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Worked Examples in Teaching Queries for Searching Academic Databases

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WORKED EXAMPLES IN TEACHING QUERIES FOR SEARCHING ACADEMIC
DATABASES

by

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ABSTRACT

WORKED EXAMPLES IN TEACHING SEARCH-QUERY FORMATION FOR ACADEMIC
DATABASES

Old Dominion University, 2013
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Dr. Amy Adcock

The worked-example effect, an application of cognitive load theory, is a well-supported method of instruction for well-structured problems (Chandler and Sweller, 1991; Cooper and Sweller, 1987; Sweller and Cooper, 1985; Tuovinen & Sweller, 1999; Ward and Sweller, 1990). One limitation is expertise-reversal effect, where advanced students perform less well when exposed to worked examples than when exposed to traditional problem solving (Kalyuga, Ayres, Chandler, & Sweller, 2003; Kalyuga, Chandler, & Sweller, 1998; Kalyuga, Chandler, Tuovinen, & Sweller, 2001). A possible alternative to the worked-example approach is the fading example, designed to transition intermediate students to solving well-structured problems without assistance (Renkl, Atkinson & Grobe, 2004). This study showed that studying worked examples was more effect than solving problems or completing fading examples when learning to form search queries for library databases, an ill-structured problem-solving environment. In addition, participants within the worked-example group with low, intermediate and high levels of domain-specific knowledge achieved parity. Within the traditional problem-solving group, those with low domain-specific knowledge performed less well than those with high domain-specific knowledge.

Keywords: cognitive load theory, worked-example effect, fading examples, expertise-reversal effect, information literacy.

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CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

Introduction

A common format for instructing students in how to use library resources is a 50-minute, single session conducted either in a classroom or a computer laboratory (Badke, 2009; Veldof, 2006; Kenney, 2007). The traditional approach to library instruction is the direct instruction method in the form of a presentation on library resources, a demonstration of searching techniques, or a combination of these teaching formats. Frequently, if a computer laboratory is available, the library instruction is followed by a student hands-on session, during which time students practice searching for books and articles related to their specific topics. In recent years, instructional librarians have been experimenting with exploratory practice sessions with limited direct instruction and minimal guidance, sometimes referred to as a workshop (Veldof, 2006; Kenney, 2007).

Over the last several decades, educational theorists and practitioners have begun advocating for more student involvement in and control over their own learning (Hannafin, Land & Oliver, 1999; Jonassen, 1999; Reigeluth, 1999). However, some scholars and researchers in instructional design caution that although student involvement is desirable, the design of the instruction should conform to the constraints imposed by human cognitive architecture (Kirschner, Sweller & Clark, 2006). Of the different instructional strategies, Kirschner, Sweller and Clark consider worked examples an ideal means of maximizing instructional guidance, especially in exploratory learning environments. Often used as an aid in the instruction of mathematics and science, worked examples are typically presented in three parts: a problem, steps to its solution, and the solution (Renkl & Atkinson, 2010). Sweller and his associates

conducted multiple studies that supported the efficacy of worked examples in facilitating learning in these well-defined domains (Sweller & Cooper, 1985; Cooper & Sweller, 1987; Ward & Sweller, 1990; Tuovinen & Sweller, 1999).

Cognitive Load Theory

The conceptual foundation for this study is cognitive load theory (CLT), which proposes that instruction facilitates learning when its design and content conform to what is known about human cognitive architecture (Sweller, 1999; Kirschner, 2002). Human cognitive architecture consists of two main parts: short-term memory and long-term memory (Atkinson & Shiffrin, 1986). Short-term memory manipulates and processes units of information, but is extremely limited in its capacity. On the other hand, long-term memory is vast and its limits are unknown (Miller, 1956).

Schema Formation

Short-term memory and long-term memory interact through two processes: schema formation and automation (Cooper & Sweller, 1987; Kalyuga, 2010). A schema is formed when individual bits of information operate together as one functioning unit (Sweller, 1999; Sweller, Van Merriënboer & Paas, 1998; Kalyuga, 2010). Schemas are used in all mental processes, including recognizing concrete objects, understanding rules and concepts, and solving problems. For example, one is able to recognize trees and distinguish them from other objects because one has a schema for trees (Sweller, 1999; Sweller, et. al., 1998).

Automation

Schemata are stored in long-term memory. In order for one to use this stored information, one must be able to retrieve it and bring it into the focus of short-term memory (Cooper & Sweller, 1987; Kalyuga, 2010). The faster and more automatic this process is, the

more efficiently one is able to use schema for the purpose of learning. Automation of schema retrieval is a slow and gradual process achieved through conscious repetition and practice (Cooper & Sweller, 1987; Kalyuga, 2010). By focusing the student's attention on a specific and targeted learning goal, worked examples facilitate schema formation and automatic retrieval (Sweller, 1999).

Problem Solving

Jonassen (2002; 2003) divided problems into two main types: well structured and ill-structured. The first type usually has one solution and very few paths to reach that solution, i.e. mathematics. The second type may have more than one answer and enumerable possible ways to solve it. An example is library research, which involves searching for, retrieving and evaluating information. These processes are ill structured, rule-based problems that have a known goal with a vast number of possible ways to achieve it (Jonassen, 2002). Therefore, the research process, a critical component of information literacy, is a solid test bed to study design issues for teaching how to solve ill-structured problems.

Information Literacy As an Ill-structured Domain

Earlier studies have shown the efficacy of worked examples in the domains of mathematics, science, computer science and applied technology (Chandler and Sweller, 1991; Cooper and Sweller, 1987; Sweller and Cooper, 1985; Tuovinen & Sweller, 1999; Ward & Sweller, 1990). However, there is a paucity of research on the use of worked examples in learning to solve ill-structured problems (Rourke & Sweller, 2009). In an effort to strengthen the evidence that the worked-example effect extends to less structured

domains, this study focuses on the application of worked examples to ill-structured problem solving in the domain of information literacy.

Literature Review

This review of the literature consists of four sections. First, the three dimensions to cognitive load theory are described. Second, the relationship of cognitive load to instructional design principles is discussed. Third, studies that validate the worked-example effect are reviewed. Fourth, limitations to the use of worked examples are explained.

Dimensions to Cognitive Load Theory

There are three dimensions to cognitive load: intrinsic, extraneous and germane (Sweller, 1998; Sweller, 2010). Intrinsic cognitive load is inherent in the material that the instruction targets. It consists of two aspects: the number of elements of the instruction and the number of connections between each element. The interconnectedness, or interactivity, of the elements of the instruction is the factor that determines the level of learning difficulty. Content of instruction is difficult when it contains many elements that must be learned simultaneously, rather than consecutively (Sweller, 1994). Extraneous cognitive load consists of distracting counter-productive elements that, due to misguided or erroneous instructional assumptions, are inadvertently or deliberately, inserted into the learning environment (Moreno & Park, 2010; Sweller, 1994; Sweller, 2010; Sweller et. al., 1998). Germane cognitive load involves schema formation. It is the dimension with which a learner creates new schema and modifies old schema to accommodate new information so that learning can occur (Van Merriënboer, Shuurman, de Croock, & Paas, 2002; Pociask & Morrison, 2007). However, some literature suggests that germane load is not an independent dimension within cognitive load theory, but rather it is subsumed under intrinsic load and a function of element interactivity (Kalyuga, 2010; Sweller,

2010; Sweller, 2011).

Sweller et. al. (1998) were careful to point out that extraneous, intrinsic and germane cognitive load are additive. To develop schema, the total cognitive load cannot exceed the capacity of the short-term memory, i.e. 7 ± 2 . An ideal instructional environment will create a mutually constructive interaction between intrinsic and germane cognitive load with minimal or no extraneous cognitive load so that meaningful learning occurs.

Cognitive Load Theory and Its Relationship to the Novice and the Expert

Cognitive load theory is informed by what is known about differences in the way the novices and experts solve problems. One important difference is that experts have extensive domain-specific knowledge. As an example, Adrian de Groot (1966) studied chess players and found that the greatest distinction between recreational chess players and professional ones was that professional players stored tens of thousands of real board configurations and were able to recall them when needed. They did not have a greater capacity than amateurs to anticipate their opponent's moves, nor were they better at figuring out the next best move, but rather, they already knew the next moves and were merely recalling them. They had superior knowledge of the domain. However, experts do not transfer this knowledge or skill to other domains. Their knowledge is domain specific. Regarding ill-defined problems, experts look for the big picture. They store knowledge of their subject in much larger chunks and retrieve it much faster than the novice. In addition, experts analyze the problem more fully, both at the beginning and the end of the problem-solving process, by taking longer than novices to decide on a solution and spending more time evaluating the results and identifying mistakes (Glaser & Chi, 1988; Bruning, Schraw, Norby, & Ronning, 2002).

Worked Examples As a Problem-Solving Strategy

A common strategy for solving problems is the use of algorithms, which are rule-based strategies (Bruning, Schraw, Norby, & Ronning, 2002, p. 169). For the expert, rule-based algorithms work well, but they work less well for the novice who may be unaware of the algorithm or unskilled in using it. A second strategy is the use of heuristics. Two common types of heuristics are trial and error, a kind of discovery strategy, and means-ends analysis, another inefficient approach that novices employ (Bruning, Schraw, Norby, & Ronning, 2002).

Sweller and Chandler (1991) describe means-ends analysis as a backward problem-solving approach. According to Sweller & Chandler, in order to solve a problem, experts work forward from the starting point to the final solution, drawing on schema stored in long-term memory. In contrast, novices solve problems by working backwards from a goal state to the starting point in search of a solution, sometimes creating sub-goals along the way. This process often overwhelms short-term memory leaving inadequate capacity for schema building.

Means-ends strategies involve the learners in processes that focus their attention on finding a solution to a problem and distract them from understanding the process, developing schema, and gaining expertise. Conventional instruction, which focuses the learner's attention on active problem solving, encourages mean-ends strategies and inhibits schema formation. On the other hand, instruction can be designed to thwart this tendency. One instructional strategy is to incorporate worked examples. (Cooper & Sweller, 1987; Sweller, 1988; Sweller & Cooper, 1985). With worked examples, the learner studies completely worked-out examples of a problem-solving process within a specific domain of knowledge before attempting to solve a problem unassisted in the same domain.

Cognitive Load Theory and Instructional Design Principles

Cognitive load theory generates two central instructional design principles. First, to help learners better understand a problem, the instruction should help learners direct their attention toward a specific problem-solving task. The learner should not be distracted by irrelevant mental operations. Second, instruction should help learners focus on the problem state and the category of solutions with which it is associated to retrieve the proper schema and discover a correct solution (Cooper & Sweller, 1987; Sweller & Cooper, 1985; Sweller & Chandler, 1991). The application of these two principles can be achieved through the use of correctly formatted worked examples (Ward & Sweller, 1990).

Worked-Example Effect

In a series of five experiments, Sweller and Cooper (1985) tested students exposed to a worked-example treatment and students exposed to a conventional problem-solving treatment, an approach characterized by engaging the students in actively solving numerous algebra problems. They found that the students who were required to study worked examples before completing algebra problems not only performed faster and more accurately on tests, but also showed improvement in their overall schema foundation, and subsequently, their problem-solving strategies. In addition, the researchers found that those students who did not have exposure to the worked-example treatment, performed more slowly and less accurately, partly because they either used a means-ends strategy by employing unnecessary moves, or used on incorrect schema that they had learned previously.

Worked examples seemed to facilitate schema acquisition and problem solving on similar problems by helping to make the learner aware of the sameness of conceptually identical problems. However, from the Sweller and Cooper 1985 study, it was not clear whether worked

examples helped learners transfer mathematical rules from one category of problems to a different one. In a series of experiments, Cooper and Sweller (1987) showed that worked examples facilitated transfer by helping to make the learner aware of the different applications of a mathematical rule to different sets of algebra problems. The results of their study showed that worked examples improved transfer of problem-solving skills from one category of problems to another category by facilitating schema formation and rule automation. However, the researchers noted that rule transfer was a gradual process. Therefore, rule transfer required extensive use of worked examples over long periods of time.

Limitations to Worked-Example Effect

Early research into worked examples showed that worked examples were more beneficial to learning problem-solving skills than the traditional problem-solving exercises method (Sweller & Cooper, 1985; Cooper & Sweller, 1987). However, subsequent studies revealed that, in some environments, worked examples were as ineffective, and in some cases, less effective, than the conventional approach that engaged the student in active problem-solving exercises (Chandler & Sweller, 1991; Kalyuga, Ayres, Chandler, & Sweller, 2003; Kalyuga, Chandler, & Sweller, 1998; Kalyuga, Chandler, Tuovinen, & Sweller, 2001; Tarmizi & Sweller, 1988; Ward & Sweller, 1990). These studies unveiled the split attention, redundancy, and expertise reversal effects.

Split-attention effect. Tarmizi and Sweller (1988) showed that geometry worked examples were not effective when the learners were required to split their attention between two or more sources of information and then integrate this information in order to solve a problem. In this study, geometry students were required to read problem statements on a worksheet and angle statements in a separate diagram. Then, in order to solve the problem, the students had to

mentally combine the information from the two sources. This effort generated extraneous load and obstructed the operation of the worked-example effect. Ward and Sweller (1990) published a similar study that showed that worked examples in physics were also ineffective when split-attention effects were present. In both studies, improperly formatted worked examples caused extraneous load. This excessive load on the short-term memory inhibited, and even prevented, schema formation, and learning.

Redundancy effect. Worked examples are also ineffective, or even counterproductive, when two or more redundant sources of information are displayed, but can be independently understood, without the learner needing to integrate them. An example of redundancy is information that is displayed within the narrative of the text and separately as an illustration. In a study involving electrical engineering and biology instruction, Chandler and Sweller (1991) found that rather than enhancing the instruction, redundant information created excessive extraneous load because the tendency on the part of the learner was to try to integrate the redundancies causing unnecessary and wasteful effort. They found that more effective and efficient learning took place when the instruction employed one complete source of information rather than two redundant ones.

Expertise-reversal effect. While improving the format of the worked examples for the novice learner has proven to be successful, these revisions are not always effective for the knowledgeable learner. Experiments showed that the effectiveness of worked examples diminished in proportion to the level of expertise of the learner. Students with little knowledge of a subject benefited from the worked examples, while students with more knowledge and experience in a domain did not benefit, and in some cases, actually experienced negative effects from the instruction (Kalyuga, Ayres, Chandler, & Sweller, 2003; Kalyuga, Chandler, & Sweller,

1998; Kalyuga, Chandler, Tuovinen, & Sweller, 2001).

Fading-Example Effect

Informed by the successes of the worked-example effect for the novice and by the expertise-reversal effect for the advanced student, researchers turned their attention to those students who were neither experts nor novices, the intermediate student (Renkl & Atkinson, 2003; Renkl & Atkinson, 2010; Renkl, Atkinson, & Grobe, 2004; Renkl, Atkinson, & Maier, 2002; Salden, Alevén, Schwonke, & Renkl, 2008). Studies were conducted to examine how to transition an intermediate learner from relying on worked examples to solving problem with no examples in an open, unguided learning environment. These studies led to the introduction of fading examples, which are problem-solving exercises in which discrete steps in an example of a problem-solving process were omitted.

At first, researchers thought that the position of the omissions was important, where backward fading was preferable to forward fading (Renkl, Atkinson, & Maier, 2002). Later it emerged that the order of the omissions was not important, but that decisions regarding omissions should be based on domain specific principles of the instruction, taking into consideration the students' prior knowledge (Renkl & Atkinson, 2003; Renkl, Atkinson & Grobe, 2004; Salden, Alevén, Schwonke, & Renkl, 2010).

When intermediate students practiced completing a series of exercises where fewer and fewer steps were displayed and when the omissions in these fading-examples exercises were aligned with the students' prior knowledge of the domain of the instruction, the students learned more efficiently (Renkl, Atkinson, & Grobe, 2004). From their experiments, Renkl, Atkinson, and Grobe (2004) concluded that practice in completing fading examples was even more effective than studying worked examples for those students who had some domain specific

knowledge of underlying principles.

Worked-Example Effect in Ill-Structured Domains

In 2009, Rourke and Sweller conducted a two-part study to test the application of the worked-example effect in an ill-defined problem-solving environment. The participants were studying art and design, which involved ill-defined problem solving because the students were required to identify the work of furniture designers by considering a number of factors and combinations of these factors. In other words, there was more than one way to identify the objects and solve the problems. In the first experiment, the researchers tested 130 first-year students who had no foundational knowledge of the principles of visual literacy. The results showed that those participants who studied worked examples before problem solving achieved better results on identification and matching tests than those who were exposed to unassisted problem-solving exercises. The second experiment involved 27 second-year students who had some domain specific knowledge. The results of this experiment also demonstrated that the studying of worked examples was a more effective method than traditional problem-solving practice when acquiring visual literacy skills. In addition, amongst the students in the second experiment, who were somewhat knowledgeable, those who were exposed to studying worked examples demonstrated greater cognitive flexibility than those who were exposed to unassisted problem-solving practice because they solved problems that were both similar to the worked examples and dissimilar, i.e. exhibiting both near and far transfer. The participants in both experiments lacked the experience and knowledge for an expertise reversal effect to emerge.

In summary, the literature suggests that the study of worked examples can be an effective tool for learning to solve problems than conventional problem-solving exercises in the domains of mathematics, science, and applied science. The use of worked examples helps the learner to

consciously form schema and store this schema in long-term memory for automatic retrieval later when needed. In addition, there is evidence that assistance in schema formation and automation helps the novice to be able to transfer rules from one application to a similar one. However, there are two environments in which worked examples did not promote learning. For worked examples to have an effect, their design should display one unified source of information that focuses the attention of the learner on the learning goal. Second, studies showed that worked examples might generate a redundancy effect with advanced learners, creating what is known as the expertise-reversal effect. This effect means that the more competent the learner is in the target subject matter, the less effective the use of worked examples is. Third, some researchers suggest that intermediate students might benefit from a modified form of worked example, the fading example. Finally, the majority of research into the worked-example effect has been conducted in mathematic-related fields of study. There is little or no research into other areas. A paucity of literature exists which validates an extension of the worked-example effect to ill-structured problem-solving domains. This study is a contribution to that literature.

Problem Statement and Hypotheses

The purpose of this study was to extend what is known about the worked-example effect to the domain of library research skills. Students learning to search academic databases have a tendency to apply the same strategies they use in searching databases to searching the World Wide Web. This strategy is often ineffective because free search engines and proprietary databases are structured differently and use different algorithms to retrieve files (Bell, 2007; Hock, 2008). For example, library databases function most effectively when the user avoids search queries that consist of sentences or strings of phrases, especially those that contain misspelled words. On the other hand, web search engines are designed to retrieve items

regardless the structure or even the spelling of the words in the query. Library databases function best when the students familiarize themselves with controlled vocabularies, and when they know how to generate search terms and combine them in strategic ways.

This study applied heuristics from cognitive load theory and the worked-example effect to teaching students how to form effective queries for searching library databases. This study addressed the following six hypotheses:

1. When learning to search academic journal databases, participants in the worked-examples treatment group will generate a greater number of search terms than those exposed to a problem-solving activity.
2. Participants in the worked-example treatment group will generate search terms with stronger relevancy to the research topic and organize them more effectively than those exposed to a problem-solving activity.
3. Participants in the worked-example treatment group will rate the task on a perception of difficulty scale as less difficult than those exposed to a problem-solving activity.
4. Participants in the worked-example treatment group will achieve a higher score on a test that measures competency in producing discrete components of a database search query.
5. Participants in the worked-example treatment group will retrieve more relevant articles during the practice segment than those exposed to a problem-solving activity.
6. Participants in the worked-example treatment group will demonstrate greater skill in applying what they learned by displaying a greater number of articles retrieved from databases in the references page of a subsequent research assignment than those exposed to a problem-solving activity.

CHAPTER II

METHODS

This study focused on the effect of worked-example exercises and fading-example exercises on performance in designing a query for searching academic databases. The methods for this study were based on a double-blind experimental research design. The participants were randomly assigned to one of three groups: 1) a control group, where the participants were exposed to exercises with no examples, 2) a worked-example group, where participants were exposed to worked-example exercises, and 3) a fading-example group, where the participants were exposed to fading-example exercises.

The main technique of analysis was a Multivariate Analysis of Covariance. The independent variable was group assignment, the fading-example group or the worked-example group. The dependent variables were: 1) the total number of search terms generated on a worksheet designed to facilitate search query formation, 2) the overall performance on this search-query formation worksheet, 3) the total number of relevant journal articles retrieved during a practice session, 4) the number that the student assigned to an instrument that measured cognitive load, 5) a score on a posttest that tested understanding of the content of the prerecorded presentations, which focused on domain-specific knowledge of the search-query formation process. The covariate variables were three: 1) previous library experience, 2) level of academic preparedness, and 3) domain-specific knowledge of the search-query formation process as measured by a pretest. To test the sixth hypothesis related to applied learning, an Analysis of Covariance was conducted, where the independent variable was group assignment, the dependent variable was the number of articles cited in a list of references in a subsequent assignment, and the covariate was the pretest.

Participants

The researcher asked 14 professors at a community college who taught courses that included a research project for assistance in recruiting the students attending their courses to participate in the study. Twenty-four courses, with a combined enrollment of approximately 647 students, were involved in the study: three anthropology courses, one business communications, two computer science, five English composition, one history of film, one Latin American studies, five public speaking, four psychology, and two sociology courses. All students were encouraged to attend both the first and second sessions, view the presentations and complete the exercises. For the first session, when participants took the pretest and signed informed consent forms, 540 were in attendance. Of these 27 opted out of the study by not signing the informed consent form. For the second session, during which time participants viewed the presentations and completed the exercise, 479 participants attended. Of the 479, 107 did not attend the first session when the informed consent was signed and submitted. Therefore, of the total possible number of students, only 372 attended both the first and second sessions and signed the informed consent form. Of these, forty-nine participants neglected to answer every question in the student profile, and therefore, were excluded from the study. Thus, out of a possible 649, the total number of participants was 323.

All the participants, a fairly diverse group, were community college students. The minimum age was 14 and the maximum 60, with a mean, median and mode of 24, 20, and 18 respectively. As for gender, 35% were male and 65 % female. As for highest degree obtained, ninety % of the participants were high school graduates, six % had obtained their associates degree, three % had obtained a four-year college degree and one student had obtained a post-graduate degree.

Instruments

The researcher collected data using four instruments. First, students completed a survey that elicited data about the participant in three areas: 1) library experience, i.e. attendance at a prior library instruction and prior use of the online catalog and the databases, 2) the student's educational experience, i.e. high school GPA, college credits completed, highest degree obtained and educational goals, and 3) demographic data, i.e. age and gender (see Appendix A). The second instrument was a pretest used to determine the participant's prior domain-specific knowledge of the content of the library instruction (see Appendix B). Third, there was a posttest to assess what the student learned from viewing a prerecorded presentation and completing an in-class exercise (see Appendix C). Fourth, students completed a perception of cognitive load instrument (Brünken, Seufert & Paas, 2010). This instrument was a scale that measured the participant's perceived sense of difficulty of an activity (see Appendix D). The participants responded to this difficulty scale in two situations: 1) after viewing a two prerecorded presentations and 2) after completing a 25-minute practice session.

The parallel versions of the pretest and the posttest, which tested domain-specific knowledge of library database search queries, had three multiple-choice questions each, one where the participant was required to recall a fact from the presentation, a second where the student was required to synthesize information from the presentation, and a third question where the student was required to apply information explained in the presentation. In addition, there were two fill-in-the-blank questions, where the student was required to form a noun from a word in another part of speech. Finally, there were points for correct identification of key words in a research question. Although the pre- and posttests involved knowledge of the same skill sets, the question prompts were different to reduce test-retest issues.

The lesson included a worksheet designed to illustrate one way to design a query for searching databases (See Appendix E). The worksheet contained subjective elements of which raters had to judge the quality. To assist the raters in assigning quantitative values to these subjective elements, the researcher designed a Search-Query Worksheet Evaluation instrument. This instrument guided the raters in assigning values on a scale of 1 – 3 for each of six competencies related to the participants ability to generate relevant search terms and organize them logically (see Appendix F).

Piloting Instruments and Instructional Materials

All materials used in this study were piloted. The instructional materials, i.e. the presentations, ready-reference handouts and worksheets, were designed and developed over a five-year period. Materials were revised based on the researcher's observations of student responses and feedback from interviews with their professors.

The researcher developed the items for the pre- and posttests based on a task analysis of the search-query formation process being taught. Then, prior to the treatments, the two tests were piloted with approximately 50 students, attending three classes: history of film, speech communications and civil engineering. Based on an error analysis of the test items and observations of the participants while they were taking the tests, the researcher revised the instruments by improving the wording of some of the questions and eliminating redundant, irrelevant, or flawed items.

The Search-Query Worksheet Evaluation instrument was tested to establish inter-rater reliability. The researcher conducted training with two volunteer raters, who were librarians in community colleges, in how to assign values to the components of the Search-Query Worksheet Evaluation instrument. The training was conducted in several steps. First, the researcher gave

brief instructions to the volunteers on how to use the evaluation instrument. Then, the three raters, i.e. the researcher and the two volunteers, used the evaluation instrument to practice assigning values to two sample worksheets. Next, the researcher calculated the percentage of inter-rater agreement.

The results of this first practice activity showed 72% inter-rater agreement on the first sample and 89% on the second. After discussing these discrepancies with the volunteer raters, the researcher revised the worksheet to make the instructions clearer and the instrument easier to use. Finally, the researcher distributed a third mock evaluation instrument, with which the three raters achieved a 94% rate of agreement.

Procedures

In consultation with the 14 selected professors, the researcher visited each class on two separate occasions: once for a 15-minute introductory session and once for a 50-minute lesson. During the introductory session, the researcher explained the study to the students, obtained signed informed consent forms from those students who agreed to participate in the study (see Appendix G), and administered the pretest and the student-profile survey.

On the day of the actual lesson in designing search queries, the researcher conducted classroom activities in two stages. In the first stage, the researcher presented the content of the instruction via two short prerecorded presentations. The first presentation demonstrated how to navigate to the library website, and then, search for and find journal articles using the library databases. The second presentation instructed the students in one method of generating search terms and combining them to form search queries. In addition to the presentations, students also received two, one-page ready-reference handouts. After the presentations, the students completed the perception of difficulty instrument with which they indicated how difficult they felt the

presentations were to understand.

In the second stage, immediately after having viewed the two prerecorded presentations, the participants engaged in a 25-minute practice session by completing a 13-page packet of materials. Each packet contained a cover page, an instrument to measure perception of difficulty of the presentations, three example worksheets for designing search queries and one blank worksheet, an exercise that prompted the participants to search for articles in the databases, and an instrument to measure perception of difficulty of the exercises. After completing the 25-minute practice session, the participants completed the five-minute posttest. To conclude the session, the researcher thanked the participants, and presented each with a retractable ballpoint pen as a token of appreciation.

The control group, the worked-example group and the fading-example group each received a different set of worksheets in their packets. The control group received a packet where the worksheets were a series of three exercises, each of which contained a one-word prompt, i.e. marijuana, identification, and radiation (See Appendix H). The fading-examples group received a packet that included a series of three worksheets in which each worksheet contained an incomplete example of the search-query formation process. The first worksheet was mostly complete, the second was less complete, and the third was mostly incomplete. Decisions regarding omissions in the fading-example exercises were based on a task analysis of the domain-specific principles of the search-query formation process (See Appendix I). The third group received a packet of worked-examples, which included a series of three completed examples on three topics, i.e. marijuana, identity badges and radiation (See Appendix J).

Content of the Instructions

Steps were taken in order to keep the lesson for all groups as similar as possible.

Introductory information was delivered in-person from a script. By prerecording the two presentations, the researcher was able to expose all participants to identical instruction. To produce these recordings, the researcher scripted the text of each set of instructions in PowerPoint software. Then, with the assistance of instructional technologists at her institution, she recorded each of the two presentations using a screen-capturing computer program, Camtasia.

Time on Task

The control group and the two experimental groups had the same amount of time-on-task. Based on the time-constraints of a typical 50-minute library instruction session, all three groups were presented with a scripted in-person introduction, followed by two prerecorded instructional presentations. After the instruction, the participants engaged in a 25-minute practice session. Within the 25-minute practice session, all three groups studied and/or completed four worksheets designed to help them form a search query and retrieve articles relevant to their research.

Data Screening Prior to Analysis

In order to be included in the study, the student had to have attended both the first and the second library instruction sessions, arrived on time and signed the informed consent form. After these exclusions, the total number of student participants was 372. From this sample population of 372 cases, raw data were input into an Excel file and then exported into an SPSS file. After that, the data were examined for accuracy of data entry and missing values.

Outliers. Outliers were authentic cases and not excluded from the analysis. For example, some participants received 0% on the worksheet because they did not respond to any of the prompts. However, there was no evidence of a lack of effort to complete the worksheet.

Missing Data. A screening of the data identified 14 cases where the participant did not complete the student profile/questionnaire, and 35 cases in which one, two or three values were missing from the student profile/questionnaire. These 49 cases were deleted from the study. There remained a total of 323 cases for analysis.

Data Analysis

After screening the data, the researcher conducted a one-way MANCOVA to determine which of the three treatments, i.e. traditional practice in solving problems, completion of fading worked examples, or studying completed worked example, improved the student's performance on six dependent variables. The first dependent variable was the total number of search terms generated on a search-query formation worksheet. The second variable was the participants' overall score in percentage points, out of a possible 18 points, on the same worksheet, which measured the relevancy of the terms to the students' topic and the logic of the way the terms were organized. The third was the perception of-difficulty rating, on a on a scale of 1 to 9, for the worksheet. The fourth was the posttest, out of a possible 15 points. The fifth was the number of articles retrieved from databases during the practice session. The covariates were prior library experience, general academic preparedness and domain-specific knowledge.

Test of applied learning. To determine how well the participants were able to apply the skills learned to a real research situation, the researcher examined a list of references that the participants compiled for a subsequent research assignment. The researcher conducted an ANCOVA to analyze whether those participants who were exposed to worked examples, whether completed or fading, were more likely to use articles found in library databases in a subsequent research project than students in the control group. Table 1 displays the relationships between the hypotheses, data, the instruments of measurement, and the tests of analysis.

Table 1.

Hypotheses, Data, the Instruments of Measurement, and the Tests of Analysis

Hypotheses	Data	Instrument of Measurement	Analysis
1. Participants in the work-examples treatment group will generate a greater number of search terms than those exposed to a problem-solving activity	Number of terms generated during instructional session, with a range of 0 to infinity (an open-ended range).	Number of terms generated in the chart of the worksheet	MANCOVA followed by an ANCOVA
2. Participants in the worked-example treatment group will generate search terms with stronger relevancy to the research topic and organize them more effectively than those exposed to a problem-solving activity.	Overall score in percentages on the search query formation worksheet, with a range of 0 – 18.	Worksheet Evaluation Instrument	MANCOVA followed by an ANOVA and a Comparison of Main Effects Test
3. Participants in the worked-example group will rate the in-class exercise on a perception of difficulty scale as less difficult than those exposed to a problem-solving activity	Score on the perception of difficulty scale, with a range of 1 - 9	Perception of Difficulty Scale	MANCOVA followed by an ANOVA and a Comparison of Main Effects Test
4. Participants in the worked-example treatment group will achieve a higher score on a posttest than those exposed to a problem-solving activity.	Score in percentage points on the end-of-session Knowledge Test, with a range of 0 – 15.	The posttest of Domain-specific Knowledge	MANCOVA followed by an ANCOVA
5. Participants in the worked-example treatment group will retrieve more articles during the practice segment than those exposed to a problem-solving activity	Number of articles students e-mailed during the practice segment of the instructional session, with a range of 0 to infinity (an open-ended range).	n/a	MANCOVA followed by an ANCOVA
6. Participants in the worked-example treatment group will demonstrate greater skill in applying what they learned by displaying a greater number of articles retrieve from databases in the references page of a subsequent research assignment than those exposed to a problem-solving activity.	Number of library resources displayed in the references page of a subsequent research assignment, with a range of 0 to infinity (an open-ended range).	Reference page of a subsequent research assignment	ANCOVA

CHAPTER III

RESULTS

To test the hypotheses and to control for the differences between the groups for covariate variables, the researcher conducted a MANCOVA, where the covariates were prior library experience, academic preparedness and domain-specific knowledge, i.e. the pretest. The independent variable consisted of the three groups of participants: the worked-examples group, the fading-example group and the control group. The dependent variables were: 1) the number of search terms generated on a search-query formation worksheet (word count), 2) the overall performance on the same search-query formation worksheet, 3) the number of relevant articles and abstracts found during the practice session, and 4) the score on the Perception of Difficulty Scale for completion of the worksheet, and 5) a posttest of domain-specific knowledge.

A preliminary analysis was conducted to evaluate homogeneity of slopes between the covariates and the dependent variables across groups. The interaction between the groups and the covariates was not significant, and the power was very weak, Wilks' Lambda = .97, $F(15, 856) = .70$, $p = .78$, $\eta^2 = .01$. These results indicated that a MANCOVA was appropriate.

Table 2 displays the results of the MANCOVA. The covariates, library experience and academic preparedness, were not significant influences on the dependent variables across the groups, Wilks' Lambda = .98, $F(5, 310) = 1.02$, $p = .41$, $\eta^2 = .02$ and Wilks' Lambda = .98, $F(5, 310) = 1.10$, $p = .38$, $\eta^2 = .02$, respectively. However, the pretest did have a significant influence on the dependent variables across the groups, Wilks' Lambda = .80, $F(5, 310) = 15.91$, $p = .00$, $\eta^2 = .20$. The partial eta squared was quite strong, accounting for 20% of the variation.

Adjusting for the differences between groups on the pretest and with significance set at .01 (.05 divided by 5), the group assignment had a statistically significant influence on overall

performance on the search-query formation worksheet, $F(2, 314) = 10.54$, $p = .00$, $\eta^2 = .06$, but not on the other four dependent variables, where word count was $F(2, 314) = 3.85$, $p = .02$, $\eta^2 = .02$, number of articles and abstracts retrieved was $F(2,314) = 1.24$, $p = .30$, $\eta^2 = .01$, the Perception of Difficulty for the in-class exercise was $F(2, 314) = .12$, $p = .89$, $\eta^2 = .00$, the Posttest was $F(2, 314) = .02$, $p = .98$, $\eta^2 = .00$.

Table 2

Results of the MANCOVA for Comparison between Groups for the Dependent Variables with Library Experience, Academic Preparedness, and Pretest As Covariate.

Source		Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Between Groups	Word count	42.745	2	21.373	3.846	.02	.02
	Worksheet	11917.031	2	5958.515	10.535	.00	.10
	Articles	4.876	2	2.438	1.236	.30	.01
	Difficulty	.905	2	.452	.122	.89	.00
	Posttest	11.403	2	5.702	.02	.98	.00
Library Experience	Word count	.922	1	.922	.166	.68	.00
	Worksheet	357.746	1	357.746	.633	.43	.00
	Articles	1.411	1	1.411	.715	.40	.00
	Difficulty	3.607	1	3.607	.974	.33	.00
	Posttest	579.310	1	579.310	2.055	.20	.01
Academic Preparedness	Word count	21.118	1	21.118	3.800	.10	.01
	Worksheet	884.980	1	884.980	1.565	.21	.01
	Articles	.215	1	.215	.109	.74	.00
	Difficulty	1.767	1	1.767	.477	.50	.00
	Posttest	494.738	1	494.738	1.755	.19	.01
Pretest	Word count	26.241	1	26.241	4.722	.03	.02
	Worksheet	9568.018	1	9568.018	16.918	.00	.05
	Articles	42.600	1	42.60	21.601	.00	.06
	Difficulty	3.441	1	3.441	.929	.34	.00
	Posttest	15346.677	1	15346.677	54.428	.00	.15
Group*Pretest *Academic Preparedness* Library Experience	Word count	14.679	2	4.893	.881	.45	.01
	Worksheet	598.402	2	199.467	.353	.79	.00
	Articles	3.04	2	1.013	.514	.67	.01
	Difficulty	15.278	2	5.092	1.374	.25	.01
	Posttest	500.949	2	166.983	.592	.62	.01
Within Groups	Word count	1744.809	320	5.557			
	Worksheet	177588.405	320	565.568			
	Articles	619.264	320	1.972			
	Difficulty	1163.395	320	3.705			
	Posttest	88535.939	320	281.962			
Corrected Total	Word count	1850.502	322				
	Worksheet	199406.025	322				
	Articles	674.644	322				
	Difficulty	1188.854	322				
	Posttest	107700.099	322				

Table 3 displays the unadjusted means and standard deviations on the dependent variables for the three groups. For the search-query formation worksheet, there were statistically significant differences between the groups. On average, participants in the control group scored 73%, those in the fading-example group scored 76%, and those in the worked-example group scored 86%. More details of the pair-wise differences between the groups are discussed below on pages 36 – 41.

For the other four variables, word count, the number of relevant articles and abstracts found during the practice session, the score on the Perception of Difficulty Scale, and the posttest, there were no statistically significant differences between the groups. For word count, participants in the worked-example group and the fading-example group generated seven words, on average, while the control group generated an average of six words. The number of articles and abstracts retrieved was also not significant, where all three groups retrieved one article or abstract, on average. Differences between the groups for perception of difficulty on the in-class exercise were also not significant, where the means for all groups was “5” on a scale of “1” through “9,” where “9” indicated the highest mental effort. The scores on the domain-specific knowledge posttest also lacked statistical significance, where both the control group and the fading-example group scored 61% correct, on average, and the worked-example group scored 59%.

Table 3

Unadjusted Means and Standard Deviations on the Dependent Variables for the Three Groups

Group	Word Count		Performance on In-Class Exercise ^a		Number of Articles & Abstracts Retrieved		Perception of Difficulty of the In-class Exercise ^b		Posttest of Domain-specific Knowledge ^c	
	<i>M</i>	<i>SD</i>	M	SD	M	SD	M	SD	M	SD
Control	6	3	73	28	.90	2	5	2	61	18
Fading	7	2	76	26	.58	1	5	2	61	18
Worked	7	2	86	18	.80	1	5	2	59	18

^a Scores are percentage points out of 100%.

^b The least mental effort is 1 and the greatest mental effort is 10.

^c Scores are percentage points out of 100%.

Test of Pre-existing Domain-Specific Knowledge: The Pretest

Because the Wilks' Lambda test showed that the pretest was significant and its influence on the dependent variables across the groups was strong, accounting for 20% of the variance, the researcher conducted a series of tests to examine more closely the relationship of the pretest to the dependent variables across the groups.

First, an ANOVA was conducted to establish whether or not participants within groups had similar domain-specific knowledge of the skills needed to design search queries. The dependent variable was the pretest and the independent variable was the groups. Table 4 displays the unadjusted means, standard deviation, and 95% confidence intervals for performance on the pretest for the three groups. The results showed that there was a statistically significant difference between the groups in terms of skill level in designing search queries, as measured by the pretest, where $F(2, 320) = 3.18, p = .04, \text{partial } \eta^2 = .02$.

A consequence of the randomness of group assignments was that the groups were not demographically equivalent. In other words, the results of the ANOVA showed that the control group had stronger domain-specific knowledge of the content of the instruction than participants in the other two groups. More specifically, the control group scored 46% on the pretest, a statistically significantly higher score than the worked-example group, which scored 37%. Though not statistically significant, the control group also scored higher on the pretest than the fading-example group, which scored 41%.

Table 4

Unadjusted Means, Standard Deviation, and 95% Confidence Intervals for Performance on the Pretest for the Three Groups.

	Group	<i>M</i>	Standard Deviation	95% Confidence Intervals	
				Lower Bound	Upper Bound
Pretest	Control	45.50*	23.58	40.97	50.02
	Fading-example	41.04	24.31	36.77	45.31
	Worked-example	37.20*	22.67	32.56	41.84

*significant difference between the control group and the worked-example group.

Next, to test the hypotheses and to control for the differences between the groups on the pretest, a second MANCOVA was conducted. The independent variable consisted of the three groups of participants: the control group, the fading-example group and the worked-examples group. The dependent variables were: 1) the number of search terms generated on a search-query formation worksheet (word count), 2) the overall performance on the same search-query formation worksheet, 3) the number of relevant articles and abstracts found during the practice session, 4) the score on the Perception of Difficulty Scale for completion of the worksheet, and

5) a posttest of domain-specific knowledge.

A preliminary analysis evaluating the homogeneity of slopes assumption was conducted. With significance set at .01 (.05 divided by five, the number of dependent variables), the Wilk's Lambda test showed that the relationship between the covariate and the independent variable was not significant, Wilk's Lambda = .94, $F(10, 626) = 2.10$, $p = .02$. The multivariate η^2 based on Wilk's Lambda was weak, accounting for only 3% of the variant. These results indicated that a MANCOVA was appropriate.

Table 5 displays the results of the MANCOVA. Adjusting for the differences between groups on pretest scores, group assignment had a statistically significant influence on overall performance on the search-query formation worksheet, $F(2, 317) = 10$, $p = .00$, $\eta^2 = .06$, but not on the other four dependent variables, where word count was $F(2, 317) = 1.88$, $p = .16$, $\eta^2 = .01$, number of articles and abstracts retrieved was $F(2,320) = 3.51$, $p = .03$, $\eta^2 = .02$, the Perception of Difficulty for the in-class exercise was $F(2, 320) = 2.02$, $p = .13$, $\eta^2 = .01$, the Posttest was $F(2,323) = .50$, $p = .63$, $\eta^2 = .00$.

Table 5

Results of the MANCOVA for Comparison between Groups for the Dependent Variables with Pretest as Covariate.

Source		Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Between Groups	Word count	20.946	2	10.473	1.876	.155	.01
	Worksheet	11078.422	2	5539.211	9.995	.00	.06
	Articles	13.389	2	6.694	3.512	.031	.02
	Difficulty	14.91	2	7.455	2.024	.134	.01
	Posttest	265.550	2	132.775	.467	.627	.00
Pretest	Word count	36.336	1	36.336	6.51	.011	.02
	Worksheet	9833.501	1	9833.501	17.744	.00	.05
	Articles	43.168	1	43.168	22.645	.00	.07
	Difficulty	4.361	1	4.361	1.184	.277	.00
	Posttest	17235.937	1	17235.937	60.649	.00	.16
Group*Pretest	Word count	11.068	2	5.534	.991	.372	.01
	Worksheet	3534.806	2	1767.403	3.189	.043	.02
	Articles	19.608	2	9.804	5.143	.006	.03
	Difficulty	16.934	2	8.467	2.299	.102	.01
	Posttest	249.684	2	124.842	.439	.645	.00
Within Groups	Word count	1769.467	317	5.58			
	Worksheet	175674.170	317	554.177			
	Articles	604.285	317	1.906			
	Difficulty	1167.448	317	3.683			
	Posttest	90089.313	317	284.193			
Corrected Total	Word count	1850.502	322				
	Worksheet	199406.025	322				
	Articles	674.644	322				
	Difficulty	1188.854	322				
	Posttest	107700.099	322				

Follow up tests for each of the six hypotheses were conducted. The researcher prepared a series of ANCOVAs to test the dependent variables. When the ANCOVA was not appropriate because there was significant interaction between the covariate and the independent variable, tests of simple group main effects were conducted for low, medium and high values on the covariate, where low was one standard deviation below the mean, medium was the mean, and high was one standard deviation above the mean, i.e. 17.57, 41.03, and 62.04, respectively.

Hypothesis One

A one-way analysis of covariance was conducted to evaluate whether group assignment influenced the number of search terms that a participant generated during an in-class practice session. The covariate was the pretest and the independent variable was the groups. The dependent variable was the number of search terms that the participant generated in a chart on a worksheet during the practice session.

The Levene's test was significant, indicating that the variation between the groups may not be homogenous. However, Tabachnick & Fidell (2007) referenced Watermaux (1976) in stating that the Levene's test may be overlooked when the sample size is large. They wrote that "underestimation of variance associated with positive kurtosis...disappears with samples of 100 cases or more; with negative kurtosis, underestimation of variance disappears with 200 or more cases" (p. 80). In this study, the sample was large, $N = 323$.

A preliminary analysis evaluating the homogeneity of slopes assumption indicated that the relationship between the covariate and the dependent variable did not differ significantly as a function of the independent variable, $F(2, 317) = .99$, $MSE = 5.58$, $p = .37$, $\text{partial } \eta^2 = .01$, indicating that ANCOVA was appropriate. Table 6 displays the results of the ANCOVA for comparison between groups for number of search terms generated. The ANCOVA was not

significant, $F(2, 317) = 1.88, p = .16$. In addition, the strength of the relationship between the independent variable and the number of words generated was small, accounting for only 1% of the variance of the dependent variable, as assessed by Partial Eta Squared.

Table 6

Results of the ANCOVA for Comparison between Groups for Word Count.

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Between groups	20.946	2	10.473	1.876	.16	.01
Pretest	36.34	1	36.336	6.51	.01	.02
Groups*Pretest	11.068	2	5.534	.991	.37	.01
Within groups	1769.467	317	5.582			
Corrected Total	1850.502	322				

Table 7 displays the unadjusted means and standard deviations on the dependent variable, i.e. word count, for the three groups. The control group generated six search terms, on average. The fading-example group generated seven, and the worked-example group generated seven.

Table 7

Unadjusted Means and Standard Deviations for Each Group on Number of Words Generated.

Group	<i>M</i>	<i>SD</i>
Control	6	3
Fading-example	7	2
Worked-example	7	2

Frequency descriptive statistics show a word count cluster, where 146 participants generated eight search terms. One explanation for the cluster around the number eight is

that, the chart in the worksheet had two columns with four rows, totaling eight spaces.

Although the participants were instructed to generate as many terms as they could think of, in the spirit of a kind of brainstorm, with little regard for quality, the researcher observed that the participants appeared inclined to generate enough terms to fill in all the blank spaces available in the chart, to the extent that some participants repeated terms in order to fill the spaces, though the scorers did not include these repetitions in their tabulations.

Due to an unfortunate oversight on the part of the researcher, the worksheet for the control group had an extra row, leaving 10 spaces for words. Out of the 21 participants that generated 10 search terms, 19 were from the control group, giving this group a possible statistical advantage. In contrast, one participant in the worked-example group and one participant in the fading-example group generated 10 terms. About 65 Participants from the worked-example group and about 70 from the fading-example group generated eight search terms, the number of spaces on their charts. Only about 11 participants from the control group generated eight terms. Had this flaw not existed, it is possible that the two treatment groups would have made a greater statistical difference in word count over the control group. Figure 1 shows the comparison between the groups for number of terms generated during an in-class exercise, displaying obvious clusters for the control group at 10 search terms and for the fading-example group and the worked-example group at eight search terms.

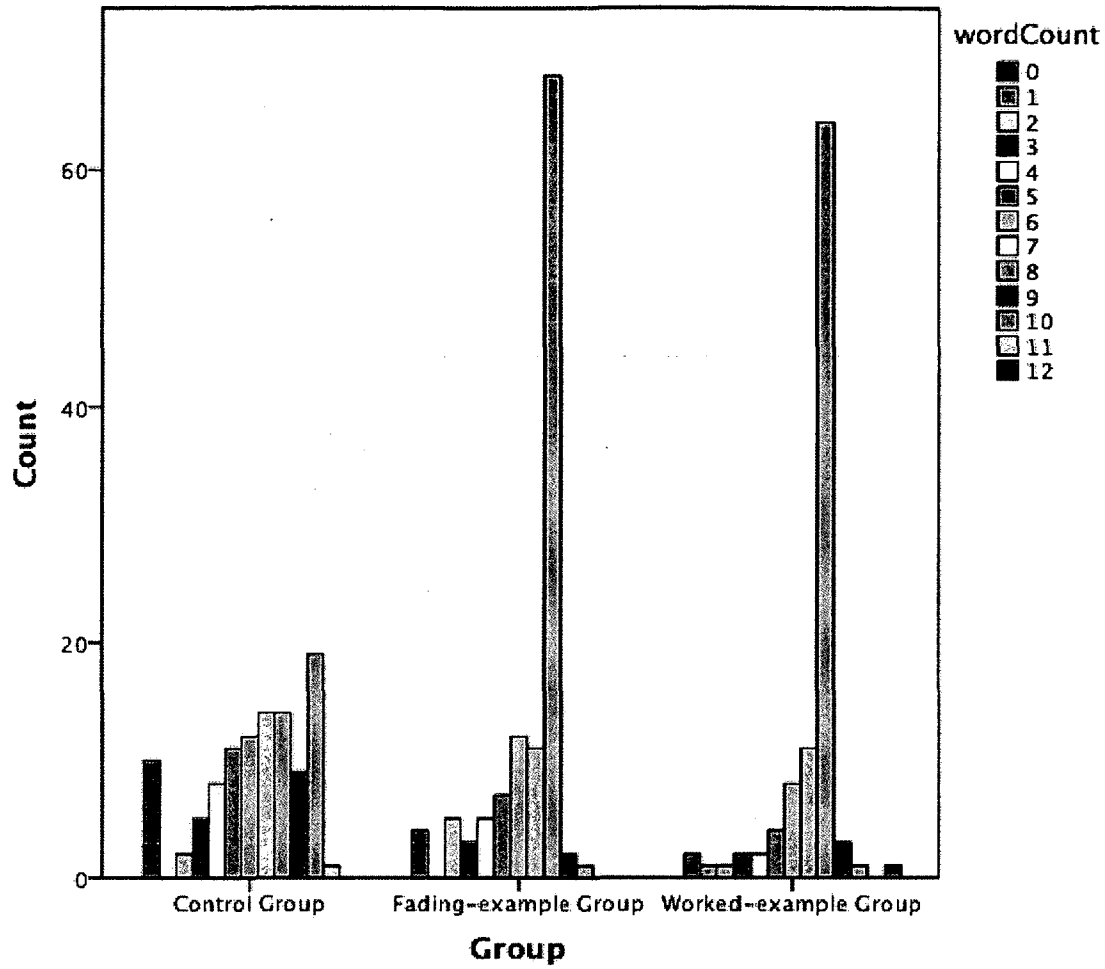


Figure 1. Comparison between Groups for Search Terms Generated during Class Exercise.

Hypothesis Two

A second one-way analysis of covariance was planned to evaluate which of the two treatment groups and the control group was most effective in helping the participants improve their overall performance on a search-query formation worksheet, which was designed to help learners generate search terms with a stronger relevancy to a research topic and organize them more effectively. The dependent variable was the overall score in percentage points on the worksheet completed during the practice session. The covariate was the pretest score. A preliminary analysis evaluating the homogeneity-of-slopes between the covariate and the dependent variable across groups showed that the interaction between the independent variable and the covariate was significant, $F(2, 317) = 3.19$, $MSE = 554.177$, $p = .04$, partial $\eta^2 = .02$, indicating that an ANCOVA was not appropriate (See Green and Salkind, 2007).

Based on the results of the significant interaction between the covariate and the dependent variable across groups, despite its weak power, only 2% of the variance, the researcher conducted an ANOVA rather than an ANCOVA, and then, conducted a comparison of main effects at three levels of the covariate, i.e. low, medium and high. Table 8 displays the results of this ANOVA. The ANOVA was significant, $F(2, 320) = 8.18$, $p = .00$, partial $\eta^2 = .05$.

Table 8

Results of the ANOVA for a Comparison between Groups for Performance on the Search-Query Formation Worksheet.

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Between groups	9699.31	2	4849.654	8.18	.00	.05
Within groups	189706.72	320	592.833			
Corrected Total	199406.025					

Follow-up tests were conducted to evaluate pair-wise differences amongst the means. The Levene's test was significant, indicating that the variance between the groups may not be homogenous. Therefore, the Dunnett C post hoc test, which does not require homogeneity of variance was conducted. The 95% confidence intervals for the pair-wise differences, as well as the means and the standard deviations for the groups, are reported in Table 9. The box plot in Figure 2 illustrates the differences between the means of the groups. The results of the post hoc test showed that the group that received the worked-example treatment performed statistically significantly better on the in-class worksheet than either of the other two groups. The unadjusted means for the worked-example group was 86%, thirteen-percentage points higher than the control group, which scored 73%, and 10-percentage points higher than the fading-example group, which scored 76%.

Table 9

Unadjusted Means, Standard Deviations, and 95% Confidence Intervals of Pairwise Differences on Performance on the Search-query Formation Worksheet for Each Group.

Group	<i>M</i>	<i>SD</i>	Control Group	Fading Example
Control	73	27.45		
Fading Example	76	26.21	-11.14 to 5.99	
Worked Example	86	18.68	5.36 to 20.62*	3.31 to 17.52*

* indicates a significant difference between the groups at the .05 level, using Dunnett C post hoc test.

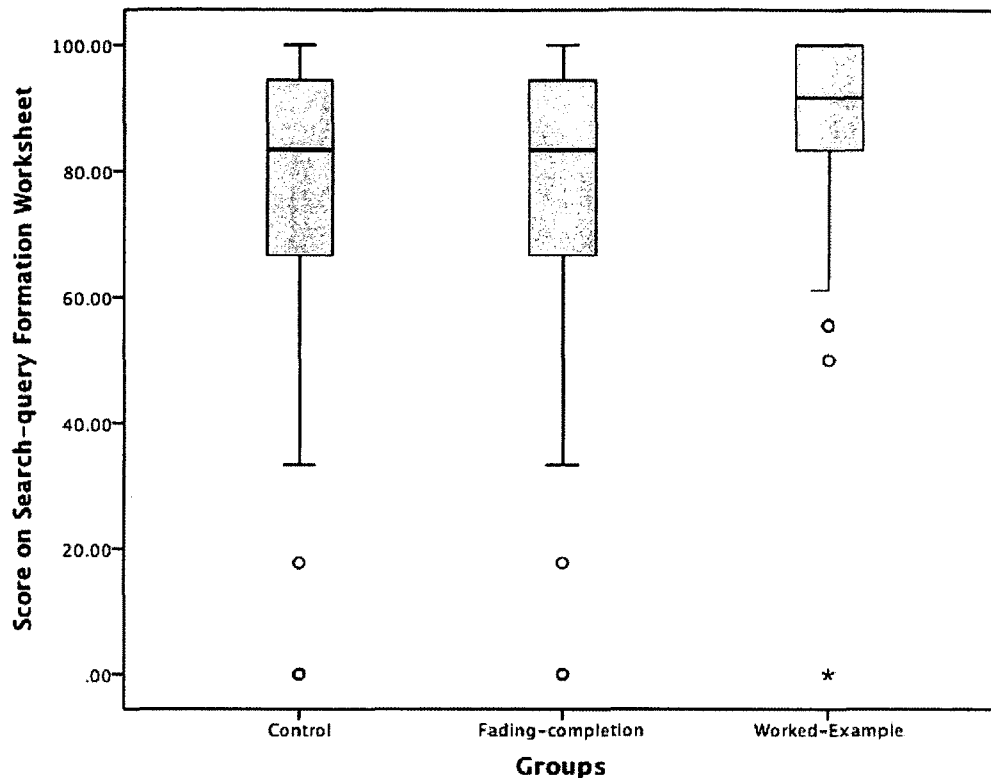


Figure 2. Boxplot Displaying the Differences between the Groups for Performance on the Search-query Formation Worksheet.

Next, because there was a significant difference between the groups on pretest scores, simple main effects tests were conducted to assess differences between the groups at low, medium and high values on the covariate, i.e. the pretest, where low was one standard deviation below the mean, or 18%, medium was the mean at 41%, and high was one standard deviation above the mean, or 65%. The significance value was set at .017, i.e. $.05/3$. Figure 3 shows the differences between groups for the three levels of scores on the pretest. The simple main effects test was significant for the low pretest scores, $F(2, 317) = 12.94, p = .00, \text{partial } \eta^2 = .08$. It was also significant for the medium scores on the pretest, $F(2, 317) = 10.67, p = .00, \text{partial } \eta^2 = .06$. However, the simple main effects test was not significant for the high pretest scores, $F(2, 317) =$

1.20, $p = .30$, partial $\eta^2 = .01$. There was a statistically significant difference between the groups when measured against low and medium scores on the pretest. However, there was no statistically significant difference between the groups for the participants with high scores on the pretest.

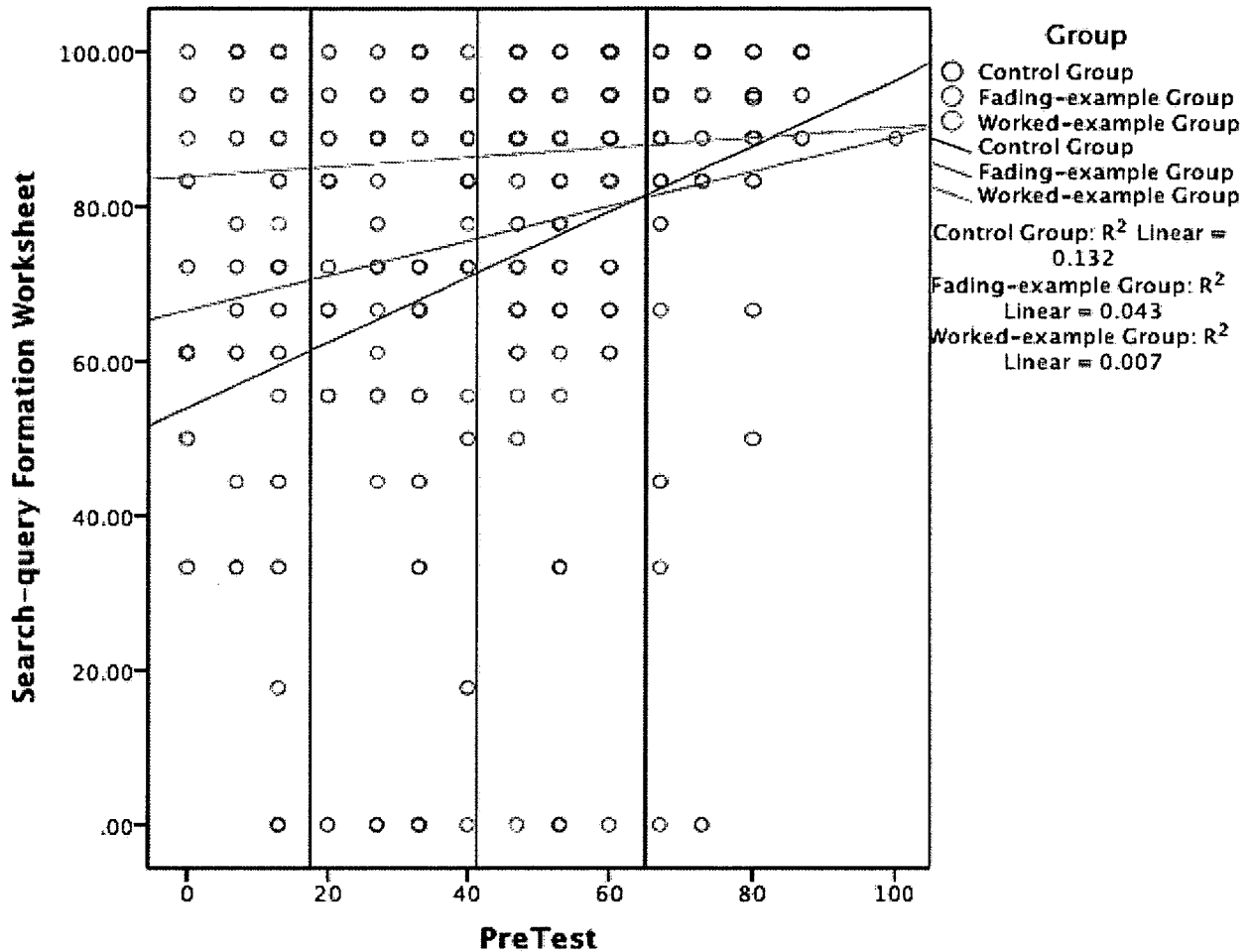


Figure 3. Scatterplot Displaying Differences between the Groups for Scores on the Search-Query Formation Worksheet for Three Levels of Pretest Scores.

Hypothesis Three

A one-way analysis of covariance was planned to evaluate whether group assignment influenced the number of relevant articles and abstracts that a participant retrieved during an in-class practice session. The covariate was the pretest and the independent variable was the groups. The dependent variable was the number of relevant articles and abstracts that the participant retrieved. A preliminary analysis evaluating the homogeneity of slopes assumption indicated that the relationship between the covariate and the dependent variable differed significantly as a function of the independent variable, $F(2, 317) = 5.14$, $MSE = 1.91$, $p = .01$, partial $\eta^2 = .03$, indicating that an ANCOVA was not appropriate (See Green and Salkind, 2007).

Because of the significant interaction between the covariate and the dependent variable across the groups and despite its weak power, only 3% of the variant, the researcher decided to conduct an ANOVA rather than an ANCOVA, and then, conduct a comparison of main effects at three levels of the covariate, i.e. low, medium and high. Table 10 displays the results of the ANOVA. The ANOVA was not significant, $F(2, 320) = 1.60$, $p = .21$, partial $\eta^2 = .01$. There was no statistical difference between the groups for retrieval of relevant articles.

Table 10

Results of the ANOVA for a Comparison between Groups for Retrieval of Relevant Articles and Abstracts during a Practice Session.

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Between groups	6.601	2	3.30	1.58	.21	.01
Within groups	668.043	320	2.088			
Corrected Total	674.644					

Table 11 displays the unadjusted means and the standard deviations on retrieval of articles and abstracts. Participants in all three groups, i.e. the control group, the fading-example group, and the worked-example group, retrieved one article, on average.

Table 11

Unadjusted Means and Standard Deviations on Retrieval of Relevant Articles and Abstracts.

Group	<i>M</i>	<i>SD</i>
Control	.92	1.78
Fading-example	.58	1.32
Worked-example	.80	1.17

Figure 4 displays the frequencies for retrieval of relevant articles and abstracts by group. A large number of participants failed to retrieve even one article or abstract, but many were able to retrieve at least one.

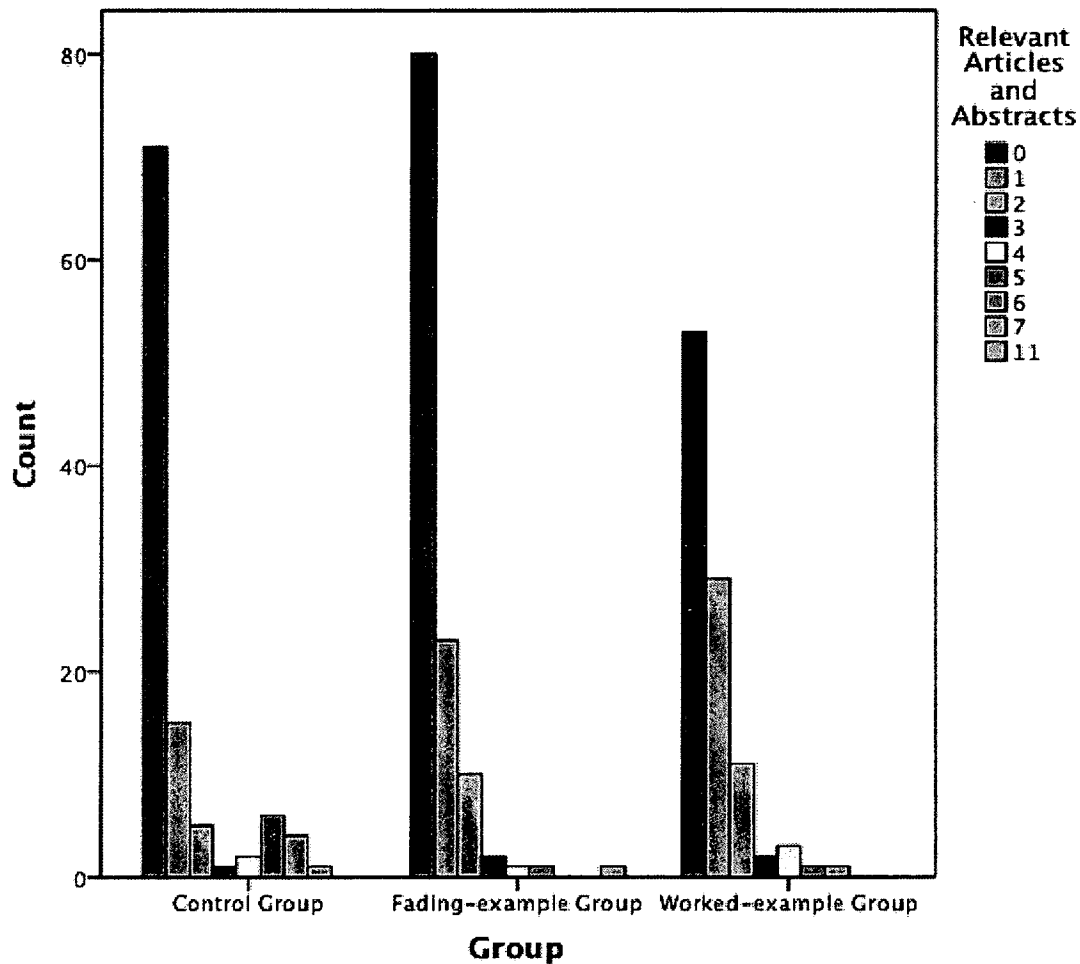


Figure 4. Comparison of Groups for Frequencies of Relevant Articles and Abstracts Retrieved during the In-class Practice Session.

Next, simple main effects tests were conducted to assess differences between the groups at low, medium and high values on the covariate, i.e. the pretest, where low was one standard deviation below the mean, or 17.57, medium was the mean at 41.30, and high was one standard deviation above the mean, or 65.03. The significance value was set at .017, i.e. .05/3. With significance set at .017 (.05/3), the simple main effects test was not significant for the groups, $F(2, 317) = 3.51$, $p = .03$, partial $\eta^2 = .02$, but it was significant for the pretest, $F(1, 317) = 22.65$, $p = .00$, partial $\eta^2 = .07$ and for the interaction between the groups and the pretest, $F(2, 317) = 5.14$, $p = .01$, partial $\eta^2 = .03$.

When examining the relationships between the groups and the pretest by low, medium and high scores for success in retrieving articles and abstracts, a significant difference did emerge. Figure 5 shows the differences between groups for the three levels of scores on the pretest. There was no statistically significant difference between the groups for low pretest scoring participants, $F(2, 317) = 2.51$, $p = .08$, partial $\eta^2 = .02$, nor for medium pretest scoring participants, $F(2, 317) = .97$, $p = .38$, partial $\eta^2 = .01$, but there was a difference for the participants that scored high on the pretest, $F(2, 317) = 4.124$, $p = .017$, partial $\eta^2 = .03$. Participants in the fading-example group who scored high on the pretest retrieved fewer articles and abstracts than participants who scored high on the pretest in either the control group or the worked-example group. However, it should be noted that the effect size accounted for only 3% of the variance, greatly diminishing its practical significance. As for the high pretest scoring participants in the control group and the worked-example group, there was no statistically significant difference in their success in retrieving articles and abstracts.

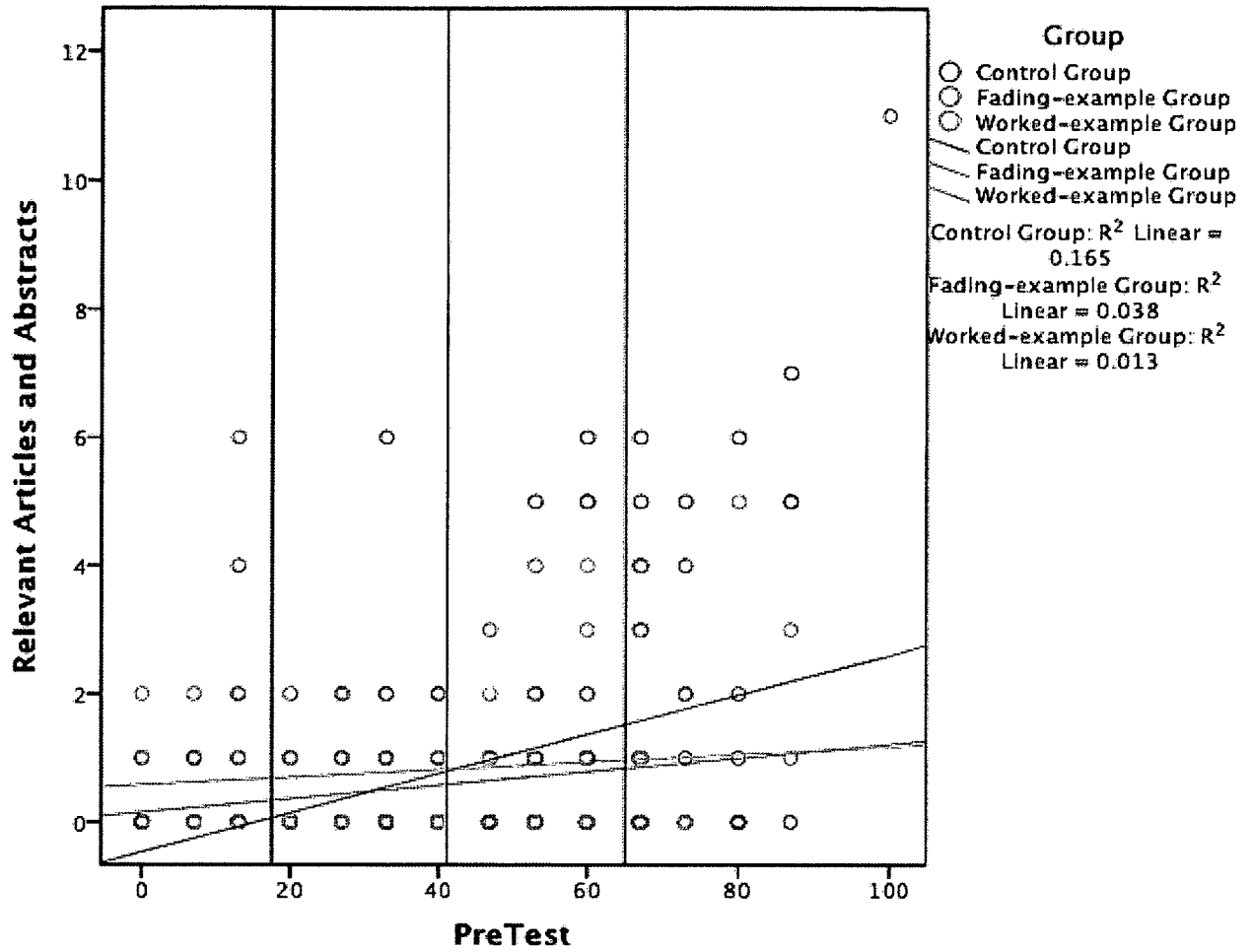


Figure 5. Comparison of Groups at Different Scores on the Pretest for Number of Relevant Articles and Abstracts Retrieved During the In-class Practice Session.

Hypothesis Four

A one-way analysis of covariance was conducted to evaluate perceptions of difficulty amongst the groups for the in-class activity, i.e. the search-query formation worksheet and the retrieval of articles and abstracts exercise. The covariate was the pretest and the independent variable was the groups. The dependent variable was the score on a perception of difficulty scale, which ranged from 1 to 9. A preliminary analysis evaluating the homogeneity of slopes assumption indicated that the relationship between the covariate and the dependent variable did not differ significantly as a function of the independent variable, $F(2, 317) = 2.30$, $MSE = 3.70$, $p = .10$, partial $\eta^2 = .01$, indicating that ANCOVA was appropriate.

Table 12 displays the results of the ANCOVA for comparison between groups for perception of difficulty. The ANCOVA was not significant, $F(2, 317) = 2.02$, $p = .13$. In addition, the strength of the relationship between the independent variable and score on the perception of difficulty scale was small, accounting for only 1% of the variance of the dependent variable, as assessed by Partial Eta Squared.

Table 12

Results of the ANCOVA for Comparison between Groups for Perception of Difficulty.

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Between groups	14.91	2	7.455	2.024	.13	.01
Pretest	4.40	1	4.361	1.184	.27	.00
Groups*Pretest	16.934	2	8.467	2.299	.10	.01
Within groups	1167.448	317	3.683			
Corrected Total	1188.854	322				

Table 13 displays the unadjusted means and standard deviations on the dependent variable, i.e. perception of difficulty, for the three groups. Participants in all three groups indicated a score of five on the perception of difficulty scale.

Table 13

Unadjusted Mean and Standard Deviations on Perception of Difficulty for Each Group

Group	<i>M</i>	<i>SD</i>
Control	5	1.83
Fading-example	5	1.90
Worked-example	5	2.10

Figure 6 displays a comparison of the groups at different scores on the pretest for the Perception

of Difficulty Scale, where low was one standard deviation below the mean, or 17.57, medium was the mean at 41.30, and high was one standard deviation above the mean, or 65.03.

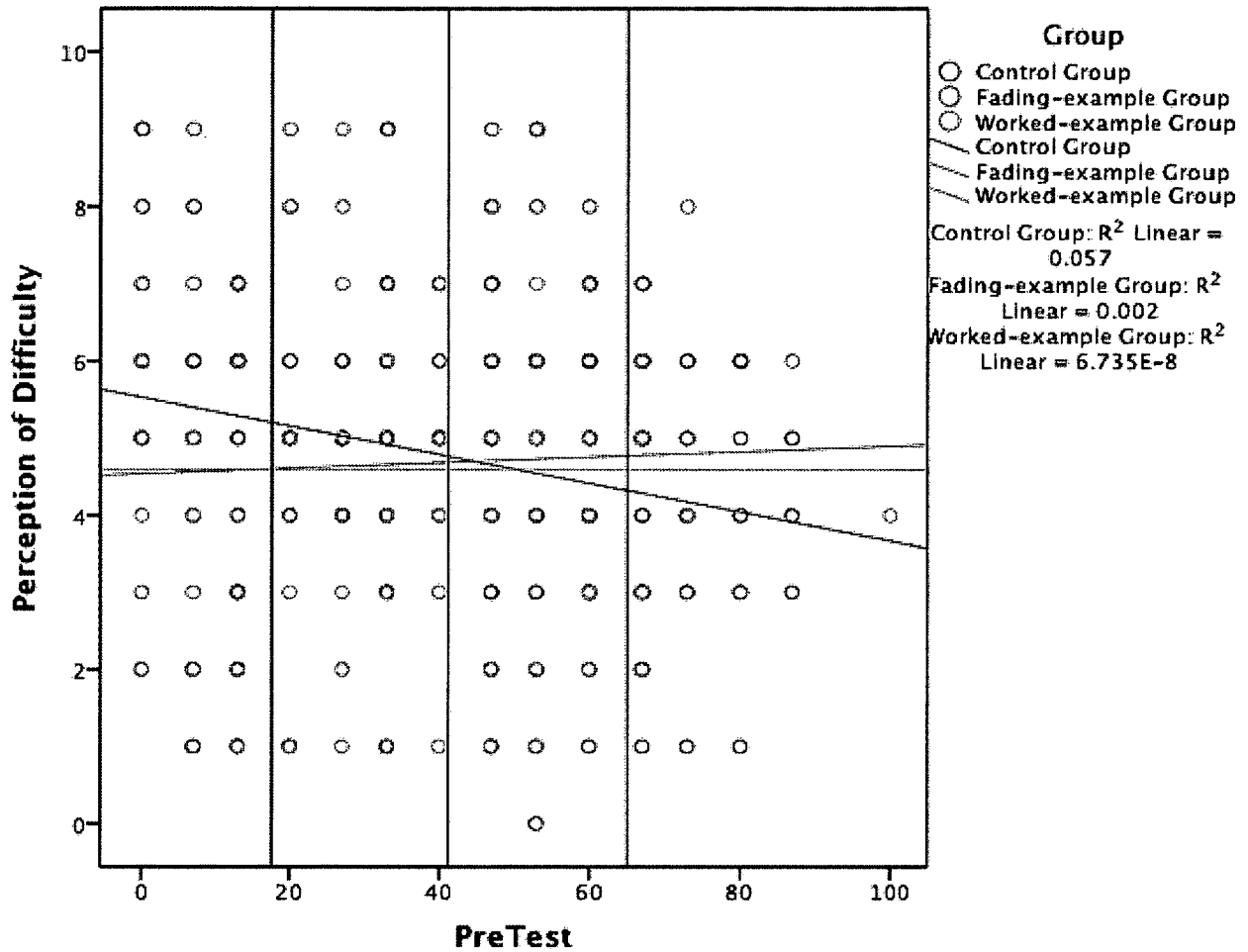


Figure 6. Comparison of Groups at Different Scores on the Pretest for Perception of Difficulty of the In-class Activity Session.

Hypothesis Five

A one-way analysis of covariance was conducted to evaluate whether participants in the control group, the fading example group or the worked-example group scored higher on a posttest. The covariate was the pretest and the independent variable was the groups. The dependent variable was the score on the posttest. A preliminary analysis evaluating the homogeneity of slopes assumption indicated that the relationship between the covariate and the dependent variable did not differ significantly as a function of the independent variable, $F(2, 317) = .44$, $MSE = 284.193$, $p = .65$, partial $\eta^2 = .00$, indicating that ANCOVA was appropriate.

Table 14 displays the results of the ANCOVA for comparison between groups for scores on the posttest. The ANCOVA was not significant, $F(2, 317) = .47$, $p = .63$. In addition, the strength of the relationship between the independent variable and the posttest scores was extremely weak, accounting for 0% of the variance of the dependent variable, as assessed by Partial Eta Squared. However, the pretest score was significant, $F(2, 317) = 60.65$, $p = .00$. The strength of the relationship between the pretest and the posttest scores was very strong, accounting for 20% of the variance of the dependent variable, as assessed by Partial Eta Squared.

Table 14

Results of the ANCOVA for Comparison between Groups for Posttest.

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Between groups	265.550	2	132.775	.47	.63	.00
Pretest	17235.937	1	17235.937	60.649	.00	.16
Groups*Pretest	249.684	2	124.842	.44	.65	.00
Within groups	90089.313	317	284.193			
Corrected Total	107700.099	322				

Table 15 displays the unadjusted means and standard deviations on the posttest scores for the three groups. The control group scored 62%, the fading-example group scored 61%, and the worked-example group scored 59%, on average.

Table 15

Unadjusted Mean and Standard Deviations on Posttest Scores for Each Group

Group	<i>M</i>	<i>SD</i>
Control	62	18
Fading-example	61	18
Worked-example	59	19

Figure 7 displays a comparison of the groups at different scores on the pretest for the posttest scores, where low was one standard deviation below the mean, or 17.57, medium was the mean at 41.30, and high was one standard deviation above the mean, or 65.03.

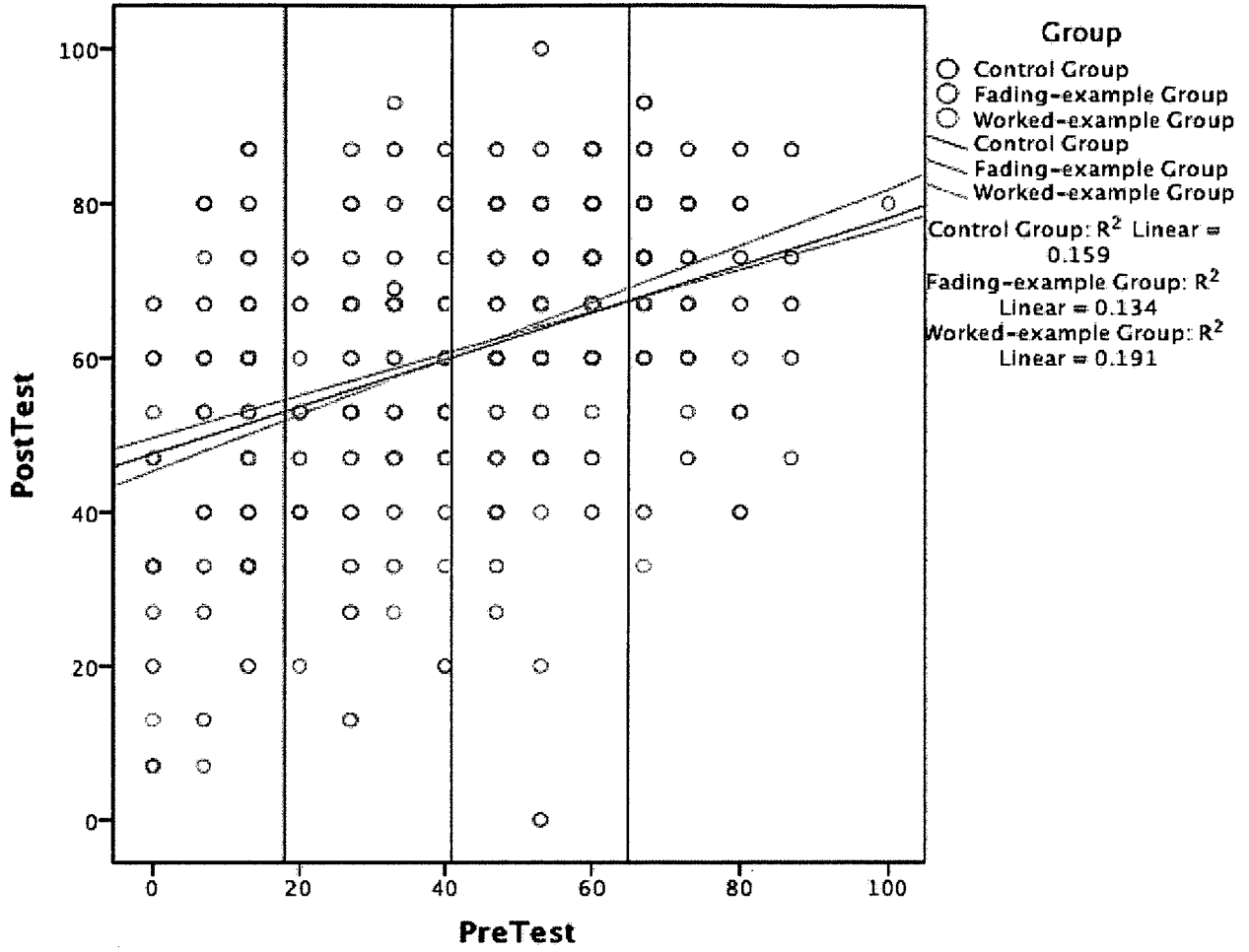


Figure 7. Comparison of Groups at Different Scores on the Pretest for Scores on the Posttest.

Hypothesis Six

Of the 24 classes that participated in the study, the researcher was able to collect data on a subsequent research assignment from students attending 17 of these classes, a total of 252 participants, down from 323. Of these 252 participants, 200, or 79%, did not use any articles from library databases in their reference list. Thirty-five participants, or 14%, used one article from a library database as a source for their research. Seventeen participants, or 7%, used two or more articles from one of the library databases. Figure 8 displays, by groups, the frequency of the number of articles and abstracts displayed in participants' reference lists in a subsequent assignment.

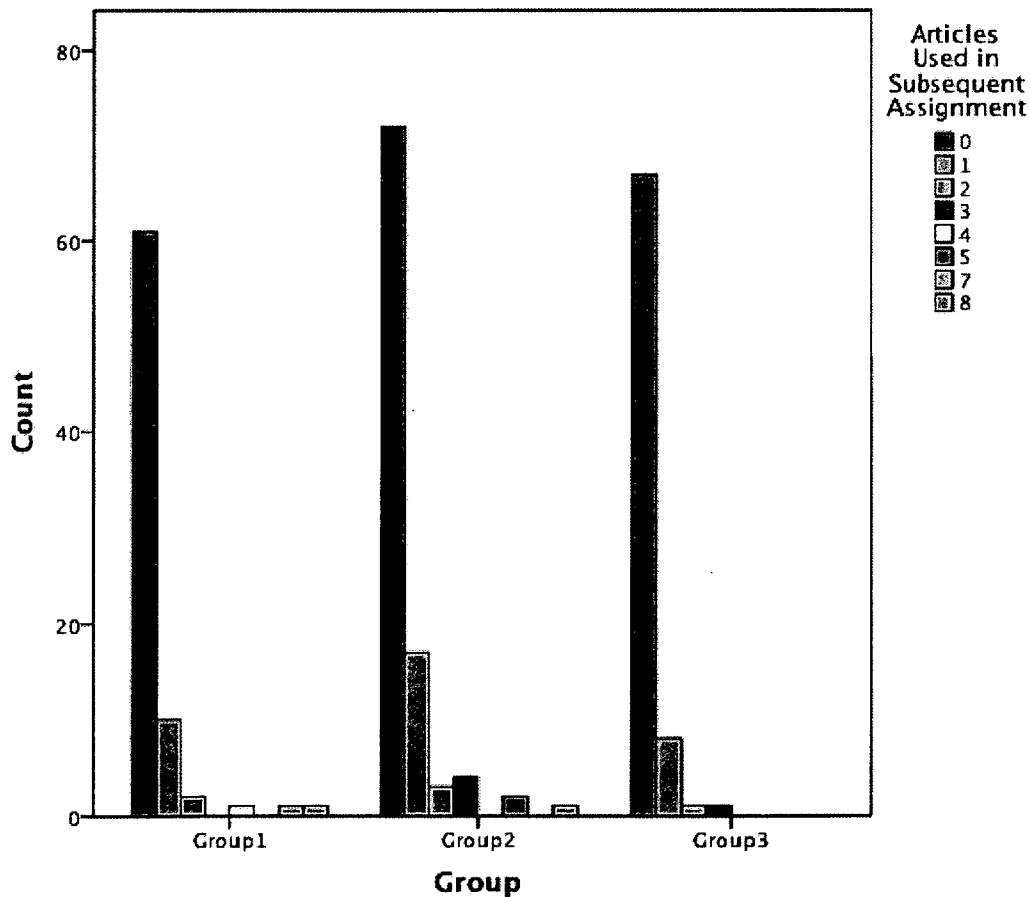


Figure 8. Frequency of Articles Retrieved from a Database and Used in a Subsequent Research

To compare groups in terms of their application of their search-query formation skills in a subsequent assignment, a sixth one-way analysis of covariance was conducted. The covariate was the pretest and the independent variable was the groups. The dependent variable was the number of articles retrieved from databases that are listed in the reference list in a subsequent research assignment.

A preliminary analysis evaluating the homogeneity of slopes assumption indicated that the relationship between the covariate and the dependent variable did not differ significantly as a function of the independent variable, $F(2, 246) = 1.47$, $MSE = 1.195$, $p = .23$, partial $\eta^2 = .01$, indicating that ANCOVA was appropriate. Table 16 displays the results of the ANCOVA for comparison between groups for number of journal articles displayed in a reference list for a subsequent assignment. The ANCOVA was not significant, $F(2, 246) = .51$, $p = .60$. In addition, the strength of the relationship between the independent variable and the dependent variable was extremely weak, accounting for 0% of the variance of the dependent variable, as assessed by Partial Eta Squared. The pretest score was not significant, $F(1, 246) = 3.14$, $p = .08$. The strength of the relationship between pretest score and the number of journal articles displayed in a reference list for a subsequent assignment was very weak, accounting for 1% of the variance of the dependent variable, as assessed by Partial Eta Squared.

Table 16

Results of the ANCOVA for Comparison between Groups for Number of Journal Articles Displayed in a Reference List for a Subsequent Assignment.

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Between groups	1.214	2	.607	.51	.60	.00
Pretest	3.747	1	3.747	3.14	.08	.01
Groups*Pretest	3.503	2	1.751	1.47	.23	.01
Within groups	294.032	246	1.195			
Corrected Total	308.107	251				

Table 17 displays the unadjusted means and standard deviations on the number of journal articles displayed in a reference list for a subsequent assignment for the three groups. The control group .43, the fading-example group scored .54, and the worked-example group scored .17, on average.

Table 17

Unadjusted Means and Standard Deviations for Each Group on Number of Journal Articles Displayed in a Reference List for a Subsequent Assignment

Group	<i>M</i>	<i>SD</i>
Control	.43	1.3
Fading-example	.54	1.2
Worked-example	.17	.5

Figure 9 displays a comparison of the groups at different scores on the pretest for the posttest scores, where low was one standard deviation below the mean, or 17.57, medium was the mean at 41.30, and high was one standard deviation above the mean, or 65.03.

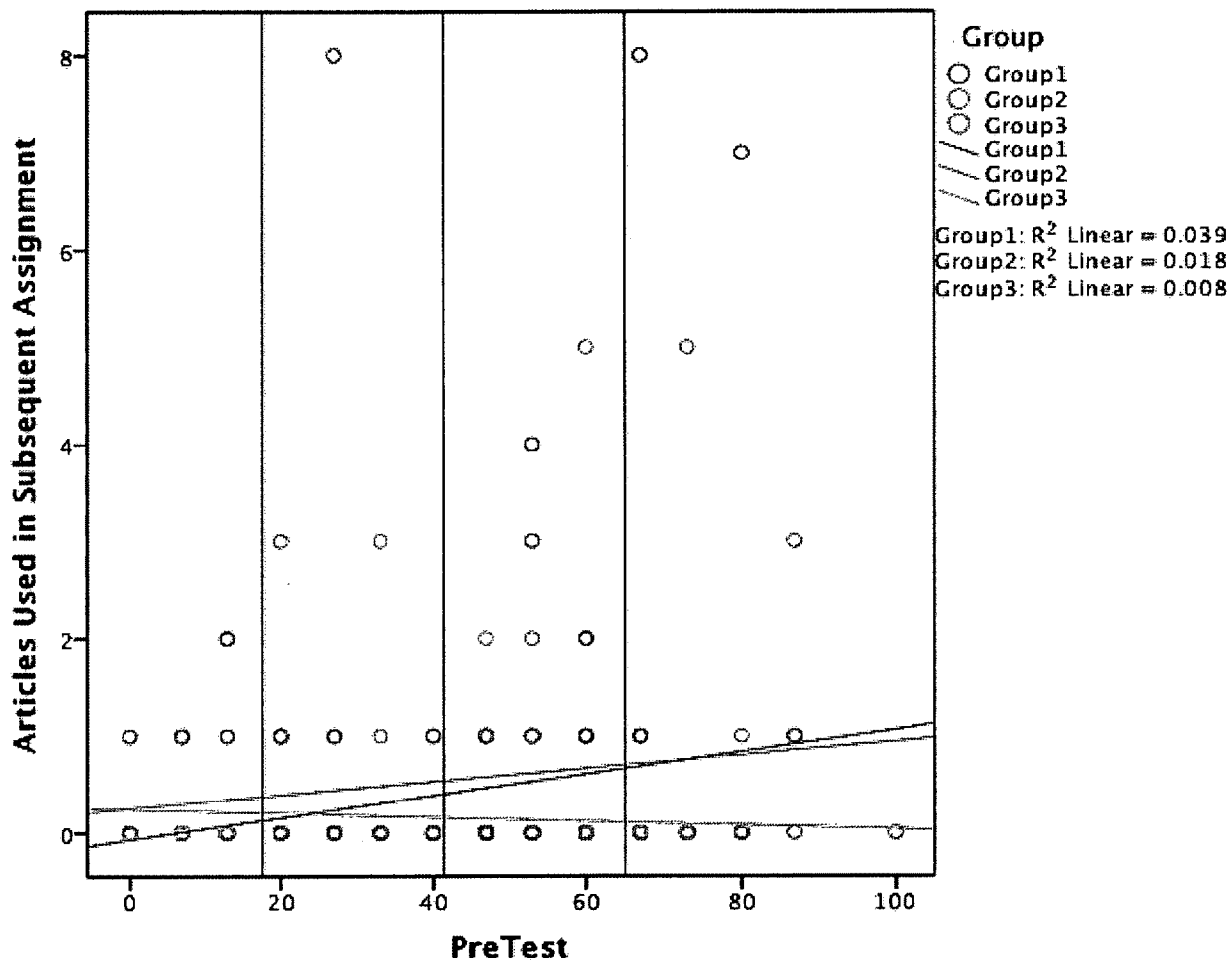


Figure 9. Comparison of Groups at Different Scores on the Pretest for Number of Articles Used in a Subsequent Research Assignment.

In summary, after conducting appropriate tests for each of the hypotheses, the results showed that the participants exposed to worked-example treatment were able to perform better on a worksheet designed to help them to develop database search queries than participants in either of the other two groups. In addition, the participants within the worked-example group performed equally well on the worksheet regardless of their scores on the pretest, a test of domain-specific knowledge. This pattern did not emerge amongst the participants in the other two groups, i.e. the control group and the fading-example group. For those two groups, low and medium pretest scoring participants performed less well on the worksheet than high pretest scoring participants.

As for the remaining five hypotheses, there was no difference in the number of search terms participants generated on the search-query formation worksheet, there was no difference in the way the participants perceived the difficulty of these tasks, nor was there a difference in the scores they received on the posttest. Similarly, there was no statistically significant difference amongst the groups in the practical application of the skills they learned when retrieving articles during an in-class practice session or using an article in a subsequent assignment.

CHAPTER IV

DISCUSSION

Significant Findings

The worked-example effect has been successfully tested for positive learning outcomes in numerous experimental studies. Until recently, many considered the worked-example effect as applicable only to well-structured problem solving, such as mathematics (Renkl, Atkinson, & Groves, 2004). Consequently, research into the worked-example effect focused exclusively on this well-defined environment (Rourke & Sweller, 2009). However, in their 2009 study with art and design students, Rourke and Sweller provided evidence that worked examples can be successfully applied to teaching visual literacy, a domain that requires ill-structured problem solving. The results of the experiment described here provide further evidence that studying worked examples may be effective in a domain that involves ill-structured problem solving, in this case, information literacy instruction.

Limitations to the Study

A limitation to this study concerned the technology associated with the library databases. This study focused on instruction in designing queries to search library databases. However, in order for the participants to demonstrate success in actually retrieving an article, they were required to navigate the library website, the database itself, and ultimately e-mail an article to the researcher. These steps posed a series of obstacles for the participants that were outside the focus of the instruction or the scope of the study.

To overcome these obstacles, the first of two prerecorded webcasts that the researcher presented was a short demonstration in how to navigate the library website, search a database and e-mail an article. In addition, the students were given a ready-reference handout that listed

the steps to navigating from the desktop to the databases. Moreover, the testing packets contained instructions in how to e-mail articles within the database interface to the researcher. Despite these efforts, some participants may have been unable to complete the experimental materials due to their lack of knowledge of and skill with the technology.

A second limitation is that data on the participants' academic preparedness and prior library experience was self-reported. It would have been preferable to have objective data on these indices as well as self-reports. However, the process of acquiring these data was logistically prohibitive and may have inhibited students from participating, thus negatively impacting the sample size.

A third limitation was the researcher's lack of control over the assignments. The research projects that each class was assigned were unique to each class. Some of the assignments were more appropriate for database researching than other assignments. Some professors had stronger requirements that their students use databases than other professors, and they expressed this expectation to their students with greater and lesser clarity. Therefore, some participants had more incentives to use databases than others.

Hypothesis One. When learning to generate queries for searching academic journal databases, participants in the work-examples treatment group did not generate a greater number of search terms than those in a control group who were exposed to a traditional problem-solving treatment. Nor did the worked-example group perform better than the fading-example group. One possible explanation for this similarity in performance amongst the groups is that the task of generating search terms, without regard for relevance to the topic, was sufficiently simple a task that a distinction amongst the participants in skill level did not emerge. Neither group assignment

nor level of participant expertise influenced success. All the participants had relatively equal access to this basic skill set.

Hypothesis Two. Of all the hypotheses, hypothesis two was central to this study. The results of the second hypothesis addressed the central question more directly than the other five hypotheses because it examined the targeted skills needed to design a search query while the other hypotheses addressed secondary effects of mastering these skills. Hypothesis two tested whether the participants were able to acquire the targeted skills needed to design an effective search query by studying worked examples, by completing fading examples or practicing forming search queries without guidance.

The worked-example group performed statistically significantly better than the control group on the search-query formation worksheet. These results, which focused on the application of worked-examples in ill-defined problem solving, conform to the findings of earlier studies on worked examples in well-defined problem-solving environments (Cooper & Sweller, 1987; Sweller, 1988; Sweller and Cooper, 1985). These results also support the findings of Rourke and Sweller (2009), who conducted a study on the application of worked examples in an ill-defined problem solving environment, in which those participants who were exposed to a worked-example treatment performed better than those students who practiced problem solving without studying examples.

The worked-example group also performed statistically significantly better than the fading-example group on the search-query formation worksheet. These results conflict with an earlier study conducted by Renkl, Atkinson and Grobe that involved well-defined problem solving (2004). The Renkl, Atkinson and Grobe study supported the hypothesis that completing fading examples was a more effective method than studying worked examples. The researcher

wants to quickly point out that Renkl, Atkinson and Grobe specifically limited their hypothesis to well-structured problems and expressly excluded ill-structured problems.

Simple main effects tests showed that the differences between groups on performance on the worksheet emerged amongst those participants with low and medium domain-specific knowledge and not amongst those with high domain-specific knowledge. Those participants in the worked example group with low and medium domain-specific knowledge scored better than those in either the control group or the fading-example group. Those participants with high domain-specific knowledge scored equally well regardless of their group assignment. These results conform to research that supports the use of worked examples for novice learners, but does not conform to research that suggests that worked examples have an adverse effect on advanced learners (Kalyuga, Ayres, Chandler, & Sweller, 2003; Kalyuga, Chandler, & Sweller, 1998; Kalyuga, Chandler, Tuovinen, & Sweller, 2001). These results suggest that both novice and advanced learners may benefit from studying worked example, but that novice learners may benefit more than the advanced learners, and even achieved parity with them.

Hypothesis Three. Hypothesis three predicted that the worked-example group would retrieve more relevant magazine and journal articles from a library database than the control group. The statistical tests failed to validate this hypothesis. Simple main effects tests showed that there was no statistically significant difference amongst or between any of the groups for this variable with one exception. The participants in the fading-example group who scored high on the pretest retrieved fewer articles and abstracts than the other two groups. However, the effect size was too small to have practical implications.

A possible explanation for this result is that the process of designing a search query, selecting and conducting a search of an appropriate database, and then, within the database,

locating and understanding the e-mail function well enough to e-mail a relevant article required too heavy a cognitive load. As explained in the section on “Limitations to the Study,” in order to retrieve articles from the databases, the participant had to not only learn how to design a search query, but also how to navigate the library website and manipulate the database functions. The researcher suggests that, for these reasons and others, a majority of the participants were unable to successfully e-mail the researcher a relevant article. The cumulative effect of the intrinsic, germane and extraneous load surpassed the normal capacity of human cognitive architecture (Sweller et. al., 1998).

Hypothesis Four. There was no statistically significant difference amongst the groups in the way that the participants perceived the task of completing the 25-minute practice session. It is possible that the two groups found the same task equally difficult, but for different reasons. One might speculate that the control group and the fading-example group were dealing with heavier extraneous cognitive load while the worked-example group was grappling with heavier germane load. In addition, the more experienced learner may have experienced less intrinsic load than the novice, but greater extraneous cognitive load. The three dimensions to cognitive load theory, i.e. intrinsic, germane and extraneous, are additive (Sweller et. al., 1998). This additive effect amongst the three dimensions may have influenced the results for this variable.

Hypothesis Five. As for hypothesis five, the results of this study did not show a significant difference amongst the groups for performance on the posttest. This result raised the question why participants did not demonstrate similar performance on the posttest to that on the search-query formation worksheet, two different tasks that required parallel domain-specific knowledge to complete successfully. Informed by cognitive load theory, one explanation is that the worked-example exercise awakened prior knowledge and activated schema formation so that

the participants were able to complete the worksheet. However, these new skills did not transfer to the posttest because there had not been time for rule automation to occur. Cooper and Sweller (1987) found that rule transfer did not occur quickly. Rule transfer requires a lot of practice in using worked examples over an extended time. Therefore, it is possible that due to a lack of rule automation, the skills acquired through the study of worked examples and applied in completing the search-query-formation worksheet did not transfer to the posttest.

Hypothesis Six. Participants in the worked-example group did not use a greater number of articles retrieved from library databases in their reference list for a subsequent research assignment than participants in the control group. Group assignment did not influence a student to use an academic article in a subsequent assignment. In fact, the majority of the participants did not use articles found in the library databases in their subsequent assignment. There are two types of reasons for this result. First, students may have been unable to retrieve relevant articles on the topics of their subsequent assignment for some of the same reasons that they were unsuccessful during the practice session, i.e. the lack of familiarity in navigating the library website and in using features and functions of the academic databases, both of which skills required knowledge peripheral to the main focus of the instruction. In other words, extraneous cognitive load may have obstructed new schema formation, preventing the participant from successfully retrieving articles. This explanation is consistent with research findings reported by Sweller, van Merriënboer and Paas (1998). In addition, inadequate time studying worked examples may have prevented transfer from the in-class assignment to the subsequent assignment, a pattern described in Cooper and Sweller's seminal 1987 study.

Equally, if not more, important is the participants' attitude towards the use of library databases. Many students are not convinced that they need to use library databases to find

information for their research. They prefer to use tools that they use every day, such as a free Internet search engine, for their academic assignments. A significant body of work on cognitive load theory addressed the importance of guiding the student to focus on a specific problem and its corresponding solutions so that the correct schema for a given problem is retrieved (Cooper & Sweller, 1987; Sweller & Cooper, 1985; Sweller & Chandler, 1991). More exposure to the study of worked examples may help to modify the established web-searching schema to incorporate a more complex schema that includes database searching.

Applications to the Field of Instructional Design

The results of this study suggest that the study of worked examples, which is an established method of instruction in well-defined problem-solving environments in the fields of mathematics and science, can now be applied to the ill-defined problem-solving environments in the social sciences and the humanities with greater confidence. In particular, this study showed that novice students benefit from studying worked examples. At the same time, the intermediate-to-advanced students are not threatened by the expertise reversal effect, but rather they can also benefit from studying worked examples. These results suggest that it may be possible to present one set of worked-example exercises to a whole classroom of students with varying levels of expertise from which all may benefit. However, the results of this study pose several questions for future investigation.

Future Research

First, while many studies have shown convincingly that the worked-example effect helps learners to form schema to solve well-structured problems, few studies have been conducted to establish, with the same force, the validity of the worked-example effect with ill-structured problems. Future research should attempt to duplicate this study or conduct similar ones in other

ill-structured domains. For example, establishing the importance of using examples in the teaching of essay writing and in teaching paraphrase and summary writing, especially to non-native learners, could have a far-reaching impact on the way these skills are taught.

Second, this study showed that, in an ill-defined problem-solving environment, studying worked examples was a more effective method to completing fading-example exercises amongst three levels of learners: the novice, the intermediate, and the advanced. More research needs to be conducted to better understand how worked-example and fading-example exercises compare in effectiveness. It may be that fading examples require the instructional designer to have a detailed picture of the learners' pre-existing knowledge so that the steps are omitted in the most effective order, and the size of each omitted step does not frustrate, but maximizes learning. Designing fading examples may prove to be a much more nuanced task than that required in the design of a worked example.

Conclusion

This study provided support that, when applied to ill-structured problem solving, studying worked-examples might be a more effective method than practice in problem solving with no guidance. In addition, a close look at the data showed that a parity effect might be influencing results for those in the worked-example group. Learners in the worked-example group with low domain-specific knowledge were able to make equivalent improvement to those participants with high domain-specific knowledge. This parity effect did not emerge for participants in the control group who were exposed to problem-solving exercises, nor for those in the fading-example group.

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Appendix A

Student Profile Survey

Student Questionnaire

Part A: Your Information Seeking Experience

1. Have you had a library presentation on database searching before?
a. Yes b. No
2. Have you ever used a library database to find information?
a. Yes b. No
3. Have you ever used a library online catalog to find information?
a. Yes b. No

Part B: Your Educational Experience and Goals:

1. What is your highest degree obtained?
 - a. High school diploma
 - b. Associates degree
 - c. College degree
 - d. Graduate degree
 - e. Other, _____
2. How many college credits have you completed?
 - a. 0 – 10
 - b. 11 – 20
 - c. 21 – 30
 - d. 31 – 40
 - e. 41 – 50

f. more than 50

3. What is your educational goal? To obtain _____
- a. A certificate
 - b. An associate's degree
 - c. A four-year college degree
 - d. Other, _____

Part C: Your Personal Profile

1. How old are you? _____
2. What language are you most comfortable using?
- a. English
 - b. Other
 - c. Not Sure
3. What is your gender?
- a. Male
 - b. Female
4. What is your high school grade point average (GPA)?
- a. around 4.0 (mostly As)
 - b. above 3.0 (mostly Bs)
 - c. above 2.0 (mostly C)
 - d. less than 2.0 (mostly Ds)
 - e. Not applicable (did not graduate from high school)

Appendix B: Pretest on Domain-Specific Knowledge

What You Know about Search Queries

Part A: Circle the letter next to the best answer.

1. A well-designed query for searching library databases is a _____ .
 - a) question that identifies a research problem
 - b) sentence that contains a noun and a verb
 - c) combination of nouns and/or noun phrases
 - d) thesis statement that states one main idea.

2. When you retrieve too many or too few items in a search, the first strategy you should use to improve your results is to change the _____ .
 - a) topic you have chosen
 - b) search terms and/or fields you are using
 - c) database and/or website you are searching
 - d) research question you have formed

3. Of the four research questions listed here, which one is best?
 - a. What is global warming?
 - b. What are the causes of global warming?
 - c. Is climate change harmful?
 - d. How does the climate affect bird migration?

Part B: Below is a list of verbs, adjectives, and adverbs. Change these words into nouns. The first two have been done for you.

1. beautiful: beauty

2. spontaneously: _____ spontaneity _____
3. socialize: _____
4. anxiously: _____

Part C: Study the sentences below. Try to capture their meaning by restating them as nouns or noun phrases using only one or two words. The first two have been done for you.

- a. The boss dismissed the workers. Employee Dismissals
- b. The drivers crashed their cars. Car accidents
- c. The government raised taxes. _____
- d. The customers are unhappy with the service. _____

Part D: Study the research questions below. Then, circle the TWO single most important key words in each question with which you might begin to design a search query.

- a. What is the effect of obesity on the heart?
- d. How does inflation in the cost of goods affect the average consumer?
- e. How might legislative action lower the unemployment rate?
- f. How does the fashion industry reflect social values in America?

Appendix C: Posttest on Domain-Specific Knowledge

What You Learned During this Session

Part A: Circle the letter next to the best answer.

1. A search query is a _____ .
 - a) thesis statement that states one main idea
 - b) combination of nouns and/or noun phrases
 - c) sentence that contains a noun and a verb
 - d) question that identifies a research problem

2. Of the four research questions listed here, the best one is _____
 - a. What is cancer?
 - b. What are the causes of cancer?
 - c. Is cancer curable?
 - d. What is the relationship between smoking and lung cancer?

3. If you retrieve too many or too few articles in a database search, the first change you should make to improve your results is the _____ .
 - a) database you are searching
 - b) research question you have formed
 - c) search terms and fields you are using
 - d) topic you have chosen

Part B: Study the research questions below. Then, circle the TWO most important key words in each.

1. How does inflation affect the economy?
2. How do border disputes amongst countries lead to war?
3. How does poor nutrition contribute to heart disease in America?
4. How might a good transportation system affect small business in Detroit?

Part C: Below is a list of verbs, adjectives, and adverbs. In the space provided, change these words into nouns. The first two have been done for you.

1. obese: obesity
2. intelligent: intelligence
3. participates: _____
4. accidental: _____

Part D: Study the sentences below. Capture the main idea by restating these sentences as nouns or noun phrases. Use only one or two words. You may use your own words. The first two have been done for you.

- | | |
|--|----------------------------|
| 1. The government raised taxes. | <u>Tax increases.</u> |
| 2. The customers expressed dissatisfaction. | <u>Customer complaints</u> |
| 3. The patient drinks too much alcohol. | _____ |
| 4. There are too many people living in this world. | _____ |

Thank you for participating in this study!

Appendix D: Perception of Difficulty Instrument

Perception of Difficulty Scale: The Worksheet

Level of Difficulty: Circle the number next to the response that best describes how difficult the worksheet was for you to complete.

In order to complete the worksheet, I invested:

1. very, very low mental effort
2. very low mental effort
3. low mental effort
4. rather low mental effort
5. neither low nor high mental effort
6. rather high mental effort
7. high mental effort
8. very high mental effort
9. very, very high mental effort

PLEASE STOP WORKING. Wait until you are instructed to turn the page.

Appendix E: Search-Query Formation Worksheet

Search Query Worksheet: Respond to the following using your topic for your assignment.

1. What is the topic of your research? _____

2. What is your research question? _____

3. In your research question above, underline two words that identify the main concepts.

4. Place one underlined word in each of the columns below. All your search terms should be nouns or noun phrases. Therefore, you may need to transform a verb, adverb or adjective into a noun.

5. In each column, write down one, two, or three nouns or noun phrases that are related to the first word in the column so that you have two lists, each list on a separate subject, but all related to your question. Each word or phrase might mean the same as the first term in the column. It might be a broader term or a narrower term. When you finish, you should have at least four words or phrases with which to conduct your search.

Part III

Locating Articles on Your Topic in the Library Databases

Instructions: Find as many articles as you can on your narrowed topic. When you find an article, email the complete citation and the full text of the article to me and to yourself. If you **DO NOT** find any relevant articles, please circle this statement:

“No relevant articles found on my topic.”

Email your articles to me at: kickham-samym@macomb.edu. Remember to send yourself copies of all your articles.

In the Subject Line, type your instructor’s name, your name, and your topic. *For example:*

Professor Jones, Computer Games and Education, Jane Smith

To save time, you may want to log into your e-mail account now.

PLEASE STOP WORKING. Wait until you are instructed to turn the page.

Record the time it is now in the space provided: _____

Appendix F: Search-Query Worksheet Evaluation Instrument

Search-Query Worksheet Evaluation Instrument

Direction to raters: Complete this form by rating the students' responses to these questions on a scale of 1 to 3, where 3 is the best score.

1. What is your topic? _____

[Instructional Goal: Ability to state the topic in a noun or noun phrase in order to isolate a domain of knowledge or a concept.]

1. *The student was unable to state his/her topic.*
2. *The student stated his/her topic, but failed to state it as a noun or noun phrase.*
3. *The student stated his/her topic as a noun or noun phrase.*

2. What is your research question? _____

[Instructional Goal: The research question should contain two terms that encompass two distinct concepts. *The student's research question was...*

1. *unclearly stated or was framed as a yes/no question*
2. *incorporated only one distinct concept.*
3. *incorporated two distinct concept*

3. Circle terms that represent main concepts. _____

[Instructional Goal: Ability to form a question that investigates the interrelatedness of two concepts.]

1. *The student circled one concept, or no concept, critical to the research question.*
2. *The student circled two or more concepts, not all critical to the research question.*
3. *The student circled the two concepts most critical to a search.*

4. What words or phrases will you use to search for information on this topic? List them in the chart below. Use the columns if they help you to organize your ideas. [Chart has been deleted]

4a) *The student generated terms that were critical to the topic.*

[Instructional Goal: Ability to generate additional search terms, some of which might be broader, narrower, or the same in meaning as the original term.] *Note to raters: When scoring, count the words that are repeated from the topic and/or research question.

1. *The student listed fewer than three terms critical to his/her topic.*
2. *The student listed three or four terms critical to his/her topic.*
3. *The student listed more than four terms critical to his/her topic.*

4b) *The Student was able to organize terms associated with different concepts into separate columns.*

[Instructional Goal: Recognition of relationships between search terms, some of which might be broader, narrower, or the same in meaning as the original term.]

1. *The student was not able to group critical terms into a column or columns.*
2. *The student listed terms related to one critical term in one of the two columns.*
3. *The student grouped terms related to two critical terms into two columns.*

4c) *The words listed are nouns or noun phrases.* _____

[Instructional Goal: Avoidance of full sentences, participial, adverbial or prepositional phrases]

1. *Fewer than three of the words listed are nouns or noun phrases.*
2. *Three or four words listed are nouns or noun phrases.*
3. *More than four words listed are nouns or noun phrases.*

Appendix G: Informed Consent Form

My name is Mary Kickham-Samy, a fulltime librarian at Macomb Community College. I am working toward a doctorate in education. As part of my program, I am conducting a study. The purpose of this study is to improve the way that library skills are taught. Your participation in this study is completely voluntary. If you choose to participate, your participation will have no bearing on your performance or status in this course or at the college. It will in no way affect your grade. I will keep your identity confidential.

The information that you provide will be confidential. I will not use your name in any discussions or in any writings related to the research. Only group data will be reported. Two assistants, who will assist in rating answers, will view data that is stripped of all identifying information. My notes will not be shared with anyone, and will be stored in a locked drawer, to which only I have access. This data will be retained until such time as I no longer need it for my research, and then it will be shredded. In appreciation for your participation in this study, I will present to you a pen.

If you agree to participate in this study, please sign here.

Please print your name here:

My contact information: kickham-samym@macomb.edu

Appendix H: Materials for the Control Group

Library Research Exercise

Instructions: This is an exercise designed to help you generate a search query to use to locate articles in our databases. This exercise contains three worksheets with examples of three different research topics and questions. Complete the example worksheets to help you to understand the process better. The fourth worksheet is blank. After completing the example worksheets, complete the blank worksheet to generate search terms for the topic you have chosen for your research assignment. Then, search for articles on your research topic.

You have 25 minutes to complete these activities. Use about 15 – 20 minutes to complete the exercise so that you have at least 10 minutes to search for articles on your topic.

PLEASE WAIT UNTIL YOU ARE INSTRUCTED TO CONTINUE.

Please record the time it is now here: _____

Part I: Example Worksheets

Example A:

1. Imagine that the subject of your paper is: marijuana
2. Now, narrow your topic by asking a question about it. Write your question in the space below.

3. Study the question above. Then, underline the **TWO** most important search terms
4. Place one underlined word in each of the columns below. All your terms should be nouns. You may need to change a verb, adverb or adjective into a noun.
5. In each column, write down one, two, or three nouns or noun phrases that are related to the first word in the column so that you have two lists, each list on a separate subject, but all related to your question. Each word or phrase might mean the same as the first term in the column. It might be a broader term or a narrower term. When you finish, you should have at least four words or phrases with which to conduct your search.

Example B:

1. Imagine that the subject of your research is: campus security.

2. Now, narrow your topic by asking a question about it. Write your question in the space below.

3. Study your question. Then, underline the TWO most important search terms.

4. Place one underlined word in each of the columns below. All your terms should be nouns. You may need to change a verb, adverb or adjective into a noun.

5. In each column, write down one, two, or three nouns or noun phrases that are related to the first word in the column so that you have two lists, each list on a separate subject, but all related to your question. Each word or phrase might mean the same as the first term in the column. It might be a broader term or a narrower term. When you finish, you should have at least four words or phrases with which to conduct your search.

Example C:

1. Imagine that the subject of your research is radiation.
2. Now, narrow your topic by asking a question about it. Write your question down in the space provided.

3. Study the research question. Then, underline the **TWO** most important words.
4. Place one underlined word in each of the columns below. All your terms should be nouns. You may need to change a verb, adverb or adjective into a noun.
5. In each column, write down one, two, or three nouns or noun phrases that are related to the first word in the column so that you have two lists, each list on a separate subject, but all related to your question. Each word or phrase might mean the same as the first term in the column. It might be a broader term or a narrower term. When you finish, you should have at least four words or phrases with which to conduct your search.

Appendix I: Materials for the Fading-Examples Group

Library Research Exercise

Instructions: This is an exercise designed to help you generate a search query to use to locate articles in our databases. This exercise contains three worksheets with examples of three different research topics and questions. The example worksheets are only partially completed. To help you to understand the process better, complete the example worksheets. The fourth worksheet is blank. Use this blank worksheet to generate search terms for the topic you have chosen for your research assignment. Then, search for articles on your research topic.

You have 25 minutes to complete these activities. Use about 15 – 20 minutes to complete the exercise so that you have at least 10 minutes to search for articles on your topic.

PLEASE WAIT UNTIL YOU ARE INSTRUCTED TO CONTINUE.

Part I: Example Worksheets

Example A:

1. Imagine that the subject of your paper is: marijuana.
2. Now, narrow your topic by asking a question about it. Write your question in the space below. (An example question has been supplied for you.)

Should marijuana be legalized in Michigan?

3. Study the question above. Then, underline the TWO most important search terms. (This example has underlined the two terms for you.)

Should marijuana be legalized in Michigan?

4. Place one underlined word in each of the columns below. All your terms should be nouns. You may need to change a verb, adverb or adjective into a noun. (As an illustration, the two important search terms have been inserted for you.)
5. In each column, write down one, two, or three nouns or noun phrases that are related to the first word in the column so that you have two lists, each list on a separate subject, but all related to your question. Each word or phrase might mean the same as the first term in the column. It might be a broader term or a narrower term. When you finish, you have two sets of search terms with which to conduct a search. (The chart has been partially completed for you. Complete the chart by inserting more nouns or noun phrases related to the term marijuana.)

marijuana	legalization
	decriminalization
	liberalization
	non-prohibition

Example B

1. Imagine that the subject of your paper is: campus security

2. Now, narrow your topic by asking a question about it. Write your question in the space below.

(An example question has been supplied for you.)

Should college students be required to wear identification badges while on campus?

3. Then, study your question. After that, underline TWO words that identify the main concepts.

(As an illustration, the two words have been underlined for you.)

Should college students be required to wear identification badges while on campus?

4. Place one underlined word in each of the two columns below. Your two terms should be nouns. You may need to change a verb, adverb or adjective into a noun. (One term has been inserted for you.)

5. In each column, write down one, two, or three nouns or noun phrases that are related to the first word in the column so that you have two lists, each list on a separate subject, but all related to your question. Each word or phrase might mean the same as the first term in the column. It might be a broader term or a narrower term. When you finish, you have two sets of search terms with which to conduct a search. (One noun phrase has been supplied for you. Insert more nouns or noun phrases that mean the same thing, or are broader or narrower.)

students	
college community	

Example C

1. Imagine that the subject of your paper is: radiation

2. Now, narrow your topic by asking a question about it. Write your question in the space below.

(An example question has been supplied for you.)

How does radiation affect infants?

3. Then, study your question. After that, underline two words that identify the main concepts.

(To illustrate, one word is underlined for you. Identify a second term and underline it.)

How does radiation affect infants?

4. Place one underlined word in each of the two columns below. Both your terms should be nouns or noun phrases. You may need to change a verb, adverb or adjective into a noun. (One word has been inserted for you. You have identified the second term by underlining it.

Now, insert this second term in the chart.)

5. In each column, write down one, two, or three nouns or noun phrases that are related to the first word in the column so that you have two lists, each list on a separate subject, but all related to your question. Each word or phrase might mean the same as the first term in the column. It might be a broader term or a narrower term. When you finish, you have two sets of search terms with which to conduct a search. (One noun phrase has been supplied for you. Complete the chart by inserting more nouns or noun phrases related to the term radiation.)

radiation	
nuclear contamination	

Appendix J: Materials for the Worked-Examples Group

Library Research Exercise

Instructions: This is an exercise designed to help you generate a search query to use to locate articles in our databases. This exercise contains three worksheets with examples of three different research topics and questions. Study the example worksheets to help you to understand the process better. The fourth worksheet is blank. After studying the example worksheets, complete the blank worksheet to generate search terms for the topic you have chosen for your research assignment. Then, search for articles on your research topic.

You have 25 minutes to complete these activities. Use about 15 – 20 minutes to study the examples and complete the worksheet so that you have at least 10 minutes to search for articles on your topic.

PLEASE WAIT UNTIL YOU ARE INSTRUCTED TO CONTINUE.

Part I: Example Worksheets

Example A:

1. Imagine that the subject of your research is: marijuana
2. Now, narrow your topic by asking a question about it. Write your question in the space below.
(An example question has been supplied for you.)

Should marijuana be legalized in Michigan?

3. Study the research question. Then, underline the TWO most important words. (To illustrate, the two words have been underlined for you.)

Should marijuana be legalized in Michigan?

4. Place one underlined word in each of the two columns below. All your terms should be nouns. You may need to change a verb, adverb or adjective into a noun. (The underlined words have been inserted for you.)
5. In each column, write down one, two, or three nouns or noun phrases that are related to the first word in the column so that you have two lists, each list on a separate subject, but all related to your question. Each word or phrase might mean the same as the first term in the column. It might be a broader term or a narrower term. When you finish, you have two sets of search terms with which to conduct a search. (To provide an illustration of this process, related search terms have been supplied for you.)

marijuana	legalization
drugs	decriminalization
cannabis	liberalization
weed	non-prohibition

Example B:

1. Imagine that the subject of your research is: campus security

2. Now, narrow your topic by asking a question about it. Write your question in the space below.

(An example question has been supplied for you.)

Should college students be required to wear identification badges while on campus?

3. Study the research question. Then, underline the TWO most important words. (To illustrate, the two words have been underlined for you.)

Should college students be required to wear identification badges while on campus?

4. Place one underlined word in each of the two columns below. All your terms should be nouns or noun phrases. You may need to change a verb, adverb or adjective into a noun. (The underlined words have been inserted for you.)

5. In each column, write down one, two, or three nouns or noun phrases that are related to the first word in the column so that you have two lists, each list on a separate subject, but all related to your question. Each word or phrase might mean the same as the first term in the column. It might be a broader term or a narrower term. When you finish, you have two sets of search terms with which to conduct a search. (To provide an illustration of the process, related search terms have been supplied for you.)

students	identification
college students	identification badges
campus students	ID badges
college community	name tags

Example C:

1. Imagine that the subject of your research is radiation.
2. Now, narrow your topic by asking a question about it. Write your question down in the space provided. (As an illustration, a question has been supplied for you.)

How does exposure to radiation affect infants?

3. Study the research question. Then, underline the TWO most important words. (To illustrate, the two words have been underlined for you.)

How does exposure to radiation affect infants?

4. Place one underlined word in each of the two columns below. All your terms should be nouns. You may need to change a verb, adverb or adjective into a noun. (The underlined words have been inserted for you.)
5. In each column, write down one, two, or three nouns or noun phrases that are related to the first word in the column so that you have two lists, each list on a separate subject, but all related to your question. Each word or phrase might mean the same as the first term in the column. It might be a broader term or a narrower term. When you finish, you have two sets of search terms with which to conduct a search. (To provide an illustration of the process, related search terms have been supplied for you.)

radiation	infants
poison	children
toxic substances	babies
nuclear contamination	people

Appendix K: IRB Exemption Letter



DARDEN COLLEGE OF EDUCATION
 OFFICE OF THE CHAIR
 NORFOLK, VIRGINIA 23529-0136
 PHONE: (757) 683-3936
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November 22, 2010

Proposal Number 201001031

Professor Adcock:

Your proposal submission titled, "Using Worked Examples to Teach Queries for Searching Academic Journal Databases" has been deemed EXEMPT from IRB review by the Human Subjects Review Committee of the Darden College of Education. If any changes occur, especially methodological, notify the Chair of the DCOE HSRC, and supply any required addenda requested of you by the Chair. You may begin your research.

We have approved your request to pursue this proposal indefinitely, provided no modifications occur. Also note that if you are funded externally for this project in the future, you will likely have to submit to the University IRB for their approval as well.

If you have not done so, PRIOR TO THE START OF YOUR STUDY, you must send a signed and dated hardcopy of your exemption application submission to the address below. Thank you.

Edwin Gómez, Ph.D.
 Associate Professor
 Human Subjects Review Committee, DCOE
 Human Movement Studies Department
 Old Dominion University
 2021 Student Recreation Center
 Norfolk, VA 23529-0196
 757-683-6309 (ph)
 757-683-4270 (fx)

VITA

Mary Kickham-Samy

Old Dominion University

STEM and Professional Studies, Darden College of Education

Norfolk, Virginia

EDUCATION

- 2011 ABD, Doctoral Student, Instructional Design and Technology, Old Dominion University, Norfolk, VA.
- 2000 MLIS, Library and Information Science, Wayne State University, Detroit, MI.
- 1975 MA, Teaching English As A Foreign Language (TEFL). The American University in Cairo, Egypt.
- 1973 BGS, Bachelor's in General Studies, The University of Michigan, Ann Arbor. MI.

EMPLOYMENT

- 2002 till now Electronic Systems/Services Librarian, Macomb Community College, Warren, MI.
- 2001-2002 Researcher/Media Analyst, Hass MS&L, Ann Arbor, MI.
- 1998-2000 Assistant Reference Librarian, Saginaw Public Libraries, MI.
- 1996-1998 Director of the Children's Center of the American University in Cairo, Egypt.
- 1979-1995 Instructor, English Language Institute and the Freshman Writing Program, the American University in Cairo, Egypt.
- 1976-1979 English Language Teaching Expert/Teacher Trainer, Cairo University, Giza, Egypt.
- 1973-1976 Teaching Fellow, The American University in Cairo, Egypt.

EXPERIENCE IN TRAINING AND MATERIALS DESIGN AND DEVELOPMENT

- 2005 - 12 Training Co-ordinator, Michigan Virtual Reference Collaborative
- 2006 - 11 Editor, *ResearchHelpNow Training Newsletter*.
- 1984 - 98 Childcare Center Consultant and Teacher Trainer, The American University in Cairo, Cairo, Egypt.
- 1979 - 84 Teacher Participant, TEFL MA program on methodology and language teaching, The American University in Cairo, Cairo, Egypt.
- 1977 - 79 Instructional Design and Development Specialist, English Department, Cairo University, Giza, Egypt.

CONFERENCE MANAGEMENT

- 2002, Feb. 7 Organized a day-long conference on the Role of Libraries in Distance Education Programs, sponsored by The Michigan Chapter of the American Society for Information Science and Technology, and Macomb Community College.

2001, Spring. Co-organized a library event on Digital Libraries and Copy Right Laws at the Library of Michigan in Lansing, sponsored by the Michigan Chapter of the American Society of Information Science and Technology.

PUBLICATIONS

- "The tutorial dialogue and problem solving in virtual reference interactions." (2012). In M. L. Radford (Ed.). *Leading the reference renaissance: Today's ideas for tomorrow's cutting edge services* (pp. 47-61). New York: Neal-Schuman.
- "Balance of power and negotiaton of meaning in virtual veference learning environments." (2010). In M. L. Radford & R. D. Lankes (Eds.), *Reference renaissance: Current & future trends*. (pp. 55-70). New York : Neal-Schuman.
- Al-Lozy, M. et. al. Comp. *The Freshman Writing Program Reader*. Cairo: AUC, 1993.
- "Better Writing Less Correcting" in *Proceedings of the EFL Skills Conference "New Directions in Writing."* Cairo: AUC, 1996.
- "Spatial Description and its Relationship to Other Forms of Written Discourse" in *Discourse Analysis: Theory and Application*. Cairo: Ain Shams U., 1982.

POSTER PRESENTATION

Memcott, S., Kickham-Samy, M., McCarthy, S.C., Tobias, C., Walaskay, A., & Weismante, A. (2009, July). *Comparing Apples to Oranges? Community College and University Cooperation in Virtual Reference*. Poster session presented at the American Library Association Annual Conference, Chicago.

BOOK CONSULTATION

The Story of Egypt. Chicago: World Book, 1996.

PAPERS PRESENTED

- 2010, Aug. 8 "Asking and Answering Questions, Setting and Resetting Goals, and Switching Strategies in Virtual Reference Interactions," Denver, Aug. 8-10, at the Reference Renaissance: Inventing th Future.
- 2008, Aug. 4 "Balance of Power and Negotiaton of Meaning in Virtual Reference Learning Environments," Denver, Aug. 4-5, at the Reference Renaissance: Current & Future Trends Conference.
- 2006, Sept.21 "Transfer Calls Using Ask-A-Librarian Software," Washtenaw Community College, the Annual Meeting of the Michigan Virtual Reference Collaborative.
- 1994, Dec.14 "Better Writing Less Correcting," Cairo, Egypt, the ESL Skills Conference, "New Directions in Writing," organized by the Center for Adult and Continuing Education, the American University in Cairo.
- 1994, April 11 "Summary and Paraphrase in the Year 2000," Cairo, Egypt, the 14th CDELT National Symposium on English Language Teaching in Egypt, entitled "English Language Teaching in 2000," organized by the Centre For Developing English Language Teaching (CDELT), Ain Shams University.

1982, Mar.30 "Spatial Description and Its Relationship to Other Forms of Written Discourse," Cairo, Egypt, the 2nd National Symposium On Linguistics and English Language Teaching, Cairo University.

FILM PRODUCTIONS

- 1987 Co-producer of film entitled "Cairo: A City of Contrasts." A home video production designed for the U.S. Department of Education for classroom use in American schools, Edited by John Swanson, Office of Special Academic Programs, The American University in Cairo, Egypt.
- 1987 Co-producer of the American University in Cairo Daycare Center Documentary, Edited by Paul Burgess, T.V. News Training Center, The American University in Cairo, Cairo, Egypt.

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

The American Library Association (ALA)
The Association for Educational Communications & Technology (AECT)

OFFICES HELD IN A PROFESSIONAL ORGANIZATION

The American Society for Information Science and Technology (2000-2007)
Secretary/Treasurer of the Michigan Chapter (2001-2004)
President of the Student Chapter at Wayne State University (2000)

EXPERIENCE IN ADMINISTRATION

- 1984-98 Chairperson/Member of Board of Directors, AUC Children's Center.
- 1989 Co-director of Summer Projects, Special Academic Programs, AUC, Egypt.
- 1988 Coordinator of Summer Projects; Fulbright Summer Program, Special Academic Programs, AUC, Egypt.
- 1984 Founder of the "Alf Leila wa Leila" Children's Center, the American University in Cairo, Egypt.

LIBRARY HONOR SOCIETY MEMBERSHIP: Beta Phi Mu

FOREIGN LANGUAGES:

Arabic, both standard written Arabic and the spoken Egyptian dialect.
Advanced Intermediate Level Certificate in Arabic, 1996, AUC, Egypt.