Academic School Records (2010 - 2011), there had been recurring questioning by faculty, students and institutional administrators regarding the

academic quality and effectiveness of short term intensive computer courses versus the semester-length computer courses. The fundamental concern is whether or not instructors are applying similar teaching modalities (assessment, grading rubric, completing course objectives) in teaching quarter-length versus semester length courses.

Accredited institutions of higher learning use course grades as opposed to professional certification test scores in determining instructional effectiveness of quarter-length and semester-length courses. The researcher hypothesized in this study that those students who enroll in, and pass traditional semester-length courses will score higher on professional certification exams than students in the shorter, intensive course formats.

Background and justification. A major difficulty in validating past literature on intensive versus semester length formats according to Seamon (2004), is the use of students grades in measuring the difference in instructional effectiveness between both formats. Seamon (2004) contended that the use of course grades as a mode of comparison was merely because of convenience, since it is fairly easy to obtain student grades. A lack of consideration of other factors is gross oversight of potentially significant data relevant for the study.

However, comparing the grades of an intensive course with those of a traditional semester-format course may not be a valid method for comparing the instructional effectiveness of the two formats.

Seamon (2004) used the following analogy to highlight a concern: suppose a student in a semester-length course earned an "A" grade as measured by grading systems and instructional techniques tailored for a traditional-format course. Another student in a quarter-length course also earned an "A" grade as measured by guidelines explicitly tailored to fit the intensive academic environment. Seamon questioned if it is justified to conclude that the two similar grades earned from both academic formats represent similar levels of learning. Seamon's observations suggested the need for further study to determine if the similarity in course grade results could be corroborated by similar levels of comprehension and retention as measured by other assessment tools.

This study builds upon Seamon's suggestion and used mock certification scores as another assessment measure in comparing the comprehension and retention of knowledge by students completing semester and quarter-length course formats. The results are presented in Chapter 4 and a discussion of the findings are discussed in Chapter 5.

According to Williams (2002), several studies have used course grades as a benchmark for evaluating and comparing instructional effectiveness of the two formats. A study at Indiana University used course grades to compare matched pairs of 11 intensive and traditional-length courses. In that study, students who took intensive courses earned superior grades in three cases, while the traditional course grades were better in only one case (Richey, Sinks, & Chase, 2005).

Another instance of comparison based on course grades occurred in a study at Glassboro State College, where an intensive, 12-day computer-science course was judged to be superior to a 6-week version using the same instructional goals and objectives, materials, and assessment techniques (Masat, 1982). However, the grading philosophies of the instructor were unknown. The instructor may have been grading on a curve or using another method that varied between the two formats.

Deficiencies in the evidence. Due to a heightened level of curiosity amidst faculty and institutional administrators regarding higher student scores for quarter length courses than semester length courses, the researcher propounded on this heightened interest as an impetus to investigate the level of instructional effectiveness in

both formats. Data from Anecdotal Academic School records (2010-2011) generated questions regarding the academic quality and effectiveness of short term intensive computer courses versus semester-length computer courses. This research study provided empirical data responsive to the faculty and administrators' questions regarding the impact of course length on student knowledge and retention.

With a wide array of literature in favor of both quarter- and semester-length practices as acceptable presentation formats in institutions of higher learning, there is still a growing need for further research to explore the long-term retention level of students from both formats (Seamon, 2004). Similarly, there is a lack of evidence in the literature supporting the application of uniform teaching modalities (assessment, grading rubric, completing course objectives) in both formats by the faculty. This research study was conducted to uncover these deficiencies and substantively recommended future study in the field of spacing effect theory.

Audience. The target population of this research study was the faculty and institutional leaders of Prince Georges Community College located in Largo, Maryland. Current and future student enrollees in the computer literacy course are direct audiences of the study. Data was collected

voluntarily from these students for analysis.

The faculty teaching the Introduction to Computer Literacy course (CIS 1010) were equally affected considering the fact that participating faculty had to sacrifice time from their teaching schedules to participate in the research survey. The results of this study may benefit institutional leaders in providing documented facts and rationale for determining, redesigning, adopting and maintaining a teaching format (quarter or semester) best suited for the students in the course.

Definition of Terms

In the context of this document, the following terminology was established to facilitate understanding of the research, provide background knowledge and conceptual relationship among key constructs in the study.

Course format. This term refers to the length of time a course is presented to differentiate an intensive (quarter-length) vs. a traditional (semester-length) course.

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

IC3 certification. An Internet and Computing Core

Certification offered by Certiport Solutions, LLC to certify individuals in basic computing and Internet knowledge and skills.

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

Instructional effectiveness. This term refers to a determination reached when students successfully complete course material and are able to retain acquired concepts towards successfully passing certification exams.

Intensive courses. These are accelerated or crash courses taken during non-semester sessions usually ranging from 1 day to 12 weeks, as opposed to traditional 15-16 week courses. In this study, intensive courses encapsulate inter-session, mini-session, quarter and summer session courses.

Massed presentation. Course material presented over shorter periods of time, e.g., quarter-length intensive courses.

Measures of instructional effectiveness. Course Grades and Mock IC3 certification scores.

Quarter-length courses. Compressed courses offered at universities that split the academic year into four

sessions and span over a duration of up to 11 weeks.

Semester-length courses. These are courses completed in 16 weeks generally described as traditional courses.

Spaced presentation. Concepts or material presented over a long period of time such as the traditional 16-week semester.

Spacing effect theory. This theory contends that material presented and learned over different lengths of time will yield different results. Material learned over a long time (spaced presentation) will yield better results compared to same material learned during a short period (mass presentation).

Purpose and Significance of the Study

The purpose of this study was to expand educators' understanding of the spacing effect theory by comparing the effectiveness of university quarter-length computer courses versus full semester-length computer courses. This study was focused on validating whether students' higher performances in a Computer Literacy Course taken at Prince George's Community College during the intensive sessions (intersession, mini or summer session) as anecdotally purported were able to equate their performances on the nationally recognized IC3 mock certification exam or not.

This validation was based on comparing student grades and mock certification scores upon completion of the Computer Literacy Course during a regular semester or quarter session. The course is tailored to provide preparatory information required for IC3 certification exam.

The outcome of this study provided additional empirical data of students' mastery of instructional content taken during either session. Furthermore, the study provided institutional leaders documented facts and rationale for determining, redesigning, adopting and maintaining a teaching format (quarter or semester) best suited for the students taking the course.

In this chapter, the researcher (a) clearly presented that a problem related to course lengths and their impact on course grades and certification exams existed in institutions of higher learning, (b) presented evidence that supported the existence of the problem, (c) provided evidence that there was an existing trend that has led to the problem, (d) defined major concepts and terms centric to this study, (e) clearly described the setting where the study was conducted, (f) enlisted probable causes related to the problem, and (g) presented a feasibility statement supporting the research study.

Chapter 2: Literature Review

Introduction

This chapter ornately covers the following areas: (a) a discussion of the theoretical framework within which the study is grounded; (b) a synthesis of the findings in a "state-of-knowledge" summary relating to the instructional effectiveness of mass versus spaced presentation of a computer literacy course, including additional evidence relating to the nature and importance of the problem; (c) a clear discussion of how further research should extend, differ from, or replicate past studies, including the identification of critical variables in the problem area and important questions to be tested; (d) an indication of shortcomings that should be avoided in the design of future research, as well as strengths to be repeated in conducting another study; and (e) a critique of the literature as a basis for any controversial methodological decisions to be presented in the study.

Theoretical Framework

The framework of this study is centered around the spacing effect theory, a phenomenon that has surfaced over a century ago from experimental research on learning and the recollection of learned concepts. Recent and past researchers on this theory have centered their studies on

the applicability of the spacing effect phenomenon in classroom practices (Dempster, 1988; Rohrer & Pashler, 2007). The theory asserts that humans are more likely to remember learned concepts studied over longer periods of time referred to as (spaced presentation), rather than concepts studied repeatedly in shorter periods (massed presentation). Famous in his experimental study of memory and discovery of the forgetting and learning curves, German psychologist Hermann Ebbinghaus also investigated the spacing effect theory. This theory's assertion, also hypothesized by the researcher in this study, was refuted by recent literature review on intensive versus semester length course formats, some of which contended that students performed better in shorter course formats than semester-length formats (Bohlin & Hunt, 1995).

The spacing effect phenomenon suggests that "cramming" (intense, last-minute studying) is not likely to be as effective as studying at intervals over a much longer span of time. However, the benefit of spaced presentations does not appear at short retention intervals; in other words, at short retention intervals, massed presentations lead to better memory performance than spaced presentations (Weiner, Healy, Freedheim, Proctor, & Schinka, 2003).

Previous studies according to Bohlin and Hunt (1995)

and those oriented around the spacing effect theory tend to offer more support for traditional semester length courses. Many of the early writings on intensive courses favored traditional semester courses and describe intensive studies as inferior. Other studies emphasized the heavy workload and anxiety brought to bear upon students in intensive courses. Doyle and Yantis (2007) reported that, intensive courses compressed so much work into a short time that became relatively unmanageable to the students. In effect, this potentially resulted in lower student performances; an opinion in support of the spacing effect phenomena theorized that massed presentation content is not retained over longer periods.

Review of Past Literature

Researchers Angelo and Cross (2004) contended that the techniques an instructor uses to assess a classroom was geared towards enabling the instructor to know to what extent the students are learning and how well they have understood the material. The techniques mentioned in their book emphasized the objective of observing and improving learning, rather than observing and improving teaching. As students continue to learn, their expectation of a passing grade remained high.

Several research studies supported the idea that

lively, engaging methods are essential for intensive courses and that, when applied, these teaching strategies combined with the intensive format produced a more focused and memorable learning experience (Scott, 2003). Scott further reported that an engaging classroom setting was impracticable in mass presentation course formats where an instructor was faced with the challenge of completing course syllabus in a very short period. Incorporating pedagogies of significance became relatively unwelcoming during these periods as compared to longer classroom periods.

Researchers Homeyer and Brown looked into attitudes of students, their knowledge, and skill development to evaluate the existence of differences in these characteristics in relation to the length of time in taking classes. Their study focused on comparing a mini-semester three-week interim course to both a five- and 15-week semester course. The mini-semester daily contact hours were relatively longer than the contact hours of the longer course sessions. The course was taught by the same instructor, hence suggesting that similar teaching modalities were employed, even though it was not stated. The results presented no significant difference (Homeyer & Brown, 2002).

Scott and Conrad (2001) reported that, there are four areas of time-related inquiry and research that warrant scrutiny in relation to intensive learning: massed versus spaced learning, concentrated study, interference theory, and allocated time and learning (p. 10). Other researchers have focused on learning theories to explain differences between intensive and semester-length courses. In a study of the interaction between time and learning on students' anxiety, confidence, and attitudes in a computer course, Bohlin and Hunt (1995) found evidence that supported traditional course formats as being superior to intensive versions. Bohlin and Hunt's conclusion relating to the superiority of traditional formats was an unusual assertion in the research literature concerning the subject.

In a meta-analysis of 50 research examinations across 33 disciplines, Scott and Conrad, (2001) found only one instance in which intensive courses appeared clearly inferior to their semester-length counterparts. In fact, many studies in recent years are in support of shorter course presentation formats (Scott & Conrad, 2001). Increasing expectations of immediacy in project results, coupled with other factors instigated the need for short-term intensive training of the working group. Such training primarily focused on ameliorating worker skills may not

place any significance on participants' scores as compared to their performances. Researchers such as Wlodkowski and Westover (2009) have corroborated the value of intensive courses, finding them equal or superior to traditional formats.

According to Shaw (2009), in a study geared towards finding whether students in an introductory biology course had a better understanding of concepts after using course-related podcasting, results revealed no significant difference in student performances based on exam scores. Podcasting is lecture delivery methodology through iPod or other digital media that allow the students to listen to lectures when and where they deem necessary (Bashford, 2006).

Shaw's revelation was derived from comparing test scores of students who used podcasting frequently over the semester-long period (spaced study) and those who concentrated on classroom presentations that were mass presented during class schedules. The study placed emphasis on the timing - the time when students engaged in their studies. It is believed that when students engaged in studies at-will using resources deemed comfortable, and most importantly techno gadgets used in their day-to-day lives, these gadgets tend to be more rewarding to their

grades.

A digitally delivered course via podcasting, Shaw noted, gave students the leverage in downloading and listening to same lectures multiple times which contributed to the spacing effect, a theory which asserts that increased learning is evident when information is spaced out over longer periods, than information earned in a single massed presentation (Dempster, 1988; Challis, 1993). Students upon gaining first hand lectures during scheduled class session alternatively have the opportunity to use podcasted presentations to review the lectures multiple times over desired periods, hence supporting the spacing phenomenon. Spaced practices are an indicative of long-term retention of learned concepts.

Baird and Fisher (2006) stated that podcasting gave students the opportunity to pause information flow thereby enhancing their reflection. The spacing theory is not centric to in-class lectures only. Opportunities that foster reflective memories such as podcasting and other learning methodologies are welcomed for better retention. Students who were privileged to revisit course lectures after scheduled course periods were able to better reflect on areas of potential difficulty. Reflections on learned concepts have proven to increase the ability of students to

critically analyze, observe, interpret and discuss ideas (Costa, 2008; Veal et al., 2009).

Jeong and Lee (2008) supported this statement with their findings that students who had the opportunity to reflect on information from class produced 44% more responses during class discussions than nonreflective students. Higher levels of reflective thinking have been reported of students whose course curriculum incorporated opportunities for reflective thinking as opposed to those who do not (Lowe, Rappolt, Jaglal, & Macdonald, 2007; Veal, Taylor & Rogers, 2009).

Gorgievski (2011) in a recent quantitative research study on the effects of massed versus spaced practices and over-learning strategy on the performances of students revealed no significant difference in student scores between both presentation formats. The study used an ANCOVA research design in sought to determine evidence of any statistical differences in exam scores at a university level Calculus I course. Data collected during an entire semester for the study included homework and final exam scores. The former were assigned in small homework formats of (n=6) versus large homework formats in a massed (n=9) format. The findings were indifferent in either presentation formats (spaced or massed).

Students' outcome assessment is an objective evaluation of instructional programs and services to improve teaching and learning (McLeod & Atwell, 2002; Wolf, 2003). Assessment methods and grading rubric for intensive or semester course students should be indifferent irrespective of course presentation formats (massed or spaced). Similarly, classroom student composition should merit similar assessment guidelines regardless of gender or cultural orientation.

A multicultural classroom gives the instructors the opportunity to develop a fair and common student outcome assessment strategy (Reimers, 2007), regardless of the teaching format (short or long term). There has not been any documented study presenting variances in student performance results caused by gender or cultural differences. On the contrary faculty assessment methods should avoid finger-pointing to factors that may be controversial. Faculty leadership on outcomes assessment ensures program success (Diamond, 2008; Nichols, 2005).

Retention

Kapler (2009) in an applied spacing study sought to assess factual and conceptual learning of students in a university classroom setting found a significantly higher information recall effect on students' responses to

conceptual oriented questions. Conversely, there were no significant differences in the students' recollection associated to the spacing effect. Kapler explained the lack thereof of spacing benefits as a result of demographic factors applied in the study of the target population.

In this study, lecture materials were used to test student retention during the application of spacing episodes in a 5 month summer session at 1day or 2weeks spacing study episodes. Results were in favor of the spacing theory's assertion that increasing classroom learning led to a potential benefit to conceptual student learning.

A similar classroom study to evaluate the spacing effect in student retention of phonics, letter-sound and letter-combination knowledge amongst first graders yielded an overwhelming improvement in retention on children who studied in spaced conditions compared to those who studied in massed conditions. The children were thought letters and phonics daily in a spaced study of three 2-minute sessions while others were applied a massed daily study of only one 6-minute session. The results after two weeks of study application, children under spaced practice showed improvement over six times that of children in a massed study, Seabrook, Brown and Solity (2005) reported.

Similarly, Balch (2006) conducted a classroom study to demonstrate the spacing effect. A group of undergraduate students were presented a list of 16 words to be memorized - eight spaced and eight massed. Under massed conditions, the words were displayed twice in a row while an interleaving approach was used in the spaced condition where the eight words interleaved with each other. Counting the words in reverse order (backwards) after about 18 seconds, the students were asked to effortlessly recall as many numbers they retained. Findings from Balch's study revealed statistical analysis of a significant recollection of words studied in spaced practices than massed practices.

The usefulness and effectiveness of the spacing effect is not only eminent in memorized studies, but is well reputed for concepts requiring application of new concepts, contentment and structural leaning. For example, Kornell and Bjork (2008) in an inductive learning (a type of abstract learning) requested study participants to learn and master paintings from different artists. Different styles of the paintings were interleaved with other paintings in a spaced study or through a consecutive massed study conditions. Participants of the spaced study outperformed those under massed study conditions when they were asked to classify the paintings in association to

their respective artists.

Another abstract learning example was brought to bear by Rohrer and Taylor (2006). These researchers used mathematical concepts and materials in evaluating the spacing effect theory. The study used undergraduate students to calculate a number of permutation using mathematical calculations. The students were privileged to use ten practice trials in either massed or spaced schedules. The massed schedule was to use the ten trials at once or a spaced schedule of two sessions, 5 trials each for a week. Upon conducting a test of the participants after a one week or four week study, performance results of students under spaced practice in a week proved to be poor compared to their test performances after four weeks.

Cepeda, Pashler, Vul, Wixted and Rohrer (2006) discovered that in one study in sought to present the effect of gradually increasing the interval of spacing beyond an optimally determined point, participant long term retention results decreased slightly with spaced practice. The longer the study intervals were spaced, the greater propensity of forgetting useful information. Further exploration by these researchers in a 2008 study in determining what point is considered optimal in the study of the spacing effect, they used a large population of over

a thousand participants in an internet study where they implemented 26 unrelated conditions to explore interstudy intervals and retention levels. Cepeda et al. (2008) found that the optimal intervals depended primarily on the retention interval levels stating that the optimal interstudy interval (ISI) will increase relative to the retention interval. This implied that, participants tend to retain information over a long period of time, say for years, and spacing out the study material over several months of ISI.

Litke and Toppino (2011) in a recent study to evaluate the benefit of spacing practices in memory recall experimented with a list of 32 word pairs divided equally between massed and spaced participants. The researchers had hypothesized that spacing practices were more effective than massed practice. Their findings contradicted their hypothesis with results proving to be indifferent in both practices. These results had been refuted in many accounts where time pressures of the participants were analyzed to influence recollection of studied concepts. Litke and Toppino, like Son and Kornell (2009), concluded that spacing practices were influenced by the difficulty of the material to be studied. They added that people were often found to allocate less study time to items they judged to

be easier than to items they judged to be more difficult.

Metacognition

Fundamental to the study of retention and recall is metacognition technically defined as the human's ability to make judgment of their own mental process (Van Overschelde, 2008). In other words, it is the study of human ability to metamorphorsize their cognitive processes. Metcalf (2008) asserts that human judgment solely dependent on external stimuli cannot be considered metacognition, hence internal mental representation are required. The bellow diagram (Figure 1) presented Nelson and Narens' (1990; 1994) metacognition models that depicted information flow between both meta- and object-levels.

According to Van Overschelde (2008), the model illustrated the division of human cognitive processes into indispensable interrelated levels; two of which are the object-level cognition (anything that can be seen) and meta-level cognition posited to represent a goal with the knowledge and strategies geared towards achieving the goals (Nelson & Naren, 1994). This level also depicts constraint modules that could interfere with attaining cognitive goals. A third and critical feature is depicted by the flow of information between the object-level and meta-level. This control process facilitates meta-level cognition in

sending information to the object-level, thereby exercising control over this level.

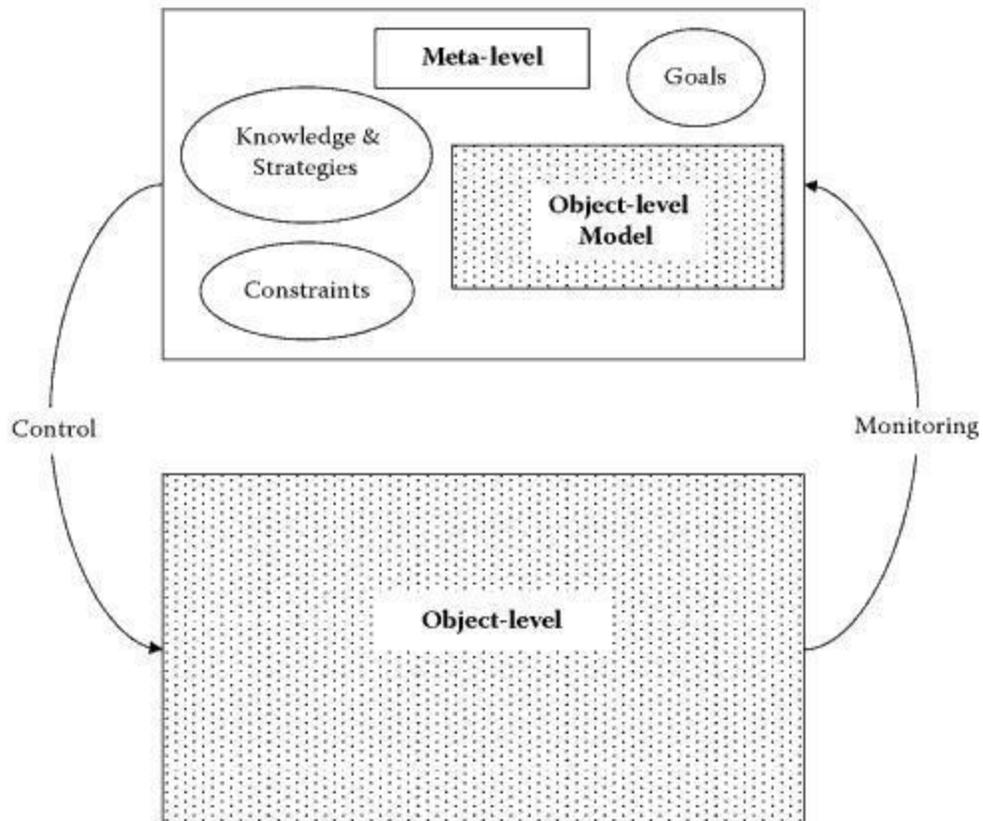


Figure 1. Meta- and Object-Level Metacognition Model.
 Reprinted from "Metacognition: Knowing about knowing," by Van Overschelde, J.P., 2008, in J. Dunlosky & R. A. Bjork (Eds.), *Handbook of Metamemory and Memory* (pp. 47-71). New York, NY: Psychology Press Taylor & Francis Group.

Although a discrepancy reduction account was supported by the results of many early studies, later studies were inconsistent with this theory (Kornell & Metcalfe, 2006; Metcalfe, 2002; Metcalfe & Kornell, 2003; 2005; Son & Metcalfe, 2000). Specifically, in conditions in which participants were put under time pressure or the expertise

level of participants was manipulated, people were often found to allocate more study time to items they judged to be easier than to items they judged to be more difficult.

Dail (2002) analyzed retention from a different perspective. He studied discrete motor tasks in golf playing (putting) to evaluate long-term retention in both massed and distributed practice sessions. Participants in this study were classified as novice golfers made up of both males and females of different age groups below 32 years. Using a 2x24x3 design (two practice schedules of massed and spaced practice; 24 acquisition trial blocks and three retention intervals of 1, 7, and 28 days), all participants practiced 240 putts. Massed participants practiced all 240 putts in one day and spaced participants took on a four consecutive day, at 60 putts daily.

Participants were asked to predict their scores after each acquisition trial phase where predicted scores and actual were the dependent variables of the study. Retention interval is pivotal in analyzing actual scores versus predicted. Results derived during the acquisition trial phase indicated higher proficiency levels of participants in spaced practice conditions based on actual performances, than actual performances under massed conditions. Similarly, greater proficiency was realized at the

retention phase for retention scores, hence supporting the posited theory of spacing practices which continue to use motor tasks. Results showed that retention intervals did not significantly impact the length of retention.

A prediction of survey participant's higher performance in the distributed practice study than in massed practice condition was evident, hence suggesting future performances (higher or lower) will be based on current performance levels. Ironically in this study a more proficient performance level was predicted from the 1-group than the predictions of the 28-day groups, meanwhile actual scores were recorded from the 1- and 7-day groups and with a higher proficiency than the proficiency level found in the 28-day group. In the final analysis the groups' actual performances did not attain a level of insignificance as predicted.

With extensive number of studies on the spacing effect theory favoring spacing practices over massed practices in retention and recall of learned concepts, very little has been directed towards understanding the rationale in deciding a suitable spacing practice. Consistent with the spacing theory, a recent study purported that spacing practices led to better learning (heighten knowledge) and this heightened knowledge was fundamental in deciding which

practices are favorable for the individual's learning, massed or spaced learning (Toppino & Cohen, 2010; Toppino et al., 2009).

Massed Presentation

Recent studies of intensive course formats have revealed student performances at significantly higher levels compared to traditional formats. According to Geltner and Logan (2001) in a study conducted at Santa Monica College, student performances in many science courses proved to be significantly higher during intensive sessions compared to the performances of students in similar courses completed during traditional courses.

The study also focused on investigating the dropout rates of students in both formats. Their findings revealed that there has been a remarkably lower rate of student withdrawal from courses offered during shorter periods as compared to those courses offered during traditional 16 week semester-length sessions. Table 1 below indicated success and withdrawal rates for intensive and traditional science courses. Geltner and Logan's findings were based on consideration that a student's passing grade was a "D" or better in either intensive or traditional format.

Table 1

Student Success and Withdrawal by Format

Discipline	Success Rate in %		Withdrawal Rate in %	
	<i>Intensive</i>	Traditional	<i>Intensive</i>	Traditional
Astronomy	71	64	10	14
Biology	81	67	9	19
Chemistry	82	70	11	18
Computer Science	76	61	12	21
Geology	89	74	4	13
Microbiology	86	70	8	17
Physics	80	71	12	17

A common belief and criticism in educational systems is that students are unlikely to retain course material or knowledge acquired during intensive shorter schedules. Cited in Hall (2008), Masat refuted this common criticism with findings that students' final grades in a BASIC programming language course showed no significant difference in an intensive six-week session compared to grades of a similar course from the traditional 16-week session. Instead, a three-week session of same course showed a remarkably higher final grade scores than those of the longer session. A subsequent study at the University of Minnesota found no significant differences in student grades. Hall in this later finding considered GPA scores of

the sample population.

Hall (2008) further investigated an intensive weekend cohort of biology students and found that the students significantly outperformed their counterparts taking a similar course during the weekday. Similarly, eight extremely intensive statistics classes in one university according to Hall, were evaluated to adequately prepare students for future courses. Each class was conducted at eight hour periods based on a qualitative and interview-based evaluation by both students and faculty. The intensive students outperformed their semester counterparts unchallengeably (Hall, 2008).

Researchers Homeyer and Brown in a 2002 study to address student attitudes, knowledge and skill development indicated no significant differences in relation to the length of time students completed a course - short or long term (Homeyer & Brown, 2002). Their study compared an intensive three-week interim semester (mini-mester) format with both a five-week summer term and a traditional 15-week semester.

Most research studies on the differences in students performances did not only focus on the length of time courses were taken, but highly considered the differences in subject areas. McLeod et al. (2005) found that most

students who enrolled in summer courses had a purpose. For example, those students may have been taking the shorter term courses to complete their required curriculum courses earlier or immerse themselves into the realm of taking courses. Some of the students may have enrolled in summer courses to ameliorate themselves in the rhythm of taking courses because they may have lacked confidence in their reading or writing skills during standardized testing. The researchers' study of a first-year composition course contradicted the common belief that intensive courses are less effective (McLeod, Horn, & Haswell, 2005). For instance, some of the summer students lacked confidence in their writing and scored low on standardized tests. They often enrolled in intensive sessions to immerse themselves or to complete required courses more quickly.

The Spacing Theory and Metacognition

Son (2010) defined metacognitive control as a process where people tend to use their judgments as a guidance to their own general behavior. Son contended that people will tend to allocate more time to study material that was judged to be difficult to them as oppose to the amount of time they will allocate for studying less difficult content. This contention had since been profoundly supported by other researchers (Kornell & Metcalfe, 2006;

Metcalfe & Kornell, 2005). Kornell and Metcalfe supported this theorem and added that as long as people have enough time to study material that is not considered unrewarding, they were most likely going to allocate more time in studying the more difficult content.

One common issue believed to be prevalent with metacognitive control is the contention that there has not been a thorough study on the topic (Benjamin & Bird, 2006 and Son, 2004). In a Son study, participants were requested to use metacognitive judgments for cue-target pairs. The decision of whether to mass or space subsequent study sessions of the target pairs was left on the participants to decide. The results of this particular study indicated that the adult participants spent more time spacing than massing, and their metacognition intrinsically guided their decision and choices of what strategy was best suited for their study. In other words, the adult participant were seen to space those target pairs that were deemed easy and mass pairs that were more difficult to study, a finding Benjamin and Bird (2006) called fascinating.

However, Benjamin and Bird (2006) contradicted these findings contending that participants were likely to mass items that were easily comprehended and spaced the more difficult items. Considering that metacognition plays an

integral role in the decision making of what participants want to study, Benjamin and Bird used three experiments to arrive at their contention. The first two experiments gave participants normatively difficult to easy word pairs to be studied under certain conditions, and fairly difficult pairs to study in the third experiment. Findings indicated that performances of participants who spaced the difficult items were superior to those who massed those considerably difficult items. Benjamin and Bird found Son's (2004) results to be "fascinating because it either reveals that subjects choose to apply more effective study conditions to easier materials— a result in conflict with the vast majority of findings from study-time allocation experiments—or it reveals a fundamental misappreciation of the greater effectiveness of spacing in promoting learning" p. 126.

Two fundamental difference between Son's (2004) study and Benjamin and Bird's (2006) study is that in the former, participants were allowed to choose not to study the pair of words thereby considering the study already completed or done. In the later, no such option existed - meaning that participants were to study all the items in either massed or spaced approaches with no option to bail out of the study. Son's participants could either mass or space the

items if they choose to, but Benjamin and Bird's study compelled participants to mass half and space the other half of the study items.

Toppino et al. (2009) in a much recent study rectified the inconsistency prevalent in the spacing choices people made, stating that these choices were fundamentally propelled by their judgment of the level of difficulty. They believed that people will choose to mass their study when encoding has been insufficient and will tend to space their study when encoding is sufficient (Toppino, Cohe, Davis & Moors, 2009). With these findings, Son (2005) believed that people should consider to what degree study items were encoded before making an informed decision whether to mass or space their studies. From a cautionary perspective, Son advised that people should understand how well-encoded items were before choosing to mass or space their study. In short, as a rule, people should decide to space their study only when they felt they have comfortably encoded the content. Otherwise, they should engage in studying the content as soon as possible en mass. "Logically speaking, then, the spacing effect should not be universal; that is, the effect should disappear if the situation made it so that sufficient encoding could not be achieved" p. 256.

In an empirical study conducted to investigate how children chose to space their studies, Son (2005) tested first graders to study word pairs allowing the children to choose whether to mass or space their study. The results revealed that the children exercised a closer inclination to massed practice than spaced practice with a total lack of metacognitive approach. Their inclination to mass practice was inconsiderate of the level of difficulty of the word pairs. The children exercised massing in relatively every study session, even with word pairs that were deemed to be considerably easy or difficult, they preferred massing - thereby, contradicting studies that considered spacing to be a preferred study methodology for easy items (Toppino et al., 2009; Benjamin & Bird 2006). It could be concluded that these results from the children study of Son's 2005 experiment was different because the children were unaware of how encoded the learning material ought to be as compared to the adults. Furthermore, the children have not had a comparatively higher exposure to to-be-learned material as the adults, hence their inclination to more massed study habits than spaced study habits.

Considering the evidence on metacognition in spacing studies and the lack thereof in children, Son in the 2005

study addressed the curiosity whether it is beneficial to impose massing or spacing strategies on learners even when it is against their metacognitive choices. In testing this question, the researcher wanted learners to learn a pair of synonymous words and use their metacognitive judgments in deciding whether to mass or space the study for each item. After the study, a computer then presented the words for recall in mass or spaced session, even though participants may have chosen a different approach. This practice was to investigate whether there was any change in the learner's performance when study items were spaced against their choice of massing, or whether there could be a possibility of eliminating the spacing effect.

Son (2010) in a much recent experimental study amongst adults and children in sought to investigate whether spacing strategies definitely enhanced final performances yielded varying results. In the study, participants were forced against their will to space or mass their learning practices. For example, the adults and children who chose to space studying their word pairs were forced to mass or do the reverse after having chosen to space. Study results revealed that when participants were forced to practice a spacing strategy against their desire, performances for the adults were not enhanced, but the performances of the

children were enhanced. According to Son (2010), "although spacing is an effective strategy for learning, it is not universal, particularly when the strategy is not chosen by the learner. In short, metacognitive control is often crucial and should be honored" (p. 255).

In Son's 2010 study, two experiments were used. He used 60 synonym pairs of words randomly selected from a pool of 100 words, 31 psychology students were requested to mass practice or space practice the word pairs. The instructions specifically stated that their choice of whether to space or mass the study were not going to be honored most of the time. To be precise, their choices were to be honored two thirds of the time and the other one-third of the time their choices were going to be dishonored, hence forcing the participants to space or mass against their preferred choices (Kornell & Metcalfe, 2006). The results of the experiment indicated that the adult participants preferred and selected spaced practices for the word pairs, while there was a decrease in massed study. This practice is in accordance with Toppino et al.'s (2009) findings that learners will continue to study items until they are fully encoded. Son summarized the findings stating that:

...the spacing effect was obtained, but only for

honored items. When strategy choices were dishonored, the spacing effect disappeared. The short implication here is that deliberately imposing a "good" strategy on the learner, even one that has had overwhelming evidence and agreement in the laboratory, should be done with caution, particularly when the strategy has not been requested by the learner. The data also imply that there are specific reasons for why an individual should and would choose a spacing strategy over massing, and those reasons are only perfectly known to the learner him- or herself, Son 2010, p. 259.

It is clear in this experiment that the spacing effect disappeared when participants are forced to exercise learning practices against their choice. In other words, spacing cannot be an unconditional benefactor to learning. Spacing is, and should be an option unimposed on participants to use depending on their comfort level of encoded items.

The second experiment indicated that the young children in the study were inept to using their metacognitive knowledge in guiding their choice of spacing or massing the study (Son, 2005), hence massed their study practices for both difficult and easy words at all times. Conversely, the adults used their metacognition in decision making, taking into consideration their past experiences and knowledge of the effects of massing and spacing. It is therefore believed that imposing spacing on the children is likely to enhance their learning at some levels.

The Spacing Theory and Retention

Investigators on the spacing theory underscored that studies on the spacing theory will remain inconclusive without an in-depth review of retention and recall of learned concepts. Information is retained in the first two human memory components. The sensory registers receive and store all human stimuli triggered internally or externally for a brief moment until they are transferred to the short-term memory. Short-term memory is the second storage component analogously referred to as the 'central processing unit' where a conscious retention of information transferred from the encoding process of the sensory registers is stored (Toppino & Bllom, 2002).

In lieu of this definition, performances of students probed to recall material gained in massed format was likely to be relatively appealing. Reasons undoubtedly resulting from the fact that materials gained from massed practices were readily recalled, if probed for recall, within a short period of time since the information is presumably resident in the short-term memory. Toppino and Bllom opposed to this view and contended that massed repetitions will result to potentially poorer performance because the learned concepts haven't had the opportunity to be differentially encoded (Toppino & Bllom, 2002).

The other component is the recall or retrieval of stored information. This component is relatively complicated, researchers contend. Studies on cognitive processes support information rehearsal as a strategy for indefinitely maintaining cognition of learned concepts. Gorgievski (2011) reported that before information can be transferred to long-term memory from working memory, it must be consciously and actively processed. Information gained and retained over long periods of time and stored in the registers require reprocessing for transfer to working memory storage where instant retrieval is facilitated.

This can be a potential issue affecting performances in test scores of students taking courses during traditional semester, compared to the performances of quarter-length student. Furthermore, information retrieval from long-term memory is cumbersome because of the belief that long-term memory has unlimited capacity of information usually stored for "indefinitely long" periods of time (Ormrod, 2004, p. 205). Repetition and review is one of the fundamental cognitive factors that can affect student's long term memory storage. This spacing effect phenomenon, as referred to by cognitive psychologists, has proven to dramatically yield better learning results where information was presented over longer periods (spaced

presentation) than massed presentation.

Toppino and Bllom explained the spacing effect according to the encoding viability theory as follows “...spaced repetition enhance memory performance because each occurrence is to be encoded differently, leading to a greater number of effective retrieval routes. In this view, massed repetitions lead to poorer performance because they are less likely to be differentially encoded” (Toppino & Bllom, 2002). Conversely, the deficient processing mechanism theory elucidates the spacing effect as:

...repetition improves memory by increasing total quantity and/or quality of processing than an item receives during encoding. In this view, when repetitions are sufficiently spaced, both occurrences of a repeated item are adequately processed, leading to superior memory performance. However, when repetitions are massed, one occurrence is assumed to receive inadequate processing, resulting in poorer memory (Toppino & Bloom, 2002, p. 437).

In one study grounded in the spacing effect theory, Kiepert (2009) examined the similarities visible in teaching practices with respect to repetition of course material and the timing of repetitions. This process focused on methodologies that were used in studies on the spacing effect. Kiepert’s study focused on investigating pre-secondary school teacher’s opinion of repetition; their beliefs of massed versus spaced teaching methods; and their beliefs about the accuracy of massed versus spaced teaching

methodologies. Based on 303 teachers surveyed in this study, results indicated many teachers used repetition in their classroom presentations. The teachers provided varying reasons in support of the methodology used at different grade levels. For example, teachers of grades 1 through 3 used more repetitive practices in classroom presentation more frequently than teachers of higher grades.

The study also looked into the timing of the repetitive practices and reported that teachers who engaged in repetitive presentations were conversant of the benefits in spaced presentations. An interesting assertion in Kiepert's study was the report that the application of the spacing effect had been impractical in classroom settings and mass presentation methodologies were considered more viable means of course presentation. He specifically stated that spaced presentations have been viewed to be practicable in semester-length courses. A clear demarcation between research on spacing effect and educational practices are perceived to not only originate from teacher's lack of knowledge, but from the comparison between research methodologies and teaching practices.

The spacing effect has been examined in recent studies to evaluate young children cognition in the mastery of

words (Childers & Tomasello, 2002; Riches, Tomasello, & Conti-Ramsden, 2005). A number of two year olds in Childers and Tomasello's 2002 study were taught a number of nouns and verbs extracted from a story book during their recreation sessions. The children were either exposed to four to eight words per day (massed exposure) or one word daily on four consecutive days (spaced exposure). The study varied the children's exposure to the words; exposing them to two exposures in one day, and two exposures three days after, or two exposures to the children twice a day, followed by four exposures three days after. The result of this study presented apparent inclination to the spaced exposures with timing of the children's exposures being a crucial variable for consideration. Findings concluded that learning was facilitated when more days were used to expose the children to the different word groups, hence in support of spaced presentation format in correlation with timing.

A similar study was conducted by Riches et al. (2005) in a controlled setting using educational material to examine the effect of spacing presentation on the learning of words in a group of children with specific language impairment (SLI). The experiment manipulated frequency of word presentation and spacing of the presented words to the target group of students with SLI ages 5 to 6 and non SLI

children. The results indicated that the children with SLI benefited from frequent exposure to the words presented over four days as opposed to multiple presentations launched at them in a single day. Conversely, a spacing effect was not eminent in this experiment with children with normal language ability of ages 3 to 4.

Recent studies have associated retention to memorization of information. A relevant study to education is Son's (2004) investigation of metacognitive strategy which allowed study participants to decide when to study. This strategy is of clear relevance to students in the educational settings that required the preparation for test, midterm or final examination. A metacognitive strategy provided the students the opportunity to decide whether to study immediately or at a later time.

Son's experiment on metacognitive strategy tested a hypothesis suggesting that if an item or material is expected to be well learned and retained, the learner will prefer to study the material later. On the other hand, if an item is considered not to be learned, the learner will choose to study them immediately. The results of this study supported the spacing effect application where students ultimately retained more information when study materials were learned at a later time. Furthermore, results also

supported metacognitive hypothesis, a hypothesis which suggested that learners preferred to learn materials at a later time to heighten their level of understanding than learn same material immediately.

In analyzing Son's findings in these studies, educators and institutional administrators continue to utilize the results resourcefully to educate metacognitive study strategies. Considering the benefits of memory for spaced learned concepts which potentially increased the learning and retention of information, educators were likely to encourage the consideration of metacognitive strategies for students.

Rohrer and Taylor (2006; 2007) in other studies recently conducted to illustrate the spacing effect in a mathematics classroom where mathematics practice problems were spaced out, the students were assigned problems on a particular topic in stages of difficulty level. The easy problems were assigned initially, followed by the moderately difficult problems and finally to very difficult problems, over a long period. The results of these studies were in favor of the spaced practice in long term memory retention than massed practice. These findings indicated that, to foster a higher retention of difficult concept, a repetitive strategy of presentation is encouraged and the

presentations should be prolonged for longer periods if possible.

Gilbert (2010) conducted a study in sought of investigating variances, if any, in student performances and retention using alternate course formats. The study indicated drastically different results amongst students at different age groups. The study compared performances and retention of learned concepts during alternative course format (weekend, short-term, and computer assisted instruction courses) to traditional 16 week semester format of an Elementary Algebra course offered over a long period of time. Students were grouped in four age group levels: those younger than 2 years, between 2 years and 29 months, between 29 months and 40 months and groups above 40 months. It was noted that retention in the younger students below 2 years were different between the alternative and traditional format course offering, but indifferent results were observed among students of older age groups.

Retention levels increased with age group progression. The younger groups retained better with spaced presentation practices, and as the age group increased, spacing practices had little or no effect in the retention level. Gilbert further noted from the study that course formats were different but confirmation of the level of interaction

amongst the age groups were undetermined. Gilbert's findings indicating varying retention and performance levels in the younger group studied were in line with the spacing effect phenomenon that retention will be heightened and effective at study intervals over longer periods. Conversely, the benefit of spaced presentations did not appear at short retention intervals; in other words, at short retention intervals, massed presentations led to better memory performance than spaced presentations (Weiner et al., 2003).

The spacing theory is not centric to in-class lectures only. Opportunities that foster reflective memories such as podcasting and other learning methods are welcomed as better retention tools for student comprehension. According to Baird and Fisher (2006) podcasting allow students the opportunity to pause information flow thereby enhancing their reflection. Reflections on learned concepts have proven to increase the ability of student to critically analyze, observe, interpret and discuss ideas (Costa, 2008; Veal, Taylor & Roger, 2009). Jeong and Lee (2008) supported this statement with their findings that students who had the opportunity to reflect on information from class produced 44% more responses during class discussions than non-reflective students. Higher levels of reflective

thinking have been reported of students whose course curriculum incorporated such opportunities for reflective thinking as opposed to those who don't (Lowe et al., 2007; Veal et al., 2009).

Perception of the Spacing Effect

Findings from Kretovics et al. (2005) in a study to understand the perception of faculty vis a vis compressed summer courses concluded that compressed courses were treated differently from semester length courses (Kretovics, Crowe, & Hyun, 2005). It was evident in their study that faculty made adjustments in course material, discussion, assignments and grading rubric to accommodate the differing time frames. This has become common practice in most compressed course formats. Faculty become relatively overwhelmed when implementing teaching modalities designed for semester-length formats during intensive sessions. Kretovics et al. concluded that a major challenge is whether faculty engaged in making such significant changes with pedagogical justification, rather than paying attention primarily to time frame (Kretovics, Crowe, & Hyun, 2005). A focal point of their study was geared towards finding differences in tenured and non-tenured faculty's teaching approaches during the summer session.

According to the authors, tenured faculty were more inclined to change course requirements in response to course length - reducing course requirements for compressed course, as compared to their non-tenured counterparts. Their findings also revealed that non-tenured faculty was more prone to be pedagogically risk averse (Kretovics, Crowe, & Hyun, 2005). Furthermore, it was concluded in their study that faculty perceived a deficiency in training and support for summer teaching (Kretovics, Crowe, & Hyun, 2005), that justified faculty's rationale for pedagogical differences.

The perceptions of faculty were found to affect general curricular characteristics of intensive courses (Hyun et al., 2006). The authors established from their study that emphasis was placed on the organizational aspects needed to address the amount of time required by students to work out of class between class meetings. For example, how much time was available for students' preparation prior to next class meeting after a compressed all-day, eight-hour course that runs for a week.

Despite completing same class contact hours in compress course sessions as semester length courses sessions, it was surmised that study hours between class hours were limited. Based on these perceptions noted by the

authors, they recommend that stringent policies be instituted restricting the number of course load a student can enroll in during the summer term and also examine the types of courses offered during compressed format (Hyun, Kretovics, & Crowe, 2006). An advanced calculus or cost account courses may not be suited for summer sessions; meanwhile, a writing course or other introductory level courses were best suited for this period.

Research Questions

The following questions helped supplement the understanding of the purpose and significance of this study.

1. How are course grades and certification scores impacted by the spacing effect theory?
2. What are the characteristics of students taking courses in quarter-length and semester length computer literacy courses?
3. What are the characteristics of course faculty teaching quarter-length and semester-length computer literacy courses?
4. What differences in pedagogical approaches are reflected in course outlines of semester vs. quarter length courses?
5. What explanations do course faculty in quarter-

length and in semester-length computer literacy courses offer about the course grades and certification exam scores of students enrolled in quarter- and semester-length courses?

6. How will the findings of this study expand educators' understanding of the application of the spacing effect theory in institutions of higher learning?

Chapter 3: Methodology

Introduction

Chapter 3 covers the methodology employed in conducting the research study. Included in this chapter are subsections that detail the research design method, a description of the target population, research sampling procedure, demographic data collected, research participants, instrumentation, data collection procedures, research assumption, data analysis, and limitations of the research study. The following research questions guided the study:

1. How are course grades and certification scores impacted by the spacing effect theory?
2. What are the characteristics of students taking courses in quarter-length and semester length computer literacy courses?
3. What are the characteristics of course faculty teaching quarter-length and semester-length computer literacy courses?
4. What differences in pedagogical approaches are reflected in course outlines of semester vs. quarter length courses?
5. What explanations do course faculty in quarter-length and in semester-length computer literacy courses

offer about the course grades and certification exam scores of students enrolled in quarter- and semester-length courses?

6. How will the findings of this study expand educators' understanding of the application of the spacing effect theory in institutions of higher learning?

Research Design

This study employed a mixed method approach also referred to as the triangulation research methodology. Triangulation is one of the multi-method research methodologies that utilize more than one approach to investigate a research question in order to enhance validity and confidence in the findings. This research method was used to examine the research questions to document the results of instructional effectiveness of quarter-length and semester teaching formats in one post-secondary education as a means to expand on the impact of the spacing effect theory.

The researcher focused data collection efforts from a local community college, Prince Georges Community College (PGCC) in Largo, MD, where courses are taught during regular semester and intensive sessions in an academic year. The results of the study as discussed and concluded in Chapters 4 and 5 may be used to suggest improvements to

the institution's current program and promote successful use of program design. If applied, the results may impact the incumbent program format; suggest favorable and efficient program design, development, and evaluation of the institution's instructional programs (Richey et al., 2004).

A data collection team made up of the researcher and two other members worked hand in hand in executing the data collection and analysis process. The team's activities were facilitated by the use of technology tools and related applications (Microsoft Office and internet-based applications). The trio have had previous data collection and analysis experience and an extensive knowledge of technology applications. The team members were instructors of the Computer Literacy course (CIS 1010) at PGCC and have taught the course during one or both quarter and semester session.

Participants

The study participants were students currently enrolled in the introductory level computer course and faculty teaching the course. The research team utilized the services of students previously enrolled in the course to participate in the face and content validation of the research instrument, prior to execution.

Survey population. The survey population was students attending Prince Georges Community College (PGCC) in pursuit of an Associate Degree. These students are required to take the preparatory computer course (Introduction to Computer Literacy - CIS 1010), preferably during their freshman year. The CIS 1010 course is considered a foundation course required of every student regardless of his/her discipline of study. The main objective of this required course is to provide fundamental concepts in computers and information technology applications. The population from which sample participants were drawn was degree students of the university. These students, as part of their curriculum requirement, are required to take the Computer Literacy course.

Target population. The target population was students actively enrolled and taking the CIS 1010 course as a curriculum requirement towards their degree programs during academic year 2011-2012. This course is a foundation course required of every student who attends PGCC and pursuing an associate degree program from any discipline. The core objective of this course is to provide fundamental concepts in computers and information technology applications required by students in their pursuit of an associate degree or other. Two common applications covered in the

course are Microsoft Word and Microsoft Excel. Students were advised and encouraged to register for this course during their freshman years and required to earn a grade of a "C" or better. According to enrollment records of PGCC during academic year 2011, less than 80% of freshman year students enrolled in the course.

Included in the target population of survey participants were those faculty teaching the CIS 1010 course sections sampled for the study. The faculties have also taught the course during a semester and/or quarter session. These instructors are well qualified with a minimum credential of a bachelor's degree in Information Systems, Engineering, or related field. Some held advanced degrees. Others with information technology-related certifications combined with past experiences in post-secondary pedagogy.

Sampling procedure. During each semester, an average of 12 Computer Literacy Course section is offered each semester, during an academic term at PGCC. Data was collected from a total sample of eight Computer Literacy course sections during the study period of academic year 2011-2012. Four semester-length course sections and four quarter-length course sections were surveyed - (two each during the Spring and Fall of 2012, one during the winter

intersession 2012 and three during the Summer of 2012). A total of 187 students were sampled in both cohorts.

A total of seven faculties teaching the sampled sections participated in the survey. The criteria for selecting participating faculty was based on their past or present engagements in teaching the course in either quarter or semester session, or both. The basis of this criterion was to ensure adequate and substantiated information were collected for the qualitative analysis of the study.

This sample purposively supported the researcher's representation of students who during an academic year completed the computer Literacy course. Students who completed the course with a passing grade were awarded the eligibility status to participate in the IC3 certification exam. In this case, the researcher applied the purposive or judgment sampling method as defined by Singleton and Straits (2005) that "in this form of sampling, the investigator relies on his or her expert judgment to select units that are representative or typical of the population" (p. 243).

Demographic data. Student and faculty demographic data of relevance was collected for the study. The data collected included student ages and age groups, gender,

employment status, course length, academic status (full or part-time), prior use of computers. Faculty qualification levels, course load, course length, employment status (full or part-time), grading rubric, and teaching modalities applied in teaching both formats were gathered.

Instrumentation

Data collection was facilitated by the use of web-based questionnaire sent out to the target population. Questions were administered through Survey Monkey, a web-based survey solution available for researchers to collect and analyze data pertaining to their topic of research. Shirley Bridges of business.com validated Survey Monkey as a state-of-the-art solution for researchers, and the medium had been utilized to facilitate research and data collection since being founded in 1999 (Bloomberg Newsweek, 2011).

Participation in the survey was voluntary. A combination of closed-ended and open-ended questionnaire formats were utilized to gather quantitative and qualitative responses from both faculty and students. This included a set of multiple choice questions, true or false questions, and a set of Likert Scale-like questionnaire from which participants indicated their answers of preference. Likert Scale-like questionnaire responses

included: "Strongly Agree", "Agree", "Neither Agree nor Disagree", "Disagree", and "Strongly Disagree". Another set of Likert Scale-like questionnaire responses included the following choices: "to a great Extent", "Somewhat", "A little", and "Not at all".

Survey validation. Considering the lack of extensive studies on evaluating instructional effectiveness in semester and intensive formats over the past decade (Seamon, 2004), the survey questions for this study are tailored specifically towards gathering information of substance. Additionally, with no known existence of prior recognized and authenticated tool that could appropriately address the research questions in this study, the primary researcher put together a survey validation team comprised of eight faculty members of Prince Georges Community College (three of whom were part of the data collection and analysis team). These validation team members were qualified and have had prior experience in questionnaire design, review and audit. Upon a keen review and modification of the research instrument (Appendix G) for clarity, simplicity and appropriateness, the validation team reached a consensus that the questions were suited for gathering adequate and relevant data required for the successful execution of this research study.

Face and content validation. The final survey questions were piloted on a group of non-sample students. This pilot group was comprised of six non-survey participants selected from the population of eligible Computer Literacy students (students of the university pursuing a degree program but not currently enrolled in the Computer Literacy course). This was done primarily to establish face and content validity of the survey questions. Participation in the pilot team was strictly voluntary.

The researcher sent a solicitation email (Appendix A) to the pilot group to voluntarily participate in a 10-15 minutes survey. The survey questions in Appendix G were administered including an additional set of five open ended questions requesting pilot participants to comment on clarity, ease of understanding, suggestions for modification, relevance of survey questions, and time taken to complete the survey. Feedback from the pilot group was incorporated into the final version of the questionnaire (Appendix G), and administered to the survey participants.

Procedure

Research design. The design methodology employed in this study is the mixed research model. Leech and Onwuegbuzie (2010) refer to this design as a methodology

where qualitative and quantitative research approaches are combined to collect and analyze data suited for evaluating instructional effectiveness in spaced pedagogies. Survey questionnaire (Appendix G) was deployed to participants via Survey Monkey to gather quantitative data (demographic data, student grades, mock IC3 scores) for analysis.

The instructor section of the survey questions (Appendix G) were tailored to gather qualitative data on pedagogical approaches and other teaching modalities faculty used in evaluating students. This approach was utilized due to conflicting schedules that did not permit a face-to-face interview. Additional qualitative questions were geared towards collecting faculty perception on the disparity of student performances during semester-length and quarter-length course format.

According to Kennedy (2009) the mixing up of multiple research methodologies will combine different techniques that complement and balance each other out: quantitative versus qualitative, individual versus group, face-to-face versus remote, self-reported versus facilitated and short engagement versus long engagement. These complementary facets are the nucleus of this mixed triangulation study.

The researcher also coordinated a team of two other members with whom they engaged in the data collection and

analysis of the study. This team members were faculty of the institution of study with prior experience in data collection and analysis. The faculties have once taught or are teaching the Computer Literacy course during one or both quarter and semester sessions.

Rationale for data collection. Student grades earned upon course completion were obtained from participating faculty. A mock version of the IC3 certification exam was administered to students prior to the end of each cohort upon completing the course material. The reason for administering a mock version of the exam as opposed to the actual IC3 exam was because the exam was not mandatory. Furthermore, the exam required a registration fee of about 100.00 U.S. dollars. Professional certification exams are not a requirement for completing a degree program at Prince Georges Community College, thereby allowing the students the option to either take the certification exam or not. Considering the level of the students in a community college setting (where the majority of the student population are high school graduates), they may not understand or find any significance in certification exams early in their educational pursuit. The Computer Literacy course is a freshman year course required of all degree students. It is incumbent upon faculty to explain the

significance of certification exams to the students, and to their future careers.

The mock questions administered were actual questions the research team (researcher and two faculty members) had access to. This was facilitated by the fact that the college is an approved center for administering IC3 certification exams. Another reason for a mock version is to gather sufficient data for analysis. If students are allowed to voluntarily take the optional IC3 exam, be it free of charge, it is most likely that majority of the students will not participate. Subsequently, non-participation will result in insufficient data for the study. For these reasons, the researcher realized the necessity to administer a mock version of the exam as a facet to guarantee maximum participation from study participants. Consequently sufficient quantitative and qualitative data was obtained for analysis.

Quantitative data collection. Quantitative data was collected at different intervals during the semester and intensive sessions. During the first week of the semester session, course syllabi, objectives, learning outcomes, course grading rubrics and student contact email addresses were collected from participating instructors. During the second week, the data collections team emailed students a

solicitation email (Appendix A) requesting their voluntary participation in responding to an electronic questionnaire that was administered via Survey Monkey. A follow up email was sent to this effect in week nine, to iterate and ensure maximum participation.

Quantitative data was collected from survey questionnaire (Appendix G) where the respondents indicated their responses. Respondents (both students and faculty) were allowed to answer open-ended type questions which were used in the qualitative analysis. Multiple choice questions were incorporated in the survey question where appropriate and administered through a web based application interface (Survey Monkey). Respondents were instructed to contact the team members if they had any questions, comments or clarification via email or telephonically. Collected data was imported into Microsoft Excel application and SPSS for analysis. Analyzed results indicated the aggregate totals, mean performances and variances of student scores and grades obtained during semester or quarter session in comparison to their mock IC3 certification scores.

During week 12 of the regular semester session, participating instructors administered a mock version of the IC3 certification exam. Administration of the exam at this time was to ensure that core concepts in Microsoft

Word and Excel fundamentals and general IT concepts have been successfully completed. This certified students' eligibility to take the mock exam. Same was administered on day 5 of the intercession session and at the end of week three during the five week summer-length session, according to course syllabi. The mock exam was administered via blackboard where students' mock scores were automatically reflected in the grade reports of participating instructors. At the end of the semester or quarter-length session, the data collection team collected students' grades and mock exam scores from instructors.

Qualitative data collection. Qualitative data was collected electronically by administering open-ended questionnaires through Survey Monkey, and through electronic interview methodology using a Computer Assisted Personal Interviewing (CAPI). Singleton and Straits (2005) contend that CAPI has become the standard for large-scale survey research in the United States. The intent was to gather data on pedagogical approaches and other teaching modalities instructors used in evaluating students not detailed out in course syllabi. Furthermore, this electronic interview was intended to gather faculty perceptions on the disparity in student performances in semester-length and quarter-length course formats.

Mixed Methods. Data collected from both the qualitative and quantitative gathering process were merged to present findings. This blend of data through a matrix presented a visual depiction of how demographic variables were married into the independent variables to support or refute the researcher's hypothesis. A multilevel triangulation model depicted in Appendix F presented the stages used by the analysis team in arriving study results.

Triangulation is a mixed method metaphorically termed complementarity model by Erzberger and Kelle (2003). This model was used to tie supplemental findings from demographic data to the dependent variable. The Erzberger and Kelle's (2003) complementarity model depicted below (Figure 2) was used in this study to integrate data collected at different intervals of the study for analysis.

According to Kennedy (2009) the mixing up of multiple research methodologies combine different techniques that complement and balance each other out: quantitative versus qualitative, individual versus group, face-to-face versus remote, self-reported versus facilitated and short engagement versus long engagement. These complimentary facets are the nucleus of this triangulation study.

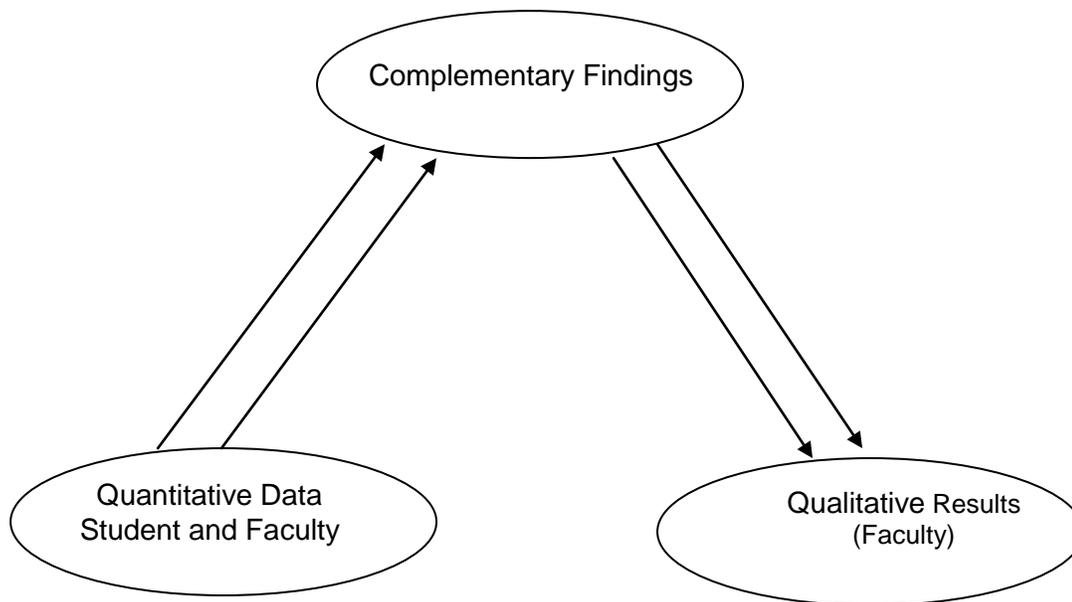


Figure 2. Complementarity model.
Erzberger and Kelle's (2003) Complementarity Model for Validation of Mixed Methods Research.

Data collection timeline. The study was conducted at multiple intervals during the academic year 2011-2012 and 2012-2013 in an effort to obtain sufficient data needed to substantiate analyzed results. A team of three data collectors (the researcher and two other faculty members) with prior research experience undertook the data collection responsibility. A total of eight courses were surveyed. Four course sections during the semester format (fall and spring semester) and four intensive course sections: two during the summer and two during the intersession.

During the spring 2012 semester (a traditional 15 week session) the following detailed timeline was followed for

data collection. Two course sections were surveyed. During the first two weeks in the month of February, the primary researcher organized a brown bag lunch session where a formal introduction of the data collection team and participating faculty took place. After this introduction, the team requested registered students' names, email addresses, course syllabi, grading rubric and other information of significance.

In Week 3, a solicitation email (Appendix A) was sent to the students requesting their participation in the survey questionnaire (Appendix G) via Survey Monkey. The email was carbon copied to participating faculty with an addendum (Appendix B) requesting their assistance in encouraging their respective students' participation in the survey. In March during Week 6 of the semester, an email (Appendix C) was sent to participating instructors requesting their availability for a face-to-face one-on-one interview on or about the last week in April. Also contained in the email was a reminder request to encourage their respective students to endeavor participating in the survey. In Week 7, the data collection team sent a reminder email (Appendix D) to students to ensure maximum participation in the survey questionnaire. In April during Week 9, the data collection team began importing student

responses from Survey Money into Microsoft Excel worksheets.

In Week 10, after each participating Computer Literacy course section had completed the fundamental concepts required for the IC3 exam, participating instructors scheduled the mock exam and made it available to students via Black Board. The exam was timed and remained open for a week with student's maximum attempt set at "1", and the timer set to two hours. The exam included multiple choice, true/false and matching questions. The team urged participating instructors to continually encourage maximum participation from each student, and if possible, the mock exams scores were to be integrated in the overall student score for the semester.

In Week 12, due to scheduling conflict, participating instructors were unavailable for a face-to-face interview. The team administered interview questions via Survey Monkey for the instructors to respond at their leisure prior to the end of the semester. Data from the electronic interview remained on the Survey Monkey site. In May, during the final week of the semester, student grades and mock IC3 exam scores were collected from instructors and imported into Excel and subsequently into SPSS for analysis. The team then engaged in de-identifying student data to avoid

associating any piece of information to the human subjects.

A similar timeline was applied to gather data from two CIS 1010 section in the fall semester of 2011. This semester is a similar 15-week long session that started in August through the December month.

During the intersession two week (intensive session in mid-January of 2012) the following detailed timeline was followed. The intersession courses begin the second week of January from Monday through Thursday from 9:00 am to 4:00pm, ending the third week of January. On the first day of class during the first week, the data collection team introduced themselves to participating faculty, collect names and email addresses of registered students. Additionally, course syllabi, grading rubric and other information of significance were collected.

On the third day of class, solicitation email was sent to the students requesting their participation in the survey questionnaire. This email was forwarded to participating instructors with an addendum requesting their assistance in encouraging their respective students' participation in the survey. Accompanying the addendum was an email to the instructors requesting their availability for a brief face-to-face one-on-one interview. As an encouragement strategy to the students, a few extra credit

points were to be given to those students who participated in the survey.

At the beginning of the second week, the data collections team began importing student responses from Survey Monkey into Microsoft Excel worksheets and subsequently into SPSS. The instructors scheduled the mock exam and made available to students via Black Board. The exam was timed and remained open through the end of the session with student's maximum attempt set to one, and timer set to two hours. The exam included multiple choice, true/false and matching questions. In an effort to ensure maximum participation, instructors were asked to encourage students to take the exam at their earliest convenience before the end of the session.

Face-to-face interviews with the faculty were not feasible during this session due to timing constraints. Questions were administered electronically and data imported into Excel and subsequently into SPSS for analysis. Student grades and mock IC3 exam scores were equally imported into Excel and SPSS for analysis after the final exams are graded.

During the Summer 2012 six week (intensive session) a similar timeline to the above intersession session was followed. Summer classes are usually five to six weeks in

length with about two daily contact hours, meeting Monday through Thursday. In June, during the first week of summer, a formal introduction of the data collection team and participating faculty was initiated at a brown bag lunch session to establish a rapport eased the collection process. Furthermore, students' names and email addresses were collected from these instructors teaching course sections sampled for the study. Additionally, course syllabi, grading rubric and other information of significance were collected.

In the second week, a solicitation email was to the students requesting their participation in the survey questionnaire. This email was forwarded to participating instructors with an addendum requesting their assistance in encouraging their respective students' participation in the survey. A subsequent email was sent to participating instructors requesting their availability for face-to-face one-on-one interview on or about the fifth week. At the beginning of the third week in June, the data collections team sent reminder emails to students to ensure maximum participation in the survey questionnaire via Survey Monkey (Appendix G).

During the fourth week, the data collection team began begin importing student responses to survey questionnaire

from Survey Money into Microsoft Excel worksheets and subsequently into SPSS. Instructors scheduled the mock exam making it available to students via Black Board. The exam was timed and remained open through the weekend with student's maximum attempt set to "1", and the timer set to two hours. The exam included multiple choice, true/false and matching questions. Instructors were asked to encourage maximum participation from their students, considering that this exam is voluntary. As an incentive to students, participating instructors were asked to incorporate these mock scores as part of the overall student grade for the session.

In July during the fifth week, an attempt for a face-to-face interview with participating instructors was unfruitful due to scheduling conflicts. Alternatively, interview questions were administered electronically, giving the respondents the flexibility of participating at their leisure. Data from the electronic interviews were transferred into Excel and SPSS. During the final week of the summer session, student grades and mock IC3 exam scores were collected from instructors and imported into Excel and SPSS for analysis.

Data Analysis

Students' mock exam scores and final grades were

imported into Microsoft Excel for de-identification and subsequently into SPSS application for analysis. Analyzed results indicated the aggregate totals, mean performances, correlations and variances of student scores and grades obtained during semester or quarter session in comparison with their mock IC3 certification scores.

During this phase, the analysis team used the information obtained to analyze the variance of each survey question's responses and produced results that were discussed to support or refute the researcher's hypothesis. The researcher had hypothesized that the students who enrolled in, and passed traditional semester-length courses were likely to fare better on professional certification exams than students in the shorter, intensive courses. This indication may affect institutional dynamics in course curriculum and syllabi design in the future.

Data collected was entered into SPSS 20.0 in three separate data sets: student scores, student surveys, and instructor surveys. Frequencies and percentages were presented for gender and means and standard deviations were presented for final grades and mock IC3 scores. The results are revealed in Chapter 4.

Research Question 1. How are course grades and certification scores impacted by spacing effect theory?

To assess Research Question 1, two independent sample *t* tests were conducted to assess if there were differences on final grades by format (semester vs. intensive) and differences on mock IC3 scores by format (semester vs. intensive). Additionally, three Pearson product moment correlations were conducted. The correlations assessed the overall relationship between final grades and mock IC3 scores, the relationship between final grades and mock IC3 scores for those in semester format, and the relationship between final grades and mock IC3 scores for those in intensive format. The independent sample *t* test was the appropriate statistical analysis where the goal of a research was to assess if differences existed on continuous dependent variables by dichotomous grouping variables (Pagano, 2010). The Pearson product moment correlation was the appropriate statistical analysis where the goal of research was to assess the relationship between two continuous variables (Pagano, 2010).

For the *t* test analyses, the dependent variables were the final grades and the mock IC3 scores; each being a dependent variable in one *t* test. The independent variable in both *t* test analyses was the teaching format (semester

vs. intensive).

The assumptions of normality and homogeneity of variance were assessed prior to conducting t test analysis. Normality was assessed with the examination of scatterplots depicted in Figures 3 and 4.

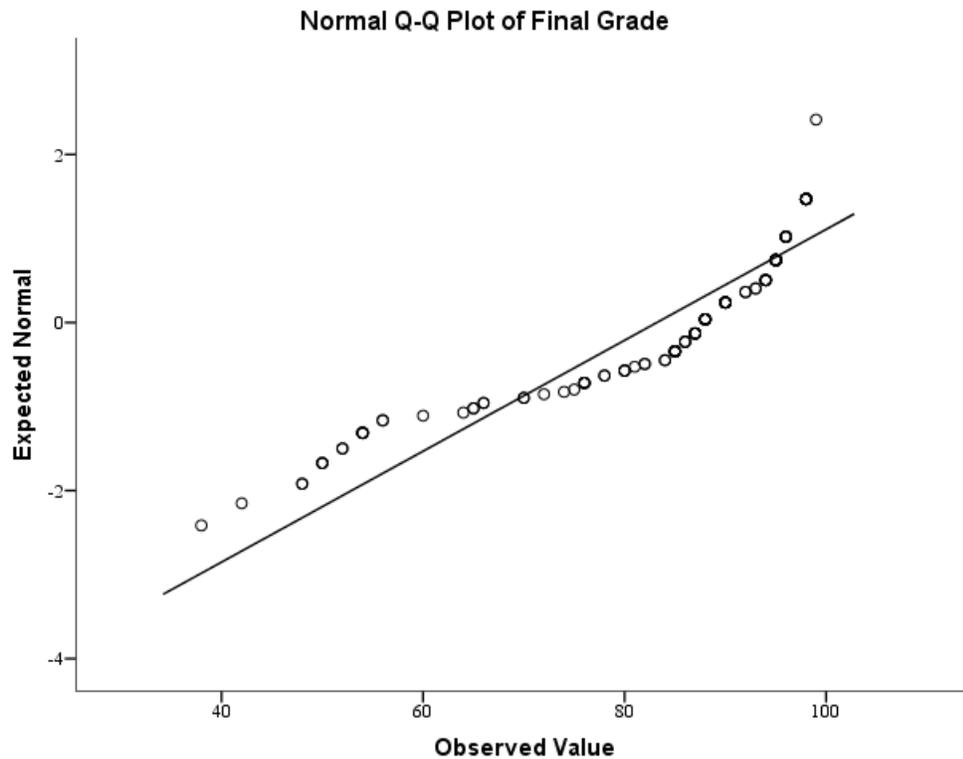


Figure 3. Normality Plot Displaying Final Grades.

This examination assumed that scores were normally distributed. However, in situations where normality was shown to be violated, the t test was quite robust against those violations (Morgan, Leech, Gloekner, & Barrentt, 2007). Homogeneity of variance assumed that both groups (semester and intensive) had equal error variances and were

to be assessed using Levene's test.

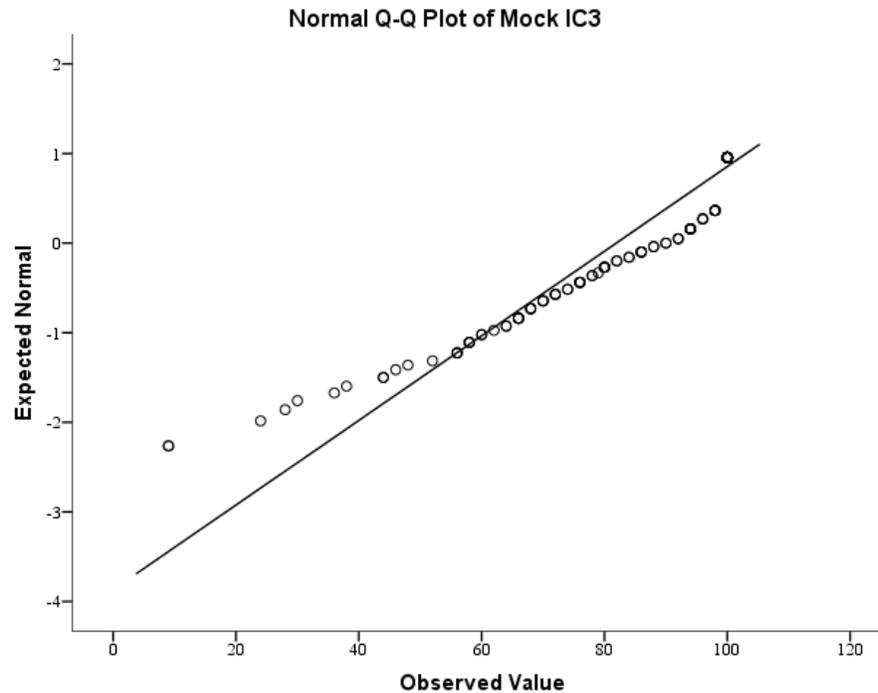


Figure 4. Normality Plot Displaying Mock IC3 Scores.

If Levene's test was significant, the assumption was violated. To adjust for this violation, the degrees of freedom unequal error variances will be used. The t test was two tailed, with alpha levels set at $p < 0.05$ and ensured a 95% confidence that differences did not occur by lone chance. Given an alpha set at .05, a significant finding was rendered when a calculated t value was larger than the critical t value after considering degrees of freedom (df) for independent samples ($n - 2$).

The Pearson product-moment correlation (r) used was a bivariate measure of the strength of the relationship

between two variables. Correlation coefficients can vary from 0 (no relationship) to +1 or -1. Positive correlation coefficients indicated a direct relationship; as one variable increases, the other variable also increases. Negative correlation coefficients indicated an inverse relationship; as one variable decreases, the other variable increases.

Cohen's standard (Cohen, 1988) was used to evaluate the coefficient to determine the strength of the relationship, where coefficients between .10 and .29 represented a small association; coefficients between .30 and .49 represented a medium association; and coefficients above .50 represented a large association or relationship.

Prior to analysis, the assumptions of linearity and homoscedasticity were assessed. Linearity assumed a straight line relationship between the variables and homoscedasticity assumed that scores are normally distributed about the regression line. Linearity and homoscedasticity were assessed with the examination of scatterplots (Stevens, 2009).

Research Question 2. What are the characteristics of students taking courses in quarter-length and semester length computer literacy courses?

To examine Research Question 2, descriptive

information was presented for question 1 - 3 split by Question 5 from the student survey (see Appendix G). From Question 5, fall/spring indicated semester format and intersession/summer indicated intensive format. Frequencies and percentages were presented for gender, age, and employment status; data are categorical.

Research Question 3. What are the characteristics of course faculty teaching quarter-length and semester-length computer literacy courses?

To assess Research Question 3, frequencies and percentages presented the instructors education. Responses presented for education were split by instructor Survey Question 2; and the data was categorical.

Research Question 4. What differences in pedagogical approaches are reflected in course outlines of semester vs. quarter length courses?

To examine Research Question 4, descriptive statistics was presented for instructors to respond to instructor Survey Question 3. Responses were presented split by instructor question two pertaining to what type of sessions were taught in the past. Frequencies and percentages were conducted; and data categorical.

Research Question 5. What explanations do course faculty in quarter-length and in semester-length computer

literacy courses offer about the course grades and certification exam scores of students enrolled in quarter- and semester-length courses?

To examine Research Question 5, descriptive statistics was presented for instructor responses to instructor Survey Questions 6 and 7. For questions 6a and 7a, frequencies and percentages were presented. Data was categorical. For Survey Question 6b and 7b, open ended responses were presented in paragraph form. Responses were presented split by instructor question two pertaining to what type of sessions were taught in the past. Responses for 6b and 7b were then further split by corresponding 6a and 7a instructor responses.

Research Question 6. How will the findings of this study expand educators' understanding of the application of the spacing effect theory in institutions of higher learning?

To examine Research Question 6, a summary and conclusion was presented. The conclusion triangulated the results that were presented throughout the study.

Research Variables

The independent variables were the course outline and length of time taken to complete course. The dependent variables were student grades for quarter-length and

semester-length computer courses, and student mock certification exam scores after completing either training format (see Appendix G).

Student demographic data and characteristics gathered from survey questions in Appendix G included age, gender and employment status. Also collected were faculty demographics on gender, qualification, grading rubric and teaching modalities for both formats. These data added credibility and supplemented the dependent variables of the study.

Research Assumptions and Limitations

Research assumptions are presuppositions of the study while limitations identified potential weaknesses to the study. A noteworthy assumption of this study was that similar teaching modalities were utilized by participating instructors teaching both quarter and semester formats. It was assumed that the course outline, course objectives and course grading rubrics in the semester-length and quarter-length courses were the same.

A key limitation was the fact that results could not be generalized. The number of survey respondents for the qualitative data were few, and thus, results from this population was not an adequate representation of the population. Interview with just a few faculty members of

the target audience did not meet the statistical reliability of the total population. Another remarkable limitation was that the findings of this study could potentially be open to other interpretations, depending on the interpreter's mindset.

Summary

The purpose of this study was to expand educators' understanding of the spacing effect theory by comparing the effectiveness of university quarter-length computer courses versus full semester-length computer courses. In this chapter, the researcher discussed the procedure, design and methodology that utilized in conducting the study. Also detailed in this section were descriptive and analytical approaches to evaluating students' academic performances, their performances in mock IC3 certification exam, and course delivery format. The sample participants were based on registered students for the Computer Literacy course during the data collection period for both semester and intensive sessions.

Chapter 4: Results

Introduction

Chapter 4 presents the data collected for the research, the process for data screening, a descriptive statistics of collected data, and data-analysis techniques employed to respond to the research questions.

Both quantitative and qualitative data were collected concurrently at different intervals during the data collection period and given equal precedence. The findings of the quantitative and qualitative data results, including relevant tables are presented in this chapter as guided by the research questions. The chapter closes with a summary of the results.

Data Screening

Data were collected and transferred into SPSS 20.0 in three separate data sets: student scores, student surveys, and instructor surveys. Data in all three data sets were screened for accuracy and missing data. For the student and teacher survey data sets, data appeared to be accurate and were not missing data in patterns; no cases were removed. For the student scores data set, six cases were missing scores on both final grade and mock IC3; all six cases were removed from the data set.

The data set that contained the student scores were

assessed for the presence of outliers by examining standardized residuals. Standardized values (z scores) were created for each score and cases were examined for values that fell above 3.29 and values that fell below -3.29 (Tabachnick & Fidell, 2012); two cases were removed. Analyses conducted on student score data contained 159 cases. Analysis conducted on student survey data contained 119 cases. Analysis conducted on instructor survey data contained seven cases.

Descriptive Statistics

Of the 119 participants in the student survey, the majority was male (84, 71%). Of the seven participants from the instructor survey, 4 (57%) were male. Frequencies and percentages for the gender of the participants who took part in each survey are presented in Table 2.

Table 2

Frequencies and Percentage for Gender of Students and Instructors

Gender	Students		Instructors	
	n	%	n	%
Male	84	71	4	57
Female	35	29	3	43

Means and standard deviations were conducted on the student scores dataset. Course grades ranged from 28 - 99

with a mean of 79.58. Scores on the Mock IC3 ranged from 9 - 100 with a mean of 81.76. Means and standard deviations for course grades and Mock IC3 scores are presented in Table 3.

Table 3

Means and Standard Deviations for Course Grade and Mock IC3 Scores

Variable	<i>M</i>	<i>SD</i>
Course grade	79.58	17.27
Mock IC3	81.76	21.06

Research Question 1

How are course grades and certification scores impacted by spacing effect theory?

To assess Research Question 1, two independent sample *t* tests were conducted to assess if there were differences on final grade by format (semester vs. intensive) and differences on mock IC3 scores by format (semester vs. intensive). Additionally, three Pearson product moment correlations were conducted. The correlations assessed the overall relationship between course grades and mock IC3 scores, the relationship between course grades and mock IC3 scores for those in semester format, and the relationship between course grades and mock IC3 scores for those in intensive format.

Prior to conducting the t test analysis, the assumptions of normality and homogeneity of variance were assessed. The assumption of normality was assessed with scatterplots (Figures 3 and 4) and data appeared to be normal. The following scatterplots in Figure 5 and Figure 6 display the linearity between final grades and mock scores for the intensive and semester formats respectively. Figure 7 display the linearity between final grade and mock IC3 scores overall.

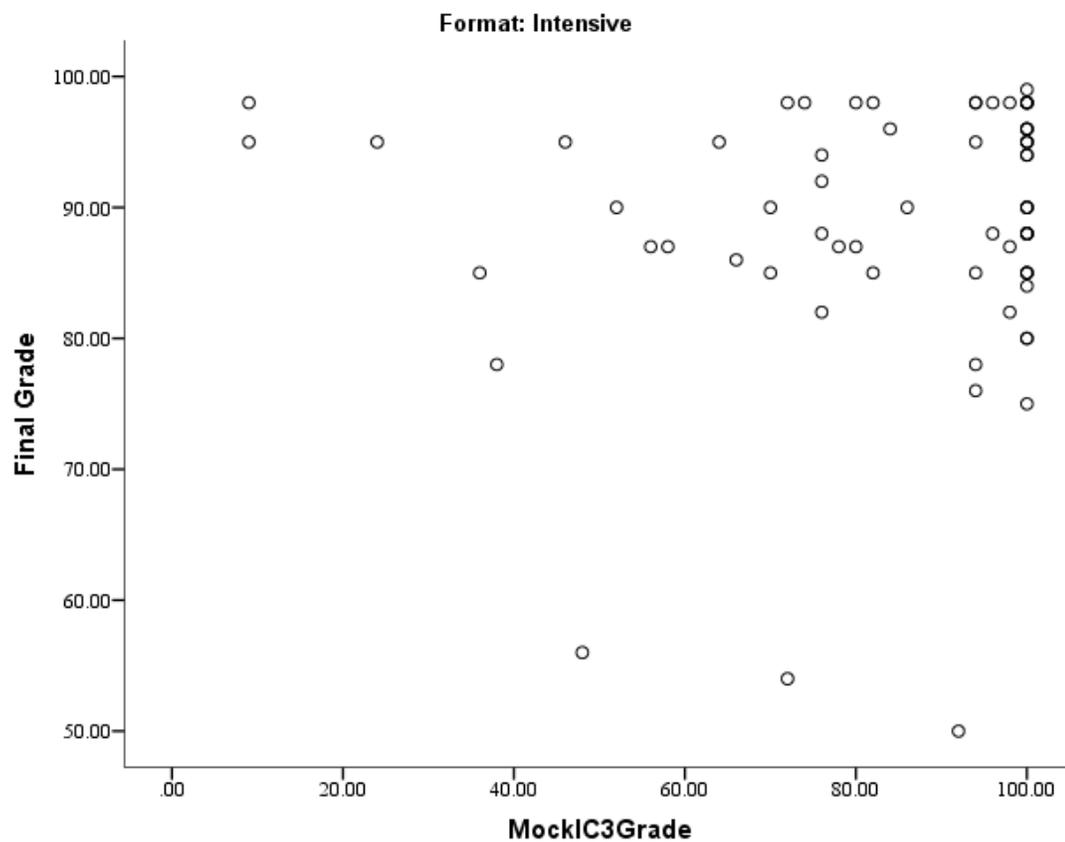


Figure 5. Scatterplot Displaying Linearity Between Final Grades and Mock IC3 Scores for Intensive Format.

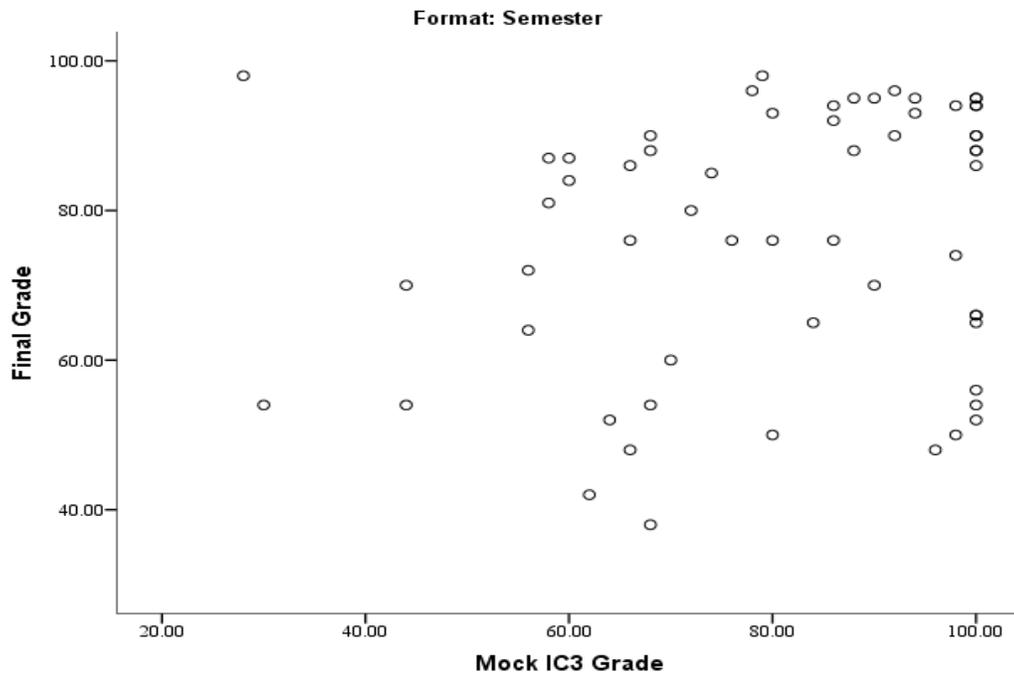


Figure 6. Scatterplot Displaying Linearity Between Final Grades and Mock IC3 Scores for Semester Format.

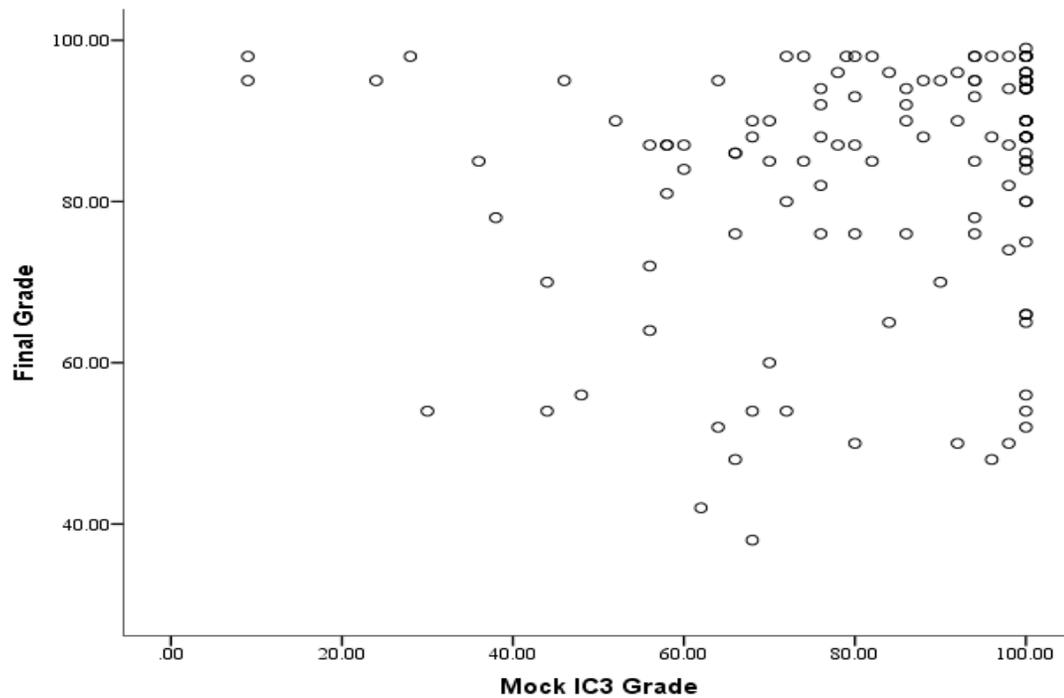


Figure 7. Scatterplot Displaying Linearity Between Final Grades and Mock IC3 Scores Overall.

The assumption of homogeneity was assessed with Levene's tests. The Levene's test was significant for course grades ($F = 29.76, p < .001$); due to the violation, the degrees of freedom for the equal variances not assumed was reported. The Levene's test was not significant for mock IC3 scores ($F = 0.60, p = .440$), indicating that the assumption of homogeneity of variance was met. The assumptions of the Pearson product moment correlation, linearity and homoscedasticity, were assessed with the examination of scatterplots (Figure 8).

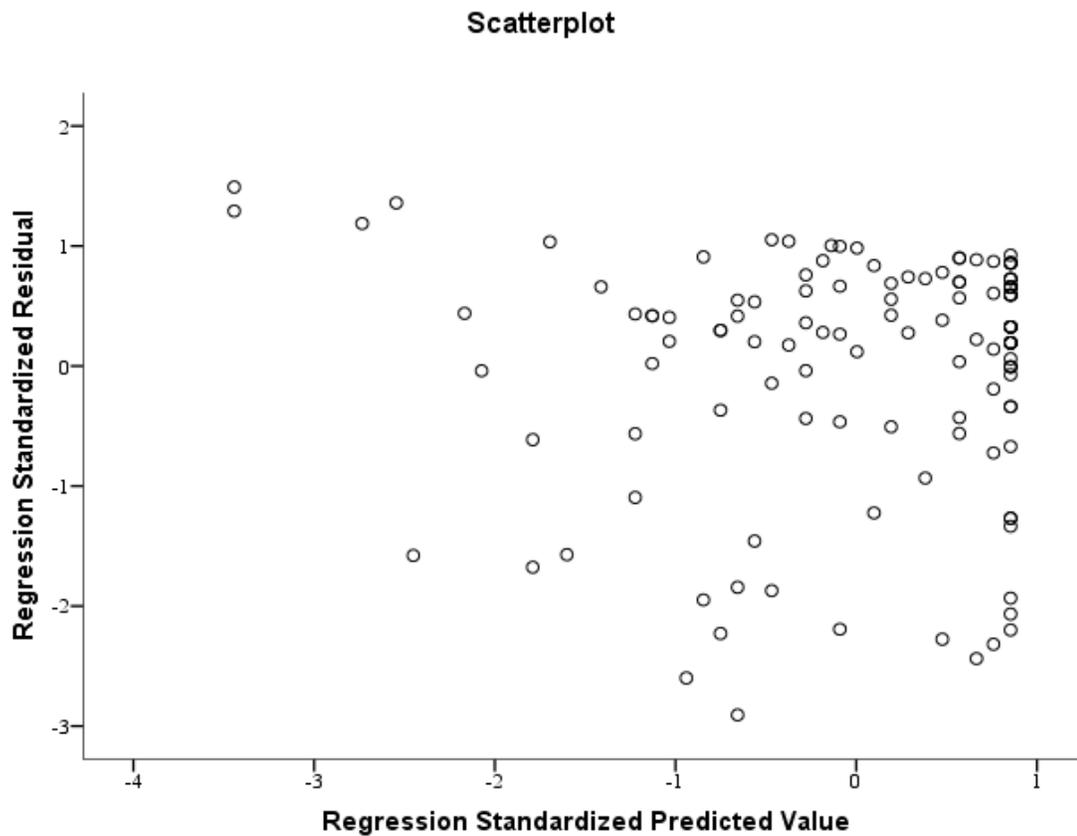


Figure 8. Scatterplot Displaying Homoscedasticity.

Data appeared to be linear indicating that the assumption was met. In the residuals scatterplot, data appeared to be rectangularly distributed above the regression line, also indicating that the assumption was met.

The independent sample t test that was conducted to assess if differences on course grades were significant indicated that there were differences on course grades by format (semester vs. intensive) -- $t(135.25) = -5.73, p < .001$, Cohen's $d = -.91$. An effect size of $-.91$ indicated a larger than typical difference on the scores between the two groups (Cohen, 1988). The students in the intensive format scored significantly higher ($M = 86.87, SD = 11.98$) than the students in the semester format ($M = 72.56, SD = 18.68$). Table 4 present the results of the t test, means and standard deviations by format.

The independent sample t test that was conducted to assess differences on mock IC3 scores was not significant, $t(126) = -0.84, p = .400$, Cohen's $d = -.15$, indicating there were not differences on course grades by format (semester vs. intensive). Results of the t test, means and standard deviations of students' course grades and mock IC3 scores are presented in Table 4.

Table 4

Independent t Test on Course Grades and Mock IC3 Scores by Format

Variable	Semester		Intensive		<i>t</i>	<i>df</i>	<i>p</i>	Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Course grades	72.56	18.68	86.87	11.98	-5.73	135.25	.001	-.91
Mock IC3	80.08	18.97	83.24	22.78	-0.84	126	.400	-.15

Three Pearson product moment correlations were conducted to assess the overall relationship between course grades and mock IC3 scores, the relationship between course grades and mock IC3 scores for those in semester format, and the relationship between course grades and mock IC3 scores for those in intensive format. The overall correlation between final grades and mock IC3 scores were not significant, $r(126) = .15$, $p = .102$, indicating there was no relationship between the two variables. The correlation conducted for the semester format was not significant, $r(59) = .20$, $p = .127$, indicating there was no relationship between final grade and mock IC3 scores. The correlation conducted for the intensive format was not significant, $r(67) = .06$, $p = .641$, also indicating that there was no relationship between final grades and mock IC3 scores. The results of the correlation analysis are

presented in Table 5.

Table 5

Pearson Product Moment Correlations Between Course Grades and Mock IC3 Scores Overall and by Format

Variable	Course grade		
	Overall	Semester	Intensive
Mock IC3	.15	.20	.06

For Research Question 1, the null hypothesis - course grades and certification scores are not impacted by spacing effect theory - must be rejected. There were differences in course grades by semester format.

Research Question 2

What are the characteristics of students taking courses in quarter-length and semester length computer literacy courses?

To assess Research Question 2, descriptive statistics were conducted on student demographic information and presented by semester format, where fall/spring indicated semester format and winter intersession/summer indicated intensive format. Age and gender information were gathered by the data collections team from participating instructors, while employment data was obtained from survey questionnaire. Of the 96 students who took CIS 1010 during

the semester format, the majority were males (51, 53%). Many students indicated their age was 31 or older (40, 42%). Table 6 present demographic information for students by semester format.

Table 6

Means and Standard Deviations for Student Demographic Information by Format

Variable	Semester		Intensive	
	<i>n</i>	%	<i>n</i>	%
Gender				
Male	51	53	38	60
Female	45	47	25	40
Age				
18 - 20	16	17	13	20
21 - 22	16	17	25	40
26 - 30	24	25	25	40
31 or older	40	42	0	0
Employment status				
Full time	40	42	25	40
Part time	16	17	13	20
Not employed	40	42	25	40

Note. Percentage columns may not total 100 due to rounding error.

Many of those students who took CIS 1010 in semester format also indicated that they were either employed full time (40, 42%) or not employed (40, 42%). Of the 63 students who took CIS 1010 in the intensive format, 38 (60%) were male and 25 (40%) were female. These students reported their ages to be 18 - 20 (13, 20%), 21 - 22 (25, 40%), and 26 -

30 (25, 40%). Of the students who took CIS 1010 in intensive format and responded to the survey questions, 25 (40%) indicated they were employed full time, 25 (40%) indicated they are not employed, and 13 (20%) indicated part time employment.

Research Question 3

What are the characteristics of course faculty teaching quarter-length and semester-length computer literacy courses?

To assess Research Question 3, descriptive statistics were conducted on faculty demographic information and presented by semester format or both formats referring both intensive and semester. Of the four possible semester formats faculty could indicate (Winter, Spring, Fall, and Summer), only one indicated full semester (1, 14%) or both were selected (6, 86%). The faculty member who selected full semester indicated the highest level of education completed to be master's degree. Of the six faculty members who indicated both format, 5 (83%) indicated master's degree as the highest level of education completed. One (17%) faculty member indicated a doctoral degree as the highest level of education. Frequencies and percentages are presented in Table 7.

Table 7

Frequencies and Percentages for Highest Level of Education Faculty Completed by Semester Format

Variable	Semester		Both	
	<i>n</i>	%	<i>n</i>	%
Education				
Master's	1	100	5	83
Doctoral	0	0	1	17

Research Question 4

What differences in pedagogical approaches are reflected in course outlines of semester-length vs. quarter-length courses?

To assess Research Question 4, descriptive statistics were conducted for instructor responses to six sub-questions of Survey Question 3 (Appendix G). It was proposed that data would be presented by type of sessions taught in the past (semester versus both), however, the instructor who taught full semester only did not respond to survey items 3a - 3f. Data was presented only for faculty members who have taught both formats. Question 3a asked, "Have you modified or reduced the course syllabi during your teaching session in the past?" The majority of participants indicated "yes" (4, 67%) in response to this question. Question 3b asked, "Was the modification because

of a more compressed session (summer or intersession)?" The majority of participants responded "yes" (4, 80%) to question 3b and one (20%) participant responded "no". Other faculty members did not respond to the question. Question 3c asked, "Did you reduce the number of MS Word/Excel assignments and projects required during this session?" In response to this question, half (3, 50%) of the instructors indicated "yes" and half (3, 50%) indicated "no". Question 3d asked, "Did you modify the grading rubric for course assignments?" In response to question 3d, half (3, 50%) of the instructors indicated "yes" and half (3, 50%) indicated "no". Question 3e asked, "Did you reduce or completely eliminate the research project requirement of the course?" Again, half (3, 50%) of the instructors indicated "yes", that they did reduce or completely eliminated the research project requirement of the course, and half (3, 50%) indicated "no". Question 3f asked, "Overall, did your students grasp the course content upon completing the course?" Only five of the participants responded to this question and all five (100%) participants indicated a "yes". Frequencies and percentages for participants' responses to survey items 3a - 3f are presented in Table 8.

Table 8

Frequencies and Percentages for Faculty Responses to Items 3a - 3f for Instructors who Have Taught CIS1010 in Both Formats

Question	Yes		No	
	<i>n</i>	%	<i>n</i>	%
3a	4	67	2	33
3b	4	80	1	20
3c	3	50	3	50
3d	3	50	3	50
3e	3	50	3	50
3f	5	100	0	0

Research Question 5

What explanations do course faculty in quarter-length and in semester-length computer literacy courses offer about the course grades and certification exam scores of students enrolled in quarter and semester-length courses?

To assess Research Question 5, descriptive statistics were conducted for instructor responses to survey items six and seven. Both survey items had two parts; the first part required a multiple choice response and the second part required an open ended response. The first part of question six asked, "Which format do you believe your students performed or will perform better at the end of the course?" Data was assessed by type of sessions taught in the past (semester vs. both).

The lone instructor who had taught CIS 1010 only during the regular semester indicated that regular semester students will outperform their intensive format counterparts. The instructor indicated the following reasons for this belief: (a) previous experience with intensive format student indicated that the students did not take the course seriously, (b) most intensive students did not take notes or had time to read the text book, (c) the instructor had to substitute a lot of hands-on in-class exercises to complement the lack of not completing assigned homework, (d) Students were mostly ill prepared for class, and (e) Most students prepared for class quizzes and exams from practice tests without reviewing the text book.

Of the six instructors who have taught both formats, four (67%) instructors indicated that students performed or will perform better in the intensive format. Of the four instructors who indicated that students will perform better in intensive format, one instructor simply responded, "Compressed course material." Of the other three responses provided by the instructors, two instructors reported that the students who took the intensive course displayed characteristics of students who want to succeed. One instructor listed the following five reasons: (a) Intensive session students in the long run prove to be more retentive

of their material, (b) Intensive students prove to be more mature, (c) These students are more punctual and attend all class sessions, (d) These students are more prepared and focused, and (e) Intensive students are taking fewer classes hence will study better for the course.

Presenting a similar response, one instructor stated that, the students actually tend to perform better during the summer session than the regular 15 week semester. The instructor added that it is difficult to determine the reason for this disparity. However, the reason could be because those who stick with the course until the end are usually very determined to succeed, even after having been explained the rigors of the course. Oftentimes the ones who find it very challenging withdraw from the course, leaving those who are willing to put the effort to pass the course. On the other hand, the regular 15 week semester is usually full of students who sometimes approach the course as though their parents were forcing them to be there. The instructor concluded that some of the students do not make any extra effort to succeed.

In support of the intensive format, one of the instructors stated that many of the projects that were assigned during a regular semester do not need to be completed. That teacher stated the following reasons for

success in the intensive format: (a) The session was short but the students were more focused, (b) Due to shorter term and modified course content, students only covered lectures, (c) Research project which took much of the students' time were eliminated, (d) Word projects were reduced to accommodate the short term, and (e) Excel projects were reduced to accommodate the short term.

Two (33%) instructors indicated that the 15 week semester afforded the students the opportunity to perform better. One of the instructors cited the following reasons: (a) Better semester for students, (b) More hands on with computers, (c) More attention, (d) SAM was good to use, and (e) Blackboard provided good feedback. The other instructor simply stated, "I believe students perform equally well over the semester. If students are committed to completing the course, they will do better whether in the full academic semester or over the summer." The statement indicated that this instructor did not necessarily believe the students performed better in any one format over the other.

Instructor survey item seven asked instructors, "After which session do you believe the students will be able to retain course material for a longer period?" In response to this survey item, the instructor who has taught only in

semester format indicated semester. Of the instructors who have taught in both formats, 3 (60%) indicated semester format and 2 (40%) indicated both; one instructor did not respond to the question. Of the instructors who selected both, one went on to say:

I checked "Semester" because I did not see the option I was looking for which is "Not Sure." The reasons I would have selected "Not Sure" are: (a) It is difficult to measure such an outcome since I may not see the students again to test what they retained, (b) Peoples' styles of learning differ tremendously; while some students are able to retain much of the materials they encounter no matter the format; others simply are not able to do so no matter the format, (c) My observation of Summer Session students is that most are there to fulfill a requirement for a course they may not otherwise take, so they simply want to earn a passing grade and move on. Those who intend to major in the field tend to pay more attention to course materials (this is also true with regular 15 week sessions), (d) Retention of course materials may depend on whether the student's course of study is in "Information Technology" or if it's not, and (e) My overall opinion is that students may retain more materials for the regular 15 week semester format; again it depends on numerous factors.

The instructor who has taught only semester format indicated that the response is the same as it was for question six: (a) In past experience, most students did not take the course seriously, (b) most students did not take notes or read the book, (c) he had to substitute a lot of hands-on in-class exercises to complement the lack of not doing work on own, (d) students were mostly ill prepared

for class, and (e) most students only used practice test as their preparatory tool for tests. The instructor also added a sixth point, that "The material is a lot" to be covered during the intensive format.

Of the two instructors who taught both formats and indicated students will retain material longer in semester format, one simply stated, "longer term for rehearsal." The other instructor did indicate five reasons for selecting semester format and those reasons were: (a) The students had more time to study course material, (b) Excel projects were covered for two weeks, (c) Word projects were covered for two weeks, (d) students had a chance to ask questions on assignments to get a better understanding during the semester session, and (e) students had a chance to discuss assignments with friends or obtain other source of support.

Of the instructors who have taught both and indicated that students retain material the same in both formats, only one instructor properly supported the answer with five reasons. Those reasons were: (a) More time on projects, (b) a better learning curve, (c) individual Attention, (d) longer use of computers, and (e) use of current events to enhanced a learning climate. The other instructor simply stated, "Once the material is related to real life experiences, I think they will retain the information."

Research Question 6

How will the findings of this study expand educators' understanding of the application of the spacing effect theory in institutions of higher learning?

To address this research question, an in-depth discussion and analysis of the findings in research questions one through five were reached. The researcher addressed this question by discussing the he practical implications of the study, and presented these implications in Chapter 5. In that section to follow, the researcher's perspective of how educators' will apply the findings of this study at institutions of higher learning are elicited.

Conclusion

Research question 1 asked, "How are course grades and certification scores impacted by spacing effect theory?" The *t* test analysis revealed that students in the intensive format had significantly higher course grades than those in the semester format. Conversely there were no significant differences on the mock IC3 scores. The Pearson correlations that were conducted to assess Research Question 1 also revealed no significance, indicating there were no significant relationships among the course grades and mock IC3 scores overall or by format (semester vs. intensive).

Of the students who took CIS 1010 in the semester format, the majority were males and many indicated their ages were 31 or older. Many students, 40 (42%) also indicated that they were employed full time, 16 (16%) indicated they were employed part-time and the remaining 40 (42%) indicated that they were unemployed.

Of the 63 students who took CIS 1010 in the intensive format, the majority were male students and reported their age range between 18 and 30. An equal number of students indicated they were employed full time (25) or part time (25), and 13 indicated they were not employed.

Of the faculty who had taught CIS 1010 in both formats, the majority indicated they had modified or reduced the course syllabi during teaching sessions stating that the modification was because of a more compressed session (summer or intersession). Half of the faculty indicated they reduced the number of MS Word/Excel assignments and projects required during the intensive session and the other half indicated they did not. The same number also indicated they modified the grading rubric as well as reduced or completely eliminated the research project requirement of the course. Five of the faculty members indicated their students grasped the course content upon completing the course in both formats.

In regards to instructor Survey Questions 6 and 7, some of the instructors did not follow the directions in support of their responses, therefore all frequencies did not properly add up to the complete number of responses. Of the four instructors who indicated that students will perform better in intensive format, only two provided five reasons. Of those two instructors, one indicated that the reason for student success was due to an internal drive to succeed, while the other instructor indicated that the success was merely due to fewer projects, assignment, and lectures. Two instructors indicated that the 15 week semester afforded the students the opportunity to perform better. One instructor stated that the 15 week semester was the format students performed better, and cited a reason related to the availability of computer programs. The other instructor believed students perform equally well over the session regardless of the format in question.

In response to instructor survey question inquiring which session or teaching format they believed the students will be able to retain course material for a longer period, four instructors (60%) indicated the semester format and two (40%) indicated both formats. Of the instructors who indicated students retained more in the semester format, two felt this was because the students had a longer time to

study and learn the material. A similar reason was provided by the instructor who indicated students from both formats will retain information equally.

Summary

In this chapter, results were presented from both the qualitative and quantitative data collected and analyzed in an effort to answer the research questions. Direct excerpts from faculty responses to survey questions revealed their perceptions of student performances in either teaching format (intensive or semester) were also presented. In Chapter 5, the researcher elaborates on the research findings relating to each survey question and provides an overview of the significant findings in relation to existing research and literature on the spacing effect theory.

Chapter 5: Discussion

Introduction

Years of anecdotal reports of continuous disparity in student grades after completing quarter-length versus semester-length Computer Literacy course at the Prince Georges Community College aroused the researcher's interest in initiating this study. The researcher began investigating this concern to understand the reason behind the disparity. Furthermore, the study explored whether similar teaching modalities were employed and compared student semester grade performances with their certification scores. A mixed triangulation study was employed where qualitative and quantitative data were collected and analyzed. Grounded by the spacing effect theory, the following six research questions guided the study:

1. How are course grades and certification scores impacted by the spacing effect theory?
2. What are the characteristics of students taking courses in quarter-length and semester length computer literacy courses?
3. What are the characteristics of course faculty teaching quarter-length and semester-length computer literacy courses?

4. What differences in pedagogical approaches are reflected in course outlines of semester vs. quarter length courses?

5. What explanations do course faculty in quarter-length and in semester-length computer literacy courses offer about the course grades and certification exam scores of students enrolled in quarter- and semester-length courses?

6. How will the findings of this study expand educators' understanding of the application of the spacing effect theory in institutions of higher learning?

Chapter 5 begins with an overview of the research study and continue with an in-depth discussion of how the study results ties into current and past studies on the spacing effect theory. Furthermore, the implications of the study results at institutions of higher learning are discussed. The researcher's interpretation of the study's findings in light of the relevant research and the context of the findings as supported by literature on the spacing effect theory are also discussed. The chapter concludes with a discussion on the limitations of the study and recommendations for future research.

Overview

The purpose of this study was to expand educators'

understanding of the spacing effect theory by comparing the effectiveness of university quarter-length computer courses against full semester-length computer courses. Students who were enrolled in a Computer Literacy Course (CIS 1010) during academic year 2011-2012 and 2012-2013 at Prince Georges Community College were sampled for the study. Student grades of four quarter-length (intensive) and four semester-length sessions were collected and compared.

The study was directed towards validating whether students' higher performances in the CIS 1010 course taken during the intensive session (intersession, mini- and summer session) as anecdotally purported equated their performances on the nationally recognized Internet and Computing Core Certification (IC3) exam or not. The process of this validation was based on comparing student grades and mock certification scores after completing the CIS 1010 course during an intensive versus semester format. CIS 1010 is designed to cover preparatory material required for IC3 exams.

The outcome of this study discussed in this chapter described the level students' mastery of instructional content acquired during either format. A further discussion of the results is to provide institutional leaders a rationale for determining, redesigning, adopting and

maintaining a teaching format best suited for the students in the course (quarter or semester).

Summary of Findings

Research Question 1. In addressing this research question, a *t* test analysis was performed and the test revealed that students in the intensive format had significantly higher course grades than those in the semester format. The test on the other hand revealed no differences on the mock IC3 scores. A Pearson correlations conducted to assess this research question also showed no significance, indicating that there were no significant relationships among the students' course grades and their mock IC3 scores overall or by format (semester vs. intensive). Assumption of normality assessed with scatterplots revealed data appearing to be normal. Levene's tests used to assess the assumption of homogeneity indicated a significance for course grades ($F = 29.76, p < .001$) and no significance for mock IC3 scores ($F = 0.60, p = .440$) - indicating that the assumption of homogeneity of variance was met.

Research Question 2. This research question addressed the demographics of the students who took the course in both formats. Demographic data on participants' age, gender and employment status were collected. Of the students who

enrolled in the CIS 1010 course during the semester format, majority were males and many indicated their ages were 31 or older. Of the semester enrollees, 40 (42%) indicated that they were employed full time, 16 (16%) indicated they were employed part-time and the remaining 40 (42%) indicated they were unemployed. Of the 63 students surveyed during the intensive session, the majority were males with an age range between 18 and 30. Employed full time in this surveyed group were 25 students and 13 indicated they were not employed. Participant demographics revealed no direct significant relationship between the students' course grades and their mock IC3 scores overall or by semester or intensive format.

Research Question 3. This research question was designed to gather demographic data on CIS 1010 faculty. Demographic data of significance to the study was the qualification of each faculty member teaching the course and their teaching formats thought in the past. Seven faculty members were sampled for the study and they all indicated their educational backgrounds were information technology or IT related. Of this faculty, one indicated having thought the full semester only and the remaining six indicated they have thought in both formats. The faculty member who selected full semester only indicated the

highest level of education completed to be master's degree. Of the six faculty members who indicated having taught both formats, one faculty member indicated a doctoral degree as the highest level of education and the rest indicated a master's degree as their highest level of education. These indications justified their qualifications in teaching the introductory CIS 1010 course, but had no direct significance in impacting students' course grades and mock IC3 scores during a semester or intensive format.

Research Question 4. In addressing what differences in pedagogical approaches reflected in course outlines of semester vs. quarter length courses, the researcher obtained and compared course syllabi for both formats. There were no differences in these documents. Faculties were also surveyed to understand teaching practices for both formats. This survey revealed that the faculty modified or reduced the course syllabi content during the intensive format because of a more compressed session. Most of the faculty indicated that they reduced the number of MS Word/Excel assignments and projects required during this session than during the regular semester. They also indicated that they modified the grading rubric, research project requirement, or completely eliminated the research project during the intensive session. These reasons were

analyzed to directly impact student performances. The findings presented a significant relationship between faculty actions and the disparity in students' course grades during the semester and intensive formats. Analysis also revealed no direct correlation in faculty action and student mock IC3 scores overall or by teaching format.

Research Question 5. Faculty responses to the survey question regarding which teaching format they believed students were likely to retain course material for a longer period, revealed that students from the intensive outperformed their semester-length counterparts in the short term. Reasons they cited in support of this assertion were that: the intensive students had an internal drive to succeed, fewer projects required, fewer assignments, and a stress free lecture sessions. Faculty (a minority) who leaned towards the semester format students performing better in the long term cited reasons that there were availability of computer programs for the students. They further added that the students had a longer time to study the course material and had the opportunity to discuss with other students.

Research Question 6. Research Question 6 was geared towards understanding how this research study's findings were to expand educator's application of the spacing theory

in institutions of higher learning. The researcher addressed this question in the practical implications section discussed further in this chapter. Furthermore, a detailed perspective of how leaders may use the results of this study in course design, scheduling and teaching practices is also discussed.

Interpretation of Findings

As anecdotally purported in the introduction of this study that students in intensive format earn better grades than their semester-length counterparts, data collected clearly supported the assertion. The *t* test analysis supported this assertion presenting results that students in the intensive format earned significantly higher course grades than those in the semester format. The *t* test analysis did not reveal any significant differences on the mock IC3 scores of students from both formats.

A Pearson correlation conducted to assess whether course grades and certification scores were impacted by the spacing effect revealed no significant impact. This discovery indicated that there were no significant relationship between course grades and mock IC3 scores overall or by format (semester vs. intensive).

Student and faculty demographic data had no significant impact on the study results. Students' ages,

gender or employment statuses had no effect on their scores in either format (intensive or semester). Students' employment statuses of full-time, part-time or unemployed revealed no significance in either course grades or mock exam scores. Similarly, faculty gender or qualification had no direct impact on the student's performances in either mock exams or end of session performance.

Of the faculty who taught the CIS 1010 in both formats, the majority indicated they had to modify or reduce the course syllabi during the intensive teaching sessions. They justified their actions stating that the session was too compressed. Considering this reason offered for modifying course syllabi, a course redesign is necessary. The redesign process must begin with a thorough evaluation of the course objectives and expected learning outcome. If the redesign warrants a reduction in course material for the intensive format, the reduction should be done with caution. A redesign consideration must factor in the requirement that modified objectives and outcome cover course content that satisfies the prerequisite for completing the IC3 exam, and meets the accreditation requirements of the institution.

Survey responses indicated that faculty reduced or modified course requirements for the intensive format.

Majority of the faculty reduced the number of Microsoft Word or Excel assignments. Some reduced or completely eliminated the research project requirement. Other faculty modified the grading rubric requirement of the course during the intensive format. Though majority of the faculty who thought both formats indicated that their students grasped the content upon completing the course, the modifications of course requirements during the intensive format establishes inequality in content covered. Consequently, the course material being learned by students is different in both formats.

A majority of the faculty also perceived that their students will perform better during the semester format. The data collected on student end-of-term performances revealed the contrary. Considering the unconstitutional practices adopted by faculty in modifying course content during the intensive format, it is evident that students in both formats were not being thought similar content. Supported by the *t* test analysis of this study, students in the intensive format in effect, earned significantly higher course grades than those in the semester format. However, results revealed no significant differences on the mock IC3 scores of the students in both formats.

Also indicated by faculty responses to the survey

question about which session they believed students were to retain course material for longer periods, majority indicated semester format students will retain the information the longest. A common reason faculty provided was that the semester-length students had a longer time to study and learn the course material. This belief could not be corroborated or justified with semester students' mock scores. The *t* test analysis revealed no significant difference in mock IC3 scores.

Faculty pedagogical approaches for the CIS 1010 course had a direct influence on student performances at final exam level. As confirmed in study results, many faculty modified the syllabus, content, assignments, projects, and grading rubric for intensive session due to a shorter period to complete the course requirement. These modifications were confirmed by the *t* test analysis which revealed that students in the intensive format earned significantly higher grades than those in the semester format.

A Pearson correlation conducted to assess the overall relationships among the course grades and mock IC3 scores presented no direct relationship between course grades and mock scores of the students in either format. The *t* test analysis also revealed that there were no significant

differences on the mock IC3 scores of students in both formats.

Context of Findings

Researchers Rohrer and Pashler (2007) and Dempster (1988), in recent and past research on the spacing effect theory, focused on the applicability of the spacing effect phenomenon in classroom practices. Doyle and Yantis (2007) supported the assertion in the spacing effect theory that humans are more likely to remember learned concepts studied over longer periods of time, rather than concepts studied repeatedly in shorter periods.

Contrary to Doyle and Yantis (2007) and past researchers Dempster (1988) and Challis (1993), the results from this study corroborated most recent researchers' findings on intensive and traditional formats. Westover (2009), Hall (2008), and Bohlin and Hunt (1995) in recent and past studies revealed results that favored the superiority of intensive format (massed presentation) over semester-length formats (spaced presentation). Similar to these results and findings from other researchers like McLeod, Horn, & Haswell (2005), Weiner et al. (2003), and Wlodkowski, Geltner and Logan (2001), this study results also found intensive student performances surpassing the traditional semester students' performances. This provides

an indication that massed presentation led to better memory performances than spaced presentations as stated in Weiner et al. (2003).

Weiner's study on memory performances was based on short term investigation during a semester or academic year. Studies geared towards comparing performances and participant retention of learned concepts over long periods may reveal results in support of spaced presentation. This study investigated the relationship of student scores and their performances in certification exams after taking courses during intensive or semester session. Results revealed no significance differences.

German psychologist, Hermann Ebbinghaus, who was famous in his experimental study of memory and discovery of the forgetting and learning curves, also investigated the spacing effect theory. This theory asserted that learned concepts during a spaced presentation format will be retained and recalled over longer periods. As discussed in previous paragraphs, recent literature has refuted this theory's assertion contending that students will perform better in shorter course formats (Bohlin & Hunt, 1995) than semester-length formats.

Implications of Findings

The researcher expounded on the implications of this study findings from different perspectives. From a theoretical perspective, the researcher discussed study results as related to the spacing effect phenomena. Further discussed are implications associated to current and past research on spacing theory. The section concludes with a discussion on issues with existing design and the practical implications of the findings.

Theoretical implications. The t test results of this study revealed that students in the intensive format earned significantly higher course grades than those in the semester format. This finding remained consistent with current theories of the spacing effect as supported by current and past research. This study results supported previous researchers' whose results found intensive students overwhelmingly outperforming their semester student counterparts. Contrary to Bohlin and Hunt (1995) and other researchers whose studies were also oriented on the spacing effect theory and offered support for traditional semester length courses, this study's results refuted their assertions.

The findings in this study also contradicted other studies on the spacing effect phenomena that labeled massed

presented content as being inferior. Doyle and Yantis (2007) believed this inferiority in learning standard was due to an overwhelming amount of workload compressed over a short period. Doyle and Yantis added that intensive course loads became relatively unmanageable by the students, and ultimately resulting to low student performances. Most students usually enroll in one or two courses during the intensive session compared to an average of four courses during the 16-week semester period.

Research implication. The findings from this study revealed facts in support of past and recent research on the spacing effect phenomena. Researchers Westover, 2009; Hall, 2008 and Bohlin and Hunt, 1995 in recent study revealed results that favored the superiority of intensive format (massed presentation). Similar to these researchers' findings, the results from this study revealed that intensive course formats awarded students' better grades. However, these grades had no significance when correlated with the student's mock certification scores overall by semester format.

Retention of learned concepts over longer periods was not measured in this study due to survey participants dispersing after the cohort ended. This triggers further investigation in unveiling new confounding variables for

future research. Conducting a study in the spacing effect phenomena should consider long term retention of learned concepts from students of massed and spaced presentation sessions.

Researchers Homeyer and Brown in their 2002 study on student attitudes and their performances after taking courses during massed or spaced presentation formats revealed no significant difference in the results. Similarly in this study, the Pearson correlation results revealed no significant differences in the Mock IC3 scores taken by students who completed the course material during intensive or semester format.

Contrary to many research findings in favor of intensive students outperforming their semester counterparts, researchers who engaged in abstract studies reached results in favor of semester formats. Kornell and Bjork (2008) performed an abstract learning study on student performance from massed and spaced presentation cohorts. Their results revealed that participants of the spaced study outperformed those under massed study. Similarly, Rohrer and Taylor (2006) in an abstract study to calculate the number of permutations using mathematical calculations, students who engaged in the practice over longer periods outperformed those who took a shorter term.

Practical Implication. The results of this study supported offering more intensive courses in institutions of higher learning as evidenced by the data collected in Chapter 4. Analyzed results presented the superiority of intensive format over traditional format based on students' end of session grades. With this evidence, institution leaders should rethink, redesign and redirect their focus in offering more intensive courses during an academic year.

The study further enlightens institutional leaders on teaching modalities utilized during an academic period. This gives them the opportunity to establish and adopt standardized teaching practices across formats. Furthermore, the leaders could use the findings to enforce teaching practices expected of their faculty.

Academically at-risk students with failing grades and low GPA scores should be encouraged to enroll in intensive courses to refurbish their academic standing. This in turn increases their chances of earning higher scores and consequently bringing up their grade point averages.

More intensive courses should be offered across disciplines. Foundation level credit courses are excellent examples to be offered in the summer or mini-sessions. The more intensive courses offered, the more flexibility students have in decision making, and consequently better

performances.

Traditionally, most junior and senior level courses are offered during regular semester and very few during shorter periods. Institutional leaders may consider offering more freshman to senior level courses during intensive the sessions.

A caveat with offering more intensive courses is ensuring that control measures are established to limit the number of accelerated courses each student can enroll in during an intensive session. This control measure should relieve the students from carrying an overwhelming school load that could ultimately snow ball into unsuccessful completion of the course, a course repeat, possible withdrawal, poor grade, and consequently a lower grade point average.

Curriculum designers must ensure course syllabi and course guides for intensive courses include relevant content that satisfy the overall objectives of each course offered. An unacceptable practice is to have different versions of course syllabi for the same course being at different intervals (semester or intensive). This may lead to accreditation issues at the institution.

Most intensive courses are offered during the summer and the winter intercession. Accelerated courses should be

offered all year round. To fulfill this proposition, a traditional 15 week semester can be divided into a couple of shorter sessions. As such, more than one intensive course can be offered during a regular 16-week semester, at two eight-week mini-semesters.

Faculty teaching intensive courses should utilize pedagogies and teaching modalities that must cover all relevant material. This will guarantee that students taking classes in either intensive or semester format are awarded the opportunity to cover similar at all times.

A standardized teaching approach should be adopted by all faculty members in disseminating course content, student assessment, and evaluation of students in either intensive or semester formats. This practice should be adopted across all disciplines. Circumventing course syllabi and grading rubric, as revealed in this study, indicated evidence of overwhelming amount of faculty workload during the intensive session. Leaders should keenly investigate these reasons for future curricula redesign.

Discussion on limitations of Study

After reviewing practical and scholarly literature on the application and dynamics of the spacing effect phenomenon, comparable sets of limitations of were evident.

Some limitations were complex and un-fulfillable, while others were limited by the scope of the research. The following limitations were compiled during this study and presented a foundation for further research in the spacing effect phenomena.

A key limitation of this study was the researcher's inability to utilize actual IC3 exam scores of students for analysis. Many freshman level students taking the course have no motivation in obtaining certification of any kind. Some do not understand the significance of certification. Their primary goals were to earn a passing grade and fulfill the credit requirements in their curriculum, not taking a certification exam upon completion. Furthermore, considering the fact that the IC3 exams required a registration fee, most college students struggling to make ends meet placed no significance in certification exams.

In this study, a mock exam was administered to the students instead of collecting data on actual IC3 scores. Future research should use actual IC3 scores of students who completed both intensive and semester formats. This could be challenging considering that students who complete the preparatory course for the exam may disperse after the cohort, or may not have the desire to register for the exam. The mock scores in this study may not factually

reflect student performances if they had completed the course with an innate desire of taking the exam thereafter. Most likely the students would be more attentive and focused in class in preparation to take the exam.

Another limitation was the fact that results could not be generalized. Few participants responded to the qualitative questions. Responses from this population were not adequate to satisfy and represent the population. A larger sample which included all the students enrolled during the survey period would be ideal for this study. Supported by Salvia and Ysseldyke (2004), research goals are to generalize findings to a larger population. This was not feasible in this study because participation was voluntary and requests for participation were sent out when students were concentrating on their final exams.

Qualitative data were collected from few faculty members of the target audience which did not meet the statistical reliability of the total population. This defeated the goal of research purported to generalize research findings to larger populations (Salvia & Ysseldyke, 2004). A reason for this limited data was due to scheduling constraints. The institution where research was conducted has a vast pool of adjunct faculty seeking teaching opportunities. Course sections surveyed were

unlikely to be taught by the same instructor during the survey period. This resulted in dissimilarities in teaching modalities for the survey classes. Another consequence of this was evidenced by the disparity in students' grades in intensive and semester-length sessions.

A consideration of survey participant's course load during the survey period was not included. Students enrolled in compressed sessions are usually inclined to registering for fewer courses than students in semester session. Fewer course loads per participant during the intensive format could be an indicative in the disparity in their grades against their semester counterparts. Future studies should consider the number of courses each participant is enrolled in during the survey period.

A crucial limitation of this study was the inability to determine student retention level of learned concepts over an extended period of time beyond the quarter or semester in question. College students normally disperse from their institution after graduation, leaving the researcher relatively no means of reaching sampled participants to continue conducting research that could shed light and justify retention of prior learned concepts. This calls for further research to determine long term retention of learned concepts.

Discussion on Future Directions of Research

While this study's findings added to the bulk of studies in favor of intensive format (Westover, 2009; Hall 2008; Bohlin & Hunt, 1995; McLeod, Horn & Haswell, 2005; Weiner et al., 2003; Wlodkowski, Geltner & Logan, 2001; etc.), the data findings presented no significant differences in certification results. This research was fundamentally designed and focused on the arena of the spacing effect phenomena to correlate student class grades with their certification-based performances. The research results have triggered the need to replicate the study, improve on the study and an ardent desire for further research on long term retention of learned concepts in either format (intensive or semester).

A replication of this study is required to explore the impact on the study results considering variables such as participants prior knowledge of computers before taking the class, frequency of computer usage, the number of courses taken in combination with the CIS 1010 course, whether the course is a repeat or not, whether faculty teaching the course is new to teaching or not. In support of the later consideration, Kretovics, Crowe, and Hyun (2005) in their study geared towards finding differences in tenured and non-tenured faculty's teaching approaches during the summer

session revealed that tenured faculty were more inclined to change course requirements in response to course length - reducing course requirements for compressed course, as compared to their non-tenured counterparts. Furthermore, the study should be replicated to extend to students of other disciplines.

The study could be improved to add a pre/post evaluation of students understanding of computer concepts before and after taking the computer literacy course. Administering a pre-test at the beginning of the session could provide the researcher with factual data used to determine each student's competence level in computers prior to taking the course. A post-test will certify student mastery of learned concepts after completing the course. Comparing both results will justify students' mastery of acquired knowledge from either intensive or semester format.

A long-term investigation of students' mastery of learned concepts after completing either format is necessary to determine and corroborate the findings from which students were able to retain more. During this investigation a consideration should be made in evaluating other variables such as the participants' frequency in using learned concepts after course completion and how this

may have extended each student's retention. A reasonable, and probably the most practicable, outcome to be reached from this finding is the analysis of data relating to the usage of learned concepts by study participants.

Future studies should include collecting and analyzing additional demographic data from participants to include: prior computer knowledge, prior use of computers, frequency of computer use, and participants' level of computer applications usage (introductory, intermediate or advance users). These variables should be analyzed to determine their impact on student performances.

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Appendix A
Student Solicitation Email Request

Student solicitation request for in survey.

Date: (Date email is composed)

From: (Data Collection Team email)

To: (student email of participating course sections)

Fwd: Survey Participation Request

Hello,

Please take a few minutes of your time to participate in a survey I am conducting about your Computer Literacy course you are currently enrolled in during this semester. Your honest response to the questions shall be appreciated. If you have any questions or concerns, feel free to contact me via email or by phone at (contact number).

Click on the bellow link to access the survey. If the link does not lead you to the survey site, you may cut and paste the link to your browser's URL.

(Link to Survey Monkey Questions)

Thank you,

Data Collection Team

Appendix B
Student Encouragement Email Request

Solicitation request forwarded to instructors of participating classes.

Date: (Date email is composed)

From: (Data Collection Team email)

To: (Instructor email of participating course sections)

Fwd: Survey Participation Request

Hello,

The bellow email was sent to your students to participate in an online survey. Please encourage your students to complete the survey as soon as possible.

Thank you for your support.

Data Collection Team.

Please take a few minutes of your time to participate in a survey I am conducting about your Computer Literacy course you are enrolled in during this semester. Your honest responses to the questions shall be appreciated. If you have any questions or concerns, feel free to contact me via email or by phone at (contact number).

Click on the bellow link to access the survey. If the link does not lead you to the survey site, you may cut and paste the link to your browser's URL.

Thank you,

Data Collection Team

Appendix C
Interview Participation Request

Email sent to participating instructors requesting their availability for a face-to-face interview.

Date: (Date email is composed)
From: (Data collection team email)
To: (Participating instructor email addresses)
Re: Interview Participation Request

Hello,

I am conducting a study about the instructional effectiveness of the CIS 1010 course you are currently teaching and will like to schedule a face-to-face interview with you when it is most convenient. Please let me know when it will be most convenient for us to for no more than 30 minutes.

Also, please click on the bellow link to participate in a short survey. If the link does not lead you to the survey site, you may cut and paste the link to your browser's URL.

(Link to Survey Monkey Questions)

Thank you for your time.

Data Collection Team

Appendix D
Survey Participation Reminder

Reminder email sent to students to ensure maximum participation in the survey.

Date: (Date email is composed)

From: (Data Collection Team email)

To: (Student email)

Re: Survey Participation Request

Hello,

A participation email request was sent to you earlier on during this semester. If you have already completed the survey, we appreciate your time and contribution. If you haven't yet done so, please follow the below link to the survey site.

If the link does not lead you to the survey site, you may cut and paste the link to your browser's URL.

(Link to Survey Monkey Questions)

Your honest response to the questions will be appreciated. If you have any questions or concerns, feel free to contact me via email or by phone at (contact number).

Thank you

Data Collection Team

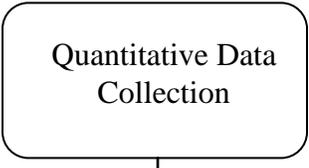
Appendix E
Data Collection Timeline

Data Collection Timeline				
Semester	Intensive		Quantitative	Qualitative
Fall and Spring 16 week	Winter 15 day Intersession	Summer 8 week		
Week One and Two	Day 1	Week 1	Confer with data collection team to review questionnaire.	Communicate data collection intentions with participating faculty.
			Obtain Survey Money Account.	
			Seek consent from participating instructors. Collect course syllabi, course objectives, learning outcomes, grading rubrics and class roster information (student names, email addresses).	Setup appointment for face to face interview of faculty
Week Three and Four			Submit link to students requesting their participation in Survey Money Questionnaire to gather student demographic data	
Week Nine				
Week 12			Administer Mock IC3 exam via Blackboard. Collect Mock scores from instructors.	
Week 16			Collect Student grades after completion of school term	

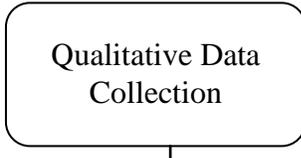
Appendix F
Multilevel Triangulation Model

Procedure

- Student Responses
- Student Mock IC3 scores
- Faculty Survey responses



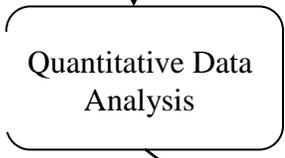
Quantitative Data Collection



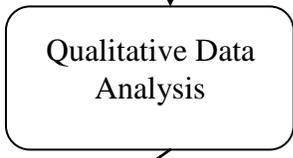
Qualitative Data Collection

Procedure

- Faculty interview responses



Quantitative Data Analysis



Qualitative Data Analysis

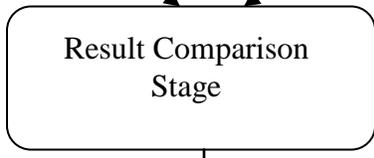
Procedure

Import student data into Excel

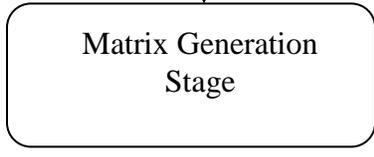
Perform Analysis

Code text data into Excel

Perform Analysis



Result Comparison Stage



Matrix Generation Stage

Appendix G
Survey Questionnaire

CIS 1010 Student Survey

1. What is your gender?

- Female Male

2. Which category below includes your age?

- 18-20 21-22 23-25 26-30 31 or older

3. Which of the following categories best describes your employment status?

- Employed Full Time Employed Part time Not employed

4. If you took or are taking the CIS 1010 course, please answer the following.

	Yes	No
Are you majoring in Information Technology, Engineering or other Computer related?	<input type="radio"/>	<input type="radio"/>
Is CIS 1010 one of your first college course you are taking?	<input type="radio"/>	<input type="radio"/>
Is CIS 1010 a required course for your degree program?	<input type="radio"/>	<input type="radio"/>
Are you taking this course as an elective course?	<input type="radio"/>	<input type="radio"/>
Will you be taking the IC3 certification after completing this course?	<input type="radio"/>	<input type="radio"/>
Would you take the IC3 certification if it was offered free of charge?	<input type="radio"/>	<input type="radio"/>

5. Semester which you took CIS 1010.

- Winter Intersession Summer Fall or Spring Semester

6. Semester(s) taken in the past.

- Full Semester Summer Intersession All None

7. Semester(s) Preferred.

- Full Semester Summer Intersession All None

Please explain your choice

8. CIS 1010 Specific Question.

	To a great Extent	Somewhat	A little	Not at all
How often do you use computers?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How often do you use other electronic devices?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent do you use the internet?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How knowledgeable were you in the use of computers before taking cis1010?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How knowledgeable were you in the use of Microsoft Word before taking cis1010?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How knowledgeable were you in the use of Excel before taking cis1010?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How knowledgeable are you in the use of computers after taking cis1010?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How knowledgeable are you in the use of Microsoft Word after taking cis1010?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How knowledgeable are you in the use of Excel after taking cis1010?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

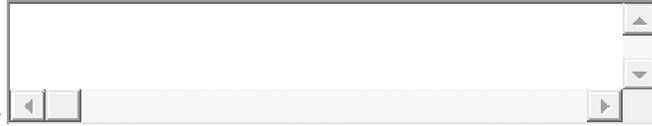
9. Did you take CIS 1010 more than once?

- Yes No

10. Do you believe you mastered the content for CIS 1010 when you completed the course?

- Yes No

Explain your answer



11. Do you believe the learning objective and course outcome was fully covered?

Yes

No

Explain your answer



12. Did you pass the CIS 1010 course?

Yes

No

CIS 1010 Instructor Survey

1. What is the highest level of education you have completed?

- Associate
 Bachelors
 Masters
 Doctoral

2. These questions pertain to your past teaching.

	Summer / Winter Interession	Full Semester	Both
CIS 1010 sessions taught in the past.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During which session did you modify (add or reduce) the standard course syllabi.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. The following questions are relating to Summer or Winter Interession only

	Yes	No
Have you modified or reduced the course syllabi during your teaching session in the past?	<input type="radio"/>	<input type="radio"/>
Was the modification because of a more compressed session (Summer or interession)?	<input type="radio"/>	<input type="radio"/>
Did you reduce the number of MS Word/Excel assignment and projects required during this session?	<input type="radio"/>	<input type="radio"/>
Did you modify the grading rubric for course assignments?	<input checked="" type="radio"/>	<input type="radio"/>
Did you reduce or completely eliminate the research project requirement of the course?	<input type="radio"/>	<input type="radio"/>
Overall, did your students grasp the course content upon completing the course?	<input type="radio"/>	<input type="radio"/>

4. Course Curriculum related questions.

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
The course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

content was consistent with the stated learning outcomes. The texts, materials, and resources supported the course objectives. The Word and Excel projects reflected the course content. The content of this course supports the goals of the degree program.

<input type="radio"/>				
<input type="radio"/>				
<input type="radio"/>				

5. These questions are related to student's Learning Outcome

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
----------------	-------	----------------------------	----------	-------------------

Knowledge and skills gained from this course are relevant to the students. The course content is sufficient in preparing students for the IC3 certification. Learning outcomes are grounded in best practices. Appropriate assessment techniques are used to evaluate

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

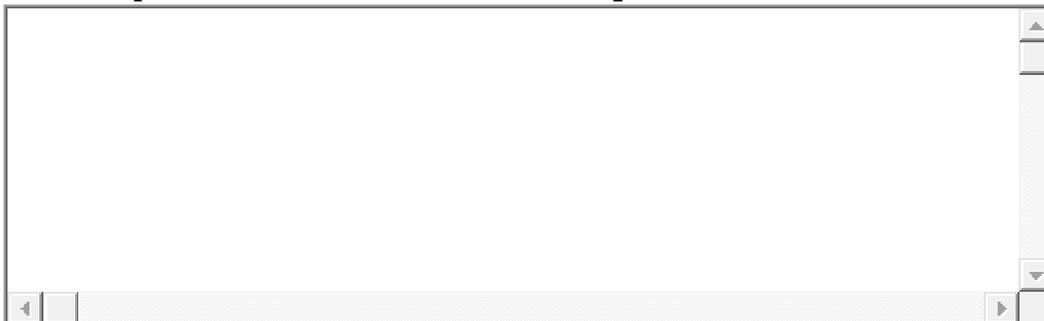
student learning
outcomes.

6. Your overall perception of the course
Intensive (summer or
Interession)

Regular 15 week
Semester

Which format do you
believe your
students performed
or will perform
better at the end
of the course

Please provide five reasons for your answer

A large rectangular text input area with a vertical scrollbar on the right and horizontal scrollbars at the top and bottom.

7. After which session do you believe the students will be
able to retain course material for a longer period?

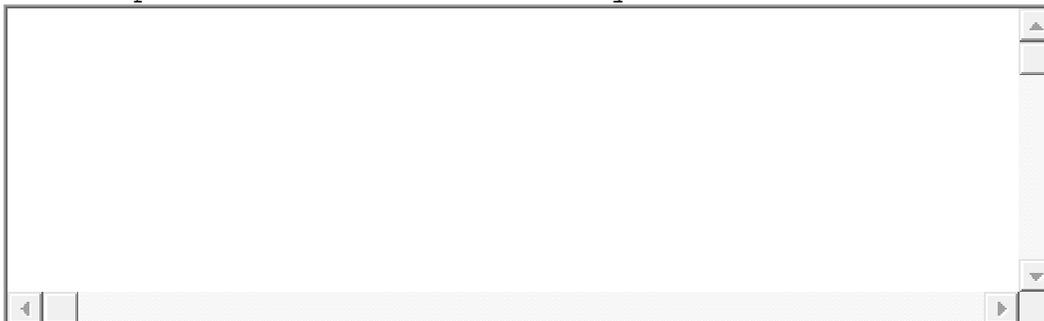
Intensive

Semester

Both

(summer/interession)

Please provide five reasons for your choice.

A large rectangular text input area with a vertical scrollbar on the right and horizontal scrollbars at the top and bottom.

Mock IC3 Certification Questions

Question 1

In Windows software applications, clicking the right mouse button _____.

- selects text.
- brings up a shortcut menu.
- is the same as double clicking.
- is the same as clicking the left mouse button.

Question 2

_____ is the ability to move through a website.

- Linking.
- Grouping.
- Citing.
- Navigation.

Question 3

In Excel, putting the formula =SUM(A1:A16) in cell A16 would cause which of the following errors:

Answer

- Circular reference.
- Missing parentheses.
- Parentheses missing.
- Complex formula.

Question 4

In Excel, if a formula works correctly, but it does not work correctly in cells that you copy it to, this probably means that

- the original formula is wrong.
- absolute addressing should be used in the original formula.
- the original formula has been protected.
- your computer is infected with a virus.

Question 5

The Word feature that would allow you to insert fields from an Access database into multiple copies of a Word document is called

- Track changes.
- List styles.
- Mail merge.
- Insert tables.

Question 6

_____ is the type of physical transmission medium that consists of a single copper wire surrounded by an insulating material, a woven or braided metal and a plastic outer coating.

- wireless cable.
- twisted pair cable.
- fiber-optic cable.
- coaxial cable.

Question 7

Check all of the following that are advantages of fiber optic cable.

- less susceptibility to noise.
- lower cost.
- greater security.
- smaller size.
- faster data transmission.

Question 8

A _____ controls access to the hardware, software, and other resources on the network and provides a centralized storage area for programs, data, and information.

- peer.
- client.
- server.
- internet.

Question 9

The hard drive on a personal computer is usually assigned which drive letter?

- A:
- B:
- C:
- D:

Question 10

When a computer system is operating very slowly, running a(n) _____ utility may allow programs to run faster and improve response time.

- disk defragmenter.
- uninstaller.
- backup utility.
- file compression utility.

Question 11

Permitting programs to run in the foreground or the

background is a function of _____.

Answer

- multi-file management.
- multi-user interface.
- multiprocessing.
- multitasking.

2 points

Question 12

A function in Excel _____

- provides images, pictures, and video to enhance the spreadsheet.
- compares the spelling of words with an electronic dictionary.
- is a request for specific data from a spreadsheet.
- is a predefined formula that performs common calculations.

Question 13

Which of the following goals is related to ergonomics?

- making computer systems more secure.
- preventing repetitive stress injuries.
- reducing software piracy.
- making technology more available to more people.

Question 14

The electric, electronic, and mechanical equipment that makes up a computer is called _____.

- hardware.
- software.
- data.
- information.

Question 15

Which of the following are input devices? Check ALL that are.

- mouse.
- monitor.
- digital camera.
- keyboard.
- speaker.
- microphone.

Question 16

Arrange the following in order from least powerful (this will be #1) to most powerful (#5).

supercomputer.
mainframe.
workstation.
desktop computer.
PDA.

Question 17

The underlying hardware and software of a computer is called its
brand.
platform.
peripheral.
structure.

Question 18

The ALU uses _____ to hold data that is being processed.
cells.
bits.
caches.
registers.

Question 19

The filename extension .jpg indicates the file contains
_____.
word processing data.
graphics data.
programming data.
games.

Question 20

The main directory for a storage device is its _____.
boot.
root.
source.

Question 21

In the file specification
C:\School\English\Homework\Paper1.doc, the item named
English is a
storage device.
file or folder.
folder or subdirectory.
document.

Question 22

The _____ contains user interfaces that allow programs to

be run

- operating system.
- utility program.
- antivirus program.
- software package.

Question 23

In My Computer, if you drag a file from one folder to another on the same drive, you are _____ the file.

- copying.
- moving.
- deleting.
- renaming.

Question 24

If you want to save an existing Microsoft Word document on your screen under a different name, you would use the _____ command under the File menu.

- Save.
- Save As.
- Export.
- View.

Question 25

In order to produce the proper alignment for a bibliographic entry (see below), you should use which feature in Microsoft Word?

Alton, Ronald and Karen Smith.

Fortress of Tragedy: Hong Kong and British Imperial Policy. Toronto: Grolier, 1992.

- first line indent.
- indent.
- hanging indent.
- center indent.

Question 26

Suppose you wish to select several files out of a list in My Computer in order to perhaps copy or delete them as a group. The files are not next to each other in the list. Which of the following keys would you hold down while clicking the mouse on each filename?

- Shift.
- Ctrl.
- Alt.
- Tab.

Question 27

Word processors refer to the layout where the printed page is wider than it is tall as

- portrait.
- landscape.
- xml.
- mail merge.

Question 28

Selecting text would be likely to be done before all of the following EXCEPT

- copying.
- bolding.
- cutting.
- saving.

Question 29

Those concerned with the issue called the "digital divide" are focused on people who have

- difficulty in learning how to use technology.
- little or no access to the latest technology.
- fears about using technology.
- too much exposure to technology.

Question 30

Which of the following is an accurate statement about the Internet

- It began as a project of the Department of Defense. Its operations are controlled by the United States government.
- It was designed primarily for the purpose of e-commerce.
- Most of the information on the Internet is accessible through the World Wide Web.

Question 31

A _____ virus uses the language of an application that records a sequence of keystrokes and instructions in an application, such as word processing or spreadsheet, to hide virus code.

- system.
- Trojan horse.
- file.
- macro.

Question 32

In Microsoft Windows applications software packages such as Word and Excel, the clipboard is used when doing which of the following:

- saving.
- printing.
- copying.
- enhancing.

Question 33

If a word processor spell checker highlights a word as a possible error, which of the following MUST be true?

- The word is a proper noun.
- The word is incorrectly spelled.
- The word is not in the software's dictionary.
- The word should be added to the software's dictionary.

Question 34

Which of the following is the most likely way to get a virus on your computer?

- Sending email to your friends.
- Having it on a new computer that you have just purchased.
- Opening an email attachment.
- Booting a computer with a floppy disk in the A: drive.

Question 35

If you often purchase items at the same e-tailer and do not have to type in your username and/or password, this probably means

- The e-tailer has placed a cookie on your hard drive.
- Your computer has been infected by a virus.
- The data you send to the e-tailer is encrypted.
- Your password is not long enough.

