THE ROLE OF PRACTICE
IN LEARNING COMPUTER LITERACY SKILLS

by

Judy A. Clark

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There is a framework of thought that identifies practice activities as an important component in the learning process. The intent of this study was to investigate the relation between the number of practice activities completed by the student and the student’s exam score. The population (n=183) consisted of students enrolled in a computer literacy course at a small midwestern university. SAM, Skills Assessment Manager, was the software that was used to train and assess the students in this study. The student first completed a pretest. The student was then provided access to training activities and lastly completed an actual assessment covering the same performance tasks. The Hake Model was implemented to calculate a normalized gain score. The correlation between the number of practice activities completed by the participant and the participant’s exam score was significant. The correlation between the number of practice activities completed and the participant’s normalized gain score was also significant. An alpha level of 0.002 was used for all statistical analysis. The findings reveal that those students that completed all of the practice activities performed at a higher level on their actual assessment than did other students.
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# TABLE OF CONTENTS

LIST OF TABLES............................................................................................................. vi

CHAPTER I - INTRODUCTION ...................................................................................... 1
  Statement of Problem.............................................................................................. 2
  Purpose of the Study .............................................................................................. 4
  Research Questions............................................................................................... 4
  Theoretical Perspective.......................................................................................... 5
  Significance of Study............................................................................................ 7
  Delimitations........................................................................................................... 7
  Design Controls ...................................................................................................... 7

CHAPTER II - LITERATURE REVIEW .......................................................................... 8
  Practice Activities .................................................................................................. 9
  Deliberate Practice and Learning.......................................................................... 10
  Deliberate Practice and the Cognitive Load Theory............................................. 12
  Deliberate Practice and Feedback........................................................................ 12
  Work Activities Compared to Deliberate Practice................................................. 13
  Practice Compared to Deliberate Practice ............................................................ 14
  Conclusion ............................................................................................................ 14

CHAPTER III - RESEARCH DESIGN AND METHODOLOGY.................................. 16
  Introduction........................................................................................................... 16
  Research Questions.............................................................................................. 16
  Population and Sample ....................................................................................... 17
<table>
<thead>
<tr>
<th>Appendix F - Sample Actual Assessment Performance Task</th>
<th>56</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix G - UNL IRB Approval</td>
<td>57</td>
</tr>
<tr>
<td>Appendix H - NWMSU IRB Approval</td>
<td>58</td>
</tr>
<tr>
<td>Appendix I - Student Consent Form</td>
<td>59</td>
</tr>
<tr>
<td>Appendix J - Student Demographic Data Form</td>
<td>61</td>
</tr>
<tr>
<td>Appendix K - Sample Practice Exam Performance Task</td>
<td>62</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.01</td>
<td>Summary of Dependent and Independent Variables</td>
<td>20</td>
</tr>
<tr>
<td>4.01</td>
<td>Frequencies and Percentages for Gender (n=183)</td>
<td>23</td>
</tr>
<tr>
<td>4.02</td>
<td>Frequencies and Percentages for Age (n=183)</td>
<td>24</td>
</tr>
<tr>
<td>4.03</td>
<td>Self-reported Frequencies and Percentages for computer courses completed during high school</td>
<td>24</td>
</tr>
<tr>
<td>4.04</td>
<td>Word Descriptive Statistics</td>
<td>25</td>
</tr>
<tr>
<td>4.05</td>
<td>Descriptive Statistics for Excel Essentials A</td>
<td>27</td>
</tr>
<tr>
<td>4.06</td>
<td>Descriptive Statistics for Excel Essentials B</td>
<td>29</td>
</tr>
<tr>
<td>4.07</td>
<td>Descriptive Statistics for PowerPoint Essentials A</td>
<td>32</td>
</tr>
<tr>
<td>4.08</td>
<td>Descriptive Statistics for PowerPoint Essentials B</td>
<td>34</td>
</tr>
<tr>
<td>4.09</td>
<td>Descriptive Statistics for Access Essentials Exam</td>
<td>36</td>
</tr>
<tr>
<td>5.01</td>
<td>Pearson Correlation for Assessment Score Means and Practice Activities Completed</td>
<td>40</td>
</tr>
<tr>
<td>5.02</td>
<td>Pearson Correlation for Normalized Gain Scores</td>
<td>40</td>
</tr>
</tbody>
</table>
CHAPTER I
INTRODUCTION

It is claimed that very high levels of achievement in virtually all domains are mediated by mechanisms acquired during an extended period of training and development (Ericsson, 2005). There have been various frames of thought that have attempted to explain this exceptional performance. Gardner (1993) argues that exceptional performance is the result of a close match between an individual’s intelligence profile and the demands of the particular domain. Newell and Simon (1972) have attempted to explain exceptional performance using the human information-processing approach. Their approach suggests that incremental increases in knowledge and skill are due to the extended effects of experience. Murray (1989) suggests that this exceptional ability is a gift from God. Bloom (1985) went through different domains to point out the essential qualities and felt they were mostly inborn.

Ericsson and Charness (1994) propose a different approach to explain exceptional ability. They suggest that the primary mechanism for creating expert level performance in a domain is deliberate practice. Within this framework, it is not innate abilities or mere exposure to experience but rather the accumulated amount of deliberate practice that is essential for high performance (Sonnetag & Kleine, 2000).

Deliberate practice is more than simply repeating a task (Dubner & Levitt, 2006). Deliberate practice leads to deep learning (Anderson & Schunn, 2000). Deliberate practice is focused and intensive practice (Brooks & Crippen, 2005) and requires the goal of competence improvement (Sonnetag & Kleine, 2000). Deliberate practice can be
characterized as the activities that are especially designed to improve the current level of performance (Sonnetag & Kleine, 2000).

Statement of Problem

Schools in this century must provide opportunities for their students to reach a level of mastery in their chosen discipline if they are to compete in this diverse global economy. Educators at all levels design effective instruction for learning that goes beyond the mastery level. They try to implement components that foster the development of expertise (van Gog, Ericsson, Rikers & Paas, 2005). McKinney and Davis (2003) suggest that the difference between experts and those less skilled is not just a matter of the amount and complexity of accumulated knowledge; it is also the qualitative differences in the organization of knowledge and its representation. Ericsson (2000) suggests that this knowledge is encoded around domain-specific concepts and procedures which allow rapid retrieval of relevant information stored in long-term memory. These representations are essential if one is to be able to monitor, evaluate, and improve their performance (Ericsson, 2000).

Higher education is faced with the challenge of teaching their majors to think and solve problems like professionals in their chosen field (De Corte et al., 2004). Education and discipline specialists believe this knowledge can best be learned through experience which is based entirely on the procedures of the discipline (Kirschner, Sweller, & Clark, 2006). The assumption is that requiring students to solve authentic problems, such as those found in the workplace, will guide the student to construct their own solutions and encounter an effective learning experience (Kirschner et al., 2006). Worked examples can
be job realistic and can be used to build the mental models for procedural learning tasks (Clark & Mayer, 2003, p. 177).

Learning can be greatly enhanced when the course content and exercises are sequenced in a step-wise fashion to create a better theoretical foundation (Farmer & Williams, 2005). There appears to be greater retention when the information is learned in a more spaced manner (Anderson & Schunn, 2000). A worked example, which is a step-by-step demonstration of how to perform a task, is a model of this learning paradigm (Clark & Mayer, 2003, p. 175).

Limitations to working memory are also a major concern (Kalyuga, Chandler, & Sweller, 2001). The cognitive load theory assumes that a learner has a limited processing capacity (working memory) which must be properly allocated or learning may be inhibited (Kalyuga et al., 2001). Long-term memory, by contrast, can store a vast quantity of information (Clarke, Ayres, & Sweller, 2005). Skilled problem solvers obtain their expertise by drawing upon the extensive experience stored in their long-term memories (as cited by van Gog et al., 2005).

Motivation is the process by which a learner consciously or unconsciously allocates working memory resources to learning (Brooks & Shell, 2006). Learners must be motivated to engage in the to-be-learned material in a mindful manner if they are to develop appropriate schemas (Morrison & Anglin, 2005). A well-designed learning strategy will motivate the learner to make the connections between the new information and what the learner already knows (van Gelder et al., Bissett, & Cumming, 2004).

Learning environments should assist students to become more competent in the learning process (De Corte et al., 2004) so they can construct a meaningful relationship
between the new knowledge presented and their existing knowledge (van Gelder et al.,
2004). The question persists then, “How can we help students progress to a level of
mastery or expertise?” (van Gelder et al., 2004).

Purpose of the Study

The purpose of this study was to determine if learner practice results in a higher
level of learning in a college-level computer skills course.

Research Questions

1. Is there a significant correlation between the amount of Word Essentials
Training activities practiced by the student and the student’s score on the Word Essentials
Actual Exam? Is there a significant correlation between the amount of Word Essentials
Training activities practiced by the student and the student’s normalized gain score?

2. Is there a significant correlation between the amount of Excel Essentials A
Training activities practiced by the student and the student’s score on the Excel Essentials
A Actual Exam? Is there a significant correlation between the amount of Excel Essentials
A Training activities practiced by the student and the student’s normalized gain score?

3. Is there a significant correlation between the amount of Excel Essentials B
Training activities practiced by the student and the student’s score on the Excel Essentials
B Actual Exam? Is there a significant correlation between the amount of Excel Essentials
B Training activities practiced by the student and the student’s normalized gain score?

4. Is there a significant correlation between the amount of PowerPoint Essentials
A Training activities practiced by the student and the student’s score on the PowerPoint
Essentials A Actual Exam? Is there a significant correlation between the amount of
PowerPoint Essentials A Training activities practiced by the student and the student’s normalized gain score?

5. Is there a significant correlation between the amount of PowerPoint Essentials B Training activities practiced by the student and the student’s score on the PowerPoint Essentials B Actual Exam? Is there a significant correlation between the amount of PowerPoint Essentials B Training activities practiced by the student and the student’s normalized gain score?

6. Is there a significant correlation between the amount of Access Essentials Training activities practiced by the student and the student’s score on the Access Essentials Actual Exam? Is there a significant correlation between the amount of Access Essentials Training activities practiced by the student and the student’s normalized gain score?

Theoretical Perspective

Guiding students toward a promising future is a challenge for today’s educator (Breivik, 2005). The demand for highly skilled employees is expected to continue to accelerate at a rapid pace (Strom & Strom, 2004). One of the prevalent topics in education today is the reform that is necessary to produce these highly skilled graduates. Schools are expected to encourage and support learning with rich, relevant curricula and authentic learning experiences (March, 2006). Students need to see a real-life connection between classroom learning and future careers (Association for Career and Technical Education, 2006). When the student is able to connect an academic concept to something meaningful in their own life, understanding deepens as the student becomes emotionally engaged in the process (“Promising Practices,” 2006). Learning environments must be
structured so that learners can move beyond the acquisition of knowledge to understanding and applying the knowledge (Dare, 2001). Researchers agree that instruction should center on authentic tasks and should reinforce and encourage the learner to plan, monitor, and evaluate their learning process (van Gog et al., 2005). Authentic learning tasks that are based on real-life tasks can be the driving force for complex learning (as cited by van Merriënboer & Sweller, 2005). A highly developed skill level requires the acquisition of representations and mechanisms that not only allow execution of performance but also planning, reasoning, and evaluating to mediate further improvement of performance (Ericsson, 2005).

After their formal education, students must be able to shape their own learning processes in order to improve their performance (van Gog et al., 2005). Today’s workplace is a continuously changing environment that requires its workers to stay current with new technologies and modified work procedures (Sonnetag & Kleine, 2000). Students will need to know how to continue the learning process if they are to be able to make effective and innovative use of what they know in the workplace (Kay & Houlihan, 2006).

Renkl reports that many learners do not effectively use their available resources for processing (as cited by van Merriënboer & Sweller, 2005). If learning is to take place, the student must be motivated to actually invest mental effort into the learning process (van Merriënboer & Sweller, 2005). Motivation is the process whereby a learner either consciously or unconsciously allocates the working memory resources to the task (Brooks & Shell, 2006).
Significance of Study

This study sought correlations between the amount of practice activities completed and assessment scores in a computer literacy course to determine whether there is measurable impact upon learning as a result of undertaking the practice activities. It is believed that practice can provide students with a deeper learning experience in a variety of domains.

Delimitations

This study is limited in nature and scope as it will only involve students enrolled in a computer literacy course at a small midwestern university. This course fulfills an institutional requirement for computer literacy on campus, so the enrollees represent a broad spectrum of majors.

Design Controls

Each student completed online computer applications assessments. The online student assessment provided an opportunity for the student to demonstrate an ability to perform at a particular level of proficiency. The students had ample opportunity to prepare for the assessments by practicing or rehearsing the tasks in online training and/or online practice exams before they completed each assessment. The training and practice exams included the same performance tasks as the actual assessment.
Deliberate practice entails repetitive performance of a cognitive or psychomotor skill in a focused domain (Issenberg, et al., 2002). Ericsson explains deliberate practice as those activities which are highly relevant to improving performance and require significant personal effort to initiate and maintain (Dunn & Shriner, 1999). The framework of deliberate practice recognizes the importance of goals, feedback, and the role of a teacher or trainer (Dunn & Shriner, 1999). When scientists measured the assumed superior power(s) of experts’ mental speed, memory, and intelligence, they did not find a general superiority (Ericsson, 2005). Deliberate practice is the key activity that must be used in the acquisition of expert performance (Charness, Tuffiash, Krampe, Reingold, & Vasyukova, 2005; Ericsson, 2005). Deliberate practice is a learning strategy that works best when the individual is highly motivated and is centered on a set of well defined tasks (Farmer & Williams, 2005). These deliberate practice activities should be performed on a regular basis with the explicit goal of improving one’s competence (Sonnetag & Kleine, 2000).

Intense, deliberate practice in a focused domain is consistently found to be more important than so-called innate abilities (Issenberg, et al. 2002). Sonnentag et al, (2000) suggest that it is not innate ability or mere exposure to experience but, instead, the amount of accumulated deliberate practice that affects the level of performance. The perception that a person is innately talented in a domain directs that individual to an early start of deliberate practice (Ericsson, Krampe, & Tesch-Romer, 1993). Children that
become elite performers start practice in that domain at a very young age (Ericsson et al., 1993). The social reactions of parents and others in a child’s immediate environment are very important in helping to establish the original motivation (Ericsson et al., 1993). Deliberate practice should be of a limited duration in the beginning and slowly extended over a period of time (Ericsson et al., 1993). Parents can encourage their children to develop regular practice habits and the value of deliberate practice by noticing improvements in their performance (Ericsson et al., 1993). As they become more involved in the activities of the domain, competitions and public performances can provide the motivation for specific task improvement (Ericsson et al., 1993).

**Practice Activities**

Students engage in practice not for the enjoyment but for the improvement of their performance (van Gog, et al., 2005). Instruction can be tailored to each individual (Farmer & Williams, 2005). The current knowledge base of the learner can be assessed in order to design effective instruction (van Gog, et al., 2005). Learners engage in post-performance evaluation so that their current level of performance and possible performance problems can be identified and activities designed to alleviate these problems (Farmer & Williams, 2005; van Gog, et al., 2005). A task analysis is used to identify knowledge structures (Anderson & Schunn, 2000) so that activities are designed to help students improve specific aspects of their performance (van Gog, et al., 2005). The design of the activities should be based on the current knowledge level of the learner (Ericsson et al., 1993). The instructor should organize an appropriate sequence of activities and monitor them closely to know when it is time for the individual to transition to a more complex and challenging activity (Ericsson et al., 1993). Carefully sequenced
activities should guide the learner in a step-wise fashion to the mastery of the target skill (Farmer & Williams, 2005).

**Deliberate Practice and Learning**

With the expansion of our understanding of cognition, we are able to design robust learning environments that will facilitate the student’s acquisition of skilled learning, thinking, and problem solving (De Corte et al., 2004). Laboratory research has identified several factors that increase the effectiveness of learning such as well-defined goals of appropriate difficulty, informative feedback, and opportunities for repetition and gradual improvement (Ericsson, 2000). The framework for deliberate practice suggests that participation in these prescribed activities is necessary to improve competence in the domain (Dunn & Shriner, 1999). For a learner to perform at an expert level, s/he must master all of the relevant knowledge and skills within that domain (Ericsson & Charness, 1994).

Deliberate practice will transform the learners’ performance from a consciously directed activity to a well-encoded activity (Ericsson et al., 1993; Farmer & Williams, 2005). An expert’s knowledge is encoded around concepts that are domain specific and solutions that are easily accessible (Ericsson, 2000). This encoding will enable the learner to circumvent the limited capacity of short-term memory (Ericsson et al., 1993). Experts rely on long-term memory to increase the amount of information that is available for planning and reasoning (Ericsson, 2000, 2005). Control over some of the important aspects of expert performance must remain with the learner (van Gog, et al., 2005). Conscious monitoring and control are necessary for further improvement (van Gog, et al., 2005). Some of the same representations that are used to complete the task are also
utilized by the learner to monitor and evaluate their own performance (Ericsson, 2000).

Building new mental representations will produce improved performance on cognitive tasks (Ericsson, 2000).

Skill acquisition that is demonstrated at an expert level is the result of an extensive process that includes daily amounts of deliberate practice (Ericsson et al., 1993). A high level of performance is directly associated with even higher levels of deliberate practice (Ericsson et al., 1993). At the core of these deliberate practice activities is the focus on current performance deficits and the execution of specific tasks to improve and refine their performance (Sonnetag & Kleine, 2000). Increased complexity and proficiency of acquired skills will lead to an enhanced performance and a more extensive level of deliberate practice activities (Ericsson et al., 1993). Ericsson et al (1993) attribute the dramatic differences in performance between experts, amateurs, and novices as the difference in recorded amounts of deliberate practice (Ericsson et al., 1993).

Deliberate practice activities are drafted with the intent to raise the current level of performance (Ericsson et al., 1993). Deliberate practice should allow for repeated experiences so the learner can attend to the critical aspects of the task and improve their performance based on their knowledge of their own results and feedback from the instructor (Ericsson et al., 1993). The acquired performance of an individual is a direct result of the amount of time engaged in deliberate practice activities (Ericsson et al., 1993). As the students stretch themselves to a higher level of performance, they must give their full concentration and maintain their effort for extended periods of time.
In order to maintain the desired level of performance, the individual must perform the sustained level of deliberate practice (Ericsson, 2000).

**Deliberate Practice and the Cognitive Load Theory**

The cognitive load theory assumes that working memory capacity is limited when dealing with novel information (van Merriënboer & Sweller, 2005). Working memory alone would limit individuals to minor cognitive activities (Paas et al., 2003). It is the long-term memory that provides humans with an extensive processing ability (Paas et al., 2003). Long-term memory is what holds the cognitive schemata that vary in complexity and automation (van Merriënboer & Sweller, 2005). These schemata organize and incorporate numerous elements of information into a single element (van Merriënboer & Sweller, 2005; Paas et al., 2003). Complex schema can be processed as a single element thus reducing the demand on working memory capacity (Paas et al., 2003; Kalyuga et al., 2001). The automation of those schemas would further reduce the demands on working memory capacity as the activity would be processed unconsciously (van Merriënboer & Sweller, 2005; Paas et al., 2003). A constructed schema can become an automated process with a great deal of practice (van Merriënboer & Sweller, 2005). Human expertise develops as learners mindfully combine simple ideas into more complex ones (van Merriënboer & Sweller, 2005).

**Deliberate Practice and Feedback**

Learning will take place when a student is motivated and maintains focus while performing a well-defined task (Farmer & Williams, 2005). Assessment that includes informative feedback must also be incorporated in order for the learner to demonstrate improved performance (Issenberg, et al. 2002). The instruction should be tailored so that
each individual student receives constant feedback from the coach or teacher (Farmer & Williams, 2005). This informative feedback provides the learner with the opportunity to perfect their performance (Farmer & Williams, 2005). Feedback is a key ingredient if the student is to develop comprehensive theoretical models (Ericsson, 2005; Farmer & Williams, 2005).

As the individuals acquire increasingly complex cognitive mechanisms, they also acquire the mechanisms needed to monitor and assess their own performance (van Gog, et al., 2005). Experts have gained a broad range of these complex cognitive mechanisms that support their superior performance (van Gog, et al., 2005). These models help learners to monitor and gradually refine their own performance (Ericsson, 2005). To receive maximal benefit from the feedback, learners must monitor their training with full concentration (Dunn & Shriner, 1999).

**Work Activities Compared to Deliberate Practice**

Work activities are directly motivated by social and/or monetary external rewards (Ericsson et al., 1993; Ericsson & Charness, 1994). The external rewards could consist of money in the form of prizes or pay that is used to sustain a living (Ericsson et al., 1993). Deliberate practice does not lead to immediate social or monetary rewards (Ericsson & Charness, 1994) but could lead to additional costs related to teachers and trainers (Ericsson et al., 1993). Work activities may provide some opportunity for learning but are not the most advantageous (Ericsson et al., 1993; Ericsson & Charness, 1994). Deliberate practice provides excellent opportunities for learning and skill acquisition (Ericsson & Charness, 1994). The goal of the work activity is to generate quality services or products (Ericsson & Charness, 1994). The goal of deliberate practice is the improvement of
performance (Ericsson & Charness, 1994). In work activities, individuals rely on well-entrenched methods to perform the work activities with consistently high quality (Ericsson & Charness, 1994). Deliberate practice activities are challenging and carefully sequenced activities usually designed by a teacher or trainer for the sole purpose of improving specific aspects of an individual’s performance (Farmer & Williams, 2005; McKinney & Davis, 2003; Van Gog, et al., 2005).

**Practice Compared to Deliberate Practice**

Practice alone is enough to develop some level of competence (“A Model”, 1997). To attain an expert level of performance, the individual must engage in a special activity called deliberate practice (Ericsson, 2005). Experience is a necessary component, but that experience alone does not guarantee a high level of performance (Dunn & Shriner, 1999). It is not the amount of relevant experience in a domain, but the amount of deliberate effort that brings performance improvement (van Gog, et al., 2005). Most individuals do not spend time on deliberate practice (Ericsson & Charness, 1994). Their goal in performing the activity is more for the enjoyment and playful interaction (Ericsson et al., 1993; Ericsson & Charness, 1994). Deliberate practice activities are “deliberate” efforts to improve and to perform at a higher level (Dunn & Shriner, 1999). Learning from practice activities is a possibility but it is not guaranteed (Dunn & Shriner, 1999). Deliberate practice, however, provides many opportunities for genuine learning and skill acquisition (Anderson & Schunn, 2000; Dunn & Shriner, 1999).

**Conclusion**

It appears that the road to excellence in a particular domain must include deliberate practice (Farmer & Williams, 2005). Deliberate practice does not just happen
(Farmer & Williams, 2005). Authentic training tasks that qualify as deliberate practice activities must be developed (van Gog, et al., 2005). These tasks need to support self-regulated learning, generate feedback, and offer opportunities to practice corrected performance (van Gog, et al., 2005). A supportive environment is critical for performers to maintain improvement over long periods of time and develop competence at an expert level of performance (Dunn & Shriner, 1999). The level of deliberate practice must be maintained if one is to retain a certain performance level (Ericsson & Charness, 1994). The mechanisms that mediate superior performance are acquired and result from extended deliberate practice (Ericsson & Charness, 1994; Ericsson et al., 1993). Educators must persist to find ways to engage their students in this kind of effortful study if they are to attain a level of expertise in their chosen discipline (Ross, 2006).
CHAPTER III
RESEARCH DESIGN AND METHODOLOGY

Introduction

The review of literature has revealed that learner performance is improved when
the learner participates in domain specific activities that provide optimal learning
opportunities (Dunn & Shriner, 1999). These activities should be performed frequently as
it is believed that the amount of practice directly correlates to the level of performance
(Dunn & Shriner, 1999). This practice must be a specific type of practice that is focused
and intensive (Brooks & Crippen, 2005.; Hodges, Starkes, Kerr, Weir, & Nananidou,
2004). It must be a deliberate effort to improve performance on relevant practice
activities (van Gog, et al., 2005).

Research Questions

1. Is there a significant correlation between the amount of Word Essentials
Training activities practiced by the student and the student’s score on the Word Essentials
Actual Exam? Is there a significant correlation between the amount of Word Essentials
Training activities practiced by the student and the student’s normalized gain score?

2. Is there a significant correlation between the amount of Excel Essentials A
Training activities practiced by the student and the student’s score on the Excel Essentials
A Actual Exam? Is there a significant correlation between the amount of Excel Essentials
A Training activities practiced by the student and the student’s normalized gain score?

3. Is there a significant correlation between the amount of Excel Essentials B
Training activities practiced by the student and the student’s score on the Excel Essentials
B Actual Exam? Is there a significant correlation between the amount of Excel Essentials B Training activities practiced by the student and the student’s normalized gain score?

4. Is there a significant correlation between the amount of PowerPoint Essentials A Training activities practiced by the student and the student’s score on the PowerPoint Essentials A Actual Exam? Is there a significant correlation between the amount of PowerPoint Essentials A Training activities practiced by the student and the student’s normalized gain score?

5. Is there a significant correlation between the amount of PowerPoint Essentials B Training activities practiced by the student and the student’s score on the PowerPoint Essentials B Actual Exam? Is there a significant correlation between the amount of PowerPoint Essentials B Training activities practiced by the student and the student’s normalized gain score?

6. Is there a significant correlation between the amount of Access Essentials Training activities practiced by the student and the student’s score on the Access Essentials Actual Exam? Is there a significant correlation between the amount of Access Essentials Training activities practiced by the student and the student’s normalized gain score?

Population and Sample

The population for this study consisted of students enrolled in a computer literacy course at a small midwestern university during the fall semester of 2006. Permission to use the student’s scores was obtained through informed consent.
Student Assessment Procedures

Assessments were given at scheduled intervals during the course of the semester. The student first completed a pretest (Appendix A). The pretest was to help the students determine their current knowledge. The students were then given the opportunity to prepare for the actual assessment by completing training components (Appendixes B, C, D, and E) which included the same types of performance tasks as the pretest and the actual assessment (Appendix F).

A University of Nebraska - Lincoln IRB (Appendix G) and a Northwest Missouri State University IRB (Appendix H) were obtained. A student consent form (Appendix I) and a student demographic data form (Appendix J) were collected from each participant.

Measurement Instrument

The computer application assessments were administered using a commercial software program called SAM (Skills Assessment Manager). This software has both training and assessing components.

The training provided the students with several learning alternatives each including prepare, observe, practice, and apply options. The prepare option (Appendix B) required critical thinking on the part of the student as the student read the task explanation and learned the steps required to complete the task (“SAM Software,” 2006). The observe option (Appendix C) allowed the student to view the process while listening to a narration which explained each step to the student (“SAM Software,” 2006). The practice option (Appendix D) contained guided self-paced practice that directed the student through the process step-by-step (“SAM Software,” 2006). The apply option (Appendix E) is unassisted and gives the student the opportunity to perform the task
hands on ("SAM Software," 2006). The students could select the option that best met their learning needs for each particular task.

The students had access to a practice exam (Appendix K) which included the same tasks that were assessed in the actual exam (Appendix F). SAM provided the student with tasks that supported a self-regulated learning environment, provided the student with feedback, and offered the student an opportunity to practice corrected performance which van Gog, et al. (2005) considers an essential characteristic of practice activities.

**Validity and Reliability Issues**

SAM is a commercial software that was developed by Course Technology ("SAM Software," 2006). This software has been used widely to teach, train, and test critical computer skills that prepare a learner for academia and the workplace ("SAM Software," 2006). More than 21,000,000 SAM assessments have been completed and reported ("SAM Software," 2006).

**Data Collection**

The computer applications assessments were administered using SAM software. The assessments were graded online and immediate results were provided to the student. The results were recorded on a Course Technology server. Each student completed a pretest prior to gaining access to the training components available with the SAM software. The current knowledge of the learner was assessed in order to design effective instruction (van Gog, et al., 2005). The pretest provided a valuable tool to the learners to help direct their focus during their practice activities.
Reports were generated from the SAM server that listed the students’ pretest score, their actual assessment score, and the amount of the prescribed learning activity completed by the student.

Variables

The dependent variables that were analyzed in this study included the actual assessment scores for the performance tasks that are included in the Word Essentials Actual Assessment, Excel Essentials A Actual Assessment, Excel Essentials B Actual Assessment, PowerPoint Essentials A Actual Assessment, PowerPoint Essentials B Actual Assessment, and the Access Essentials Actual Assessment.


Table 3.01
Summary of Dependent and Independent Variables

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<th>Dependent Variables (n = 6)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Word Essentials Actual Exam</td>
<td>Word Essentials Training</td>
</tr>
<tr>
<td>Excel Essentials A Actual Exam</td>
<td>Excel Essentials A Training</td>
</tr>
<tr>
<td>Excel Essentials B Actual Exam</td>
<td>Excel Essentials B Training</td>
</tr>
<tr>
<td>PowerPoint Essentials A Actual Exam</td>
<td>PowerPoint Essentials A Training</td>
</tr>
<tr>
<td>PowerPoint Essentials B Actual Exam</td>
<td>PowerPoint Essentials B Training</td>
</tr>
<tr>
<td>Access Essentials Actual Exam</td>
<td>Access Essentials Training</td>
</tr>
</tbody>
</table>

Data Analysis Plan

The results from the reports that were generated from the SAM server were recorded on a spreadsheet. Each report generated showed the students' assessment scores and the number of practice activities completed. The spreadsheet information was
transferred to SPSS software for statistical analysis including determining the correlation between the actual test scores and the amount of training completed prior to each assessment. The Pearson correlation can be used to measure the direction and the degree of the relationship between the two variables (Gravetter & Wallnau, 2004, p. 527). The strength of the correlation was measured by the value of $r^2$, the coefficient of determination (Gravetter & Wallnau, 2004, pp. 534-536).

The pretest scores and the actual assessment scores were analyzed to determine the normalized gain score $\langle g \rangle$ using the Hake model (as cited by Meltzer, 2002b). According to Hake (1998), the following formula is used to calculate the normalized gain score.

$$
g = \frac{\text{post test score} - \text{pretest score}}{\text{maximum possible score} - \text{pretest score}}
$$

Hake’s work has been very significant as an objective measure of learning (Coletta & Phillips, 2005). The normalized gain score takes into account the possible variance in the pretest scores and has incorporated the issues of the “floor and ceiling” effect (Meltzer, 2002b). The normalized gain score $\langle g \rangle$ is a valid and reliable measure of student learning that has been used with consistent results (Meltzer, 2002b). Normalized gain score is well-established as a sensible method of analyzing pre/post test results. It has been used to analyze outcomes in the physics and astronomy content areas (Hake, 1998; Fagen, Crouch, & Mazur, 2002; Singh, 2005; Pollock, 2004; Coletta & Phillips, 2005; and Bao, 2006).

The Pearson Correlation was used to measure the relationship between the normalized gain score $\langle g \rangle$ and the amount of training completed by the participant prior to taking the actual assessment.
Follow-up tests were conducted to evaluate the three pairwise differences among the means for the participants based on their level of practice activities completed.

An alpha level 0.01 was chosen for all statistical tests. With six tests, Bonferroni suggests a level of $0.01/6 = 0.002$. Therefore, to be deemed significant in this study, a measure was required to have an alpha level of $\leq 0.002$. 
CHAPTER IV
RESULTS

Introduction

This study investigated the relation between practice activities completed by the students and the students’ actual assessment score as well as their normalized gain score \( <g> \). The study also considered demographic variables including age, gender and the number of computer classes completed during the student's secondary education.

Population and Sample

The population for this study consisted of students enrolled in a computer literacy course at a small midwestern university during the fall semester, 2006. Permission to use 263 student’s scores was obtained through informed consent. There were 183 students with all assessment components complete.

Demographic Statistical Analysis

Demographic data collected on all student participants included gender, age, and number of computer courses completed during high school. Of the 183 participants, 112 or 61.2% self-reported as female and 71 or 38.8% male.

<table>
<thead>
<tr>
<th>Gender</th>
<th>( f )</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>71</td>
<td>38.8</td>
</tr>
<tr>
<td>Female</td>
<td>112</td>
<td>61.2</td>
</tr>
<tr>
<td>Total</td>
<td>183</td>
<td>100</td>
</tr>
</tbody>
</table>
One hundred sixty-seven students (91.26%) self-reported as in the 18-20 age group, 14 (7.65%) in the 21-24 age group, and 2 (1.09%) in the over 25 age group.

Table 4.02
Frequencies and Percentages for Age (n=183)

<table>
<thead>
<tr>
<th>Age</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-20</td>
<td>167</td>
<td>91.26</td>
</tr>
<tr>
<td>21-24</td>
<td>14</td>
<td>7.65</td>
</tr>
<tr>
<td>Over 25</td>
<td>2</td>
<td>1.09</td>
</tr>
<tr>
<td>Total</td>
<td>183</td>
<td>100</td>
</tr>
</tbody>
</table>

Students were asked the number of computer classes they completed during high school. The responses ranged from 0 to 6 computer courses completed during their secondary education. Ninety-seven (53.01%) students reported as having not completed a computer course in high school, 43 (23.5%) as completing one computer course, 25 (13.66%) two computer courses, 10 (5.46%) three computer courses, 4 (2.19%) four computer courses, 2 (1.09%) five computer courses and 2 (1.09%) six computer courses in high school.

Table 4.03
Self-reported Frequencies and Percentages for computer courses completed during high school.

<table>
<thead>
<tr>
<th>Computer Courses Completed</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>97</td>
<td>53.01</td>
</tr>
<tr>
<td>1</td>
<td>43</td>
<td>23.5</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>13.66</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>5.46</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>2.19</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1.09</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>1.09</td>
</tr>
<tr>
<td>Total</td>
<td>183</td>
<td>100</td>
</tr>
</tbody>
</table>
Statistical Analysis of Research Questions

Research Question 1. Is there a significant correlation between the amount of Word Essentials Training activities practiced by the student and the student’s score on the Word Essentials Actual Exam? Is there a significant correlation between the amount of Word Essentials Training activities practiced by the student and the student’s normalized gain score?

Each of the participants completed a pretest over Word essentials performance tasks (n = 30). After the students completed the pretest, they were able to practice the training activities (n = 30) that covered the same performance tasks included in the pretest. The students later completed the actual or final Word essentials assessment (n = 30) which covered the same performance tasks as the pretest and training. As noted earlier, an alpha level of ≤ 0.002 was used for all statistical tests.

Table 4.04
Word Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Training – Performance Tasks Practiced</td>
<td>16.35</td>
<td>14.177</td>
<td>183</td>
</tr>
<tr>
<td>Word Exam – Performance Tasks Executed Correctly</td>
<td>25.20</td>
<td>5.073</td>
<td>183</td>
</tr>
</tbody>
</table>

A Pearson correlation coefficient was calculated to determine the relationship between the number of Word practice activities completed by the participant and the participant’s final Word Essentials assessment score. The Pearson revealed a significant relationship, $r = +0.34$, $n = 183$, $p < 0.002$.

The data were divided into three groups based on the number of practice activities completed by the participant. The three groups were those that completed all of the practice activities ($n = 84$), those that completed between 1 and 29 practice activities ($n = 38$), and those that completed 0 practice activities ($n = 61$). A one-way ANOVA
comparing the Word exam scores of the participants based on their level of practice activities completed was computed. A significant difference was found, $F(2,180) = 15.346, p < 0.002$. Tukey’s HSD was used to determine the nature of the difference between the levels of practice completed. This analysis revealed that students who had completed 0 practice activities scored significantly lower ($M = 22.72$, $SD = 5.379$) than the students that completed all of the practice activities ($M = 27.11$, $SD = 4.240$). The students that completed part of the practice activities ($M = 24.97$, $SD = 4.571$) were not significantly different from the other two groups.

A normalized gain score was calculated using the Hake model ($M = 0.748$, $SD = 0.234$). According to Hake (1998), a normalized gain score that is $> 0.7$ is a high gain score. A Pearson correlation coefficient was calculated for the relationship between the number of practice activities completed by the participant and the participant’s normalized gain score which revealed a significant relationship, $r = +0.44$, $n = 183$, $p < 0.002$.

The normalized gain scores were divided into three groups based on the number of practice activities completed by the participant. The three groups were those that completed all of the practice activities ($n = 84$), those that completed between 1 and 29 practice activities ($n = 38$), and those that completed 0 practice activities ($n = 61$). A one-way ANOVA comparing the normalized gain scores of the participants based on their level of practice activities completed was computed. A significant difference was found, $F(2,180) = 25.488, p < 0.002$. Tukey’s HSD was used to determine the nature of the difference between the levels of practice completed. This analysis revealed that students who had completed 0 practice activities had a significantly lower normalized gain score
than the students that completed all of the practice activities (M = 0.605, SD = 0.033). The students that completed part of the practice activities (M = 0.739, SD = 0.199) were not significantly different from either of the other two groups.

Research Question 2. Is there a significant correlation between the amount of Excel Essentials A Training activities practiced by the student and the student’s score on the Excel Essentials A Actual Exam? Is there a significant correlation between the amount of Excel Essentials A Training activities practiced by the student and the student’s normalized gain score?

Each of the participants completed a pretest concerning Excel Essentials A performance tasks (n = 25). After the students completed the pretest, they were able to practice the training activities (n = 25) that covered the same performance tasks included in the pretest. The students later completed the actual or final Excel Essentials A assessment (n = 25) which covered the same performance tasks as the pretest and the training.

Table 4.05

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excel Essentials A Training - Performance Tasks Practiced</td>
<td>17.46</td>
<td>10.364</td>
<td>183</td>
</tr>
<tr>
<td>Excel Essentials A Exam - Performance Tasks Executed Correctly</td>
<td>23.22</td>
<td>2.832</td>
<td>183</td>
</tr>
</tbody>
</table>

A Pearson correlation coefficient was calculated to determine the relationship between the number of Excel Essentials A practice activities completed by the participant and the participant’s final Excel Essentials A assessment score. The Pearson revealed a significant relationship, r = +0.358, n = 183, p < 0.002.

The participants’ results were then divided into three groups based on the number of practice activities completed. The three groups were those that completed all of the
practice activities (n = 101), those that completed between 1 and 24 practice activities (n = 51), and those that completed 0 practice activities (n = 31). A one-way ANOVA comparing the Excel Essentials A exam scores of the participants based on their level of practice activities completed was computed. A significant difference was found, F(2,180) = 11.663, p < 0.002. Tukey’s HSD was used to determine the nature of the difference between the levels of practice completed. This analysis revealed that students who had completed 0 practice activities scored significantly lower (M = 21.45, SD = 5.253) than the students that completed all of the practice activities (M = 23.99, SD = 2.832). The students that completed part of the practice activities (M = 22.76, SD = 2.550) were not significantly different from either of the other two groups.

A normalized gain score was calculated using the Hake model (M = 0.868, SD = 0.174). A Pearson correlation coefficient was calculated for the relationship between the number of practice activities completed by the participant and the participant’s normalized gain score which revealed a significant relationship, r = +0.415, n = 183, p < 0.002.

The normalized gain scores were divided into three groups based on the number of practice activities completed by the participant. The three groups were those that completed all of the practice activities (n = 101), those that completed between 1 and 24 practice activities (n = 51), and those that completed 0 practice activities (n = 31). A one-way ANOVA comparing the normalized gain scores of the participants based on their level of practice activities completed was computed. A significant difference was found among the levels of practice, F(2, 180) = 14.219, p < 0.002. Tukey’s HSD was used to determine the nature of the differences between the levels of practice activities.
completed. This analysis revealed that the students who had completed 0 practice activities had a significantly lower normalized gain score (M = 0.756, SD = 0.273) than the students that completed all of the practice activities (M = 0.922, SD = 0.098). The students that completed part of the practice activities (M = 0.831, SD = 0.177) were not significantly different from either of the other two groups.

Research Question 3. Is there a significant correlation between the amount of Excel Essentials B Training activities practiced by the student and the student’s score on the Excel Essentials B Actual Exam? Is there a significant correlation between the amount of Excel Essentials B Training activities practiced by the student and the student’s normalized gain score?

Each of the participants completed a pretest over Excel Essentials B performance tasks (n = 25). After the students completed the pretest, they were able to practice the training activities (n = 25) that covered the same performance tasks included in the pretest. The students later completed the actual or final Excel Essentials B Assessment (n = 25) which covered the same performance tasks as the pretest and training.

Table 4.06
Descriptive Statistics for Excel Essentials B

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excel Essentials B Training - Performance Tasks Practiced</td>
<td>16.66</td>
<td>10.102</td>
<td>183</td>
</tr>
<tr>
<td>Excel Essentials B Exam - Performance Tasks Executed Correctly</td>
<td>22.13</td>
<td>3.282</td>
<td>183</td>
</tr>
</tbody>
</table>

A Pearson correlation coefficient was calculated for the relationship between the number of Excel Essentials B practice activities completed by the participant and the participant’s final Excel Essentials B assessment score. The Pearson revealed a significant relationship, r = + 0.304, n = 183, p < 0.002.
The data were divided into three groups based on the number of practice activities completed by the participant. The three groups were those that completed all of the practice activities (n = 87), those that completed between 1 and 24 practice activities (n = 67), and those that completed 0 practice activities (n = 29). A one-way ANOVA comparing the Excel Essentials B exam scores of the participants based on their level of practice activities completed was computed. A significant difference was found, F(2,180) = 11.047, p < 0.002. Tukey’s HSD was used to determine the nature of the difference between the levels of practice completed. This analysis revealed that the students who had completed all of the practice activities scored significantly higher (M = 23.23, SD = 1.737) than the students that completed 0 practice activities (M= 20.55, SD = 4.380) and the students that completed part of the practice activities (M = 21.39, SD = 3.794). There was not a significant difference between the students that completed 0 practice activities (M= 20.55, SD = 4.380) and the students that completed part of the practice activities (M = 21.39, SD = 3.794).

A normalized gain score was calculated using the Hake model (M= 0.868, SD = 0.174). A Pearson correlation coefficient was calculated for the relationship between the number of practice activities completed by the participant and the participant’s normalized gain score which revealed a significant relationship, r = + 0.329, n = 183, p < 0.002.

The normalized gain scores were divided into three groups based on the number of practice activities completed by the participant. The three groups were those that completed all of the practice activities (n = 87), those that completed between 1 and 24 practice activities (n = 67), and those that completed 0 practice activities (n = 29). A one-
way ANOVA comparing the normalized gain scores of the participants based on their level of practice activities completed was computed. A significant difference was found, $F(2, 180) = 12.417, p < 0.002$. Tukey’s HSD was used to determine the nature of the differences between the levels of practice completed. The analysis revealed that the students that had completed all of the practice activities had a significantly higher gain score ($M = 0.884, SD = 0.102$) than the students who had completed 0 practice activities ($M = 0.725, SD = 0.235$) and the students that completed part of the practice activities ($M = 0.762, SD = 0.236$). There was not a significant difference between the students that completed 0 practice activities ($M = 0.725, SD = 0.235$) and the students that completed part of the practice activities ($M = 0.762, SD = 0.236$).

*Research Question 4.* Is there a significant correlation between the amount of PowerPoint Essentials A Training activities practiced by the student and the student’s score on the PowerPoint Essentials A Actual Exam? Is there a significant correlation between the amount of PowerPoint Essentials A Training activities practiced by the student and the student’s normalized gain score?

Each of the participants completed a pretest over PowerPoint Essentials A performance tasks ($n = 25$). After the students completed the pretest, they were able to practice the training activities ($n = 25$) that covered the same performance tasks included in the pretest. The students later completed the actual or final PowerPoint Essentials A assessment ($n = 25$) which covered the same performance tasks as the pretest and training.
A Pearson correlation coefficient was calculated for the relationship between the number of PowerPoint Essentials A practice activities completed by the participant and the participant’s PowerPoint Essentials A final assessment score. The Pearson revealed a significant relationship, $r = +0.299$, $n = 183$, $p < 0.002$.

The data were divided into three groups based on the number of practice activities completed by the participant. The three groups were those that completed all of the practice activities ($n = 77$), those that completed between 1 and 24 practice activities ($n = 70$), and those that completed 0 practice activities ($n = 36$). A one-way ANOVA comparing the PowerPoint Essentials A exam scores of the participants based on their level of practice activities completed was computed. A significant difference was found, $F(2, 180) = 8.096$, $p < 0.002$. Tukey’s HSD was used to determine the nature of the difference between the levels of practice completed. This analysis revealed that students who had completed 0 practice activities scored significantly lower (M = 22.94, SD = 2.425) than the students that completed all of the practice activities (M = 24.27, SD = 0.755). The students that completed part of the practice activities (M = 23.66, SD = 1.903) were not significantly different from either of the other two groups.

A normalized gain score was calculated using the Hake model (M = 0.802, SD = 0.296). A Pearson correlation coefficient was calculated for the relationship between the number of practice activities completed by the participant and the
participant’s normalized gain score which revealed a relationship that was not significant, \( r = +0.136, n = 183, p > 0.002 \).

The normalized gain scores were divided into three groups based on the number of practice activities completed by the participant. The three groups were those that completed all of the practice activities (\( n = 77 \)), those that completed between 1 and 24 practice activities (\( n = 70 \)), and those that completed 0 practice activities (\( n = 36 \)). A one-way ANOVA comparing the normalized gain scores of the participants based on their level of practice activities completed was computed. No significant difference was found, \( F(2, 180) = 3.082, p > 0.002 \). The level of practice activities completed by the participant did not significantly affect the participant’s normalized gain score.

**Research Question 5.** Is there a significant correlation between the amount of PowerPoint Essentials B Training activities practiced by the student and the student’s score on the PowerPoint Essentials B Actual Exam? Is there a significant correlation between the amount of PowerPoint Essentials B Training activities practiced by the student and the student’s normalized gain score?

Each of the participants completed a pretest over PowerPoint Essentials B performance tasks (\( n = 25 \)). After the students completed the pretest, they were able to practice the training activities (\( n = 25 \)) that covered the same performance tasks included in the pretest. The students later completed the actual or final PowerPoint Essentials B assessment (\( n = 25 \)) which covered the same performance tasks as the pretest and training.
Table 4.08  
*Descriptive Statistics for PowerPoint Essentials B*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerPoint Essentials B Training - Performance Tasks Practiced</td>
<td>17.02</td>
<td>10.320</td>
<td>183</td>
</tr>
<tr>
<td>PowerPoint Essentials B Exam - Performance Tasks Executed Correctly</td>
<td>23.49</td>
<td>2.797</td>
<td>183</td>
</tr>
</tbody>
</table>

A Pearson correlation coefficient was calculated for the relationship between the number of PowerPoint Essentials B practice activities completed by the participant and the participant’s PowerPoint Essentials B final assessment score. The Pearson revealed a significant relationship, \( r = +0.311, n = 183, p < 0.002 \).

The data were divided into three groups based on the number of practice activities completed by the participant. The three groups were those that completed all of the practice activities \( (n = 99) \), those that completed between 1 and 24 practice activities \( (n = 55) \), and those that completed 0 practice activities \( (n = 29) \). A one-way ANOVA comparing the PowerPoint Essentials B exam scores of the participants based on their level of practice activities completed was computed. A significant difference was found, \( F(2,180) = 14.868, p < 0.002 \). Tukey’s HSD was used to determine the nature of the difference between the levels of practice completed. This analysis revealed that students who had completed part of the practice activities scored significantly lower \( (M = 22.13, SD = 3.849) \) than the students that completed all of the practice activities \( (M = 24.43, SD = 1.513) \). The students that completed 0 practice activities \( (M = 22.86, SD = 2.656) \) were not significantly different from either of the other two groups.

A normalized gain score was calculated for the Group using the Hake model \( (M = 0.868, SD = 0.286) \). A Pearson correlation coefficient was calculated for the relationship between the number of practice activities completed by the participant and
the participant’s normalized gain score which revealed a significant relationship, 

\[ r = +0.299, \ n = 183, \ p < 0.002. \]

The normalized gain scores were divided into three groups based on the number of practice activities completed by the participant. The three groups were those that completed all of the practice activities (\( n = 99 \)), those that completed between 1 and 24 practice activities (\( n = 55 \)), and those that completed 0 practice activities (\( n = 29 \)). A one-way ANOVA comparing the normalized gain scores of the participants was computed. A significant difference was found, \( F(2, 180) = 10.778, \ p < 0.002 \). Tukey’s HSD was used to determine the nature of the differences between the levels of practice completed. The analysis revealed that the students who had completed part of the practice activities had a significantly lower normalized gain score (\( M = 0.742, \ SD = 0.449 \)) than the students that completed all of the practice activities (\( M = 0.949, \ SD = 0.112 \)). The students that practiced 0 practice activities (\( M = 0.827, \ SD = 0.198 \)) were not significantly different from either of the other two groups.

Research Question 6. Is there a significant correlation between the amount of Access Essentials Training activities practiced by the student and the student’s score on the Access Essentials Actual Exam? Is there a significant correlation between the amount of Access Essentials Training activities practiced by the student and the student’s normalized gain score?

Each of the participants completed a pretest over Access Essentials performance tasks (\( n = 25 \)). After the students completed the pretest, they were able to practice the training activities (\( n = 25 \)) that covered the same performance tasks included in the
pretest. The students later completed the actual or final Access Essentials assessment (n = 25) which covered the same performance tasks as the pretest and training.

Table 4.09
*Descriptive Statistics for Access Essentials Exam*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access Essentials Training - Performance Tasks Practiced</td>
<td>16.68</td>
<td>9.690</td>
<td>183</td>
</tr>
<tr>
<td>Access Essentials Exam - Performance Tasks Executed Correctly</td>
<td>19.46</td>
<td>4.068</td>
<td>183</td>
</tr>
</tbody>
</table>

A Pearson correlation coefficient was calculated for the relationship between the number of Access Essentials practice activities completed by the participant and the participant’s Access Essentials final assessment score. The Pearson revealed a significant relationship, r = + 0.527, n = 183, p < 0.002.

The data were divided into three groups based on the number of practice activities completed by the participant. The three groups were those that completed all of the practice activities (n = 57), those that completed between 1 and 24 practice activities (n = 101), and those that completed 0 practice activities (n = 25). A one-way ANOVA comparing the Access Essentials exam scores of the participants based on the number of practice activities completed was computed. A significant difference was found, F(2,180) = 29.769, p < 0.002. Tukey’s HSD was used to determine the nature of the difference between the levels of practice completed. This analysis revealed that the students that completed all of the practice activities scored significantly higher (M = 22.33, SD = 2.641) than the students who had completed 0 practice activities (M = 16.72, SD = 3.814) and the students that had completed part of the practice activities (M = 18.51, SD = 3.903). There was not a significant difference between the students that completed 0 practice activities (M = 16.72, SD = 3.814) and the students that completed part of the practice activities (M = 18.51, SD = 3.903).
A normalized gain score was calculated using the Hake model (M = 0.657, SD = 0.250). According to Hake (1998), a normalized gain score that is < 0.7 and > 0.3 and is a medium gain score. A Pearson correlation coefficient was calculated for the relationship between the number of practice activities completed by the participant and the participant’s normalized gain score which revealed a relationship that was significant, $r = +0.586$, $n = 183$, $p < 0.002$.

The normalized gain scores were divided into three groups based on the number of practice activities completed by the participant. The three groups were those that completed all of the practice activities ($n = 57$), those that completed between 1 and 24 practice activities ($n = 101$), and those that completed 0 practice activities ($n = 25$). A one-way ANOVA comparing the normalized gain scores of the participants based on their level of practice activities completed was computed. A significant difference was found, $F(2, 180) = 37.801$, $p < 0.002$. Tukey’s HSD was used to determine the nature of the differences between the levels of practice completed. The analysis revealed that the students that completed 0 practice activities had a significantly lower normalized gain score (M = 0.441, SD = 0.271) than the students that completed part of the practice activities (M = 0.605, SD = 0.223) and the students that completed all of the practice activities (M = 0.842, SD = 0.151). The students that completed part of the practice activities (M = 0.605, SD = 0.223) had a significantly lower normalized gain score than the students that completed all of the practice activities (M = 0.842, SD = 0.151).
CHAPTER V
DISCUSSION

Introduction

The purpose of this study was to determine the role of practice activities in the learning process in a computer literacy course. More specifically, it was, to determine whether there was a relation between the number of practice activities completed by the student and the student’s exam score, and to determine whether there was a relation between the number of practice activities completed by the student and the student’s normalized gain score.

The demographic data revealed that 97 students (53%) had not completed a computer class prior to taking this course and 43 students (23.5%) had completed only one computer class during their secondary education. The data also revealed that 147 (80%) of the students were either 18 or 19 years of age. This suggests that the students were first-time college freshmen. The population consisted of 112 female participants (61.2%) and 71 male participants (38.8%).

An alpha level of 0.01 was used for all statistical tests in this study. This more stringent level was selected in order to maintain balance and to provide a relatively low risk of Type I error (Gravetter & Wallnau, 2004). A Bonferroni correction was applied to all analyses (i.e., .01/6 = 0.002).

The students completed a pretest for each computer application assessment. This pretest served as an introduction to the material and the performance tasks that would later be assessed on the actual exam. The students completed the pretest during their
normally scheduled class period and then worked on the practice activities for the remainder of the lab session. The pretest could have served to help the students focus on the performance tasks they were not able to perform correctly and provide the student with a well-structured plan for learning the other performance tasks. The software created a learner-centered format structured to meet the individual learning needs of each student.

The software provided feedback to the student as to whether or not the task was performed correctly but did not guide the student with corrective performance. The learn and/or practice training modes could be accessed to provide the student with the correct performance steps. Each of the students needed to determine for themselves that they would allocate the needed resources to this learning.

The practice was also available outside of the normally scheduled class period. This gave the student sufficient opportunity to practice and rehearse the content prior to completing the actual assessment.

The actual assessment over the application was completed during the next normally scheduled class period. The time between each pretest and the actual assessment ranged from 2 to 5 days.

The Pearson correlation coefficient was calculated to determine the relationship between the number of practice activities completed by the participant and the participant’s actual exam score for each assessment (n = 6). In each case, the data revealed a significant correlation between the number of practice activities completed by the participant and the participant’s actual exam score (See Table 5.01). When a Bonferroni corrected alpha level of 0.002 was applied, the correlations retained statistical significance.
### Table 5.01

**Pearson Correlation for Assessment Score Means and Practice Activities Completed**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Number of Tasks</th>
<th>Pretest Score</th>
<th>Practice Completed</th>
<th>Post Test Score</th>
<th>Pearson Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word</td>
<td>30</td>
<td>11.63</td>
<td>16.35</td>
<td>25.20</td>
<td>0.343*</td>
</tr>
<tr>
<td>Excel Essentials A</td>
<td>25</td>
<td>11.61</td>
<td>17.46</td>
<td>23.22</td>
<td>0.358*</td>
</tr>
<tr>
<td>Excel Essentials B</td>
<td>25</td>
<td>10.38</td>
<td>16.66</td>
<td>22.13</td>
<td>0.304*</td>
</tr>
<tr>
<td>PowerPoint A</td>
<td>25</td>
<td>14.54</td>
<td>15.97</td>
<td>23.76</td>
<td>0.299*</td>
</tr>
<tr>
<td>PowerPoint B</td>
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<td>12.98</td>
<td>17.02</td>
<td>23.49</td>
<td>0.311*</td>
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<td>Access</td>
<td>25</td>
<td>8.54</td>
<td>16.68</td>
<td>19.46</td>
<td>0.527*</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.002 level.

A normalized gain score was calculated using the Hake model to determine the learning growth between the pretest and post test for each assessment (n = 6). According to Hake (1998), a normalized gain score that is > 0.70 is a high gain score. The Pearson correlation coefficient was calculated to determine the correlation between the number of practice activities completed by the participant and the participant’s normalized gain score (See Table 5.02).

### Table 5.02

**Pearson Correlation for Normalized Gain Scores**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Pretest Score</th>
<th>Post Test Score</th>
<th>Normalized Gain Score</th>
<th>Pearson Correlation</th>
</tr>
</thead>
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<td>0.136</td>
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<td>23.49</td>
<td>0.868</td>
<td>0.299*</td>
</tr>
<tr>
<td>Access</td>
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<td>19.46</td>
<td>0.657</td>
<td>0.586*</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.002 level.

As seen in Table 5.02, there was a significant correlation found in each case with the exception of the PowerPoint A exam.

The data on this PowerPoint A exam produced anomalous results. Those students that completed no (zero) practice activities had a higher normalized gain score than did...
those students that completed only part of the practice activities. There are several assumptions for possible explanation. Even though 53% of the students indicated they had not experienced formal training with PowerPoint software, the students had most likely encountered PowerPoint software prior to or during this course. The PowerPoint Module comes in the latter part of the semester and by this point the student would have interacted with the PowerPoint lectures that are placed on the course web site. At this point in the semester, the student also might have experienced PowerPoint lectures in other courses. Further, it is quite common for students to use PowerPoint software to create assigned presentations. The students could have found PowerPoint software easier to navigate than other software applications. Whatever the reason for this occurrence, it must be noted that the students that completed all of the practice activities had a significantly higher normalized gain score (M = 0.85, SD = 0.251) than the students that completed 0 practice activities (M = 0.827, SD = 0.197) or the students that completed part of the practice activities (M = 0.742, SD = 0.449).

Summary

The data revealed that those students utilizing all of the training activities performed best on the exam and enjoyed the highest normalized gain score. Even though the practice activities were available, the students had to determine for themselves the amount of time they were willing to invest in order to prepare for the actual exam. The students needed to see the value-added side of the practice activities. Even though they did not receive credit for completing the training activities, the data suggests that the students could have improved their exam score by completing the training activities.
There could have been some learning from test and retest. However, the actual assessment, the pretest, and the training were different tests. They covered the same concepts in each of the performance tasks, but the student had to apply the learning in a different context in order to be successful on the actual exam.

One of the main findings of this study revealed that all participants were able to improve their level of performance regardless of the number of practice activities completed. However, the participants that completed all of the training activities were able to perform at a higher level on the actual exam than the students that performed none or only part of the available practice activities.
CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study examined the role of practice activities in the learning process in a computer literacy course. The results provide potential recommendations for educators to incorporate practice activities within the scope of classroom learning. Practice activities can provide the student with the opportunity to be introduced to novel information, process the information, and transfer the information to long-term memory for later use.

As the students devote time to practice, they are able to develop cognitive structures that will mediate learning. In time, those structures can be automated to further enhance the student’s performance.

The data in this study revealed a significant correlation between the number of practice activities completed by the student and the student’s actual exam score. It is true that most of the students were able to improve their level of performance on the exam regardless of the number of practice activities completed. However, the participants that completed all of the training activities were able to perform at a higher level on the actual exam than the students that performed none (zero) or part of the practice activities.

Recommendations

The results from this study indicate that further investigation into the learning possibilities attached to practice activities is a viable undertaking for educators that continue to search for relevant learning tasks. It appears that practice activities could offer great promise in helping the student connect the learning to real-world applications.
Practice activities incorporated in the learning strategies could present students with the tools needed to meet with success as these activities offer possibilities to keep the learner focused and engaged in the learning process.

Practice activities could provide the bridge to understanding the concepts and provide the learner with a better grasp of the material to be learned. Practice activities may well be able to address the special learning needs of students and be the avenue for accomplishing their desired learning goals.

The data in this study revealed a significant correlation between the number of practice activities completed by the student and the student’s exam score. The data also revealed a significant correlation between the number of practice activities completed by the student and the student’s learning gains. In this study, practice was the independent variable which left the practice option at the discretion of the participant. Future researchers might want to consider more stringent control over the amount of practice activities required of the learner. Looking at larger amounts of practice and its relation to learning outcomes offers promise to educators in all domains and should therefore warrant further investigation.
REFERENCES


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Issenberg, S., McGaghie, W., Gordon, D., Symes, S., Petrusa, E., Hart, I., & Harden, R. (2002). Effectiveness of a cardiology review course for internal medicine


http://www.mff.org/edtech/article.taf?_function=detail&Content_uid1=70


Appendix A

This is a sample performance task from the Excel Essentials B Pretest.
Appendix B

This is a sample performance task from the Excel B Prepare Training.
Appendix C

This is a sample performance task from the Excel B Observe Training.
Appendix D

This is a sample performance task from the Excel B Practice Training.
Appendix E

This is a sample performance task from the Excel B Apply Training.

![Excel Spreadsheet](image)

<table>
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<th>E</th>
<th>F</th>
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<th>H</th>
<th>I</th>
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</table>

**Assumptions**

- Cost of Inventory: 60%
- Advertising (Monthly increase): 8%
Appendix F

This is a sample performance task from the Excel B Actual Exam.
October 2, 2006

Judy Clark
Dr. David Brooks
CSIS Department
Northwest Missouri State University
709 North 7th Street
Tarkio MO 64491

IRB# 2006-09-033 EX

TITLE OF PROJECT: The Role of Deliberate Practices in the Learning Process

Dear Judy:

This letter is to officially notify you of the approval of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. This project has been approved by the Unit Review Committee from your college and sent to the IRB. It is the Board’s opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study. Your proposal seems to be in compliance with this institution’s Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46) and has been classified as exempt.

Date of EX Review: 09/27/06

You are authorized to implement this study as of the Date of Final Approval: 09/29/06. This approval is Valid Until: 09/28/07.

1. Enclosed is the IRB approved Informed Consent form for this project. Please use this form when making copies to distribute to your participants. If it is necessary to create a new informed consent form, please send us your original so that we may approve and stamp it before it is distributed to participants.

This project should be conducted in full accordance with all applicable sections of the IRB Guidelines and you should notify the IRB immediately of any proposed changes that may affect the exempt status of your research project. You should report any unanticipated problems involving risks to the participants or others to the Board. For projects which continue beyond one year from the starting date, the IRB will request continuing review and update of the research project. Your study will be due for continuing review as indicated above. The investigator must also advise the Board when this study is finished or discontinued by completing the enclosed Protocol Final Report form and returning it to the Institutional Review Board.

If you have any questions, please contact Shirley Horstman, IRB Administrator, at 472-9417 or email at shorstman1@unl.edu.

Sincerely,

Dan R. Hoyt, Chair
for the IRB

Shirley Horstman
IRB Administrator

cc: Unit Review Committee
Appendix H

Northwest Missouri State University
Institutional Review Board
Decision Form

Proposal #1394 Date 09/15/06

Proposal Author(s): Judy Clark
Proposal Title: The role of deliberate practice in the learning process

__X__ The Institutional Review Board has accepted/approved your proposal.

You are now officially ready to start collecting data.

______ The Institutional Review Board has voted to accept your proposal with the following revisions:

Please revise and resubmit before you begin collecting data.

______ The Institutional Review Board has voted to not accept your proposal as it currently stands. The reason(s) in essence, is (are) as follows:

Please adjust/correct your proposal, resubmit it for approval, and know that the IRB will act upon it as soon as possible.

Thank you for your interest in research at Northwest Missouri State University.

Jerrold Barnett, Chair
Professor of Psychology/Sociology/Counseling
Appendix I
INFORMED CONSENT FOR STUDENT PARTICIPATION IN RESEARCH ACTIVITIES

Principal Investigator
Judy Clark
Computer Science/Information Systems
Northwest Missouri State University
800 University Drive
Maryville, MO 64468
clarkj@nwmissouri.edu

Secondary Investigator
David W. Brooks
Teaching, Learning and Teacher Education
University of Nebraska-Lincoln
123A Henzlik Hall
Lincoln, NE 68588-0355
dbrooks1@unl.edu

PROJECT TITLE: The Role of Deliberate Practice in the Learning Process

Northwest Missouri State University IRB approval number: 1394
University of Nebraska – Lincoln IRB approval number: 2006-09-033 EX

As a requirement for completion of my doctoral degree at the University of Nebraska-Lincoln, I am working on a dissertation entitled “The Role of Deliberate Practice in the Learning Process.” My data will require input from a group of Northwest students who are currently enrolled in 44-130 Computers and Information Technology. The study will provide valuable data on the role of deliberate practice in learning to perform specific tasks in the Microsoft Office applications of Word, Excel, PowerPoint and Access.

You are invited to participate in this research study that will be conducted during this trimester of 44-130 Computers and Information Technology. By participating in this research study, it is not anticipated that you will experience any personal risks. Your input, however, could greatly benefit my research study and thus benefit Northwest Missouri State University as well as other institutions across the nation. Your valuable participation in this study will help identify whether or not deliberate practice does result in better performance on the final assessment. The results of the study will be beneficial for improving the quality of education offered to undergraduate students and can be used to guide institutional leaders and faculty members to better serve the learning needs of undergraduate students. The research study will end on December 8, 2006.

All students in the course will take a pretest to determine their computer skills level upon entering the module. The areas to be covered in the various modules include Microsoft Word, Microsoft Excel, Microsoft PowerPoint and Microsoft Access. The pretest and the final assessment will be given at scheduled intervals during the course of the trimester during your regularly scheduled class period. There will also be a few demographic
questions. Participation in this study involves your permission to use your assessment scores for research purposes. Your participation is voluntary and you may withdraw from participation at any time you wish.

You will be required to complete the assessments as a part of your course grade, but inclusion of your scores in the research study is a voluntary choice. You will not be required to participate in this study and may drop out at any time.

Results of individual assessments will be kept confidential and will be used only for the purposes of this study. The results of this research may be subject to possible publication in the future, but you can be assured that your identity will be protected. In other words, no individual student name will appear in the findings of this study.

You are free to decide not to participate in this study or to withdraw at any time without adversely affecting your relationship with the investigators, or University of Nebraska-Lincoln, or Northwest Missouri State University. Your decision will not result in any loss of benefits to which you are otherwise entitled.

If you have any questions during the study, you may contact Judy Clark by phone at (660) 562-1281 or e-mail: clarkj@nwmissouri.edu or Dr. David Brooks at phone (402) 472-2018 or email: dbrooks1@unl.edu. If you have any questions about your rights as a research participant that we have not answered, or to report any concerns about the study, you may contact the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965.

If you are interested in receiving a summary of the results of this study, please contact the primary investigator, Judy Clark. Expected completion date will be May, 2007.

Rewards for your effort include the knowledge that you have helped a graduate student complete her dissertation and that you have contributed to further research in the role of deliberate practice in the learning process of undergraduate students.

By signing below, you will indicate that you have read and understood this letter, and have decided to participate in this research project. You will be given a copy of this letter for your records.

I have received a copy of this informed consent and have been given the opportunity to ask questions. I understand I will also be given a copy for my records. I hereby consent to allow the researcher to use my data for the research study.

___________________________________   ____________________
Signature of Research Participant     Date

Please accept my sincere thank you in advance for your participation in this study.
Judy Clark, Principal Investigator
Dr. David Brooks, Secondary Investigator
Appendix J

Project Title: The Role of Deliberate Practice in the Learning Process

Date: Fall 2006

Student Demographic Data

Student Name: 

Age: 

Gender: Male _____ Female _____

Number of computer literacy courses completed prior to this course: 

Your participation is voluntary and you may withdraw from participation at any time. Your decision to participate or not to participate will not affect your grade in the course.

The data will be collected during the fall trimester and will be run during the spring of 2007. Your name will never be published and will be deleted when the data has all been recorded.
Appendix K

This is a sample performance task from the Excel B Practice Exam.

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<tr>
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<th>B1</th>
<th>C1</th>
<th>D1</th>
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