

USING CASE COMPARISON TO SUPPORT
THE DEVELOPMENT OF INSTRUCTIONAL DESIGN
PROBLEM-SOLVING STRATEGIES

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Dedicated to

my grandparents

Bernard and Betty Horvitz

Jules and Pauline Weinstein

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Brian S. Horvitz

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A popular instructional approach for developing problem-solving abilities is case-based instruction (CBI). One limitation of CBI is that problem solvers, especially novices, often fail to recall relevant cases from memory when needed. Analogical encoding is a promising approach to CBI for overcoming this limitation. Analogical encoding is the comparison of multiple cases through which learners come to understand the principle or strategy common to both. This study investigated the effectiveness of CBI with analogical encoding for the teaching of instructional design (ID) strategies.

Participants, 62 graduate and undergraduate education students, were assigned to one of three treatment groups. The first group read a case demonstrating an ID strategy. The second group read a different case demonstrating the same strategy. The third group read both cases and was asked to compare them. All participants were then asked to describe the ID strategy demonstrated in the case(s) and to describe an instructional solution to a problem similar to those found in the two cases. Responses were scored by external judges. Participants' levels of ID experience and ID self-efficacy were measured to examine the impact of these factors on the effectiveness of this instructional technique. A subset of the participants were interviewed to explore what other factors might explain their performance.

Analysis revealed no significant differences among the participants in each of the treatment groups and that neither ID experience nor self-efficacy explained variance in participant performance. Review of the findings, interviews, and the literature suggest the

following possible explanations for these results: 1) effective ID strategies for solving ill-structured problems may be different from those for highly-structured problems; 2) effective CBI with analogical encoding may require coupling the use of cases with direct instruction; and 3) effective CBI with analogical encoding may require encouraging learners to surface and reflect on their preconceptions.

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Chapter One: Introduction and Background

Problem solving ability is considered by many psychologists and educators to be one of the most important of all learning outcomes (Jonassen, 2000). Problem solving is something that people have to do everyday in all aspects of their lives. Interpersonal relations, technical challenges, moral dilemmas, even figuring out what to make for dinner, all require problem solving ability. Karl Popper went so far as to say, “All life is problem solving. All organisms are inventors and technicians, good or not so good, successful or not so successful, in solving technical problems” (Popper, 1999).

Despite the central importance of problem-solving skills in all aspects of people’s lives, Jonassen (2000) points out that “Problem solving has never been sufficiently acknowledged or articulated in the instructional design literature. With few exceptions, it is not even mentioned in most textbooks on instructional design” (p. 63-64).

Case-based instruction (CBI) is an instructional approach which has been used to develop problem-solving skills for over a century (Williams, 1992) and has recently received a considerable amount of attention among instructional design and learning sciences researchers (Ertmer & Dillon, 1998; Hernandez-Serrano & Jonassen, 2003; Jonassen & Hernandez-Serrano, 2002; Kolodner, 1997; Kolodner & Guzdial, 2000; Kolodner, Owensby, & Guzdial, 2003; Stepich, Ertmer, & Lane, 2001; Wang, Moore, & Wedman, 2003). CBI has long been used to educate students of law, medicine and business (Gentner, Loewenstein, & Thompson, 2003; Williams, 1992) and it has also been used extensively in education, particularly for teacher education (Shulman, 1992; Smith, 2005; Sykes & Bird, 1992).

Some leading educational researchers have explained that the use of cases or stories in instruction derives its potency from the fact that people use case-based reasoning (CBR) as a primary mode of thought (Jonassen & Hernandez-Serrano, 2002; Kolodner, 1992; Kolodner et al., 2003; Schank, 1990; Schank, Berman, & Macpherson, 1999). Schank and Abelson (1995) claim that “Virtually all human knowledge is based on stories constructed around past experiences” (p. 1). According to this view, understanding occurs when a person can explain what is happening in a way that corresponds with what the person already knows. When understanding does not happen and there is an expectation failure (Schank et al., 1999), either new stories, or cases, are necessary, or old ones need to be revised. This situation is similar to the CBR cycle described by Aamodt and Plaza (1996) which suggests that, when faced with a problem, a person goes through a cycle in which he retrieves a case from memory and reuses the old case. If the old case does not help to solve the problem, the person will revise the old case iteratively until it does. The person will then retain this new case for future use.

Assuming that people do, indeed, use remembered stories, cases or experiences in their efforts to solve problems, it is logical that CBI should be an attractive approach for supporting the development and learning of problem-solving skills and strategies. Gentner et al. (2003) describe the attractiveness of CBI like this: “Because cases and examples are concrete, they are more engaging and more easily understood than abstract, domain-general principles. The understanding gained through these specific cases can then be transferred to novel situations” (p. 393). They go on to cite a series of studies that provide

...considerable evidence that familiar examples can serve as models or analogies to new situations... If people notice a similarity between a new problem and one

of their previously learned examples – that is, if the new problem reminds them or a prior example – they can use the prior example to inform the current problem (Gentner et al., 2003, p. 393).

While there is optimism regarding the effectiveness of CBI, researchers have also cautioned about its limitations. Though CBI can help people learn about cases for use in solving future problems, people often fail to recall relevant cases when necessary or will even recall inappropriate cases (Gentner et al., 2003; Gick & Holyoak, 1980). This is particularly true when a current problem and the relevant case in memory differ in surface or contextual features. Kurtz, Miao and Gentner (2001) explain:

In the traditional framework, retrieval is typically required; examples are presented in isolation and it is assumed that learners will draw on appropriate prior examples when they are given a new target problem... However, it has been shown that learners frequently fail to transfer relevant stored knowledge. (p. 418)

From their research, Gick and Holyoak (1980) presume that it is people's sensitivity to surface similarity (e.g. similar context, common object attributes) that prevents them from recalling cases that are structurally similar and would be useful in addressing a given problem. Rather, people will recall cases that have superficial similarities but are not structurally useful for the problem at hand.

How then can people be supported in recalling cases from memory that are appropriate for the problem at hand? Cognitive psychology researchers have investigated a technique called *analogical encoding*. This is when, in comparing two examples or cases, people come to understand the structure common to both (Gentner et al., 2003; Kurtz et al., 2001). The idea is that when a learner compares two cases with underlying structural similarities and surface level details, the learner will focus on their parallel structure and develop a deeper understanding of both cases. As Gentner et al. (2003) explain, "Analogical encoding fosters learning by taking advantage of a basic property of

analogical reasoning: Analogies promote attention to commonalities, including common principles or schemas” (p. 394).

In typical analogical learning, learners are cued to remember a well-understood example and map that knowledge onto a new example. “In analogical encoding, the mapping can occur in both directions – whatever is understood about one example can serve to shed light on the other” (Gentner et al., 2003). If, through analogical encoding, learners are able to see beyond surface details and come to understand the general problem-solving principle or strategy underlying a set of cases, they should be able to index this principle in memory more efficiently for later recall when needed. This, in turn, should increase the likelihood that learners will be able to recall prior cases and transfer them to the practice of solving problems in new contexts.

Given the theoretical potential of analogical encoding in CBI, there have been several recent studies investigating its effectiveness in controlled, experimental settings. Gentner and Thompson at Northwestern University and Loewenstein at Columbia University have published a series of such studies (Gentner et al., 2003; Gentner, Loewenstein, & Thompson, 2004; Loewenstein, Thompson, & Gentner, 1999, 2003; Thompson, Gentner, & Loewenstein, 2000). The researchers conducted a series of experiments in which they examined the use of analogical encoding in the instruction of negotiation skills among college and graduate level business students. Each study provides evidence that CBI using analogical encoding can promote the learning and application of problem-solving skills more effectively than CBI that does not use analogical encoding.

As stated above, this series of studies was conducted in the context of undergraduate and graduate business education. This seems a reasonable choice since business students are expected to develop skills necessary to solve complex problems in a seemingly infinite number of possible contexts. Instructional design (ID) students are expected to do the same. There have been calls for improved methods in the instruction of ID – some have suggested the use of CBI (Rowland, Parra, & Basnet, 1995; Tessmer & Wedman, 1995). To date, there are few published accounts of the use of CBI in the education of ID competencies (Ertmer & Dillon, 1998; Stepich et al., 2001).

Purpose and Significance of the Study

Investigating the effectiveness of CBI using analogical encoding in the instruction of ID strategies is a worthwhile endeavor, given the demonstrated promise of CBI using analogical encoding among business students, the success of case approaches in teacher education, and the need for innovative instructional approaches for teaching ID. The findings from such an investigation should inform the design of instruction used to teach ID students in a variety of educational environments (e.g. classrooms, distance courses, tutoring systems) as well as inform the broader knowledge base on what works well in CBI.

Chapter Two: Review of the Literature

Importance of Problem Solving

Problem solving is among the most important skills people need in all aspects of their lives. Problem solving is an essential part of nearly all professions as well as all facets of life. Robert Gagne (1980), in his seminal book *The Conditions of Learning*, wrote, “. . . the central point of education is to teach people to think, to use their rational powers, to become better problem solvers” (p. 85). Reigeluth (1999) concurs, arguing that “. . . as we evolve deeper into the information age, learners need more skill for complex cognitive tasks, such as solving problems in ill-structured domains” (p. 21). As such, it should come as no surprise that, as noted by Jonassen and Hernandez-Serrano (2002), most contemporary instructional theories and approaches focus on problem solving as a primary learning outcome. These include anchored instruction, problem-based learning, open-ended learning environments, constructivist learning environments, goal-based scenarios, cognitive flexibility theory, and cognitive apprenticeship. Despite this work, “insufficient advice is available to instructional designers to help them to design and develop learning and instructional supports for every kind of problem solving” (Jonassen and Hernandez-Serrano, 2002, p. 65). The goal of this study is to examine a particular instructional approach for developing problem-solving skills and to begin to address this gap in the instructional design literature.

Learning from Case-Based Reasoning

Before developing an instructional approach that supports the development of problem-solving skills, it is important to understand how people learn these skills (Reigeluth, 1999). In this case it is important to look at how respected educational

scholars explain human problem-solving. One theory that many respected scholars advance is that people use case-based reasoning (CBR) to develop and practice problem-solving skills (Jonassen & Hernandez-Serrano, 2002; Kolodner, 1992; Schank, 1990). There are four steps in the CBR cycle: retrieve, reuse, revise, and retain (Aamodt & Plaza, 1996). When a person encounters a problem he will first retrieve an experience or case from memory that might suggest a solution to the problem. This case may come from first-hand experience or it may have been learned from another person, book, or other source. Next, the person will reuse the solution from the remembered case by applying it in the current situation. If the solution works, the problem is solved and the cycle ends. If the remembered solution does not work, the person will revise the remembered solution and try it again. This will be repeated until the remembered solution has been sufficiently revised and the person has successfully solved the current problem. Once the problem has been solved, the revised solution will be retained as case in memory for later use. There is empirical evidence that if people find a similarity between a new, current problem and a prior example in memory, they can use the remembered example to help solve the current problem (Pirulli & Anderson, 1985; Ross, 1984).

If people use CBR to help them solve problems, it stands to reason that helping to improve people's CBR will help them become better problem-solvers. How can people improve their CBR? One way to give students practice in CBR and to build up their mental library of cases is CBI.

History of Case-Based Instruction

The CBI instructional approach has been used in professional educational contexts for over a century. It is based on exposing learners to documented experiences

with the purpose of developing problem solving expertise. Following is a summary of the history of CBI in professional education in the United States.

Legal education. The roots of CBI are usually traced back to Harvard Law School where, in 1870, Christopher Langdell became the school's dean and proposed that the curriculum be centered on cases (Merseeth, 1991; Shulman, 1992; Williams, 1992). Langdell argued that it was critical for law students to analyze carefully the reasoning of judges in actual cases in order to understand the law (Shulman, 1992). The educational objective ". . . was to generalize particular decisions into broader understandings of the principles of law" (Merseeth, 1991, p. 243).

Around this time, "The two most prominent methods of training lawyers . . . were apprenticeship in a private law office and study at a private law school using the lecture method" (Williams, 1992, p. 378). The strength of the apprenticeship model was the practical understanding and competencies developed by working alongside an experienced lawyer. The weaknesses of the apprenticeship model were a lack of consistency and completeness. Apprenticeships varied greatly in the degree of thoroughness of training and in the selection of legal topics addressed. The degree of consistency and completeness were a direct result of the skills, specialties and resources of the experienced lawyer with whom the apprentice worked.

On the other hand, instruction at private law schools that primarily employed lecture-based instruction was more consistent and thorough, but was criticized for being too theoretical and not practical (Williams, 1992). The lecture-based instruction at these private schools was also criticized for not being as easily remembered as knowledge that came from practice.

By 1915, the case method was used in most of the prominent law schools in the country (Merseth, 1991). Lynn (1999) argues for the appropriateness of the case method in legal education because the practice of law is inductive. Generalizations in the practice of law come from a set of particular legal cases. “Thinking like a lawyer involves analogical reasoning and formal, inductive logic applied to the essential facts of a case” (Lynn, 1999, pp. 6-7). If thinking like a lawyer involves poring through the facts of individual legal cases and reasoning through them, practicing such methods in legal education might be an effective instructional approach. CBI, then, serves two primary purposes for law students. First, cases provide opportunities to develop and hone the skills practiced by actual lawyers. Second, cases help law students come to understand the law by building their knowledge base in a case-by-case manner which reflects how legal precedents come into being.

Business education. Based on the popularity of CBI in its law school, Harvard Business School, established in 1908, developed its own case-based curriculum (Merseth, 1991). Wallace B. Donham, a graduate of Harvard Law School, was appointed dean of Harvard Business School in 1919 and was a strong proponent of CBI. Instead of supporting more traditional lecture-based courses, he helped shape the school’s curriculum around a problem-centered approach based on real-life situations in the form of written cases.

CBI focused on problem-centered instruction in business contexts is different from the method used in the law school. Rather than using formal documents that summarize precedent setting legal cases, business cases more typically summarize a business situation or issue that has been faced by business executives including relevant

facts and opinions (Lynn, 1999). In this setting, CBI is intended to help students develop the skills necessary to make difficult decisions about problems in complex environments where the correct answer is not always obvious and about which multiple practitioners may disagree. While there is a somewhat standard method for analyzing legal cases and making legal decisions, business methods lack clear rules and uniformity, requiring more intuition and pattern recognition than the pure logical reasoning called for in the practice of law (Lynn, 1999). So, in business education the primary purpose of cases is to serve as a stimulus for students to practice the kind of complex problem-solving they will need to perform in their future careers.

Medical education. Similar to graduate schools of business, many medical schools have adopted a problem-based approach to CBI. In this variation, patient cases are used as stimuli for learning (Williams, 1992). Williams (1992) suggests that the use of CBI “was clearly influenced by the case method of instruction begun at Harvard Law School...” (p. 395).

In the practice of medicine, similar to the legal profession, there is a formal written record of patient cases, since physicians thoroughly document every patient’s medical and treatment history (Lynn, 1999). Medical cases differ from legal ones in that legal cases are definitive and set precedent while medical cases are highly dependent on “the time-pressured, sequential nature of clinical reasoning (that) cannot be captured in a written record” (Lynn, 1999, p. 7). Medical thinking is different from legal thinking. Physicians must, sometimes in very short periods of time, follow a reasoning process that includes gathering information, forming hypotheses, narrowing down hypotheses through inquiry, formulating the problem, and making a diagnostic or therapeutic decision (Lynn,

1999). Patient cases provide medical students the opportunity to practice this kind of reasoning so they will be able to execute it competently in the care of new, unique patients whose profiles, symptoms, and circumstances will no doubt be different from any case studied in school. Problem-based learning using patient cases makes this highly complex reasoning process visible so it can be developed (Lynn, 1999).

Teacher Education. In field of education, CBI has been used most notably in the preparation of teachers. Case methods were used in the training of teachers in New Jersey and Massachusetts as early as 1920 (Sykes & Bird, 1992; Merseth, 1999). In the face of the school reform movement of the early 1980s, professional educators and educational researchers began to take a more active interest in CBI, as evidenced by its public recognition in the 1985 Presidential address to the American Educational Research Association (AERA) (Merseth, 1999). Despite this recognition, by the early 1990s it was acknowledged that “(CBI has) been almost nonexistent in teacher education” (Shulman, 1992, p. 27) and “Cases and case methods of teaching represent a relatively new and promising approach in the education of teachers” (Merseth, 1994, p. 1). The use of case methods in the preparation of teachers is still in its infancy.

Not surprisingly then, empirical research on the use of CBI in the training of educators is lacking. Merseth (1999) notes that although by the early 1990s there were a number of books and articles about cases and methods that advocated for their use, “Any empirical basis for the claims was rarely evident” (p. x). She goes on to quote the Handbook of Research on Teacher Education (1996, p. 722): “The collective voice of (CBI’s) proponents far outweighs the power of existing empirical work” (Merseth, 1999, p. xi).

There are, however, strong proponents of CBI for the instruction of teachers (Merseeth, 1991, 1994, 1999; Shumlan, 1992; Wasserman, 1994). Merseeth (1994) suggests “the current interest of teacher educators in this pedagogy is due in part to a growing interest in the development of teacher knowledge and cognition and an acknowledgement of the complexities of teaching.” (p. 1)

According to Merseeth (1994) cases are used in teacher education in three different ways: a) as exemplars of theory; b) as opportunities to practice problem-solving; and c) as stimuli for reflection. According to Shulman (1992, p. 2), cases are used to teach: (a) theoretical concepts, (b) precedents for practice, (c) morals or ethics, (d) strategies, and (e) visions of the possible. As in the application of cases to teach law, teacher educators can use cases to show how theories are put into practice. As in the application of cases to teach medicine and business, teacher educators can use cases to present realistic educational problems on which their students can practice.

Educational researchers, interested in the potential and the effectiveness of CBI in teacher education, have recently embarked on the empirical study of its use. Smith (2005) has conducted a review of empirical research on CBI in teacher education between 1994 and 2004 to identify the current status of this research. He reviewed 19 published studies on the impact of CBI in teacher education, focusing primarily on the design and methodology of the studies. Most of the studies he reviewed used an action research orientation in which teachers collect and analyze data gleaned from their own classrooms and instruction. While Smith’s (2005) enthusiasm for the continued use and study of CBI was not dampened by the results of his review, he did find that the majority of studies have significant design and methodological limitations. The most consistent

flaw he noted was researchers failing to summarize the theoretical orientation guiding their inquiry. Echoing the education leaders cited above (Shulman, 1992; Merseth, 1994), Smith (2005) concluded that more research on the use of CBI in the training of educators is needed.

Definition of Case

How does the current literature define instructional “cases” and how are cases typically used in instruction? There are several different definitions and perspectives. Definitions of cases range from the detailed and specific to the more simple and broad.

One of the more detailed definitions belongs to Wasserman (1994) who defines cases as:

. . . complex educational instruments that appear in the form of narratives. A case includes information and data - psychological, sociological, scientific, anthropological, historical, observational, and technical material. (p. 3)

Wasserman includes specific ideas about the kinds of information that ought to be included in a case in his definition.

Similarly, Merseth (1994) defines a case as:

. . . a descriptive research document, often presented in narrative form, that is based on a real-life situation or event. It attempts to convey a balanced, multidimensional representation of the context participants, and reality of the situation. (p. 1)

Merseth not only spells out what kind of information should be included in a case, but also explains how the case should be developed (research) and what it should reflect (a real-life situation).

Shulman (1992) takes a more philosophical approach in defining cases. He makes the following argument:

To call something a case is to make a theoretical claim. It argues that the story, event, or text is an instance of a larger class, an example of a broader category. In a word, it is a “case-of-something” and therefore merits more serious

consideration than a simple anecdote or vignette. It implies an underlying taxonomy or typology, however intuitive or informal, to which a given case belongs. (p. 17)

Rather than focusing on what specific information a case should contain or how it ought to be developed, Shulman seems more interested in what a case represents. To him, a case needs to be considered in the context of the class of events or examples of which it is a member.

There is another community of researchers (Jonassen & Hernandez-Serrano, 2002; Kolodner et al., 2003; Schank, 1990) who define cases simply as examples or stories that are experienced or learned so they can be recalled later when relevant. Kolodner et al. (2003) say simply, “Cases are interpretations of experiences” (p. 2). Schank, Berman, and Macpherson (1999) define cases as “. . . a memory of a particular instance of something that happened” (p. 168). Jonassen & Hernandez-Serrano (2002) refer to cases simply as “old experiences” (p. 69). These researchers share an assumption that by reading cases, people gain vicarious experiences which can serve as low fidelity substitutes for direct experiences. Both direct and vicarious experiences are indexed in people’s minds, waiting to be called upon for future use when a problem or situation activates CBR.

For the purposes of this study, a case is defined as a written account of an experience – real or hypothetical. This written account will document an example or non-example of a concept or principle situated in a realistic context.

Purposes of Case-Based Instruction

For what purposes, then, are cases used in instruction? In discussing the use of CBI in the training of teachers, Merseth (1999) identifies four ways cases are used pedagogically. CBI:

1. Helps students develop skills of critical analysis and problem solving.
2. Encourages the development of higher order cognitive thinking and the generation of multiple pedagogical techniques.
3. Fosters reflection.
4. Presents a realistic picture of the complexities of teaching.

Shulman (1992) identifies five pedagogical purposes for CBI. They support the learning or development of:

1. Principles or concepts of a theoretical nature.
2. Precedents for practice.
3. Morals or ethics.
4. Strategies, dispositions, and habits of mind.
5. Visions or images of the possible.

There are similarities between these stated purposes for using CBI for teacher education.

Both endorse the use of cases as stimuli for student reflection: Merseth states this explicitly while Shulman alludes to this in suggesting that cases ought to be used to help students view the possible. Both also endorse the use of cases as a tool to support the development of problem solving skills. Merseth states this explicitly while Shulman refers to the development of strategies and habits of mind. Merseth (1999) adds, “One of the most widely cited advantages of case-based pedagogy is its ability to help students

develop skills of critical analysis, problem-solving, and strategic thinking” (p. xii). Shulman (1992) emphasizes that cases are “ideal for inducting the neophyte into those worlds of thought and work that are themselves characterized by unpredictability, uncertainty, and judgment” (p. 8). This study aims to look at CBI as a tool to support the development of problem solving skills.

Support for CBI in Instructional Design Literature

The support for CBI just discussed comes from scholars primarily focused on teacher training. There also is support for the use of CBI within the instructional design (ID) literature. The use of instructional cases is a crucial component of Cognitive Flexibility Theory (CFT) (Spiro, Collins, Thota, & Feltovich, 2003). CFT, a theory of learning and instruction, is largely concerned with helping people develop competence in ill-structured, professional domains such as medicine, business, and teaching. Spiro et al. (2003) claim that in such domains, “wide-scope abstractions and general principles do not account for enough of the variability in the way knowledge has to be used” (p. 6). They support the use of large numbers of cases that exemplify how conceptual knowledge is actually applied in real contexts. According to CFT, working with many cases is central to building expertise. They advocate revisiting cases in different combinations through hypermedia so learners can grasp the multiple facets of cases, increasing the chances that they will be recalled as needed to solve problems in unique contexts.

Williams (1992) makes a strong argument that cases can be used effectively to augment a cognitive apprenticeship instructional approach. Cognitive apprenticeship (Collins, Brown, & Newman, 1989) takes its cues from a traditional apprenticeship

arrangement in which a learner works directly with an expert, modeling the expert's behavior while learning in the context of solving real-world problems. A cognitive apprenticeship emphasizes experts explaining and making transparent how they think through strategies, procedures, and conceptual issues, so that learners can imitate and model them. Written cases are a way that learners can be exposed to the cognitive processes of experts if face-to-face interactions are not possible. If written at a level of detail that makes expert thinking explicit, cases can leverage the pedagogical strengths of a cognitive apprenticeship approach in a written form. This makes such instruction more widely available than more typical cognitive apprenticeship instruction that requires the presence of a live expert.

While support for CBI can be found in both the ID and more general education literature, there are also potential limitations of this instructional approach.

Limitation of CBI – Inert Knowledge Problem

The effectiveness of using remembered cases to solve current ones varies (Gentner et al., 2003). It is common for people to fail to remember relevant examples or experiences (Gick & Holyoak, 1980; Keane, 1988), especially when the surface features or contextual details of the current situation and the remembered cases differ (Holyoak & Koh, 1987; Weisberg, DiCamillo, & Phillips, 1978). This limits people's ability to take advantage of their experiences stored in memory to address new problems (Gentner et al., 2003).

People often catalogue or encode experiences in memory based on the case's context or surface features rather than based on the more useful concept or principle the experience exemplifies (Gentner, 1989; Medin & Ross, 1989). This can make it difficult

to recall cases in situations when they might be useful. This may be particularly true of novices who, given their limited experience and limited number of cases in memory, have no basis other than these contextual and surface features for making sense of and recalling their experiences (Gentner et al., 2003; Chi, Feltovich, & Glaser).

The inability to recall prior examples from memory that could be useful for a current problem is known as the inert knowledge problem (Lancaster & Kolodner, 1987; Novick & Holyoak, 1991; Perfetto, Bransford, & Franks, 1983). Gentner, Ratterman, and Forbus (1993) and Ross (1984) found that when given an example case people are more likely to recall a remembered example on the basis of surface rather than structural similarities (Gentner et al., 2003). Research has shown that these limitations on recall are particularly acute among novices, while experts are more likely to encode a case or experience based on its critical underlying structure (Dunbar, 2001; Novick, 1988). Gentner et al. (2003) suggest that “A characteristic of expertise may be the ability to transfer concepts learned in one domain to solve problems in a different context” (p. 394). They also point out, however, that expertise can take years and thousands of experiences to attain.

Analogical Encoding

In recent years research has been published by educational and cognitive psychologists on an instructional strategy that takes direct aim at overcoming this inert knowledge problem; this strategy is analogical encoding. In instruction that uses this strategy, learners compare two cases or examples that share a common underlying structure but typically have different surface or contextual details (Ferguson & Forbus, 1998; Loewenstein, Thomson, & Gentner, 1999; Gentner et al., 2003). In comparing

these cases, learners can focus on and understand the common underlying structure in spite of the surface or contextual differences. This process differs from more typical uses of analogy in instruction in which learners are prompted to understand a new situation based on an analogy with knowledge or experience they already possess (Gentner et al., 2003). While analogies using preexisting experience can be effective, they only work if learners already possess the necessary knowledge or experience. On the other hand, analogical encoding does not require specific preexisting knowledge or experiences. In fact, Gentner et al. (2003) suggest that learners may come to understand a new concept from the comparison of two cases even if the common principle is only partially understood in either case.

Analogical encoding supports learning by focusing learners on the common structure shared by examples or cases.

According to Gentner's (1983, 1989) structure-mapping theory, drawing an analogy between two examples leads to a structural alignment – a set of correspondences between the elements of the two analogs in which their shared relational structure is highlighted. (Gentner et al. 2003, p. 394)

In this way, if learners are presented with cases with a common underlying structure and different surface or contextual details, they will focus on the common underlying structure. This underlying structure is the concept or principle being targeted as the learning outcome.

Further, since learners are focused on the common underlying structure and not the surface or contextual details, it is more likely that they will be able to retrieve these cases later when they encounter a new case with a similar structure, since they will have identified the underlying principle and idiosyncratic details in the compared cases (Gentner et al., 2003). Therefore, learners using analogical encoding ought to be better

prepared to recall and apply the learned concepts in new contexts than they are concepts and principles learned through individual cases (Gentner et al., 2003; Catrambone & Holyoak, 1989; Reeves & Weisberg, 1994; Kurtz, Mao, & Gentner, 2001).

Research on Analogical Encoding in Instruction

Analogical encoding as an instructional strategy has been investigated in a series of studies by Gentner and Thompson at Northwestern University and Loewenstein at Columbia University (Gentner et al., 2003; Gentner, Loewenstein, & Thompson, 2004; Loewenstein, Thompson, & Gentner, 1999, 2003; Thompson, Gentner, & Loewenstein, 2000).

Loewenstein et al. (1999) examined CBI using analogical encoding designed to teach and promote the application of specific negotiation strategies. The study was conducted with graduate management students who were considered experienced negotiators. The participants received written copies of two cases exemplifying the use of a particular negotiation strategy. Half the participants were asked to compare the two cases and the other half was asked questions about each case separately. One week later, the participants engaged in face-to-face negotiations and were asked to write up the results of their negotiations. The researchers found that participants who explicitly compared the cases were three times more likely to use the negotiation principle exemplified in the cases than those who examined the cases separately. Also, the researchers found that the quality of the responses from the participants who compared the cases rated significantly higher than the responses from the participants who did not compare cases.

In a second study (Thompson et al., 2000), the researchers again examined the effects of analogical encoding on students' ability to transfer a negotiation strategy from cases to a test situation. In this study, all participants read two training cases that exemplified a negotiation strategy. These training cases bore little or no surface similarity to the face-to-face negotiation. Half the participants were assigned to give written advice to the protagonist in each case separately. The other half of the participants were assigned to derive an overarching negotiation principle by comparing the two cases. As in the previous study, participants were then asked to participate in an actual face-to-face negotiation. Students in the comparison condition transferred the negotiation strategy from the cases nearly three times as often as the students in the advice condition.

In their most recent paper on analogical encoding, Gentner et al. (2003) reported on a set of three experiments. The first experiment was designed to test "whether guided analogical encoding facilitates learning and transfer for novices" (Gentner et al., 2003, p. 396). Undergraduate students were presented with written materials containing two negotiation cases. One-third of the participants were trained on a trade-off negotiation strategy, one third of the participants were trained on a contingent-contract negotiation strategy, and one third, the baseline group, received no training. The participants in the two training groups were given a definition of the key negotiation principle on which they were being trained. Then they read an example case demonstrating the negotiation principle in use. These cases came with accompanying diagrams that helped explain the principle. Then they read another case exemplifying the same principle, but in a different context and without diagrams. Finally, participants were asked to fill out a diagram for the second case, similar to the diagrams they received for the first case. After this

training, all three groups responded to a test case. They read the test case which called for a negotiation and they were asked to write a solution. The researchers found that the participants given the analogical encoding training were able to transfer the principle from the training cases to the test case almost 50% of the time while only 6% of the baseline participants used an optimal negotiation strategy (trade-off or contingent-contract strategy). These findings support the researchers claim that comparing cases helps learners understand the common underlying principle in the cases and then apply it to a novel problem.

The second experiment (Gentner et al. 2003) focused on the utility of participants actively comparing two cases versus examining the two cases separately. In this experiment, undergraduate students were placed into one of two groups. In both groups, participants were given a packet of materials containing cases exemplifying the same negotiation strategy in two different contexts. One group was given instructions to compare the two cases actively and consider their similarities. The second group was asked to consider each case separately. All participants then responded to a written test case as in the previous study. The researchers found that participants who compared the two cases were over twice as likely to transfer the principle as participants in the separate cases group, supporting their “specific claim that making comparisons promotes schema abstraction and transfer” (Gentner et al., 2003, p. 400).

The last of the three experiments (Gentner et al. 2003) combined components of the first two experiments and used a different test activity. In this study, undergraduate students were placed into one of four groups: a guided-analogy group, similar to those in Experiment 1, a compared-cases group like in Experiment 2, a separate-cases group, also

like in Experiment 2, and a baseline group that received no training. The significant change in the design of this experiment is that rather than a written test case to assess participants' ability to transfer the negotiation principle from the training cases, participants engaged in a face-to-face negotiation task. As predicted, participants in the guided-analogy group (90%) transferred the trained negotiation principle to the test activity more than the compared-cases group (70%), who transferred the principle more than the separate-cases group (55%), who used the principle more than the baseline group (37%). The researcher interpreted these results as providing further evidence of the efficacy of analogical encoding in CBI.

Through this series of studies, these researchers found evidence for the following claims:

1. People who compare contextually different cases exemplifying a particular strategy are more likely to comprehend the underlying principle than people who do not compare cases.
2. People who compare contextually different cases exemplifying a particular strategy are more likely to apply that strategy to a novel problem than people who do not compare cases.
3. People who compare contextually different cases exemplifying a particular strategy are more likely to apply an optimal strategy to a novel problem than people who do not compare cases.

Problem-solving in Instructional Design

The reviewed studies were conducted with college and graduate students studying business. This is a reasonable choice since business students are expected to develop

skills necessary to solve complex, ill-structured problems, in a seemingly infinite number of possible contexts. Jonassen (2000) describes ill-structured problems as:

the kinds of problems that are encountered more often in everyday and professional practice, so they are typically emergent. Because they are not constrained by the content domains being studied in classrooms, their solutions are not predictable or convergent. Ill-structured problems may also require the integration of several content domains. (p. 67)

Jonassen (2000) outlines a typology of problems that fall along several continua, including degree of structuredness. Among the problem types listed as ill-structured are design problems. ID is a field of study primarily focused on design problems. In discussing design problems, Goel and Pirolli (1989) acknowledge that design is “too complex an activity to be captured in a one-line definition . . .” (p. 21). As such Goel and Pirolli characterize (1989), “design” as:

a category in which a central, ideal, or prototypical case exists as well as some unpredictable but motivated variations. On this assumption, if one shows people a list of professions – for example, medicine, legal work, architecture, teaching, engineering, research – and asks them which are the best examples of design professions, they will all invariably and consistently pick the same few cases. In this list, we believe the best examples are architecture and engineering. We propose to call these “good,” “central,” or “prototypical” examples of design professions. (p. 21)

In describing prototypical design situations and design problems, Goel and Pirolli (1989) list ID among those fields that best fit this schema. Goel (1995) describe a set of characteristics shared by prototypical design problems:

1. Lack of information about the problem’s start state, goal state, and transformation function.
2. Constraints on design task environments are flexible and not rigid.
3. Design problems are generally large and complex.
4. Design problems have many parts.

5. The components are not logically interconnected, but they do have contingent interconnections between them.
6. Design problems do not have right or wrong answers, only better and worse ones.
7. The input to design problems consists of information about the end-users, their goals, and the design behavior the solution or artifact needs to facilitate in order to satisfy those goals. The output consists of the solution or artifact specification.
8. Real-world feedback on the problem-solving process is delayed, so feedback during the problem-solving process must be simulated by the designer.
9. There are costs associated with errors which can be high.
10. The artifact is required to function independently of the designer.
11. The specification of the artifact is distinct from the construction and delivery of the artifact.
12. The specification and delivery of the artifact are separated in time. (pp. 85-87)

Lawson (1997) defines and describes design problems, design solutions, and the design process as follows. Design problems 1) cannot be comprehensively stated; 2) require subjective interpretation, and 3) tend to be organized hierarchically. Design solutions 1) contain an inexhaustible number of different solutions; 2) possess no optimal solutions; 3) are often holistic responses; 4) are a contribution to knowledge; and 5) are parts of other design problems. The design process (1) is endless, (2) has no infallibly

correct process, (3) involves finding as well as solving problems, (4) inevitably involves subjective value judgment, (5) is a prescriptive activity, and (6) happens in the context of a need for action (pp. 121-127).

These descriptions by Goel (1995) and Lawson (1997) seem to be valid, if not complete and sufficient, sets of characteristics used to identify and describe ID problems and problem-solving. As such, this study posits that ID problems are design problems that reflect the characteristics and challenges shared by the larger category of design problems. There have been calls for improved methods in the instruction of ID, some of which have suggested the use of CBI (Rowland et al., 1995; Tessmer & Wedman, 1995). To date, there are few published accounts of the use of CBI in ID education (Stepich et al., 2001; Ertmer & Dillon, 1998).

ID Experience and Self-Efficacy

In an examination of the potential effectiveness of a particular instructional strategy for developing ID skills, it is important to consider other factors that contribute to the performance of instructional designers. Two such factors are ID experience and ID self-efficacy. ID experience is a straight forward concept. It stands to reason that a significant indicator of the competence and level of expertise of an instructional designer is the amount of experience the designer has had.

The construct of self-efficacy was first described by Bandura (1997) as “. . . beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments” (p. 3). Research in a variety of fields and contexts has supported the claim that self-efficacy helps explain performance (Bandura, 1986). More specifically, there is empirical evidence that teachers’ confidence in their abilities to

instruct students accounts for variability in their effectiveness (Gibson & Dembo, 1984). It seems reasonable to assume that differences in the performance of instructional designers and ID students can also be explained, in part, by their confidence in their abilities.

Statement of the Problem

Previous studies (Gentner et al., 2003; Gentner et al., 2004; Loewenstein et al., 1999, 2003; Thompson et al., 2000) have used experimental designs to examine the use of analogical encoding in CBI designed to teach negotiation skills to undergraduate and graduate business students. Each of these studies provides evidence that learners who compare cases are more likely to understand and be able to transfer the principle or strategy embedded in the cases than learners who examine the cases separately. While this series of studies represents a systematic effort to examine the efficacy of analogical encoding in CBI, the ability to generalize from these studies to other instructional contexts is limited due to the narrow scope of the content reflected in these cases and the backgrounds of the studies' participants. A study that replicates the core components of these previous studies in a different content area with participants from a different academic field would help to broaden the scope of the claims that can be made about analogical encoding as an instructional strategy.

As suggested earlier, two factors that may significantly affect task performance are experience and self-efficacy. The series of studies discussed above did not examine the influence of either factor. It would be interesting to see if learner experience or self-efficacy is responsible for any variability in the effectiveness of CBI with or without analogical encoding.

While previous studies on analogical encoding have been carefully designed to isolate the effects of case comparison, no efforts have been made to document and analyze the participants' perceptions of the training and tasks in these studies. Exploratory interviews of participants in a similar study could reveal as yet unforeseen issues and factors that contribute to the relative effectiveness of CBI among learners with varying levels of experience and self-efficacy. Such findings could inform the design of and hypotheses for future studies.

This study investigated the effectiveness of CBI with analogical encoding for the instruction of ID strategies. Participants' levels of ID experience and ID self-efficacy were measured to examine the impact of these factors on the effectiveness of this instructional strategy. A subset of participants from this study were interviewed to explore how these factors contributed to the effectiveness of the CBI in this study and to explore what other factors might have contributed to its effectiveness.

Chapter Three: Method

The literature suggests that CBI which uses analogical encoding is more effective than CBI that does not. This study used an experimental design to examine the effectiveness of analogical encoding in CBI to support the learning of an instructional design problem solving strategy. The following research questions were investigated in this study:

1. Do participants who compare cases demonstrating the same instructional design strategy perform significantly better on a task asking them to identify and describe the strategy than participants who read an individual case?
2. Do participants who compare cases demonstrating the same instructional design strategy perform significantly better on an application task asking them to apply the strategy than participants who read an individual case?
3. Does instructional design experience explain variance among participants' performance on a case-based identification task or application task?
4. Does self-efficacy explain variance among participants' performance on a case-based identification task or application task?
5. What else may help explain participants' performance on a case-based application task?

Participants

Participants in this study were undergraduate and graduate students enrolled in the school of education at a large Midwestern university. Participant gender, age, years in higher education and years of teaching experience is summarized in Table 1. While Table 1 reports the mean values for years in higher education and years taught, it is also

interesting to note the spread of this data. Of the 62 participants, 35 were in their first year of college, 15 were in their second year, five were in their third year, three were in their fourth year, and four were in their first year of graduate school, or fifth year of higher education. Of the 62 participants, 49 had no teaching experience, eight had one half to one year of experience, and five had more than one year of experience (with the most experienced subject having taught for six years).

The students were recruited from four sections of an education course focused on using computers in the classroom. Participation in this study was not a course requirement for the participants. Students were given extra points toward their final course grades as well as gift certificate for participating in the study. All participants, whether they completed the study or not, earned the equivalent of 1% of the total points available for the semester (i.e. if the particular course section has 1000 possible points for the semester, students were offered 10 points for completing the activity).

Table 1

Participant Demographic Data

| | Gender (% female) | Age (mean) | Years in higher education (mean) | Years taught (mean) |
|------------------|-------------------|------------|----------------------------------|---------------------|
| Treatment 1 | 81 | 21.3 | 1.8 | 0.9 |
| Treatment 2 | 76 | 22.0 | 1.6 | 0.1 |
| Treatment 3 | 75 | 21.5 | 2.1 | 0.2 |
| All participants | 77 | 21.6 | 1.8 | 0.4 |

Data Collection

This study was a post-test only design with nonequivalent groups (Shadish, Cook, & Campbell, 2002) that were randomly assigned. It examined and compared the effects of three different treatments on participants' ability to learn an instructional design principle and apply it in a written task. Participants were randomly and evenly distributed into three treatment groups: Compared Cases (experimental group), Case A Only (control group #1), and Case B Only (control group #2). All participants completed a unique set of training activities followed by a test activity.

In each treatment group, participants read either one or two case descriptions. These fictional cases were written by the researcher. They exemplified the use of an instructional strategy for teaching a particular concept. "A concept is a group or class of things which have something in common, such as plants, animals, reptiles, snakes, essays" (Reigeluth, 1999). According to Reigeluth (1999), the principles involved in teaching a concept are as follows:

1. Help the learner form a prototype of the concept by presenting a prototypical or common example of the concept.
2. Help the learner discriminate examples of the concept from non-examples of the concept. Showing learners sets of similar examples and non-examples of the concept, an instructor helps learners identify the critical characteristic(s) that make one item an example and another item a non-example.
3. Help the learner generalize from the prototype to all other members of the concept.

For the purpose of this study, the instructional design strategy that was demonstrated in the two training cases included in the treatment activities as follows:

When designing instruction on a concept, it is important to provide typical examples and non-examples of the concept as well as examples and non-examples that are tricky, or borderline instances that illustrate the full range of the conceptual domain and clearly illustrate the border between what would and would not be considered a member of the conceptual domain.

Compared cases treatment. The experimental group in this study is the group of participants randomly assigned to the compared cases treatment. These participants were given the study materials in a large envelope. They were instructed by the researcher to remove the sheets from the envelope, fill out the forms and work on the case activity until they had completed it, at which time they were to place the sheets back in the envelope and return it to the researcher.

The case activity included two training cases, cases A and B (Appendix A). Case A focused on a middle-school music lesson on the concept “woodwind instruments”. Case B focused on a creative writing lesson on “alliteration”. Each case described a classroom scenario in which a teacher faces an instructional challenge, followed by a description of how each teacher designs instruction to address the challenge. In each case, the teacher’s instructional solution exemplified the instructional strategy described above.

Following the training cases was a sheet (Appendix B) with the following statement:

Compare the two cases in terms of how the person in each case designed her lesson. In the space below, describe the teaching technique that was used in both cases. Put another way, explain in your own words the strategy Sheila and Gayle used in their lessons to teach the concepts “woodwind instruments” and “alliteration”.

This constitutes the study’s identification task. Responses to this statement were analyzed and used to examine the first research question regarding participants’ ability to

identify the instructional design principle by comparing two cases versus reading just one case. This was followed by the test case activity described below.

Case A only and Case B only. The two control groups in this study are the Case A Only group and the Case B Only group. The participants randomly assigned to these two groups received treatments that were similar to the compared cases treatment except the Case A Only treatment only contained Case A and the Case B Only treatment only contained Case B.

As in the compared cases treatment, the participants in these two treatment groups were handed the study materials in an envelope. The activity for the Case A Only treatment began with Case A, the woodwind instruments case (Appendix C). The activity for Case B Only treatment began with Case B, the alliteration case (Appendix D). Following the training case in each of these treatments was a sheet (Appendix E) with the following statement:

In the space below, describe the teaching technique that (Sheila or Gayle) used. Put another way, explain in your own words the strategy (Sheila or Gayle) uses in her lesson to teach the concept of (“woodwind instruments” or “alliteration”).

This constitutes the study’s identification task. Responses to this statement were analyzed and used to examine the first research question regarding participants’ ability to identify the instructional design principle by comparing two cases versus reading just one case. This was followed by the test case activity described next.

In the test activity (Appendix F) common to all treatment groups, participants were asked to read a case that describes an ID problem faced by a third grade teacher. Participants were then given the following task: “You have decided to create a lesson to help your students better understand what an automobile is. In the space below, describe

the lesson you would design on the topic ‘What an automobile is’.” This is the study’s application task. Responses to this task were used to answer the second research question.

Instructional design experience questionnaire. A questionnaire (Appendix G) was administered to participants in all three treatment groups. The primary purpose of this questionnaire was to determine participants’ instructional design experience. For the purpose of this study, instructional design experience was operationalized as each participant’s years of teaching experience. Therefore, the questionnaire asked the participants for the number of years they had taught. These data were used in a regression analysis to answer the third research question. The questionnaire also collected participants’ demographic data which will be used in future analyses.

Instructional design self-efficacy instrument. All participants completed an instrument (Appendix H) designed to measure their self-beliefs in three areas directly related to the case-based activities described above: design of instruction efficacy (scale 1, $\alpha = .90$), application efficacy (scale 2, $\alpha = .89$), and knowledge about the concept “automobiles” (scale 3, $\alpha = .89$). The design of instruction efficacy scale was intended to measure participants’ self-beliefs about their abilities to design instructional materials and lessons. The application efficacy was intended to measure participants’ self-beliefs about their abilities to take others’ instructional materials and adapt and apply them in new situations. The knowledge about the concept “automobiles” scale was intended to measure participants’ self-beliefs about their general knowledge about this concept. The items making up each scale are listed in Appendix H. Participants’ responses to the instruments’ items produce three scores – one for each scale - that measure their self-

beliefs in each of these areas. This instrument was adapted from existing self-efficacy instruments (Gibson & Dembo, 1984).

Interviews. A sub-sample of participants was interviewed three weeks after the initial paper-based data collection described above. Participants were invited to be interviewed based on their performance on the test activity. An effort was made to recruit nine participants: three from each of the treatment groups and, within each treatment group, one low performer, one mid-range performer, and one high performer. Seven participants ultimately agreed to be interviewed. Participants who agreed to be interviewed were as follows:

1. Treatment group #1: one low performer and one medium performer.
2. Treatment group #2: two medium performers.
3. Treatment group #3: one low performer, one medium performer, and one high performer.

An interview protocol (Appendix I) was used to guide these interviews. The interviewer used a funnel sequence approach, in which questions move from the general to the specific; from open-ended to close-ended. Initial questions for each interviewee were the same, but questions varied as the interview progressed, to follow the responses of the participants (Schmidt & Conaway, 1999). These semi-structured interviews were used to collect data intended to help explain why the different treatments worked as they did and to uncover unanticipated factors that help explain participants' performance on the application task. The data collected in these interviews was used to answer the fifth research question.

Data Analysis

The participants' written responses to the identification task and to the application task represent the primary data for this study.

Identification task data. All participants were asked to respond to statements after reading the training case or cases included in their treatment. Responses to these statements were intended to indicate whether or not participants learned the instructional strategy reflected in the training cases. Two independent judges, using a rubric (Appendix J) designed by the researcher, rated the participants' responses. The two independent judges were advanced instructional technology doctoral students in the same program as the researcher. The responses were rated on a 5-point scale based on participants' inclusion of four different elements in the instructional strategy they describe: typical examples and non-examples of the concept being taught as well as atypical examples and non-examples of the concept being taught. Responses receiving a score of 4 included all four elements. Responses receiving a score of 3 included three of the elements. Responses receiving a score of 2 included two of the elements. Responses receiving a score of 1 included one of the elements. Responses receiving a score of 0 included none of the elements. The judges' agreement on the scoring of the responses was 0.83, and disagreements were resolved through discussion. These scores produced interval data, suitable for a regression analysis.

Application task data. All participants were asked to respond to the following statement as part of the test case activity: "You have decided to create a lesson to help your students better understand what an automobile is. In the space below, describe the lesson you would design on the topic 'What an automobile is'". The participants'

solutions are intended to indicate whether or not participants are able to apply the instructional design principle reflected in the training cases to a test case. Two independent judges, using a rubric (Appendix K) designed by the researcher, rated the participants' solutions. The two independent judges (same as the two judges described above) were advanced instructional technology doctoral students in the same program as the researcher. The responses were rated on a 5-point scale based on participants' inclusion of four different elements in the instructional solution they describe: typical examples and non-examples of the concept being taught (what is an automobile) as well as atypical examples and non-examples of the concept being taught. Responses receiving a score of 4 include all four elements. Responses receiving a score of 3 include three of the elements. Responses receiving a score of 2 include two of the elements. Responses receiving a score of 1 include one of the elements. Responses receiving a score of 0 include none of the elements. The judges' agreement on the scoring of the responses was 0.87, and disagreements were resolved through discussion. These scores produced interval data, suitable for a regression analysis.

Testing research question #1. The first research question is as follows: Do participants who compare cases demonstrating the same instructional design strategy perform significantly better on a task asking them to identify and describe the strategy significantly better than participants who read an individual case? The null hypothesis for research question #1 is as follows: Participants who compare cases demonstrating the same instructional design strategy do not perform significantly better on a task asking them to identify and describe the strategy than participants who read an individual case.

To test this null hypothesis, a regression analysis was performed on the Instructional Strategy Response Data.

Testing research question #2. The second research question is as follows: Do participants who compare cases demonstrating the same instructional design strategy perform significantly better on an application task asking them to apply the strategy than participants who read an individual case? The null hypothesis for research question #2 is as follows: Participants who compare cases demonstrating the same instructional design strategy do not perform significantly better on an application task asking them to apply the strategy than participants who read an individual case.

To test this null hypothesis, a regression analysis was performed on the Application Task Data.

Testing research question #3. The third research question is as follows: Does instructional design experience explain variance among participants' performance on a case-based identification task or application task? The null hypothesis for research question #3 is as follows: Instructional design experience does not explain variance among participants' performance on a case-based identification task or application task.

To test this null hypothesis, regression analysis was used to test for interactions between the participants' performance in each of the treatment groups' test activities and the participants' ID experience scores.

Testing research question #4. The fourth research question is as follows: Does self-efficacy explain variance among participants' performance on a case-based identification task or application task? The null hypothesis for research question #4 is as

follows: Self-efficacy does not explain variance among participants' performance on a case-based identification task or application task.

To test this null hypothesis, regression analysis was used to test for interactions between the participants' performance in each of the treatment groups and the participants' self-efficacy scores.

Testing research question #5. The fifth research question is as follows: What else may help explain participants' performance on a case-based application task? This is an open-ended exploratory question and, as such, there is no associated null hypothesis.

As explained in the Data Collection section, semi-structured interviews were conducted with seven participants. The interviewer used a self-designed instrument with a series of questions to guide the interviews. These interviews were tape recorded and typed transcriptions were produced for each interview. The transcripts were analyzed for emergent themes related to this research question. This analysis was done using an inductive approach. Themes emerged through a constant-comparative analysis of the data (Bogdan & Biklen, 2003; Strauss & Corbin, 1998). The researcher moved from reading the data, to in vivo coding, and then to organizing codes into themes and categories. Only naturalistic generalizations were possible from the qualitative analysis of these interviews.

Chapter Four: Findings

Research Questions #1-4

Descriptive statistics and correlation coefficients for the variables used in this study are presented in Table 2. Participants' performance on the identification task was positively correlated with their performance on the application task ($r=.50, p<.01$). Instructional design experience did not significantly correlate with either task score. The only efficacy score to correlate significantly with either task score was application efficacy which was negatively correlated with participants' identification task scores ($r=-.38, p<.01$).

Table 2

Means, Standard Deviations, and Pearson Correlations

| Variable | <i>M</i> | <i>SD</i> | 1 | 2 | 3 | 4 | 5 | 6 |
|--|----------|-----------|-----|-------|------|------|--------|------|
| 1. Identification task score (0-4; low-high) | 1.95 | 1.21 | --- | .50** | -.08 | -.18 | -.38** | -.22 |
| 2. Application task score (0-4; low-high) | 1.50 | .82 | | --- | .03 | -.04 | -.21 | -.03 |
| 3. Instructional design experience (years) | .40 | 1.10 | | | --- | .04 | .23 | .13 |
| 4. Instructional design efficacy (1-5; low-high) | 3.35 | .79 | | | | --- | .58** | .32* |
| 5. Application efficacy (1-5; low-high) | 3.26 | .84 | | | | | --- | .30* |
| 6. Perceived domain knowledge (1-5; low-high) | 2.77 | .99 | | | | | | --- |

Note. $N=62$

**Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Hierarchical regression was used to examine the research questions of the study. In the first step, the influence of assignment to treatment group on performance was examined. Specifically, step 1 examined whether participants who compared cases

performed better on the identification task (research question #1) and on the application task (research question #2) than did participants who read only one case. The treatment group variable was a dummy coded variable (the compared cases treatment was coded as treatment = 0 and compared to the case A only treatment = 1 and to the case B only treatment = 2). In step 2, regression analysis was used to examine the influence of instructional design experience (research question #3) and efficacy (research question #4) on the application task (after controlling for treatment group). Results of the hierarchical regression analyses are presented in Table 3.

Table 3

Summary of Hierarchical Regression Analysis

| Variable | Identification Task | | | | | Application Task | | | | |
|---------------------------------|---------------------|------|---------|--------------|------|------------------|------|---------|--------------|------|
| | B | SE B | β | R^2 | p | B | SE B | β | R^2 | p |
| Step 1 | | | | .053 | .203 | | | | .021 | .527 |
| Case A only | .09 | .37 | .04 | | .809 | -.03 | .26 | -.02 | | .913 |
| Case B only | -.53 | .37 | -.21 | | .162 | -.27 | .26 | -.15 | | .308 |
| | | | | $R^2 \Delta$ | | | | | $R^2 \Delta$ | |
| Step 2 | | | | .176 | .022 | | | | .056 | .596 |
| Case A only | .20 | .37 | .08 | | .585 | -.01 | .28 | -.01 | | .976 |
| Case B only | -.55 | .37 | -.22 | | .141 | -.24 | .28 | -.14 | | .389 |
| Instructional design experience | -.06 | .14 | -.05 | | .700 | .05 | .11 | .06 | | .657 |
| Instructional design efficacy | .02 | .24 | .02 | | .921 | .08 | .18 | .07 | | .670 |
| Application efficacy | -.54 | .22 | -.38 | | .018 | -.28 | .16 | -.29 | | .095 |
| Perceived domain knowledge | -.12 | .16 | -.10 | | .449 | .03 | .12 | .03 | | .846 |

Note. Treatment group was dummy coded: (0 = compared both cases)

Regression results for identification task score. Treatment type (research question #1), entered in step one of the regression model, explained 5.3 percent of the variance but was not found to be a significant predictor of participants' identification task scores [$F(2,59)=1.64$ and $p=.203$]. Specifically, no significant difference was found between the participants who compared the two cases and the participants who read only case A

($\beta=.04, p=.809$) or case B ($\beta=-.21, p=.162$). Analogical encoding was no more effective than reading only the woodwind instrument case in helping participants identify the demonstrated instructional strategy and it was no more effective than reading only the alliteration case in doing the same.

In step 2 of the model years of instructional design experience (research question #3) and self-beliefs (research question #4) were entered into the model. These variables increased the amount of variance explained in the identification score by 18 percent, [$F(4,55)=3.127, p=.022$].

Years of instructional design experience did not serve as a significant predictor ($\beta=.08, p=.585$) nor did instructional design efficacy ($\beta=.02, p=.921$) or perceived domain knowledge ($\beta=-.10, p=.449$). However, application efficacy was found to be a significant negative predictor ($\beta=-.38, p=.018$). This means that participants who perceived themselves as being able to adapt and apply existing instructional materials in new situations did less well than students who did not hold these beliefs.

Regression results for application task score. Treatment type (research question #1), entered in step one of the regression model, explained 2.1 percent of the variance but was not found to be a significant predictor of participants' application task scores [$F(2,59)=.65$ and $p=.527$]. Specifically, no significant difference was found between the participants who compared the two cases and the participants who read only case A ($\beta=-.02, p=.913$) or case B ($\beta=-.15, p=.308$). Analogical encoding was no more effective than reading only the woodwind instrument case in helping participants apply the demonstrated instructional strategy and it was no more effective than reading only the alliteration case in doing the same.

In step 2 of the model years of instructional design experience (research question #3) and self-beliefs (research question #4) were entered into the model. These variables increased the amount of variance explained in the application score by 6 percent, [$F(4,55)=.837, p=.508$].

Years of instructional design experience did not serve as a significant predictor ($\beta=.06, p=.657$) nor did instructional design efficacy ($\beta=.07, p=.670$) or application efficacy ($\beta=-.29, p=.095$) or perceived domain knowledge ($\beta=.03, p=.846$).

Research Question #5

The fifth research question asks the following: What else may help explain how participants' perform on a case-based application task? To answer this question, seven of the 62 participants were selected and interviewed. Interviewees were selected based on their treatment group and their performance on the test case activity. An effort was made to interview nine total participants: three participants from each treatment group, one Low performer (received a score of 0 or 1 on the test case activity), one Medium performer (received a score of 2 on the test case activity), and one High performer (received a score of 3 or 4 on the test case activity). Participants who agreed to be interviewed were as follows:

1. Treatment group #1: one low performer, one medium performer
2. Treatment group #2: two medium performers
3. Treatment group #3: one low performer, one medium performer, one high performer

As described in chapter three, interviews were guided by an instrument with a series of questions. Interviews were tape recorded and typed transcriptions were produced for each

interview. The transcripts were analyzed for emergent themes related to the research question. This analysis was done using an inductive approach. Themes emerged through a constant-comparative analysis of the data (Bogdan & Biklen, 2003; Strauss & Corbin, 1998). The researcher moved from reading the data, to in vivo coding, and then to organizing codes into themes and categories. The primary themes that emerged from the interview data are presented next.

Interviewees were asked how they developed their responses to the test case problem. In working to solve the test case problem, five interviewees primarily drew upon their own experiences as a K-12 or college student: a low-performer and a medium-performer from the alliteration only treatment, two medium-performers from the woodwind instrument only treatment, and a low-performer from the compared-cases treatment. Conversely, two interviewees modeled their solution on the instructional strategy modeled in the training case(s): a medium-performer and a high-performer from the compared-cases treatment. The only two interviewees to report modeling their solutions on the training cases were participants who read and compared both cases.

Interviewees were asked what they thought they were expected to do in the test case activity. Three interviewees felt that they were expected to apply the instructional strategy modeled in the training case(s): a low-performer and a medium-performer from the alliteration only treatment and a medium performer from the compared-cases treatment. Four other interviewees did not think they were expected to apply that instructional strategy: two medium-performers from the woodwind instruments only treatment, and a low-performer and a high-performer from the compared-cases treatment. These results do not seem to complement the data from the first theme above. While the

only two participants who modeled their solutions on the training cases were those who compared cases, according to this self-report data four of the interviewees felt they were expected to so, yet only one was a participant who compared cases. Interestingly, it was the same high-performing participant from the compared-cases treatment who both felt that s/he was expected to apply the training cases to the test case activity and reported that s/he actually did so. There is some disjuncture among the other interviewees who reported being expected to apply the training cases and yet reported not doing so.

Interviewees were asked what they thought the teaching strategy was that was exemplified in the training case(s). Four interviewees described a strategy that utilizes examples and non-examples (an accurate reflection of the strategy modeled): a medium-performer from the alliteration only treatment, a medium-performer from the woodwind instruments only treatment, and a medium-performer and a high-performer in the compared-cases treatment. Three interviewees described some other instructional strategy: a low-performer from the alliteration only treatment, a medium-performer from the woodwind instruments only treatment and a low-performer from the compared-cases treatment. None of the low-performers described the correct strategy, nor did one of the medium-performers.

Interviewees were asked if they saw any similarities between the training case(s) and the test case problem. All of the interviewees saw similarities, though these perceived similarities varied. A low-performer from the alliteration only treatment said the cases all demonstrated the use of repetition. Two medium-performers from the woodwind instruments only treatment said the cases used comparisons of examples and non-examples of the concept being taught. A medium-performer from the compared-cases

treatment said the cases were all about a “specific thing”. Three interviewees said the cases demonstrated the teaching of a concept and its characteristics: a medium-performer from the alliteration only treatment, and a low-performer and a high-performer from the compared-cases treatment.

Interviewees were asked if anything in the classroom at the time of their data collection session affected their performance on the tasks. One low-performer and three medium-performers reported that they did not feel that any external factors affected their performance on the tasks. However, two medium-performers and one high-performer reported that they felt rushed because there was a collegiate basketball game that evening that they wanted to get to as soon as possible. One these interviewees who felt rushed reported that other participants in the room also felt rushed because of the upcoming game they planned to attend.

Interviewees were finally asked if they thought they learned anything from the application tasks. A low-performer and medium-performer from the alliteration only treatment and a medium-performer from the woodwind instrument only treatment reported that they did not learn anything from the tasks. A medium-performer and a high-performer from the woodwind instrument only treatment reported that they learned about the design of lesson plans. A medium-performer from the woodwind instrument only treatment explained that the case and the tasks were a good way to be exposed to a teaching technique that an actual teacher would use. A medium-performer from the alliteration only treatment said that she probably learned something, but all she could think of was that she learned about the concept of “alliteration”.

Chapter Five: Discussion and Conclusions

Research Question (#1-4) Conclusions

The following conclusions are drawn for each of the first four research questions:

1. Participants who compared two cases that demonstrated the same instructional design strategy did not perform significantly better than participants who read an individual case on a task in which they were asked to identify the instructional strategy and describe it in writing.
2. Participants who compared two cases that demonstrated the same instructional design strategy did not perform significantly better than participants who read an individual case on an application task in which they were asked to solve an instructional design problem similar to those in the two cases.
3. Instructional design experience did not predict participants' performance on a case-based identification task or application task.
4. Self-efficacy beliefs did not predict participants' performance on a case-based application task. Neither instructional design efficacy nor perceived domain knowledge predicted participants' performance on a case-based identification task, but application efficacy was found to be a significant negative predictor.

The mostly non-significant findings for research questions #3 and #4 were not surprising given the non-significant findings for research questions #1 and #2. One would not expect to find that potentially mediating factors like experience and self-efficacy significantly explain the variance on subjects' performance on the case-based tasks when there was not a significant amount of variance in subjects' performance across treatments.

Application Efficacy as a Negative Predictor of Instructional Design Strategy

Identification

Interestingly, one factor was found to be a statistically significant predictor of participant performance on the identification task. As reported in the previous chapter, application efficacy was found to be significant negative predictor ($\beta = -.38$, $p = .018$). This means that participants who perceived themselves as being able to take others' instructional materials and adapt and apply them in new situations did less well than students who did not hold these beliefs.

Finding that students are more confident in their abilities than their actual performance indicates has been previously documented in the literature on perceived self-confidence (Dunning, Heath, & Suls, 2004). Dunning et al. (2004) explain in their review of the literature on flawed self-assessments that decades of research in various domains have shown that "people tend to be too optimistic about their talents, expertise, and future prospects" (p. 71). In particular, they (Dunning et al., 2004) cite several studies that indicate that students tend to overestimate their abilities, overestimate the likelihood of desirable effects, and overestimate how easily they will be able to complete tasks. These findings documented in the literature on flawed self-assessment are inline with the finding in the present study that the participants overestimated their ability to adapt and apply instructional materials to new situations.

In their review of the literature on flawed self-assessment, Dunning et al. (2004) suggest some strategies that can help students improve their self-assessment and, ultimately, their academic achievement. One of these strategies in particular, having students review their own past performance (Dunning et al., 2004), may hold promise for

improving the effectiveness of case-based instruction focused on the development of ID skills. Students with limited ID experience can be given case-based activities which will indicate how proficient they actually are (or are not) in understanding and applying a particular strategy or set of strategies. These early activities could be treated as a pre-test. Having students reflect on their performance may help them more accurately assess their baseline competencies and give them and their instructors an indication of how much they need to continue to work on and practice their ID problem-solving skills.

Comparing Present Study with the Negotiation Studies

The non-significant findings for the first and second research questions are surprising. The present study in part replicated the negotiation CBI studies conducted by Dedre Gentner, Leigh Thompson, and Jeffrey Loewenstein (Gentner et al., 2003; Gentner, Loewenstein, & Thompson, 2004; Loewenstein, Thompson, & Gentner, 1999, 2003; Thompson, Gentner, & Loewenstein, 2000). As described in the review of these studies, Gentner, Thompson, and Loewenstein repeatedly found that participants who compared cases out-performed participants who did not compare cases on application tasks similar to those included in the present study. What, then, can account for the discrepancy between their significant findings and the non-significant findings in the present study?

Logically, it makes sense to identify any differences between the series of negotiation studies conducted by Gentner et al. and the present study and to consider what the available evidence has to say about these differences. There are four key differences between Gentner et al.'s studies and the present study. First, the negotiation studies revolved around cases that demonstrated a business negotiation strategy. The

present study revolved around cases that demonstrated an instructional design strategy. Second, the negotiation studies included participants who were largely graduate students majoring in business. The current study included participants who were largely first- and second-year undergraduate students majoring in education. These first two differences – different problem context and different participant profile – were reasons why the study was conducted. This study is, in part, intended to look at the efficacy of CBI with analogical encoding beyond the business-related context in which it had been predominantly examined. Third, in some of the negotiation studies, participants were given supplementary information or instruction about the negotiation strategy exemplified in the training cases. Participants in the present study were given no supplementary information about the instructional design strategy exemplified in the training cases. This is a difference in pedagogical approach that could have a significant impact on the efficacy of CBI as an instructional strategy. The negotiation study researchers did not vary the amount of supplementary information in the different treatments in their studies, making it impossible to know if it was a significant predictor of (and potential contributor to) participant performance.

Implications

Following are some possible explanations for the findings from this study. These explanations are based on the analysis of the participant data and interviews and the differences identified between this study and the negotiation studies upon which the present study was modeled, as well as on the relevant literature.

Degree of problem structure. One of the differences between the negotiation studies and the present study is the content of cases used in the studies. The negotiation

studies revolve around cases that demonstrate a negotiation strategy called “contingent contract” (Gentner et al., 2003). In this strategy, “when parties disagree on an important future issue, a contingent contract – a bet or wager based on the result of the future event (is used)” (Gentner et al., 2003, p. 395). A short summary of one of the training cases used in one their studies is provided in the following paragraph as an example.

An American company has ordered parts from a Chinese company. The Chinese company wants to send the parts by boat, but the American company, worried about how long that will take, wants the parts to be delivered by airmail. The Chinese company refused due to the extra expense of airmail. The two sides eventually agreed on a contingent contract: the Chinese company would ship the parts by airmail. Meanwhile, both companies will watch the boat the parts would have been shipped on to see when it arrives in the United States. If the boat arrives early, the American company will pay for the added expense of the airmail. If the boat arrives late, the Chinese company will pay the added expense (Gentner et al., 2003).

The test case that the participants in the negotiation studies must solve is similar to the case described above: two sides need to come to some monetary agreement in the face of differing beliefs about future events. The researchers for these studies designed their test case activity “such that three solutions could be formed: a (suboptimal) compromise solution . . . a trade-off solution, or a contingent-contract solution” (Gentner et al., 2003, p. 396). It seems the researchers were able to limit the range of participant solutions due to the nature and structure of these negotiation problems. By limiting the range of solutions, the researchers increased the level of structuredness of their problems. According to Jonassen’s (2004) typology of kinds of problems, the problems used in the negotiation studies might be characterized as “story problems” or “decision making problems”. In story problems, one must “disambiguate variables; select and apply algorithm to produce correct answers using prescribed method” (Jonassen, 2004 p. 8). In decision making problems, one must identify “benefits and limitations; (weigh) options”

(Jonassen, 2004, p. 8). Both of these kinds of problems are described as being well-defined or containing finite outcomes.

Conversely, the instructional design problem demonstrated in the present study would best be characterized in Jonassen's (2004) typology as a "design" problem. Problem-solving for these kinds of problems is characterized by "acting on goals to produce an artifact; problem structuring and articulation" (p. 9). Design problems are described as ill-structured. According to Jonassen (2004), "Ill-structured problems tend to be more complex, especially those emerging from everyday practice. Most well-structured problems tend to be less complex" (p. 5). If it is true that the kind of problem and problem-solving demonstrated in the cases and the test-case activity are more complex and less structured than those demonstrated in the cases and the test-case activity in the negotiation studies, then this could account for the unanticipated range of responses within the treatment groups.

The test-case activity in the present study was not designed to limit the number of solutions that could be formed by the participants. The instructional design solution demonstrated in the training cases would have been a good solution had it been applied, but many other instructional solutions were also possible, limited only by each participant's creativity. Therefore, the degree of structuredness of the problem type being taught through case-based or any other type of instruction may require different pedagogical considerations that account for the range of possible solutions that learners may develop or choose. For instance, a teacher may decide to work through a few problems aloud with her students, providing guidance that helps to steer them toward appropriate solutions, thus narrowing the range of possible solutions from which the

students could choose. It would be interesting to design a study in which participants receive CBI similar to that in this study, but are given one of two activities that differ in the range of possible solutions to see how this affects task performance. In such a study, one group may be given an open-ended response task while another is given a set of answers from which to choose, thus limiting the range of their potential responses.

Lack of coupled direct instruction. Another difference is the presence of supplementary information about the strategy exemplified in the training cases in some of the negotiation studies as opposed to the present study, which did not provide any supplementary information. In the negotiation studies that included supplementary information, the training cases were accompanied by diagrams that helped to explain the negotiation strategy exemplified in the cases. Given the seemingly higher degree of ill-structuredness and complexity of the problem solving strategy exemplified in the cases in the present study as compared to those in the negotiation studies, perhaps coupling the cases with some supplementary information that directly instructs the participants on the instructional design strategy would have helped their performance on the tasks. In other words, CBI without direct instruction may not be as effective as CBI with direct instruction.

Bransford, Brown, and Cocking (2000) note that “a number of studies converge on the conclusion that transfer is enhanced by helping students see potential transfer implications of what they are learning” (p. 60). They also explain that “without specific guidance from teachers, students may fail to connect everyday knowledge to subjects taught in school” (Bransford et al., 2000 p. 69). In other words, they make the argument that learners often need direct explanations about what they are learning and how they

can apply it. The activity in the present study asked the participants simply to read (or read and compare) the cases and then perform a few tasks. Direct instruction or explanation about the instructional design strategy was not included because this would make it difficult to determine to what degree the direct instruction or the cases or some combination thereof contributed to the participants' performance. It would be interesting to design a similar study in which participants receive CBI similar to that in this study, except one group gets supplementary direct instruction and the other group does not to see how this affects task performance.

Participant preconceptions. A key finding that came out of the participant interviews was that a majority of those interviewed reported that they drew on their own experiences as a K-12 or college student to develop an instructional approach for the application task. It is possible that participants drawing on their own experiences instead of on the training case or cases they had just read could account for the range of responses among the participants' within treatment groups.

Bransford et al. (2000) cite student preconceptions as one of the key findings from recent educational research that can help educators better serve their students. "Students come to the classroom with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information that are taught, or they may learn them for purposes of a test, but revert to their preconceptions outside the classroom" (p. 14-15).

To deal with students' preconceptions, Bransford et al. (2000) suggest that "Teachers must draw out and work with the preexisting understandings that their students bring with them" (p. 19). If this is true, it is possible that participants' preconceptions

about the design of instruction from their own educational experiences may have been a significant limiting factor in their ability to apply the strategy exemplified in the training case(s) to the application task. Perhaps instructional strategies that help learners to surface and reflect on their preconceptions regarding the design of instruction could improve the efficacy of CBI similar to that modeled in the present study. It would be interesting to design a similar study in which participants receive CBI similar to that in this study, except one group participates in an initial activity that helps them to think about and consider their relevant preconceptions related to the design of instruction.

Practical application of implications. How might these implications be applied in the actual practice of designing instruction?

If it is true that degree of problem of structure affects the efficacy of CBI and that ill-structured problem-solving strategies are more challenging to develop, instructional designers may need to consider varying pedagogical techniques. Instructional designers may scaffold learners' efforts by practicing ill-structured problem-solving by intentionally limiting the range of solutions possible or designers may develop simplified versions of these problems that are less complex and afford a smaller range of potential solutions.

Another strategy for scaffolding learners' efforts is for instructional designers to couple CBI with direct instruction. Over time, learners could be given less direct instructional support and expected to increasingly draw on their previous learning and experience to solve ill-structured problems.

Instructional designers may also want to explore the previous experiences and preconceptions learners have related to the particular problem-type being explored.

Learners can be asked to share aloud or write about how they think such problems ought to be addressed or how they have handled such problems in their own experiences. An instructor or teacher could then guide learners in reflecting on how their experiences and preconceptions may or may not contribute to successful problem-solving strategies.

Cases could then be used to illustrate and reinforce these discussions.

Limitations

The following are limitations related to the overall validity, reliability, and generalizability of the results in this study.

One limitation is related to the homogeneity of participants. The vast majority of participants were first or second year undergraduate females (average years in college = 1.8; 77% female). Such homogeneity can limit the degree to which this study's results can be generalized to a larger, less homogenous population.

A second limitation is related to participants' behavior during the activities of the designed experiment. Some of the subjects who were interviewed reported that they and some of their classmates may have rushed through the activities because of a desire to leave school and go home or to other activities, such as that night's basketball game.

A third limitation is related to the design of the activities of the designed experiment. The case-based tasks that the participants completed were not situated within the context of a larger educational lesson or curriculum. They also were not presented in what could be considered a realistic educational setting; rather, efforts were made control for as many external contextual factors as possible. These efforts were intended to increase the ability to generalize the findings from this study to a larger, context independent population. However, the tradeoff for these efforts may be difficulty

knowing how the results of this study can be fruitfully applied in a realistic, context-rich environment.

A fourth limitation is related to the low variability in the participants' scores on the identification task and the application task. This could be due to the limited range of possible scores built into the scoring rubrics for these data sets. It is possible that more sensitive scoring rubrics designed to account for greater ranges of participants' responses would have resulted in higher variability of scores which could have yielded statistically significant findings. These more sensitive rubrics would make finer distinctions among the ranges of participant responses to the identification and application tasks. It is not immediately clear what these finer distinctions would be.

A fifth limitation is related to participant motivation during the data collection sessions. As reported in chapter four, some participants may have felt rushed while completing this study's tasks due to a collegiate basketball game they intended to attend later that evening. This may have led to some participants not putting forth their best efforts which could explain some of the lower participant scores on the identification task and the application task

A final limitation is related to the overall methodological approach employed by this study. To generate findings and conclusions that will generalize to the largest population possible, this study was constructed as a designed experiment that sought to hold constant as many contextual and other potentially confounding variables as possible. This is why the case-based activity in this study was not a complete lesson that this researcher would encourage educators to use in their actual learning environments. The problem with the approach taken is that educational and instructional activities are, by

their nature, inseparable from social life and the complexities of social and environmental variables involved in people's lives. Berliner (2002) refers to this as "The Ubiquity of Interactions", explaining:

Any teaching behavior interacts with a number of student characteristics, including IQ, socioeconomic status, motivation to learn, and a host of other factors. Simultaneously, student behavior is interacting with teacher characteristics, such as the teacher's training in the subject taught, conceptions of learning, beliefs about assessment, and even the teacher's personal happiness with life. But it doesn't end there because other variables interact with those just mentioned - the curriculum materials, the socioeconomic status of the community, peer effects in the school, youth employment in the area, and so forth. Moreover, we are not even sure in which directions the influences work, and many surely are reciprocal. (Berliner, 2002, p. 19)

If all educational and instructional activities are bound up in the complexity of myriad social and environmental variables, what is the place for designed experiments in the study of instructional design? Ideally, a balance ought to be struck between research like the present study that aims to produce context-independent, highly generalizable findings and research that keeps intact the social and environmental complexities of learning environments. One such approach is design-based research. "Design-based research is an emerging paradigm for the study of learning in context through the systematic design and study of instructional strategies and tool" (The Design-Based Research Collective, 2003, p. 5). One can imagine a research agenda in which an instructional theory is put into practice and examined through context-rich design-based research. The local findings from such a study, limited in the degree to which they can be generalized to larger populations, could then be tested in a more context-independent designed experiment to see if the phenomena observed in the design-based research study hold true on a larger scale. Findings from this study could then be cycled back into another iteration of the instruction theory in practice and examined by design-based

research and so on. This kind of research cycle, alternating between context-rich design-based research and context-independent designed experiments could be a good way to extend the findings from the present study.

Future Research

Ideas for three potential future studies are drawn from the implications section above. These studies would extend and help to clarify the findings from this study. The first study would examine the degree to which problem structuredness affects the efficacy of CBI and would inform decisions regarding when CBI is or is not an appropriate instructional strategy. In this study participants would receive CBI similar to that in this study, but they would then participate in one of two activities that are designed to differ in the range of possible solutions to see how this affects task performance. Findings from such a study may help instructional designers and teachers make informed decisions about how best to teach problem-solving strategies, based on the type or types of problems being addressed.

The second study would examine the degree to which supplementary instruction or information affects the efficacy of CBI and would inform decisions regarding how best to design CBI so it can be most effective. In this study, participants would receive CBI similar to that in this study, except one group gets supplementary direct instruction and the other group does not, to see how this affects task performance. Findings from such a study may help instructional designers and teachers make design decisions if they have decided to use a case-based approach in their instruction.

The third study would examine the degree to which supporting learners' in examining their preconceptions affects the efficacy of CBI and would inform decisions

regarding how best to design CBI so it can be most effective. In this study participants would receive CBI similar to that in this study, except one group participates in an initial activity that helps them to think about and consider their relevant preconceptions related to the design of instruction. Findings from such a study may encourage instructional designers and teachers to consider the power of their learners' preconceptions and find ways to help learners confront and overcome them, potentially removing a obstacle to effective learning.

In addition to these potential studies, more research needs to be done on CBI in general and CBI using analogical encoding in particular on different populations and in different contexts to increase educators' ability to make decisions regarding the appropriateness of these pedagogical strategies for their particular situations. Different populations could include (among others) learners in different professional or pre-professional fields, learners with different levels of expertise, learners from different cultural or national backgrounds, or learners of different ages.

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Appendix A: Compared Cases Treatment - Training Cases

Instructions: Read the two following cases. Focus on the teaching technique used by the person in each case. Look for similarities in the teaching technique used in the two cases.

Case Example #1

Sheila is a middle-school music teacher. She is teaching an introductory unit on different kinds of musical instruments and has just started to cover woodwind instruments. Having taught this unit the previous year, she knows that the topic “woodwind instruments” can be challenging for her students. Most students assume from their name that all woodwind instruments are made from wood. In fact, woodwind instruments do not need to be made of wood. Woodwind instruments are those instruments that require a person to blow into a single reed, a double reed, or an opening over which air is blown.

Since this can be tricky, Sheila devised a careful strategy to help make sure her students will be able to figure out which instruments are and which are not woodwinds. She gave every student a handout with the following information:

Woodwind Instruments

Woodwind instruments are instruments that, in order to make sound, use a single reed (like a clarinet or saxophone), two reeds (like a bassoon), or an opening over which air is blown (like a flute). A reed is a flexible strip of cane (usually made of bamboo) in the mouthpiece or opening of certain instruments that vibrates, producing sound.

The way an instrument makes sound is what makes an instrument a woodwind or some other kind of instrument. The material the instrument is made of does not matter.

Examples of woodwind instruments that are made of wood include the following:

- Clarinet (single reed)
- Bassoon (double reed)
- Oboe (double reed)
- Wooden flute (opening over which air is blown)

Examples of non-woodwind instruments, not made of wood, include the following:

- Trumpet (mouthpiece that is vibrated with the lips)
- Tuba (mouthpiece that is vibrated with the lips)
- Trombone (mouthpiece that is vibrated with the lips)

An example of a woodwind instrument that is made of metal, not wood, is:

- Saxophone (single reed)

An example a non-woodwind instrument that is made of wood, is:

- Cornetto (mouthpiece that is vibrated with the lips)

Reminder: Continue to focus on the teaching technique used by the person in each case. Continue to look for similarities in the teaching technique used in the two cases.

Case Example #2

Gayle is a creative writing teacher. She is spending several weeks teaching her students about poetry. Today, she is introducing her students to a technique called “alliteration”. Alliteration is the repetition of the initial sound of a word in two or more adjacent words. An example is “beautiful blue balloons”. In the past, she has found that some students find this concept confusing. When asked to write a sentence using alliteration, they sometimes use words that have the same initial letter, but not the same sound. They also often do not comprehend that you can use two or more words with different initial letters, but with the same initial sound and this is alliteration. In an effort to make the concept of “alliteration” as clear as possible from the beginning, Gayle wrote the following on the board in the front of the classroom:

Alliteration

Alliteration is the repetition of the initial sound of a word in two or more adjacent words. It does not matter whether or not the words have the same initial letter – it is the repetition of the initial sound that creates alliteration.

Here are a few typical examples of alliteration:

- Picking prickly pears (repeats the “puh” sound)
- Stealthily stalking (repeats the “stuh” sound)

Here are a few non-examples of alliteration:

- Fancy red car (the initial sounds are different)
- Drying blue drapes (the “druh” sound is repeated in two words, but they are not adjacent)

Here are a few examples of alliteration that may seem tricky:

- Finding phony factors (even though the initial letters are different, they repeat the initial “fuh” sound)
- Similar seasonal cycles (even though the initial letters are different, they repeat the initial “s” sound)

Here are a few non-examples of alliteration that may seem tricky:

- Cold cider cups (even though the initial letters are the same, initial sounds are different)
- Planning psychology practice (even though the initial letters are the same, initial sounds are different)

Appendix B: Compared Cases Treatment - Comprehension Question

Question

Compare the two cases in terms of how the person in each case designed her lesson. **In the space below**, describe the teaching technique that was used in both cases. Put another way, explain in your own words the strategy Sheila and Gayle used in their lessons to teach the concepts “woodwind instruments” and “alliteration”.

Appendix C: Case A Only Treatment - Training Case

Instructions: Read the following case. Focus on the teaching technique used by Sheila in the case.

Case Example

Sheila is a middle-school music teacher. She is teaching an introductory unit on different kinds of musical instruments and has just started to cover woodwind instruments. Having taught this unit the previous year, she knows that the topic “woodwind instruments” can be challenging for her students. Most students assume from their name that all woodwind instruments are made from wood. In fact, woodwind instruments do not need to be made of wood. Woodwind instruments are those instruments that require a person to blow into a single reed, a double reed, or an opening over which air is blown.

Since this can be tricky, Sheila devised a careful strategy to help make sure her students will be able to figure out which instruments are and which are not woodwinds. She gave every student a handout with the following information:

Woodwind Instruments

Woodwind instruments are instruments that, in order to make sound, use a single reed (like a clarinet or saxophone), two reeds (like a bassoon), or an opening over which air is blown (like a flute). A reed is a flexible strip of cane (usually made of bamboo) in the mouthpiece or opening of certain instruments that vibrates, producing sound.

The way an instrument makes sound is what makes an instrument a woodwind or some other kind of instrument. The material the instrument is made of does not matter.

Examples of woodwind instruments that are made of wood include the following:

- Clarinet (single reed)
- Bassoon (double reed)
- Oboe (double reed)
- Wooden flute (opening over which air is blown)

Examples of non-woodwind instruments, not made of wood, include the following:

- Trumpet (mouthpiece that is vibrated with the lips)
- Tuba (mouthpiece that is vibrated with the lips)
- Trombone (mouthpiece that is vibrated with the lips)

An example of a woodwind instrument that is made of metal, not wood, is:

- Saxophone (single reed)

An example a non-woodwind instrument that is made of wood, is:

- Cornetto (mouthpiece that is vibrated with the lips)

Appendix D: Case B Only Treatment - Training Case

Instructions: Read the following case. Focus on the teaching technique used by Gayle in the case.

Case Example

Gayle is a creative writing teacher. She is spending several weeks teaching her students about poetry. Today, she is introducing her students to a technique called “alliteration”. Alliteration is the repetition of the initial sound of a word in two or more adjacent words. An example is “beautiful blue balloons”. In the past, she has found that some students find this concept confusing. When asked to write a sentence using alliteration, they sometimes use words that have the same initial letter, but not the same sound. They also often do not comprehend that you can use two or more words with different initial letters, but with the same initial sound and this is alliteration. In an effort to make the concept of “alliteration” as clear as possible from the beginning, Gayle wrote the following on the board in the front of the classroom:

Alliteration

Alliteration is the repetition of the initial sound of a word in two or more adjacent words. It does not matter whether or not the words have the same initial letter – it is the repetition of the initial sound that creates alliteration.

Here are a few typical examples of alliteration:

- Picking prickly pears (repeats the “puh” sound)
- Stealthily stalking (repeats the “stuh” sound)

Here are a few non-examples of alliteration:

- Fancy red car (the initial sounds are different)
- Drying blue drapes (the “druh” sound is repeated in two words, but they are not adjacent)

Here are a few examples of alliteration that may seem tricky:

- Finding phony factors (even though the initial letters are different, they repeat the initial “fuh” sound)
- Similar seasonal cycles (even though the initial letters are different, they repeat the initial “s” sound)

Here are a few non-examples of alliteration that may seem tricky:

- Cold cider cups (even though the initial letters are the same, initial sounds are different)

- Planning psychology practice (even though the initial letters are the same, initial sounds are different)

Appendix E: Case A Only and Case B Only Treatments - Comprehension Question

Question

In the space below, describe the teaching technique that Gayle/Sheila used. Put another way, explain in your own words the strategy Gayle/Sheila uses in her lesson to teach the concept of “alliteration”.

Appendix F: Test Activity for All Treatments

Case Activity

Instructions: Read the following case, then answer the question below (you may use the back of this page if necessary).

Case:

You are a 3rd grade teacher. Your students are working on a project on “automobiles”. They are supposed to create a poster-sized collage that depicts a variety of automobiles. They can use pictures cut out from magazines and newspapers. You look to see how their work is going and you notice that several of the students have cut out pictures of all sorts of modes of transportation, some of which are automobiles, but many of which are not. You would like to help them better understand what should be included in his collage. It is your understanding that automobiles are four-wheeled motorized passenger vehicles used for ground transport.

Your task:

You have decided to create a lesson to help your students better understand what an automobile is. **In the space below**, describe the lesson you would design on the topic “What an automobile is”.

Appendix G: Participant Questionnaire

Questionnaire

Year of Birth _____

Gender _____

Country of Origin _____

Primary Spoken Language _____

Academic Department _____

Academic Major _____

Year in College (1st, 2nd,
3rd, etc.) _____Collegiate Credit Hours
Earned To Date _____Years of Teaching
Experience (if any) _____Grades You Have Taught
(if any) _____Subjects You Have Taught
(if any) _____

SAT or ACT Score _____

Collegiate Grade Point
Average (GPA) _____

Have you developed
instructional materials in
any professional role
before? Yes / No
(circle one)

If you answered 'Yes' to
the previous question,
please describe in what
capacity and context you
have developed
instructional materials? _____

Appendix H: Self-Efficacy Instrument

INSTRUCTIONS: In the following please circle the one response that best represents your belief. Remember there are no right or wrong answers, just honest answers. Your responses will be kept confidential. Thank you.

The following items pertain to your confidence in your ability to develop lessons

| | |
|---|--|
| <p>KEY: 1 = Not at all confident 2 = Not very confident 3 = Somewhat confident</p> | <p>4 = Confident 5 = Extremely confident</p> |
|---|--|

Please rate your confidence in your ability to:

| | |
|--|--------------|
| Design a lesson plan to teach complex concepts (examples of complex concepts might include “transportation”, “shelter”, “celebration”, “square-dance”) | 1 2 3 4 5 |
| Create activities that will help your students learn about complex concepts | 1 2 3 4 5 |
| Break down complex concepts into teachable chunks for students | 1 2 3 4 5 |
| Provide students with examples that illustrate complex concepts | 1 2 3 4 5 |
| Provide students with non-examples of complex concepts | 1 2 3 4 5 |
| Design lessons to teach complex concepts that are appropriate for specific audiences | 1 2 3 4 5 |

The following items pertain to your confidence in your ability to apply in your teaching information from lessons developed by others

| | |
|--|--|
| KEY: 1 = Not at all confident 2 = Not very confident 3 = Somewhat confident | 4 = Confident 5 = Extremely confident |
|--|--|

Please rate your confidence in your ability to:

| | | | | | |
|--|---|---|---|---|---|
| Identify a teaching strategy used in a sample lesson developed by someone else | 1 | 2 | 3 | 4 | 5 |
| Describe how you might use a teaching strategy used in a sample lesson developed by someone else | 1 | 2 | 3 | 4 | 5 |
| Apply a teaching strategy, from someone else's lesson, in your own teaching | 1 | 2 | 3 | 4 | 5 |

The following items pertain to your knowledge about automobiles in comparison to other undergraduate students.

| | |
|---|--|
| KEY: 1 = Significantly below average 2 = Below average 3 = Average | 4 = Above average 5 = Significantly above average |
|---|--|

Please rate your knowledge in comparison to the average undergraduate student:

| | | | | | |
|--|---|---|---|---|---|
| Knowledge of specific attributes of automobiles that differentiate them from other modes of transportation | 1 | 2 | 3 | 4 | 5 |
| Knowledge of specific types of automobiles (make, model, year) | 1 | 2 | 3 | 4 | 5 |
| Your overall knowledge of automobiles | 1 | 2 | 3 | 4 | 5 |

Appendix I: Interview Protocol

Interview Questions:

First, have interviewee read through the packet and their responses again

1. How did you come up with your response to the test case problem?
 - Did you draw on previous experience or something from a class
2. Explain now, in your own words, what you think the teaching strategy is that was used in the training case(s).
3. What did you think you were expected to do in the test case activity?
4. Do you see any similarities between the training case(s) and the test case problem?
5. As you recall, did anything in the classroom affect your performance on the tasks?
6. Do you think you learned anything from the tasks?

Appendix J: Instructional Strategy Response Data Scoring Rubric

Scoring Rubric for Instructional Strategy Description

Used to analyze answers to question asked after subject read the training cases

Following is the instructional strategy that is exemplified in the training cases:

To teach a complex concept, provide learners with typical examples and non-examples to get them in the “conceptual ballpark”. Then, to fine tune their understanding of the concept, provide the learners with atypical examples and non-examples that illustrate the subtleties of the boundary between what are and what are not members of the conceptual domain.

For the purposes of this rubric, this instructional strategy is exemplified in instruction that includes typical examples, typical non-examples, atypical examples, and atypical non-examples of the concept being taught as illustrated in this matrix:

| | Example | Non-Example |
|----------|---------|-------------|
| Typical | | |
| Atypical | | |

Following are explanations for how to assign scores to the subjects’ responses to the Instructional Strategy Description question:

4 = Describes an instructional strategy that includes **all four** types of examples included in the matrix above

3 = Describes an instructional strategy that includes **three** of the four types of examples included in the matrix above

2 = Describes an instructional strategy that includes **two** of the four types of examples included in the matrix above

1 = Describes an instructional strategy that includes **one** of the four types of examples included in the matrix above

0 = Describes an instructional strategy that **does not mention** the use of examples

Appendix K: Application Task Data Scoring Rubric

Scoring Rubric for Test Case Activity

Used to analyze responses to activity in which subjects are asked to describe the lesson they would design.

Following is the instructional strategy that is exemplified in the training cases:

To teach a complex concept, provide learners with typical examples and non-examples to get them in the “conceptual ballpark”. Then, to fine tune their understanding of the concept, provide the learners with atypical examples and non-examples that illustrate the subtleties of the boundary between is and what is not included in the concept.

For the purposes of this rubric, this instructional strategy is exemplified in instruction that includes typical examples, typical non-examples, atypical examples, and atypical non-examples of the concept being taught (see matrix below).

| | Example | Non-Example |
|----------|---------|-------------|
| Typical | | |
| Atypical | | |

Following are explanations for how to assign scores to the subjects’ responses to the Test Case Activity:

4 = Uses an instructional strategy that includes **all four** types of examples included in the matrix above

3 = Uses an instructional strategy that includes **three** of the four types of examples included in the matrix above

2 = Uses an instructional strategy that includes **two** of the four types of examples included in the matrix above

1 = Uses an instructional strategy that includes **one** of the four types of examples included in the matrix above

0 = Uses an instructional strategy that includes **no** examples

Curriculum Vita for Brian S. Horvitz

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EDUCATION

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EMPLOYMENT HISTORY

Instructional Designer, Option Six, Inc., Bloomington, IN

2003 – Present

- Manage and conduct all aspects of instructional design to develop web-based and blended instructional solutions for Fortune 500 companies including Microsoft Corporation, Eli Lilly and Company, Emmis Communications, and Papa John's.

Human Performance Specialist, Division of Recreational Sports, Indiana University

2002 – 2003

- Evaluated and improved staff training, through the development of computer-based training solutions and managed the development and implementation of other computer-based performance improvement initiatives.

Evaluation Intern, The Evaluation Center, Western Michigan University, Kalamazoo, MI

2002 – 2003

- Worked with the Community College Cooperative of University of California – Berkeley in evaluating the Advanced Manufacturing Education program at Sinclair Community College in Dayton, OH. Project funded by the National Science Foundation.

Instructional Designer, WisdomTools, Inc., Bloomington, IN
2000 – 2003

- Designed web-based, scenario-based instruction for clients including the Centers for Disease Control and Prevention, National Future Farmers of America Organization, and General Re Corporation.

Research Assistant, Indiana Center for Evaluation, Indiana University
2001 – 2002

- Supported the center director in research, analysis, writing, and data management activities related to The Evaluation of the Cleveland Scholarship (Voucher) and Tutoring Grant Program.
- Member of the IU Dean of Education's Charter Schools Committee for which I provided research, writing and organizational support on its report Indiana University's Role in the Indiana Charter School Movement, submitted to the Indiana University Board of Trustees.

Research Assistant, Department of Instructional Systems Technology, Indiana University
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- Assisted faculty member, Dr. Barbara Bichelmeyer in various aspects of her research, teaching, and service activities.

Research Associate, Synectics for Management Decisions, Washington, DC
1997 – 1998

- Used statistical software, databases, and spreadsheets to manage data for the U.S. Department of Health and Human Services and the National Institute of Health.

Project Supervisor, Center for Economic Organizing, Washington, DC
1996

- Helped manage databases and personnel for the 1996 International Brotherhood of Teamsters Union Presidential Election. Processed over one million ballots.

RESEARCH, CREATIVE ACTIVITIES, AND SCHOLARSHIP

Publications

Paulus, T.M., Horvitz, B.S., & Shi, M. (In press). Becoming a better design team member: Learning in an online story-based environment. *Educational Technology Research and Development*.

Smith, K.M., Bichelmeyer, B.A., Monson, J., & Horvitz, B.S. (In press). Integrating computers in the schools: A review of criticisms. In M. Orey, V.J. McClendon, and R.M. Branch, *Educational Media and Technology Yearbook 2006* (31st Ed.). Littleton, CO: Libraries Unlimited, Inc.

Bichelmeyer, B.A. & Horvitz, B.S. (2006). Comprehensive performance evaluation: Using logic models to develop a theory-based approach for evaluation of HPT interventions. In J.A. Pershing (Ed.), *Handbook of Human Performance Technology* (3rd Ed.). San Francisco: Jossey-Bass.

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Presentations

Horvitz, B.S. (June, 2006). Using case comparison to support the development of instructional design problem-solving strategies. *International Conference of the Learning Sciences*: Bloomington, IN.

Horvitz, B.S. (January, 2006). IST alumni talk: My experience as an instructional designer at Option Six. *Graduates in Instructional Systems Technology*: Bloomington, IN (invited)

Paulus, T.M., Horvitz, B.S., & Shi, M. (April, 2005). Collaborative learning in an online, story-based learning environment: A case study. *American Educational Research Association*: Montréal, Canada.

Horvitz, B.S. & Donovan, M. (April, 2004). Blended learning: What really works? *Instructional Systems Technology Department Colloquium*: Bloomington, IN (invited).

Horvitz, B.S. & Bichelmeyer, B.A. (October, 2003). Using the performance-based evaluation method to evaluate the professional development of university physical fitness consultants. *Association for Educational Communications and Technology*: Anaheim, CA.

Paulus, T.M., Shi, M., Horvitz, B.S., & Boling, E. (October 2003). Effectiveness of a web-based scenario learning experience in the context of a graduate instructional design course. *Association for Educational Communications and Technology*: Anaheim, CA.

Paulus, T.M., Shi, M., Horvitz, B.S., Yildiz, S., Boling, E., & Siegel, M. (April, 2003). Effectiveness of a web-based scenario learning experience, IST core: Working in teams, in the context of R521: Instructional Design and Development I. *Annual Instructional Systems Technology Conference*: Bloomington, IN.

Horvitz, B.S. & Bichelmeyer, B.A. (April, 2003). Performance-based Evaluation: Using evaluation to diagnose and improve human performance interventions. *Annual Conference of the International Society for Performance Improvement*: Boston, MA.

Bichelmeyer, B.A. & Horvitz, B.S. (November, 2002). Human-performance evaluation model: A theory-based evaluation model derived from the field of human performance technology. *Annual Conference of the American Evaluation Association*: Washington, DC.

Bichelmeyer, B.A. & Horvitz, B.S. (September, 2002). Performance-based evaluation: Using evaluation to diagnose and improve human performance interventions. *Performance-based Instructional Systems Design Conference, International Society of Performance Improvement*: Chicago, IL.

Research Awards

L.C. Larson Professional Development Award, School of Education, Indiana University
2005

- In support of participation at the 2005 American Educational Research Association Annual Meeting: Montréal, Canada.

Creative Activities

IST Core: Working in Teams, Department of Instructional Systems Technology, Indiana University
2002 – 2003

- A WisdomTools Scenario designed for R521: Fundamentals of Instructional Technology
- Designed, developed, and implemented this online learning experience teaching teamwork skills to first year graduate students

R685: Instructional Solutions Design, Department of Instructional Systems Technology, Indiana University
2001

- Assisted in the conception and design of this graduate level course focused on the development of innovative instructional design strategies.

Börner, K, Lin, Y-C, Horvitz, B.S., & Hazlewood, W.R. Social Visualizations that Aim to Improve the Efficacy of Educational Three-Dimensional Virtual Worlds. Unpublished manuscript, 2001.

iUniverse: A Collaborative Information Universe for IU, School of Library and Information Science, Indiana University
2000-2001

- Collaborated with Dr. Katy Börner on development of a 3D collaborative environment with embedded information sources used in conjunction with two graduate courses.

R541: Instructional Development & Production Process I, Department of Instructional Systems Technology, Indiana University
2000

- Designed and developed online instructional materials modeling expert decision-making strategies for first year Instructional Systems Technology graduate students.

Professional Development

Workshop Participant, Project MTS (Materials Development, Training, and Support Services) Summer Institute, The Evaluation Center, Western Michigan University, Kalamazoo, MI
2002

- Three-week workshop focused on the theory and practice of program evaluation conducted by a team of international evaluation experts. Funded by National Science Foundation.

TEACHING EXPERIENCE

University Teaching

Assistant Instructor, Department of Instructional Systems Technology, Indiana University
Fall 2005

- Assisted in the instruction of R711: Readings in Instructional Technology, an advanced graduate level course that prepares doctoral students for their qualifying exams.

Instructor, Department of Instructional Systems Technology, Indiana University
Fall 2004 & Spring 2005

- Taught two sections of W200: Technology in Education, a required course for undergraduate education students. Designed all aspects of course.

Assistant Instructor, Department of Instructional Systems Technology, Indiana University
Spring 2003

- Assisted in the instruction of R561: Evaluation and Change in the Instructional Development Process, a required graduate level course for Instructional Systems Technology majors.

Assistant Instructor, Department of Instructional Systems Technology, Indiana University
Spring 2001 & Spring 2002

- Assisted in the instruction of R685: Human-Computer Interaction Design, a graduate level course, for two semesters.

Assistant Instructor, School of Library and Information Science, Indiana University
Fall 2000

- Assisted in the instruction of L578: User Interface Design for Information Systems, a graduate level laboratory course.

Adjunct Instructor, School of Education, Walden University
Summer 2000

- Taught EDUC 6450: Course Development and Delivery Utilizing Technology, an intensive summer session laboratory course for masters and doctoral students offered on the Indiana University campus. Designed all aspects of course.

Other Teaching

Educational Program Director, Milestone Learning Center, Highlands, NC
1998 – 1999

- Designed and implemented a residential, experiential education program for young Appalachian adults. Also served as center's webmaster.

Educator/Mentor, The Mountain Retreat & Learning Center, Highlands, NC
1996 – 1997

- Designed and implemented a camp-counselor training program for a summer camp.
- Led outdoor adventure training, provided counseling and was responsible for care and safety of eight high school aged youths.

Program Instructor, The Close Up Foundation, Washington, DC
1996 – 1997

- Taught high school students from around the world about government, politics, foreign affairs and history using the city of Washington, DC as the “classroom.”
- Researched, designed, and implemented daily instructional workshops.

Public School Teacher, Philadelphia Public Schools, PA
1995 – 1996

- Student-taught an eighth-grade English class at a middle school in West Philadelphia.

Instructor, Stanley Kaplan Educational Center, Cherry Hill, NJ
1994 – 1995

- Taught SAT preparation classes to high school students.

CONSULTING EXPERIENCE

Evaluation Consultant, Phi Delta Kappa International, Bloomington, IN
2003

- Planned the evaluations of four Indiana county adult education programs funded by Lilly Endowment CAPE (Community Alliances to Promote Education) Grants.

Research Consultant, Jenner & Block, LLC, Chicago, IL
2001-2003

- Provided content research and analysis support related to the field of Instructional Technology to the law firm.

Research Analyst, Rockman et al, Bloomington, IN
2002

- Supported the evaluation of a problem-based, technology based K-12 educational program sponsored by the Center for Interactive Learning and Collaboration, Indianapolis, IN.

Educational Consultant, Marlin Elementary School, Bloomington, IN
2002

- Designed, developed, and implemented professional development workshops for K-12 teachers on the use and integration of electronic portfolios in their classrooms.

Needs Analyst, Eli Lilly Corporation, Indianapolis, IN
2001

- Conducted and presented research for Lilly's Global Manufacturing Training & Development division on the leadership needs of U.S. managers.

SERVICE

Appointments

Graduate Student Representative, School of Education Long Range Planning Committee, Indiana University
2005

Graduate Student Delegate, School of Education Fall Planning Retreat, Indiana University
2005

Volunteer Roles

Conference Proposal Reviewer, 2006 American Educational Research Association Annual Meeting, Learning and Instruction Division

Judge, 2005 Brandon Hall Excellence in Learning Awards

Conference Proposal Reviewer, 2004 American Educational Research Association Annual Meeting, Instructional Technology Special Interest Group

Conference Proposal Reviewer, 2004 International Society for Performance Improvement Conference, Academic Forum Track

Conference Proposal Reviewer, 2004 Annual Conference of the American Evaluation Association, Business and Industry Topical Industry Group

Juror, 2003 Association for Educational Communications and Technology - International Student Media Festival

Reading Tutor & Mentor, Big Brothers/Big Sisters of Monroe County, Bloomington, IN
2002 – 2003

- Volunteered 70⁺ hours doing critical reading with a low performing 2nd grade student, helping him move from a 1st grade reading level to a 3rd grade level.

Professional Affiliations

Member, American Educational Research Association (AERA)

Member, Association for Educational Communications and Technology (AECT)

Member, The International Society for Performance Improvement (ISPI)