

# The Analysis Of The Relationship Between Learning Styles And The Learners' Knowledge Acquisition And Reactions Through The Online Case Study

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THE ANALYSIS OF THE RELATIONSHIP BETWEEN LEARNING STYLES AND THE  
LEARNERS' KNOWLEDGE ACQUISITION AND REACTIONS THROUGH THE  
ONLINE CASE STUDY

by

RUI ZENG

M.S. Nanjing Normal University, 2003

A dissertation submitted in partial fulfillment of the requirements  
for the degree of Doctor of Philosophy  
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## **ABSTRACT**

The purpose of this study was to examine the relationship between learning styles and student performance on a pre and post test, using an online case study, while also documenting their reactions to the case study. The case studies used in this research contained different storylines that showed multiple perspectives of case scenarios, giving students more choices to see what may happen in real school situations. Working with undergraduate students (N = 138) from the College of Education at a southeastern university, the researcher examined how students learned and responded to an online case study relative to their learning styles. Kolb's learning style inventory and a learner feedback survey questionnaire were administered respectively before and after the case study. Scores on Kolb's learning style inventory were used to classify the students' learning style preferences. A paired samples t-test was used to analyze the learners' knowledge test scores before and after the case study. The data revealed that the mean of students' post-test scores was significantly higher than the mean of their pre-test scores.

Using descriptive methods, students' responses to the feedback questionnaire were analyzed. There was no difference shown between students with different learning style preferences, their overall reactions to the case study, and their reactions to certain elements (e.g., the content map, the assistants, and the navigation) included in the case study. Overall, most students' reactions to the case study were positive. Open-ended questions in the feedback questionnaire were analyzed and three assertions were generated. Of the optional features included within the case study, eighty two percent of students used the practice quizzes to self-check whether they understood the concepts and content covered in the cases.

Students' post-test scores were congruent with their reactions to the online case study (with higher scoring students expressing more positive responses); and students' preferences regarding the use of online cases for study emerged in patterns relative to their career background.

The study results showed that case studies can be used effectively in teacher education programs, while many learners (74%) favored using the case study and developed positive reactions through their case study experiences.

This is dedicated to my parents, Shengyu Zeng and Mandong Hu. They always give support and encouragement to me. Without them, I would not finally make it.

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## CHAPTER ONE: INTRODUCTION

### *Theoretical Background*

Real-life problems can be incredibly complex because they are situated in dynamic social contexts and influence multiple goals, issues and problems (Schrader et al., 2003) There has been a growing concern among teacher educators about the limitations of current teacher preparation and in-service training programs. Traditionally, teacher educators are more likely to teach theoretical knowledge as formal principles. They neglect the ambiguity and complexity of teaching in real classrooms and expect the students to apply theoretical knowledge when they graduate and are in the workforce. The real situation, however, is that the teachers seldom remember specific principles they learned and much less use them in practice (J. H. Shulman, 1992b). A gap has existed between the complex reality of classroom life and the theoretical principals taught in the teacher education programs.

Studies in the 1980's indicated that teachers overwhelmingly perceived that their pre-service education did not adequately prepare them to be teachers (Baker, 2005). Since that time, teacher educators have purposely made strides toward improving pre-service teacher education through improved pedagogies among which case-based instruction is one. Using case studies as a teaching tool in teacher education has been of interest in recent years (Bronack & Kilbane, 1998). Case methods help students examine theories during the learning process, and apply these theories to situations they may encounter when they are no longer students (Koh & Branch, 2004). The Carnegie report, *A Nation Prepared: Teachers for the 21<sup>st</sup> Century*, also called for teachers to employ case studies to illustrate a great variety of teaching problems as the focus of teacher instruction (Cases, 2000).

The value of the case study for the learning of theory lies in the ways that cases instantiate and contextualize principles through embedding them in vividly told stories (L. S. Shulman, 1992). It is thought to be more vivid and contextual than a textbook discussion, yet more disciplined and manageable than observing or doing work in the world (J. H. Shulman, 1992b). It is considered to be “more engaging, more likely to bridge the vast chasm between principle and practice, and more likely to help neophytes learn to ‘think like a professional’”(L. S. Shulman, 1992). Because of its unique characteristics, case method is seen by many teacher educators as a solution for problems-solving. It is thought that cases help pre-service teachers to practice their skills in a low-risk, non-threatening environment (Rogers & Reiff, 1989) and help student teachers practice skills and make decisions in simulated situations without the fear of failure or negative consequences (Pindiprolu, Peterson, Rule, & Kraft, 2003).

Coinciding with the increased use of case methods, there has been an increase in the number of distance education programs to prepare teachers (Ludlow & Duff, 2001). The rapid development of information technology makes it possible to create an online learning environment that supports a wide variety of teaching functions (S. B. Smith, S. J. Smith, & Boone, 2000). For example, various media can be combined in online learning environments to provide rich representations of problem situations so that cases can be portrayed in a more realistic way (Bronack & Kilbane, 1998). The online environment also provides pre-service teachers with flexibility to work on cases at their own convenience and at anytime, anywhere.

An instructional program should be developed to support the unique needs of each individual learner (E. W. Carter, 2002). Although there are many positive aspects of using

case studies, it can not be taken for granted as an instructional strategy fitting for every learner. Previous research showed that some students oppose change in the way they are taught (Herreid, 2005). They have grown up with the lecture method and don't want to be thrown into "uncharted water." Due to a vast number of combinations of learning-style preferences, there is no single instructional method or resource that is effective for all students (Lovelace, 2005). So it is necessary to inquire about learners' learning styles and their reported preferences for learning strategies; this has been treated as an effective method to aid instructors in improving the efficacy of instruction in the learning environment via utilizing learning styles as a frame of reference guiding the design of instruction (L. A. C. Lima & Hoff, 2000).

Individuals with various learning styles differ in their performance when using technology. Although various research has shown learning style's relationship with students' learning performance and feedback towards case study in general classroom education and computer-assisted learning environments, there is a paucity of studies examining it in an online case-based learning environment.

#### *Purpose of the Study*

The general purpose of the research was to add to the existing knowledge regarding learning style and its relationship with learning performance and learner reactions. Specifically, the research was also used to evaluate the efficiency of the instructional module designed with the case-based learning instructional strategy.

The study investigated the relationship between learners' learning styles (measured by Kolb's Learning Style Inventory) and their knowledge acquisition and reactions through the

online case study experience. For the purpose of the study, students' knowledge acquisition after the case-based learning process and feedback towards the case-based learning experience were evaluated specifically in relation to the students' learning style preferences. The independent variable was the learning style preference. The dependent variables were the students' test-scores and feedback survey results.

### *Significance of the Study*

The relationship between learners' learning style, knowledge acquisition, and reactions to the online case study is an area that still needs to be widely examined. In theory, the study will contribute to both learning style research and case study research. In practice, the information obtained by this study will help instructional designers better design and deliver teacher education programs using case based learning strategy.

### *Research Questions*

The specific research questions of this study were:

1. Is there a significant difference between learners' subject knowledge before and after using an online case-based learning study?
2. Is there a significant difference between the learner groups with different learning style preferences (measured by Kolb's Learning Style Inventory) and their knowledge acquisition when using an online case study?
3. Is there a difference between the learner groups with different learning style preferences (measured by Kolb's Learning Style Inventory) and their reactions to an online case study? What elements of the case study do learners find beneficial and distracting to their learning based on their learning styles?



## *Definition of Terms*

### *Distance Education*

Distance education (or e-learning) is planned learning that normally occurs in a different place from teaching and as a result requires special techniques of course design, special instructional techniques, special methods of communication by electronic and other technology, as well as special organizational and administrative arrangements (Moore & Kearsley, 1996).

### *Case-based Learning*

A case has a narrative, a story, a set of events that unfolds over time in a particular place (L. S. Shulman, 1992). Case-based instruction is a method of pedagogy employed in conjunction with teaching cases (L. S. Shulman, 1992). It has been defined as an active-learning pedagogy designed for problem analysis and problem solving, stressing a variety of view points and potential outcomes (Cranston-Gingrass, Raines, Paul, Epanchin, & Roselli, 1996). Cases show how someone else has faced and dealt with the kinds of problems students themselves may encounter. It had a potential of becoming the most powerful medium for teaching theory (Stevens, 1983). The case provided occasion for theorizing why certain actions are appropriate; it can also be used to exemplify or to test principles (L. S. Shulman, 1992).

### *Instructional Module*

An instructional module is a self-contained instructional unit that includes one or more learning objectives, appropriate learning materials and methods, and associated criterion-reference measures. In this study, an instructional module was comprised of

interactive cases, key concepts covered in the cases, complementary learning materials, and quizzes. The students were required to finish them within two weeks.

### *Hypertext*

Hypertexts are non-linear and non-sequential semantic structures of information nodes, which are linked together in a web-like structure (Cress & Knabel, 2003). As hypertexts enable self-regulated learning and respect the various needs of different learners (Jonassen, 1989; Stanton & Barber, 1992), they improve the cognitive flexibility and increase the transfer of learned concepts (Spiro & Jehng, 1990). Hypertext information can be more easily integrated into the knowledge system than linear texts (Jonassen & Wang, 1993).

### *Learning Style*

Learning style is defined as the cognitive, affective, and psychological traits that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment (Keefe, 1979). According to Kolb (1984), learning is the process whereby knowledge is created through the transformation of experience. He defined four basic learning styles: the converging style, the diverging style, the assimilating style, and the accommodating style (D. A. Kolb, 2000).

People with a converging style are best at finding practical uses for ideas and theories; people with a diverging style are best at viewing concrete situations from many different points of view; people with an assimilating style are best at understanding a wide range of information and putting it into concise, logical form; and people with an accommodating style have the ability to learn from primarily “hands-on” experience (A. Y. Kolb & D. A. Kolb, 2005).

### *Knowledge Acquisition*

Knowledge acquisition is a recursive process of increasing a concept's level of formality usually achieved by increasing the formality of linked concepts and supplying the interpretability of the concept's un-interpreted content (Lethbridge, 1991). The intent of the case study is to provide useful examples to students as they are solving problems to enable them to make useful analogical inferences, such as "to identify issues to pay attention to, to form ideas about how to move forward, and to project the effects of solutions they have come up with." (Kolodner, 1997) By offering more hands-on inquiry-based activities through case study, this style of education helps students learn concepts in more usable ways, motivates their need to learn, and give them a chance to apply what they are learning (Kolodner, 2002) In this study, knowledge acquisition is operationally defined as the gain score students got from the online case study. It is represented as the subtraction of a parallel knowledge pretest and posttest.

### *Methodology*

#### *Population*

The population for this study encompassed undergraduate students from the College of Education at a southeastern university who enrolled in multiple sections of the course Professional Teaching Practices (EDG 4323) in the spring 2006 semester. Students were asked if they were interested in participating. Those students who agreed to participate in the study signed the consent form online. They used WebCT to study the case study module and finished all the learning activities.

### *Sampling*

The sampling method used in the study can be classified as convenience sampling. The sample was a group of students from the College of Education who were available for study (N = 138). The study was designed for students in the teacher education program and was conducted within the College of Education at a southeastern university. The instructional material had been created to familiarize students with different measurement and evaluation concepts which are essential to all students in the college of education. Due to the specific purpose of the research, the researcher chose undergraduate students who took the course Professional Teaching Practices (EDG 4323) in the College of Education at a southeastern university as the sample.

### *Instruments*

Three instruments utilized in the study were Kolb's learning style inventory; the knowledge test; and the learner feedback survey questionnaire.

The twelve-item Kolb's learning style inventory is a widely used instrument. Four basic learning styles are defined by Kolb (2000): the converging style (abstract, active); the diverging style (concrete, reflective); the assimilating style (abstract, reflective); and the accommodating style (concrete, active). The researcher was granted permission from the Hay group to use the Kolb's learning style inventory for the research study.

The 25-item parallel knowledge tests were used respectively as pre-test and post-test. The pre-test was administered before the presentation of the module. The post-test was used as the module quiz after students finished learning the module. These tests were designed by the researcher and reviewed by the experts following a systematic way.

The learner feedback survey questionnaire was administered at the end of the module. Students were required to fill out the survey after finishing the module. The survey consists of both objective questions and subjective questions, which investigate students' reactions to certain elements of the case study module and case-based learning experience (such as the content map, the navigation, and the assistants). This survey was designed by the researcher and reviewed by the experts following a systematic way. Please refer to these instruments in the appendices.

### *Procedures*

The students had a total of two weeks to finish the module study, the tests and the survey questionnaire. At the beginning of the first week, students had access to the module. Before reading the module, they were required to finish the learning style inventory and the knowledge pre-test. They then started the online case study. After finishing studying the module, students could choose to finish the post-test and the feedback survey questionnaire at their own pace.

### *Data Analysis*

Data had been collected in spring 2006 semester by the graduate researcher. Upon successful completion of the data collection, several statistical procedures were implemented and assessed for the variance of different variables. Quantitative data collected in the study were analyzed using SPSS. Qualitative data collected from the survey questionnaire were analyzed using interpretivism and was then reported.

### *Limitations*

It is hoped that the finding of the study will add empirical evidence to improve upon current methods used in case-based learning in online education and contribute to the learning style research studies. One of the study's limitations is that there was no randomization. Because the groups were formed based on their learning style preferences, there was no possibility to randomly assign subjects to each group.

There are several threats to the internal validity of the study such as the subject characteristics, the mortality, and the testing threat. First of all, subject characteristics like age and gender, may affect the results of the study. There is the likelihood that the groups defined by different learning style preferences are not equivalent on one or more variables such as age or gender. Second, the mortality rate can be another threat to the study. Eighteen students dropped out of the study. Some of them were absent when the researcher went to the classroom to introduce the case study project. They either only took the learning style inventory or failed to complete tests and questionnaires. Third, the use of a pretest may cause the testing threat. Because students learned the cases and took the tests at their own pace, there was no way to control the time they spent on studying the cases. The effects of taking the pre-test might affect the scores of the post-test.

### *Summary*

Chapter one contains the theoretical background, purpose of the study, significance of the study, research questions, definition of terms, methodology, limitations, and summary. In the following chapters, the literature review containing information related to previous

research pertinent to this study, the detailed methodology employed, the findings, and the discussion, conclusions, and recommendations of the study are presented.

## CHAPTER TWO: LITERATURE REVIEW

This chapter presents the foundation of the current research study by addressing those elements in the literature that have been written regarding the design of the present study, including the theoretical background, case method, learning styles, knowledge acquisition, and learner feedback. Furthermore, the uniqueness of the present study will also be presented.

### *Theoretical Background*

#### *Constructivism*

From the constructivist perspective, “knowing” is an adaptive activity. Concepts and theories are viable if they prove adequate in the contexts in which they were created. Sometimes, it is more important to let a student know why a particular conception or theory is considered scientifically viable in a given historical or practical context than to present it as a privileged truth (Glaserfeld, 1994). Meaning is rooted in and indexed by experience (J. S. Brown, Collins, & Duguid, 1989). Each experience with an idea and the environment of which the idea is a part becomes part of the meaning (Duffy & Jonassen, 1992). Most researchers agree that experience with concepts and relations in school typically is quite different from the experience with them in the real world (Resnick, 1987). These differences are major factors that sometimes cause the failure of knowledge transfer (Sherwood, Kinzer, Hasselbring, & Bransford, 1987). Constructivists emphasize “situating” cognitive experiences in authentic activities (J. S. Brown et al., 1989). Case method is considered to be an effective instructional strategy that is appropriate to providing authentic experiences and is beneficial for aiding students in making sense of the environment as it is encountered.



### *Cognitive Flexibility Theory*

Cognitive flexibility theory is a constructivist theory of learning and instruction that emphasizes the real-world complexity and ill-structuredness of knowledge domains (Spiro, Feltovich, Jacobson, & Coulson, 1991). Traditional theories sometimes neglect problems related to content complexity and irregularity in patterns of knowledge which cause the learning deficiencies. Cognitive flexibility theorists thought that it is important for learners to view cases in an interconnected way using multiple themes and perspectives to better understand the complexities of topics (Godshalk, Harvey, & Moller, 2004). By taking advantage of computers' random, nonlinear representational capabilities, multiple perspectives of complex problems in ill-structured knowledge domains can be addressed appropriately (M. Lima, Koehler, & Spiro, 2004), which can not be achieved by using traditional methods such as textbooks and lectures.

The learning objectives addressed by cognitive flexibility theory mainly focus on advanced knowledge acquisition which means students can “attain an understanding of important elements of conceptual complexity, use acquired concepts for reasoning and inference, and flexibly apply conceptual knowledge to new situations” (Spiro, 2002). In the educational field, much of what needs to be learned involves advanced knowledge with ill-structured aspects. This is especially true when students need to apply knowledge to real-world cases when they are facing substantially new situations.

As Spiro (1991) has pointed out, “because knowledge has to be used in multiple ways, emphasis of instruction needs to be designed to shift from the retrieval of intact knowledge structures to support the construction of new understandings, to the novel and

situation-specific assembly.” Case studies offer a way for students to look at a concept, phenomenon, and situations from multiple perspectives. They can also embody knowledge effectively and lead to fuller understanding of multiple applications of concepts in different scenarios. They can be appropriately designed to solve traditional learning problems in ill-structured domains. As suggested by Cognitive Flexibility Theory (Spiro, Vispoel, Schmitz, Samarapungavan, & Boerger, 1987), multiple case studies should be used to ensure that a variety of possible situations are presented; cross-case differences in how concepts and principles are applied should be focused on; and multiple perspectives should be considered as an aid to understanding the connected nature of the domain concepts and promoting flexible knowledge building.

### *Learning with Case Method*

As a pedagogical approach, case method is not a new concept in education (Sykes & Bird, 1992). As early as the 1870’s, Christopher Langdell began to use the case method in Harvard Law School (Redlich, 1914). In the 1920’s, it was used in education programs in New Jersey and Massachusetts (Merseeth, 1999). The apparent success of case-based instruction in the professional fields of law and business was noted by educators in the middle of the twentieth century and thus cases were broadly used in the training programs afterwards (Sargent & Belisle, 1955). In the late 1980’s, more and more educators began to take note of this approach (K. Carter, 1989; K. Carter & Unklesbay, 1989; J. H. Shulman & Colbert, 1989; L. S. Shulman, 1987) that accompanied the accelerating school reform movement. However, until the early 1990’s, the empirical basis for the advocacy of case method was rarely evident (Merseeth, 1999): “The collective voice of the proponents far

outweighed the power of existing empirical work.” (Sikula, 1996) This situation changed in the middle 1990’s. Researchers felt that it was important to understand, through empirical research, the appeal as well as the effect of case method, and began to pay attention to the exciting research issues inherent in it (Merseth, 1999).

### *Definitions*

Real-life problems can be incredibly complex because they are situated in dynamic social contexts and influence multiple goals, issues and problems (Schrader et al., 2003). A case has a narrative, a story, a set of events that unfolds over time in a particular place (L. S. Shulman, 1992). Case-based instruction is a method of pedagogy employed in conjunction with teaching cases (L. S. Shulman, 1992). It has been defined as an active learning pedagogy designed for problem analysis and problem-solving, stressing a variety of view points and potential outcomes (Cranston-Gingrass et al., 1996).

The value of the case study for the learning of theory lies in the ways that cases instantiate and contextualize principles through embedding them in vividly told stories (L. S. Shulman, 1992). Cases show how someone else has faced and dealt with the kinds of problems students themselves may encounter. It has a potential of becoming the most powerful medium for teaching theory (Stevens, 1983). Cases provide occasion for theorizing why certain actions are appropriate; they can also be used to exemplify or to test principles (L. S. Shulman, 1992).

There are many research studies related to these kinds of understandings about teaching and learning students may experience through using case methods. These effects include knowledge acquisition (Barnett, 1991; Barnett & Ramirez, 1996; Lundeberg & Fawver, 1993;

Lundeberg, Matthews, & Scheurman, 1996; Mayo, 2002, 2004); critical thinking and problem-solving skills (Harrington, 1995; Hernandez-Serrano & Jonassen, 2003; Risko, Osterman, & Schussler, 2002); self-regulation (Ertmer, Newby, & MacDougall, 1995); conceptual change (Dana & Floyd, 1993; Eberly & Rand, 2003; Lundeberg & Fawver, 1994; J. H. Shulman, 1992c); technology intervention (Beck, King, & Marshall, 2002; Borsa, Klotz, & Uzat, 1998; Cheney, Warner, & Laing, 2001; Makitalo, Hakkinen, Leinonen, & Jarvela, 2002; Schrader et al., 2003) and facilitation (Morine-Dershimer, 1993, 1996; V. Richardson, 1991).

#### *Case Method and Teacher Education*

Teacher educators have argued for the use of case studies as a pedagogical focus of teacher education (Jay, 2004). Cases illustrate a great variety of teaching issues and present an alternative to learning in the field (Richert, 1991). They have been shown to increase transfer of learning from theory to practice and improve novice teachers classroom problem-solving skills (Andrews, 1996).

In Andrew's (1996) study, teaching cases were included in a web-enhanced instruction to teach pre-service teachers to adapt instruction for limited English proficient students with disabilities. Forty participants analyzed the teaching cases and developed the adapted lesson plan for the teacher in the cases to use with the whole class and also for students with disabilities. They also completed a case online project survey and a written reflection regarding their perceptions of the project and its outcomes. It was shown that most participants agreed that the project increased their ability and confidence to make curricular and instructional adaptations for differing student needs (Andrews, 1996).

Bronack, Kilbane, Herbert, and McNergney's (Bronack & Kilbane, 1998; 1999) study also suggested that the combination of cases and technology provided a valuable opportunity to engage teachers developing professional behaviors. They used a web-based case method teaching environment called CaseNET as the medium to help pre-service and in-service educators to develop and refine their abilities to recognize, analyze, and address professional problems through the use of case studies. By the end, they conducted a qualitative analysis of over 40 participants and concluded that case studies were useful to engage teachers in professional development via exploration with authentic teaching tasks.

Moreover, several studies also suggested that teacher preparation programs can be enhanced by providing cases. For example, Russel et al.(2003) argued that using cases to educate pre-service teachers has the potential to influence pre-service teachers' beliefs about how to use computer technology and, ultimately, influence their practices in a real classroom. Angeli (2004) also claimed that case-based learning affects pre-service teachers' beliefs about the pedagogical uses of information and computer technology (ICT). In her study, she analyzed different data sources including questionnaires, reflection papers, course evaluations, and focus interviews. The findings showed that case based learning affected pre-service teachers' beliefs and conceptions about the use of ICT.

#### *Case Method and Knowledge Acquisition*

Knowledge can be categorized as either formal or practical (Fenstermacher, 1994). Formal knowledge is theoretical in nature and consists of facts and propositions that arise from research (Lundeberg, 1999). Practical knowledge is action-oriented and situation-specific knowledge which is accumulated on the basis of learners' experiences and

can be used immediately in their practice (Johnston, 1992). Depending on the context of cases and the goal of an instructor, cases may be used to do both to some degree (Moje & Wade, 1996).

Kolodner (Kolodner, 1997) pointed out that the intention of case study is to provide useful examples to students and enable them to make analogical inferences which include identifying important issues, forming ideas about how to make progress, and analyzing the effects of solutions they have come up with. In the process, students learned new cases, new concepts, and new content knowledge. Aha (2001) also mentioned that cases can address situations in which users lack further case information or domain knowledge.

For example, Mayo (2002; 2004) found that case-based instruction can be used to connect theoretical and applied knowledge. By implementing this approach, students can readily relate course content to real-life scenarios. He collected students' objective testing data; the result indicated that students exposed to case-based instruction outperformed those in traditional settings in the areas of comprehension and application of course principles. At the same time, case discussions were found beneficial for learners in connecting their practical knowledge with theoretical knowledge (Barnett, 1991).

In Boshuizen et al.'s (1998) research, the effects of experience with a series of cases on knowledge restructuring and learning from texts were studied. Students learned case content and integrated it into their prior knowledge. Results showed that the processing of a series of cases led to better knowledge acquisition.

Significant changes are also shown in Lundeberg and Fawver's (1993) study about pre-service teachers' abilities to connect theoretical principles to situated problems by

analyzing two kinds of data: students' pre- and post written analysis and students' self-reported written explanations of changes in beliefs at the end of the course unit. Later studies also proved case analysis' effectiveness in integrating learners' subsequent construction of formal and practical knowledge (Lundeberg et al., 1996). It was reported in their study that almost half of the students (45%) thought that cases helped them connect educational psychology concepts to real classroom situations.

### *Critical-thinking and Problem-solving*

Because case method is treated as a good mechanism to link theory to practice (Wright, 1996), it has been employed extensively in classrooms. Many researchers use cases to develop students' critical-thinking (McDade, 1995) and problem-solving skills (Sudzina, 1995) in complex situations. Through the process of reasoning about cases, students are engaged in problem-finding and problem-solving (Harrington, 1995; Kleinfeld, 1991; Lundeberg et al., 1996). Under some circumstances, they also show expert characteristics (Stepich, Ertmer, & Lane, 2000).

Most of the research on enhancing critical-thinking and problem-solving skills through case pedagogy has been done in the context of actual courses (Lundeberg, 1999). Harrington (1995) in her study investigated students' written case analysis in the course and found that students' problem-framing, consideration of perspectives, warranting of solutions, and consideration of consequences improved by the end of the semester.

Another study (Risko et al., 2002), which compared students' initial and final case writing, also led to similar results that throughout the case study learners' depth of reasoning substantially changed. Shifts from early unidimensional and narrow conceptions were

characterized by adopting perspectives that allowed for a wider range of theoretical and practical issues to influence thinking.

The impact of cases on undergraduate novices' abilities to solve complex and ill-structured problems was examined by Hernandez-Serrano and Jonassen (2003) over the course of a semester. Support was found for the hypothesis that cases have an effect on students' problem-solving skills when working on ill-structured problems. Among the experimental, comparative, and control groups, the experimental group which had access to experts' cases outperformed the comparative and control groups, which only had access to the fact sheets and related textbook issues. The findings were similar to the earlier research results (D. E. Brown, 1992) that cases increased problem-solving skills and addressed misconceptions.

Even though there has been praise for the use of case method in research, a few researchers have noted the difficulty learners have in analyzing problem situations (Lundeberg, 1999). Some students using case-based learning processes came up with nothing more than a quick reaction and a single solution (Kleinfeld, 1991). Researchers (Harrington, 1995; Welty, 1989), therefore, suggested that learners need some structure and guidance in framing problems to counter their tendency to construct a problem from only one perspective.

### *Self-regulation*

Self-regulation is defined as the ability and motivation to implement, monitor, and evaluate various learning strategies for the purpose of facilitating knowledge growth (Ertmer, 1995). It is assumed that students can actively regulate their cognition, motivation, or behavior, and through these processes enhance performance and achieve educational goals



(Zimmerman, 1989). Although case method may provide a positive learning environment for students, it cannot guarantee learning itself (Ertmer & Newby, 1996). Consequently, it's important to understand how this method affects individual learners. Learners' self-regulation levels are one of the factors that affect the case-based learning effect.

Some researchers thought that a successful case learning depends partly on learners' ability to regulate their learning in response to the approach (Blumenfeld et al., 1991). Conversely, case-based instruction is thought to promote and support the development of self-regulation skills. So what is implied in the literature is a reciprocal relationship between case method and self-regulated learning (Ertmer & Newby, 1996). Ertmer's (1995) study, in which he examined high and low self-regulatory students' patterns of change during the case learning process, proved this reciprocal relationship. By dividing students into high self-regulatory and low self-regulatory levels using the Motivated Strategies for Learning Questionnaire, Ertmer found that "high" students made fairly steady process while at the same time "low" students also made promising gains in terms of goals they established for the case-based course.

### *Conceptual Change*

Learners' dispositions are hard to affect, and their beliefs often revert back to more traditional notions (Goodlad, 1990). The early literature about conceptual change pointed out that the instructor can affect a change in students' beliefs by guiding them to be aware of their own beliefs and recognize conflicts between existing and alternative beliefs (Posner, Strike, Hewson, & Gertzog, 1982). More recent research, on the other hand, suggested that social interaction plays an important role in changing students' conceptions (Soloman, 1987).

Cases, as a kind of pseudo-practice, provide vivid opportunities for learners to test their ideas and beliefs in a low-risk situation (Moje & Wade, 1996). The analysis of these kinds of open-ended stories have been considered to be a promising way of changing dispositions by many researchers (Campbell, 1997; Luckowski, 1997; J. H. Shulman, 1992a).

Eberly and Rand (2003) pointed out that discussions in case analysis created a unique context for social interaction and collaboration and led to the exchange of ideas and reframing of one's outlook. In their study, graduate students in online courses were asked to study a teaching case, interact online to identify the issue in the case, and discuss short-term and long-term solutions. Discussion transcripts were collected and analyzed by the researchers. The results indicated that learners in the case discussion process revealed culturally sensitive dispositions.

The findings of Lundeberg and Fawver (1994) showed that cases might alter learners' beliefs. In their research study, pre-service teachers reflected on the cases and reported that their beliefs changed from thinking students receive knowledge from teachers to thinking students construct knowledge and create meaning themselves (Lundeberg & Fawver, 1994). Furthermore, Dana and Floyd's research (1993) showed a similar result. By comparing the pre- and post-case discussion reflections, researchers found that case studies provided opportunities for learners to examine their beliefs. The learners also used the beliefs articulated during case discussion to examine and critically reflect on their actions and practices (Dana & Floyd, 1993).

Researchers believed that the change of thinking happened in the discussion process while the case itself served merely as an anchor (Lundeberg et al., 1996). Shulman (1992c) in

her research used large group-facilitated case discussion. Students' reflections in the discussion showed that they changed their beliefs on issues related to race, gender and culture.

### *Technology Intervention*

Spiro, Feltovich, Jacobson and Coulson (1991) note that traditional methods of instruction do poorly in complex, ill-structured domains like medicine and social studies. Researchers have tried to capture the complexity in such domain areas with the use of various delivery systems (Schrader et al., 2003).

Schrader's (2003) findings noted that video cases highlight important issues, challenges and benefits in case studies. Consistent with his study, Richardson and Kile (1999) analyzed students' written descriptions at the beginning and end of the semester, and found that video cases can increase students' use of concepts and deepen their understanding. Additionally, Beck, King and Marshall's (2002) research suggested that pre-service teachers' construction of video cases enhanced their understanding of teaching and thus their ability to generate teaching-learning ideas. McCurry also proved in his study that multimedia cases which combine video and audio contributed to pre-service teachers' professional development (McCurry, 2002).

Case studies have also become increasingly popular in the distance learning environment because both cases and on-line learning are constructive by nature (Sudzina & Sudzina, 2003). In an online case-based learning environment, learning occurs when instructors and students co-construct meaning about the case dilemma at hand. The synchronous and asynchronous

nature of online teaching allows for anytime, anywhere learning that fits well with students' learning preferences (Angeli, Valanides, & Bonk, 2003)

Cheney, Warner, and Laing's (2001) research demonstrated that students from separate locations can interact and collaborate in case studies. The survey results showed that students enjoyed reading about other people's perspectives of the situations and comparing them with their own. Another research study by Borsa, Klotz, and Uzat (1998) also suggested that online case study environments are useful for students to work collegially, sharing ideas even though they are separated by a significant distance. Research also showed that by discussing and posting case analyses on a bulletin board, students have a deeper level of constructive communication between each other (Makitalo et al., 2002).

### *Facilitation*

Case-based teaching and learning includes a variety of ways of using cases and case discussion. Because cases do not teach themselves (J. H. Shulman, 1996), a facilitator plays a vital role in a case learning process (Levin, 1999). They influence the discussion through questions and comments (Garvin, 1991; Miller & Kantrov, 1998; Morine-Dersheimer, 1991, 1993) and have an impact on how learning community develops (Barnett & Tyson, 1993). Unlike classroom teachers, facilitators in a case study do not set an agenda but rather manage the emergence, direction, and evolution of a discussion (Christensen & Hansen, 1987). Due to the complexity of interactions during a case discussion, facilitators' roles are extremely important.

The empirical evidence offered the opportunity to consider this aspect of case-based pedagogy. Morine-Dersheimer in her study (1993) compared teacher-directed with

student-centered case discussion. The former was facilitated by a graduate assistant whereas the latter was discussed by students themselves in small groups. It was established that students in the teacher-directed case discussion displayed more active participation, more attention, and more complex understanding. Richardson (1991), by analyzing students' written cases, also called for the positive involvement of facilitators in guiding students through the interpretation of cases and in helping them apply theory and making appropriate judgment.

Snyder and McWilliam (2003) thought that learning to use case method effectively is not self-evident or easily mastered without guidance and supportive resources. They pointed out that case facilitation skills can be enhanced by observing an experienced case instructor. They used survey questionnaires to collect 128 instructors' opinions about facilitation strategies. Most instructors rated "observing an experienced case instructor" as very useful. Besides, Wood and Anderson (2001) also recommended that case facilitators can improve their questioning skills to enhance the critical thinking of students.

Some researchers also asserted that case facilitator's epistemological and pedagogical beliefs influence their way of facilitating case study (Levin, 1999; Wasserman, 1994). For example, in another research study, Morine-Dersheimer (1996) found that gender of case facilitators may impact outcomes of case discussions. In the classroom discussion, students were divided into two groups. One group was led by a female facilitator while the other group was guided by a male facilitator. Different patterns from two groups, who discussed the same case but were led by two instructors of different sexes, were found. The researcher asserted that discussion facilitators' gender might affect the direction of the discussion as

well as students' interaction with the topic. It might also affect students' personalized generalization to principles of practice and their focus on the individual case problems.

Research also addresses other factors such as structural and organizational factors in the facilitating process. For example, Lundeberg (1997) conducted a study to test the hypothesis that formal case discussion (the facilitator standing and recording discussion ideas on the blackboard as they emerge in case discussion) leads to more student learning than less structured discussion (the facilitator sitting, carefully listening, and verbally summarizing students' ideas). The result showed that 68% of students prefer the less structured discussion environment in which more students can participate and explore ideas in more depth.

### *Conclusion*

Case method is an effective learning strategy used broadly in the educational field. The literature review tried to cover the multiple research interests inherent in case studies in an attempt to better understand the role of case methods in teaching and learning. All the evidence cited suggests that use of the case method enhances learners' theoretical as well as practical knowledge. In a case-learning process, learners improve their critical-thinking and problem-solving skills. Case-based pedagogy also expands learners' knowledge acquisition and conceptual change.

Despite the many positive aspects of using case studies, however, there are also some pitfalls associated with this method (Graham & Cune, 1980). Since a case study is usually limited in length, it may only relate to a few of the intended course concepts. Case-based instruction usually includes a case discussion session which may take up a lot of class time. Instructors, therefore, need to consider and arrange the class time carefully to assure a

case-based instruction is effectively carried through. Although there are many proponents of case method, instructors still need to keep in mind that this learning strategy may not be suitable for all students. Students have different learning style preferences and instructors can not assume that one instructional strategy fits all of them. In other words, there still remain many research topics in the case-based learning field.

### *Learning Style*

People exhibit significant individual differences in cognitive processing styles that they adopt in problem-solving and decision-making activities (Robertson, 1985). Within the field of education, learning styles have received much attention (Kratzig & Arbuthnott, 2006). Findings from both quantitative and qualitative research have indicated several coherent major dimensions of individual differences of which learning style is a major one. While the study of learning styles can be traced to the turn of the century by German psychologists (Coop & Sigel, 1971), the construct of learning styles was originally proposed by Allport (1937) as “an individual’s habitual or typical way of perceiving, remembering, thinking, and problem solving.”. As of today, a considerable number of research studies have been conducted in this field (Whyte, 1996).

There are many different definitions of learning styles. Kratzig and Arbuthnott defined it as a combination of cognitive, affective, and psychological characteristics that describe how that individual interacts with his or her environment (Kratzig & Arbuthnott, 2006). Keefe (1979) defined it as the cognitive, affective, and psychological traits that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment. Learning styles are also defined as the “information processing habits

representing the learner's typical mode of perceiving, thinking, problem-solving, and remembering." (Chinien & Boutin, 1992-93) They are "more like generalized habits of thought, not simply the tendency towards specific acts...but rather the enduring structural basis for such behavior."(Messick, 1984) They are concerned with how individuals process information and are not likely to change with time or training (Ausburn & Ausburn, 1978). Since different researchers emphasize different aspects of learning styles, there are various terms in the literature.

### *Comparison of Different Learning Styles*

Witkin's bipolar dimensions of field dependence (FD)/field independence (FI) have had considerable influence on the learning style discipline (Coffield, Moseley, Hall, & Ecclestone, 2004). FI refers to the ability to separate out and restructure individual elements in an organized stimulus field. FD refers to the tendency to be strongly influenced by a background field such that individual elements are separated out only with difficulty from their embedding context (Witkin, Dyk, Faterson, Goodenough, & Karp, 1974).

There are many research studies using FD/FI as learning style dimensions, especially in the curriculum of second-language acquisition, mathematics, natural and social sciences (Tinajero & Paramo, 1998). Some of the research questions the information about the learning styles of students and their impact on learning. For example, in Murphy and Casey's (1997) research study, the learning style of undergraduates in a new four-year information management program were examined by using the Group Embedded Figures Test (GEFT). The researchers expected that FI students would academically outperform FD students in technical courses and non-technical courses. By comparing the average grades in technical



and non-technical courses for these FI and FD students, the researchers' initial expectations were supported by the final results.

There is also some research that reported factors that may affect the levels of FD/FI. In Ching's (1998) study, a distance-learning environment and its influence on students' FD/FI was examined. GEFT was used in this study to measure learners' learning style dimensions. The results indicated that the learning styles of the same individuals was more field independent after one year in the program than it had been when they started (Ching, 1998). In another study, the effects of chess instruction on the levels of FD/FI were examined by Smith and Sullivan (1997). By comparing students' pre-test and post-test scores on GEFT, the researchers reached the conclusion that chess instruction did have a significant effect on changing female learners' field independence levels while it had no effect on male learners.

The Dunn and Dunn model of learning styles is another widely used one. According to the Dunn and Dunn model, learning style is divided into 5 major stimuli which are: (1) environmental, (2) emotional, (3) sociological, (4) psychological, and (5) physiological elements (Dunn, 2003).

An extensive range of research has used this learning style model to determine the value of teaching students through their learning style preferences. In Dunn and Griggs' (1995) meta-analysis, 36 experimental research studies using the Dunn and Dunn model were synthesized. The overall weighted effect size value  $r$  was .353, with a residual variance of .079 and a mean standard deviation ( $d$ ) of .755. The findings indicated that students with strong learning style preferences have greater academic gains as a result of congruent

instructional interventions than those who have mixed or moderate preferences (Dunn & Griggs, 1995).

In Farkas' (2003) quasi-experimental research, based on the classes the students belonged to, 101 urban middle school 7<sup>th</sup> grade students were grouped into a control group (taught with a traditional teaching method using lectures, group discussions, and visual resources) and an experimental group (taught the same content using the Multisensory Instructional Package). Students in the experimental group were teamed together for an assignment using their most responsive instructional strategy based on their learning style preferences, while students in the control group were not teamed together according to their learning style preferences. From analyzing the achievement and attitude test scores, Farkas found that when instructed with a Multisensory rather than a traditional approach, learners displayed significantly higher achievement and more positive attitudes. In another study, using the Productivity Environmental Preference Survey (PEPS) developed by R. Dunn, K. Dunn and Price (1982), Clark-Thayer (1987) identified college students' learning style preferences and further proved that students attained significantly higher achievement and attitude scores with regard to course content when they studied with congruent study strategies.

Nelson et al. (1993) also used PEPS to identify college freshmen's learning styles. They then provided complementary learning strategies. The final results showed that those matched prescriptions had a significant impact on learners' achievement and retention.

### *Kolb's Learning Style*

The present study focuses on Kolb's Experiential Learning Theory. According to Pickworth and Schoeman (2000), Kolb's theory of experiential learning was based on the work of the experiential learning theorists John Dewey, Kurt Lewin, and Jean Piaget. Carl Jung's personality typology, which described how adults integrate and express their views, also served as one of the bases for Kolb's learning style theory (McWilliams, 2001).

Kolb (1984) thought that "learning is the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping experience and transforming it." He believed that learning begins with concrete experience serving as the basis for observation and reflection that finally leads to the formation of abstract concepts and generalizations that can be implemented and tested. He described the process of experiential learning as a four-stage cycle which involves the four adaptive learning modes- concrete experiences (CE); reflective observations (RO); abstract conceptualizations (AC); and active experimentations (AE)-and the transactions among them.

The main characteristics of the four learning styles are described below.

- Type 1: the converging style (abstract, active) relies primarily on abstract conceptualization and active experimentation; is good at problem solving, decision making and the practical application of ideas; does best in situations like conventional intelligence tests; is controlled in the expression of emotion and prefers dealing with technical problems rather than interpersonal issues (Coffield et al., 2004).
- Type 2: the diverging style (concrete, reflective) emphasizes concrete experience and awareness of meanings and values; views concrete situations from many perspectives;

adapts by observation rather than by action; interested in people and tends to be feeling-oriented (Coffield et al., 2004).

- Type 3: the assimilating style (abstract, reflective) prefers abstract conceptualization and reflective observation; likes to reason inductively and to create theoretical models; is more concerned with ideas and abstract concepts than with people; thinks it more important that ideas be logically sound than practical (Coffield et al., 2004).
- Type 4: the accommodating style (concrete, active) emphasizes concrete experience and active experimentation; likes carrying out plans and getting involved in new experiences; good at adapting to changing circumstances; solves problems in an intuitive, trial-and-error manner; at ease with people but sometimes seen as impatient and ‘pushy’ (Coffield et al., 2004).

Kolb developed the LSI based on the theory of experiential learning. The first version appeared in 1976, the second in 1985, and the third in 1999. The use of LSI in research studies has received both support and criticism from researchers. The 1976 version is a nine-item paper and pencil instrument which was subject to psychometric critique that largely centered on poor score reliability (Geller, 1979; Wilson, 1986). To address the criticism, Kolb revised the LSI in 1985 and created a twelve-item inventory. However, this version continued to receive criticism because of its ranking format (McWilliams, 2001). The third version of this 12-statement inventory, Learning Styles Inventory IIa (LSI-IIa) had been refined to the point where it demonstrated acceptable reliabilities and was suitable for evaluating learning styles (Veres, Sims, & Locklear, 1991). This version has a paper-and-pencil form and is also available online (D. A. Kolb, 1992).

Although there are various criticisms, Kolb's LSI is still widely used to measure individual learning style preferences. It has been widely used in several fields to address learning and educational issues.

### *Learning Style and Knowledge Acquisition*

There is a general acceptance that the manner in which individuals choose to or are inclined to approach a learning situation has an impact on their performance and achievement of learning outcomes (Cassidy, 2004). Research has demonstrated that students' perceived knowledge of learning styles increases their academic success in college courses (Rochford, 2003). Additionally, it was shown that instructional treatments based on learners' learning style preferences increases students' retention; significant higher achievement was reported when the study strategies were congruent with students' learning styles across subject matter (Clark-Thayer, 1987; Lenehan, Dunn, Ingham, Murray, & Signer, 1994). In different research studies, several terms are used to stand for a knowledge gain using a pre-test and post-test comparison. These terms include knowledge acquisition, learning performance, and learning achievement.

According to Kolb (1984), learning is concerned with the production of knowledge. Jarvis (1987) believed that Kolb has successfully demonstrated an intimate relationship between learning and knowledge. There have been many studies that have used Kolb's LSI to improve students' knowledge acquisition in education. The results, however, were inconsistent from study to study.

Bostrom, Olfman, and Sein (1990) argued that individual learning style differences are important in end-user computer training. They conducted four studies using Kolb's (1976) LSI as the instrument to evaluate students' learning style preferences. Based on the results

they concluded that convergers with combined active experimentation and abstract conceptualization preference performed better than students with other learning style preferences.

In 1991, Sein and Robey examined the relationship between students' learning style preferences and two training methods: abstract model and analogical model. Students' learning styles were tested using Kolb's LSI (1976). The results revealed that learning styles have a significant effect on learning achievement. It was shown that students with converger learning style preferences performed significantly better than those with the other three learning style preferences (Sein & Robey, 1991).

Carthey (1993) in his study examined 64 students' academic achievement and the relationship between their academic achievement and their learning style preferences which were measured by Kolb's LSI. Findings suggested that considering students' learning styles and matching them with the study approaches and methods might increase students' academic achievement.

Ayersman (1994) utilized Kolb's LSI to examine students' knowledge of hypermedia-related content, when using a computer-based hypermedia system for instruction. He found significant gains in students' pre/post knowledge scores across all learning styles. This suggests that all learning styles progressed equally in hypermedia knowledge, possibly due to the richness of the hypermedia environment.

The relationship between graduate students' learning styles and performance outcome in a hypermedia environment was also measured by Oughton and Reed (2000). The results

showed that assimilating and diverging learners were most productive on mapping out their acquired knowledge and grasping the interrelationships among various ideas and concepts.

Rouke and Lysynchuk (2000) investigated the influence of Kolb's LSI on students' achievement in a hypertext learning environment. A significant difference was found between divergers and accommodators. The former scored highest and the latter scored lowest. The study indicated that learning styles affected students' learning achievement through a hypertext learning environment.

Some research, on the other hand, showed different results. For example, Kraus (1996) in her study examined the effects of Kolb's LSI on learners' knowledge acquisition in a case-based hypermedia environment. Reported results showed that there is a significant effect of a case-based hypermedia program on learners' behavior disorders knowledge acquisition. However, there were no significant effects of learning styles on knowledge and on the total time spent using the hypermedia program.

In McWilliams's (2001) study, the relationship between learners' learning style preferences and learning performance was examined. Although the descriptive statistics indicated that accommodators' mean gain was higher from pre-test to post-test than did assimilators, convergers and divergers, there was no significant relationship between gain score and learning styles.

Harris, Dwyer, and Leeming's (2003) study showed that students' learning styles had no impact on their mean test scores. Learning style was not related to students' overall performance no matter whether it was in an online module or in a lecture course.

In another research study conducted by Howard, Ellis and Rasmussen (2004), even though significant learning occurred when students were taking a hypermedia module, no significant differences in achievement were observed within any of Kolb's classifications. The researchers then concluded that learning styles do not necessarily affect how well learning occurs via hypermedia.

### *Learning Style and Learner Feedbacks*

Although learners with different learning styles may not necessarily perform differentially in various learning environments, it is possible that they would prefer particular learning environments to others (Harris et al., 2003).

Bozionelos (2004) used the 1976 version of Kolb's LSI to explore college students' learning styles and the learning styles' relationship with students' feedback on the computer usage, which was measured with a 19-item Likert-type scale. The author reported that learners with converging learning style preference tended to experience fewer negative feelings when interacting with computers than did learners with the other three learning style preferences.

Du and Simpson (2002) found that learning style was significant in explaining students' enjoyment level. Their findings indicated that learning styles demonstrated a moderate positive relationship with students' enjoyment levels in a web-based learning class.

However, some research showed different results. For example, in Harris, Dwyer, and Leeming's (2003) study, learners' reactions to an online module were measured using an eight-question Likert-type scale with questions pertaining to the likeability of the online study. The results indicated that students' learning styles had no significant impact on their reactions



to the online module. However, it was shown that learners with higher scores on their online test had higher feedback on the online study.

## CHAPTER THREE: METHODOLOGY

The purpose of this study was to examine the relationship between learners' learning styles and their knowledge acquisition and reactions through an online case study. Working with undergraduate students (N = 138) from the College of Education at a southeastern university who took the course Professional Teaching Practices, the researcher examined how students with different learning styles perceived and used the case studies, and whether or not they performed differently. This chapter is devoted to the methodology applied to the study. It discusses the research questions, research hypothesis, research design, pilot study, and the data analysis plan for the empirical study.

### *Research Questions*

The study addressed the following research questions:

1. Is there a significant difference between learners' subject knowledge before and after using an online case study?
2. Is there a significant difference between the learner groups with different learning style preferences (measured by Kolb's Learning Style Inventory) and their knowledge acquisition when using an online case study?
3. Is there a difference between the learner groups with different learning style preferences (measured by Kolb's Learning Style Inventory) and their reactions to an online case study? What elements of the case study do learners find beneficial and distracting to their learning based on their learning styles?

The learners' knowledge acquisition factors examined by this study are the overall knowledge test achievement.

It is believed that the answers to these questions will assist instructors and instructional designers make informed decisions on the appropriate use of online case studies. Moreover, the results of the research will establish the significance, if any, between learning style preferences in the use and development of online case studies and their effectiveness in terms of learner knowledge acquisition and reactions.

### *Research Hypotheses*

The following three hypotheses were tested in the research study:

Null hypothesis 1: There is no difference between learners' subject knowledge before and after using an online case study.

Null hypothesis 2: There is no difference between students with different learning style preferences on knowledge acquisition when instructed through a case study in an online educational course.

Null hypothesis 3: There is no difference between students with different learning style preferences regarding their reactions to certain elements of a case study in an online educational course.

### *Research Design*

#### *Participants*

The population for this study encompassed undergraduate students from the College of Education at a southeastern university who took the course Professional Teaching Practices (EDG 4323). The students who took multiple sections of EDG 4323 participated in the main study in the spring 2006 semester. They were recruited during class time to participate voluntarily. The instructors granted permission to recruit the students.

For the convenience of class management, the researcher did not use random assignment. Students were asked if they were interested in participating. Those who were willing to participate signed the consent form online and submitted it electronically. Students could also download an electronic copy of the informed consent form for their own records. The Institutional Review Board (IRB) at the university had approved the online informed consent form collection for this study. All the participants used their Network Identification Numbers (NIDs) to log in to their WebCT accounts and read the case study module.

The beginning population of the study consisted of 138 students. Usable responses were received from 120 of them, including 102 female students and 18 male students. The majority of students were female students. There were no equal samples from each gender to work with. Based on the prior research, gender difference had only a very small effect on the performance of case studies (Scheuneman, 1997). So gender was not used as a covariance for the later data analysis.

Of the 120 students, there were 86 pre-service teachers, 14 in-service teachers, and 20 students who were from other fields (see Table 1). Students with different career backgrounds distributed across the four learning style groups (see Figure 1).

Table 1

The Students' Distribution to the Different Learning Style Groups

Learning style	Pre-service teacher		In-service teacher		Others	
	N	P	N	P	N	P
Accommodating	40	71%	9	16%	7	13%
Assimilating	15	75%	2	10%	3	15%
Converging	6	67%	1	11%	2	22%
Diverging	25	71%	2	6%	8	23%

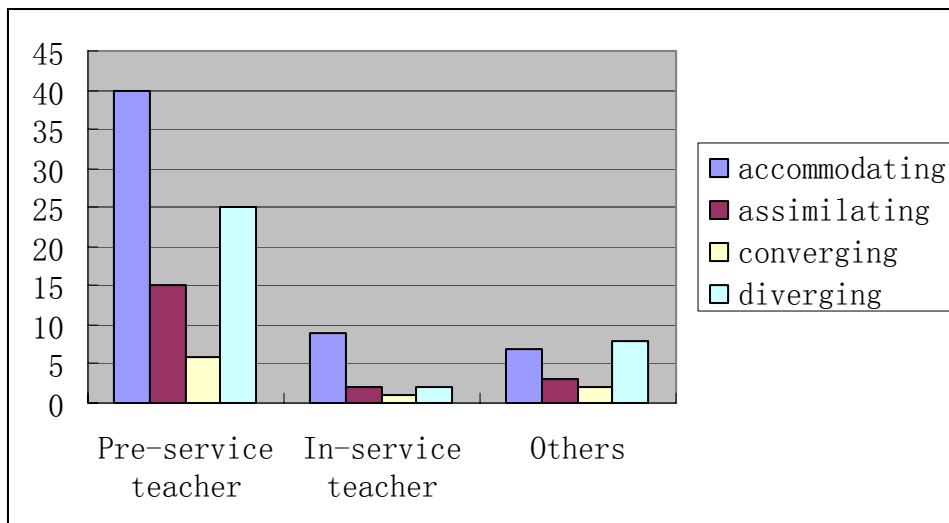


Figure 1: Distribution of students to the different learning style groups

### *Procedure*

The case study project was not part of the contents for the course Professional Teaching Practices. There was no content overlap between the case study and the course. The project was created in WebCT with a stand-alone course number. All the instructional materials and instruments had been integrated into WebCT and were provided to participants. The

researcher designed a tutorial about how to use the cases so students would have a basic idea about what the interactive cases look like and how to use them. To ensure every student had enough knowledge of using WebCT, the researcher also designed an electronic training tutorial about how to use WebCT. Both tutorials were optional for learners to use.

Before conducting the main study, the researcher went to classes to introduce the case study project to students. The researcher also showed students how to use the case study in WebCT by explaining procedures step by step. In the middle of the semester, students who volunteered to participate in the study were provided with the online cases and were given two weeks time to finish the case study, the tests and the survey questionnaires. Students had access to the case study module at the beginning of the first week. A brief introduction of the purpose and procedure of the research were provided to students via the WebCT course homepage. Before reading the module, they were required to finish Kolb's learning style inventory and the knowledge pre-test. The knowledge post-test and feedback survey questionnaire were accessible to students after they finished the knowledge pre-test. Students could choose to finish them at their own pace after studying the case study module.

### *Case Study Module*

The case study module is used to deliver knowledge to students in a contextualized environment. The emphasis is placed upon the presentation of information from multiple perspectives to show diverse examples in real school situations. The development of the case study module was based on a review of prior literature regarding the use of case studies for teaching and learning. Specific to students from the College of Education, the cases were developed with an instructor who had taught the measurement and evaluation classes to over

100 graduate students. The design drew on needs assessment and evaluative data collected over the 2004-2005 school year. From analyzing students' midterm feedback to the instructor, final course feedback, and scenarios students wrote in their final exams collected under IRB approval, the researcher finally decided to choose two themes mainly discussed by the students: standardized testing and classroom evaluation.

The initial case study module designed in the spring 2005 semester was piloted to a group of graduate students from the College of Education. Students' feedback survey data were collected at that time for revision purposes. By analyzing the data and talking with the students face-to-face after administering the survey questionnaire, the researcher revised some of the statements in the case study module. The revised module includes two case studies. One narrates how Bob, an experienced in-service teacher, wants to use the Florida Comprehensive Assessment Test (FCAT) resources on the Florida Information Resource Network (FIRN) to better prepare his students for the standardized testing. The other case depicts an inexperienced teacher, Jane, and her story of revising the classroom assessments designed by previous teachers.

To show different scenarios case characters might face in real classroom situations, multiple story lines were designed. For example, in Bob's case, issues such as how to explain FCAT scores to parents, and how to analyze question formats and question items, were developed as different story lines for students to choose (see Figure 2). In Jane's case, the analysis of validity and reliability, the design of a test blueprint (a table of specifications), and the selection of different test formats were touched upon by different story lines (see Figure 3). Overall, the topics of these cases represent the range of content areas addressed in

the measurement course, while seeking to integrate skills in the context of an actual school situation. The multiple paths designed for each case and chosen according to students' interest make the case studies nonlinear in format. Students can choose different branches and explore what the character may face in different school situations. They are given the freedom to choose their own navigational routes and topics through the subject matter (Chen & Macredie, 2004).

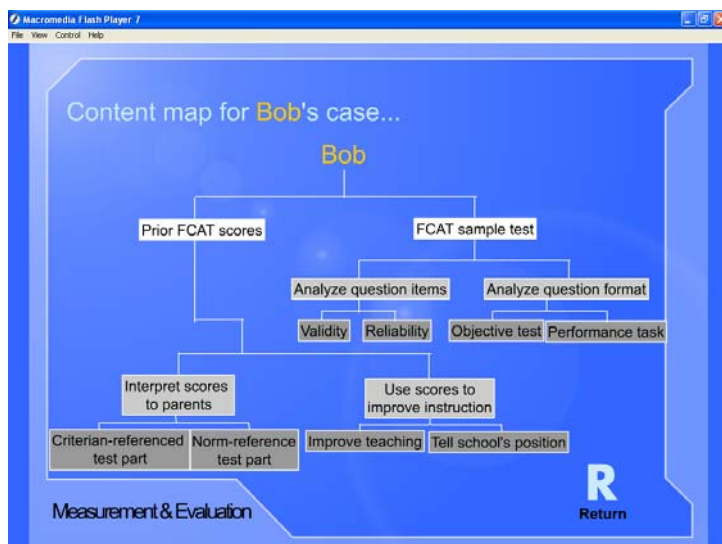


Figure 2: The content map for Bob's case

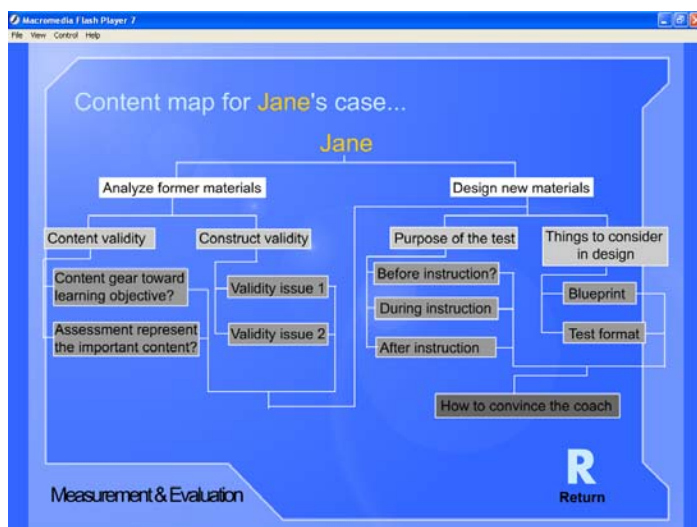


Figure 3: The content map for Jane's case



While students' explorations are self-directed, and the paths present in the story diverged, all of the possible choices unfold into narratives with equally plausible, positive outcomes. That is, the cases do not include "wrong" choices with negative outcomes for users. The paths represented alternatives rather than success or failure options. Students are asked to begin by envisioning themselves in the characters' places, integrating assessment, rather than being asked to "win" or "lose" based upon little or no prior experience with measurement. The long-term goal of the project is to support students' understanding of the various concepts related to measurement and assessment in education, while also allowing them to gain a deeper understanding of those concepts in the context of their professional goals.

The whole design of the case studies is an application of Spiro's cognitive flexibility theory (Spiro et al., 1987). Different case storylines, combined with concept explanations covered in them, are systematically presented in different content combinations, in different sequences. In this study, the case studies still used a pre-established underlying structure. In the future, the researcher wants to incorporate more options (e.g., story lines generated by students) to allow students to generate their own structural schemes in addition to those provided for them.

### *Instruments*

The research instruments for this study consisted of Kolb's learning style inventory (learning style research approval letter assigned by the Hay group is attached as Appendix F), the knowledge tests (Appendix C and D), and the learner feedback survey questionnaire (Appendix E). These instruments yield multiple variables for analysis including learning style

preferences, students' gain scores, and feedbacks from students. The properties of each of these variables are described in detail below.

### *Kolb's Learning Style Inventory*

Kolb's learning style inventory (LSI) is a widely used instrument. It is used predominantly for adult learners (Howard et al., 2004). Four basic learning styles are defined by Kolb (2000): the converging style (abstract, active), the diverging style (concrete, reflective), the assimilating style (abstract, reflective), and the accommodating style (concrete, active). The LSI is a 12-statement instrument used as a self-assessment test to measure students' learning style preferences. Veres et al. (1991) administrated the LSI three times at eight-week intervals to initial (N=711) and replication groups (N=1042) of business employees and students and found that the test-retest correlations  $r$  were above .9 in all cases. The LSI demonstrated acceptable reliabilities and was suitable for evaluating learning styles (Veres et al., 1991). However, for the validity of the LSI, research studies showed mixed results (A. Y. Kolb & D. A. Kolb, 2005). Using factor analysis to study the internal structure of the Kolb's LSI, some studies supported the internal structure of the LSI (Brew, 1996; Katz, 1986; Kayes, 2005; Marshall & Merritt, 1985, 1986; Merritt & Marshall, 1984; Yaha, 1998), some showed mixed support (Brew, 2002), while others showed no support (Weirstra & DeJong, 2002).

In the present study, the researcher picked Kolb's learning style inventory (LSI) for specific reasons. Kolb's LSI is consistent with adult teaching philosophy (Fahy & Ally, 2005). It is "one of the most useful descriptive models of the adult learning process available." (Atherton, 2002) It is argued that the case method when used properly is an effective way to

provide students with the opportunity to become involved in all four phases of Kolb's experiential learning cycle (Carolin, 2001). The present study focused on the case method so the researcher chose the Kolb's LSI. Kolb's LSI is used satisfactorily in a variety of research situations, including online education. All these facts, along with the instrument's brevity and conciseness made it suitable for this study. The researcher had obtained permission from the Hay group to use Kolb's learning style inventory.

#### *Knowledge Pre-test and Post-test*

The twenty-five item parallel knowledge tests were used respectively as pre-test and post-test to measure students' knowledge acquisition through the case study. The pre-test was administered before the presentation of the module. The post-test was used as the module quiz after students finished the module learning. The knowledge tests were designed by the researcher and the professor who was the measurement and evaluation course in the College of Education following the systematic design method described in textbooks (Kubiszyn & Borich, 2003; Linn & Gronlund, 2005; Nitko, 2004). They mainly covered the concepts and content described in the online case study module.

Kubiszyn and Borich (2003) mentioned that, with all other factors being equal, the more items included in a test, the higher the test's reliability. The original knowledge tests only had ten multiple choice questions. Based on the expert's recommendation, the researcher redesigned the knowledge tests by changing ten questions to twenty five questions. Multiple choice questions were chosen as the question format because they can effectively measure various types of knowledge and both simple and complex learning outcomes in Bloom's

taxonomy including knowledge, comprehension, and application (Nitko, 2004). Another reason is that multiple choice questions have more reliability per item.

As pointed out by Kubiszyn and Borich (2003), “content validity evidence is established by comparing test items with instructional objectives (with, for example, the aid of a test blueprint).” The design of the tests strictly followed the test blueprint and was congruent with the learning objectives (see Table 2). The proportion of the test items allocated to each content area and cognitive process in the test blueprint corresponded to the instructional emphasis and importance of the case study topics. Allocating a different number of items to each topic and cognitive process is the most obvious way of weighting topics and processes on the test (Thorndike, 2005). Although the whole decision-making process was subjective, the researcher ensured that the test maintained an appropriate balance in emphasis for both content and mental processes. The expert reviewed the test blueprint and helped check whether each of the question items matched with the learning objectives described in the blueprint. She also helped make sure that each question item was written properly and matched the respondents’ reading level. The expert review further confirmed the content validity of the knowledge tests.

Table 2

Knowledge Pre-test/Post-test: Blueprint Table

Content outline	Categories				
	Knowledge	Comprehension	Application	Total	percentage
1. The student will discriminate among the criterion-referenced			6	6	24%

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interpretation, the norm-referenced interpretation, and the raw score.				
2. The content validity, construct validity and reliability.				
2.1 The student will recall the definition of validity and reliability.	3			12%
2.2 The student will give examples of validity and reliability		1		4%
2.3 The student will identify the issue of validity and reliability in a given situation.			2	8%
3. The cognitive domain of the Bloom's taxonomy.				
3.1 The student will recall the cognitive domain of the Bloom's taxonomy.	1			4%
3.2 The student will give examples of the cognitive domain of the Bloom's taxonomy.		1		4%
4. The student will give examples of the goal of classroom test and evaluation.		2	2	8%
5. The tests in terms of their functional role in classroom instruction.				

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5.1 The student will distinguish the tests in terms of their functional role in classroom instruction.		2			8%
5.2 The student will identify the tests in a given situation, based on their functional role in classroom instruction.			3		12%
6. The students will distinguish the steps for designing of a blueprint.		2		2	8%
7. The students will explain the usage of performance assessment and objective test.		1		1	4%
8. The students will select appropriate test items based on the learning outcomes wanted to measure			1	1	4%
Total number of items	4	9	12	25	
Percentage	16%	36%	48%	100%	

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Before using the parallel knowledge tests for the main study, these two tests were piloted to a group of graduate students who took the course Measurement and Evaluation in Education (EDF 6432) in the College of Education. Twenty-eight students took the pre-test ( $M = 17.75$ ,  $SD = 2.24$ ,  $SEM = 1.73$ ,  $K-R 20 = .40$ ) and eighteen students took the post-test ( $M = 20.56$ ,  $SD = 2.10$ ,  $SEM = 1.6$ ,  $K-R 20 = .41$ ). Although the reliability was low for the pilot study, it was still reasonable because the group was small and there was not a lot of

variability of the group of students who took the tests. From the item analysis, 23 pre-test question items and all 25 post-test question items showed item discrimination powers from acceptable to excellent. The two question items with problems were revised for the main study usage. To estimate whether the two test forms were equivalent forms, the correlation coefficient was calculated. It was shown that the scores of the pre-test and post-test were correlated with a correlation coefficient  $r$  of .683. This is judged to be fairly reliable as two equivalent forms of a test (Larkey & Knight, 2002). When judging whether the two tests are equivalent forms or not, the two tests should be administered under conditions as nearly equivalent as possible. These students had three weeks' interval between taking pre-test and post-test and they took the measurement and evaluation course in that three weeks. The variation within the subjects of measurement over time (e.g., students' psychological or physical state at the time of testing) might be one reason that affected the test results (Thorndike, 2005).

#### *Learner Feedback Survey Questionnaire*

The thirty-three item learner feedback questionnaire was administered at the end of the case study module. Students were required to complete the survey after finishing the module. The survey consisted of both objective and subjective questions which drew on students' reactions to certain elements of the case study module and case-based learning experience. Students' demographic information and online learning background information were also collected. The survey questions were designed based on the blueprint which served as an organizer that framed the major content categories to be assessed (see Table 3). The survey was reviewed by experts to ensure its validity. The experts matched the blueprint and the

construct of the survey to make sure that the survey was developed based on the blueprint table. They also checked the questions to make sure that the questions matched the characters of the respondents (e.g., the reading level). Using Cronbach's Coefficient Alpha, the measurement of the survey questionnaire showed a coefficient of reliability of .74. It meant that the respondent ratings of different elements obtained from the feedback survey questionnaire were judged to be adequately reliable (Nunnally, 1978) for the undergraduate students to whom it was given.

Table 3

Learner Feedback Survey: Blueprint Table

Content base category	Number of questions in each category
Demographic information	7
Overall reaction	8
Reactions to the Navigation	5
Concepts understanding	1
Reactions to the Assistants	7
Reactions to the Content map	2
Reactions to the Practice quiz	2
Relevance	1
Total number of questions	33

#### *Pilot Study One*

A pilot study was conducted in the fall 2005 semester. A total of 23 undergraduate students participated in the study. The students' learning style distribution was: nine



accommodators, five assimilators, six divergers and three convergers. These participants were enrolled in the course Professional Teaching Practices (EDG 4323). All students volunteered to participate in the study. Some students dropped out in the process of the study and finally twelve students finished all the phases of the study.

There were mainly two reasons for the loss of the participants. First, the pilot study was conducted at the end of the semester. Most students were busy with their final exams and didn't have enough time to take it. As one student mentioned in the survey questionnaire, "All seemed great, just too busy to really put too much effort into it." So this gave the researcher pause as how to pick the right time for a study to reduce this kind of mortality threat. The second reason was due to a design problem. The researcher used the "selective release" function in WebCT but did not realize that it only worked with a content module. So after students took the pre-test, they still could not read the instructional materials. Although the researcher solved this problem after the study had been conducted for a few days, some students didn't come back to continue the study. To avoid the same problem happening again, the researcher used a guest account to test all the instructional materials before the main study.

A knowledge test was administered at pre and post stages. Because of the small sample size, there was no significance shown in knowledge acquisition. However, the results depicted on the students' feedback questionnaires were useful for the researcher to better design the study for students' usage. From the questionnaire, the researcher found that some undergraduate students did not have the prior experience in using WebCT for online learning. Based on this information, the researcher designed a specific training tutorial about how to

use the basic functions of WebCT for students. Students also showed great interest in the case study. Almost all students indicated that they would prefer to choose a case study as opposed to textbook reading. Students also expressed different opinions of the different elements in the case study, such as the content map, the assistants, and the practice quiz. These different opinions might be related to their learning style preferences. The researcher analyzed this question with a bigger sample size in the main study.

### *Pilot Study Two*

The second pilot study was conducted in the spring 2006 semester. This pilot study was used to measure whether the two knowledge tests were alternative forms. Two sections of students who enrolled in the course Measurement and Evaluation in Education were asked to participate in the study voluntarily. They took the pre-test first and, after three weeks, they were asked to take the post-test.

As described in the instruments part, 28 students took the pre-test and 18 took the post-test. After collecting the pilot pre-test data, the researcher did an item analysis with the expert to examine whether each question in the test showed an acceptable discrimination power. It was shown that 23 of the 25 questions showed discrimination powers from acceptable to excellent. There were still two questions that showed poor discrimination powers. By analyzing those two multiple choice questions, the researcher found that one question had a grammar mistake and the other one was ambiguous. Those two questions were revised for the later main study's usage. The item analysis was also conducted for the pilot post-test. All 25 questions in the pilot post-test showed good discrimination powers. The correlation coefficient  $r$  of the two tests was .683 which showed that the two tests were the parallel forms of the test.

### *Data Analysis*

Quantitative data collected in the study were analyzed using SPSS. Because this study was not an experimental design, the statistical procedures were used to describe the data, not to predict or to generalize to all students. Descriptive statistics were used to report the collected nominal data such as students' learning style preferences, and the nominal or ordinal parts in the feedback questionnaire. The interval data such as the knowledge test results were also stated. The paired samples t-test was used to measure learners' knowledge acquisition before and after the online case study. Initially, a one-way analysis of variance (ANOVA) was planned to be used when there was a categorical independent variable (with two or more categories) and a normally distributed interval dependent variable. In this study, students' learning style preferences were the categorical independent variable and students' knowledge test results were the dependent variable. However, due to the unequal sample sizes of four learning style groups, the assumption of ANOVA was not met. So the Games-Howell Post Hoc test was used as an alternative method to analyze the differences in the means of the dependent variables broken down by the levels of the independent variable. The Games-Howell Post Hoc test is considered to be robust when sample sizes and variances are not equal across compared groups (Field, 2000). It is recommended to be used when group sizes are bigger than 5. The smallest group size in the study was 8. So the data met the assumption of using the GH Post Hoc test. Moreover, descriptive analysis such as crosstabs were used to explore the association, if any, between the categorical data collected through feedback survey questionnaires and students' learning style preferences.

Qualitative data collected from the survey questionnaire was reported using interpretivism. Interpretivism promotes the value of qualitative data in pursuit of knowledge (Kaplan & Maxwell, 1994). It is concerned with the uniqueness of a particular situation and contributes to the pursuing of contextual depth (Myers, 1997). In this study, the data included students' written comments about the major themes and elements of the case study. The form of the qualitative data consisted of single words, brief phrases, or full paragraphs of texts (Erickson, 1986).

### *Summary*

This chapter described the procedures followed to construct the study and the results from the two pilot studies. One hundred and thirty eight undergraduate students from the College of Education at a southeastern university participated in this study. Students used two weeks to learn the online case studies and finished the tests and questionnaires. Data were collected and analyzed after the study had been finished. The next chapter reports the data collected from the study and the specific methods used to analyze it.

## CHAPTER FOUR: RESULTS

The purpose of this chapter is to report the findings of the study and to document the perspectives obtained from the various data sources. The original data collected via WebCT were divided into three parts: students' learning style preferences and their pre-test and post-test results; students' learning style preferences and their answers to the objective questions in the feedback questionnaire; and students' learning style preferences and their answers to the subjective questions in the feedback questionnaire. Quantitative data were analyzed in SPSS using different statistic methods while qualitative data were analyzed using Erickson's interpretivism (1986).

Table 4 depicts a summary of research questions, data sources, and the analysis procedures for each research question. Statistical analysis of the data and their significance to the research questions are discussed afterwards. Using different statistical methods, results of each question are reported, including reliability of the instruments, means, standard deviations, significance levels and so on. Demographic information as it related to the study is also presented. To obtain students' opinions to the case study, their responses to the open-ended questions in the feedback survey questionnaire were also examined and are reported.

Table 4

## Research Questions, Data Sources and the Analysis Procedures for Each Question

Research question	Data Source	Analysis Procedure
1. Is there a significant difference between learners' subject knowledge before and after using an online case study?	Students' pre-test and post-test results	Paired sample t-test
2. Is there a significant difference between the learner groups with different learning style preferences (measured by Kolb's Learning Style Inventory) and their knowledge acquisition when using an online case study?	Students' learning style preferences and their pre-test and post-test results	Games-Howell Post Hoc test
3. Is there a difference between the learner groups with different learning style preferences (measured by Kolb's Learning Style Inventory) and their reactions to an online case study? What elements of the case study do learners find beneficial and distracting to their learning based on their learning styles?	Students' learning style preferences and their feedback survey questionnaire results	Descriptive statistics method and interpretivism

*Research Question One*

Prior studies related to case studies in traditional classroom teaching suggested that case studies can be employed to teach principles or concepts of a theoretical nature (L. S. Shulman, 1992). Web-based cases are also thought to be a useful tool for student learning. Shokar et al. (2005) analyzed students' feedback questionnaire and written comments on web-based medical cases and concluded that students were enthusiastic about the interactive web-based cases. The students thought that cases reinforced knowledge on common problems seen in the clinical setting.

Research question one looked at online case studies and their effect on learners' content knowledge. It was hypothesized that there is no statistically significant difference between

learners' subject knowledge before and after using the online case study. Students' subject knowledge was measured separately using parallel knowledge pre and post tests. Using a paired samples t-test, it was found that there is a statistically significant mean difference between learners' knowledge acquisition before ( $M = 13.94$ ,  $SD = 3.25$ ,  $SEM = 2.03$ ,  $KR-20 = .57$ ) and after ( $M = 17.62$ ,  $SD = 2.89$ ,  $SEM = 2.14$ ,  $KR-20 = .72$ ) the online case study,  $t(110) = -14.116$ ,  $p < .01$ . The effect size (using Cohen's  $d$ ) equaled to 1.2. The KR-20 results showed that both the pre-test and the post-test demonstrated acceptable reliability. The paired samples t-test result indicated that after learning the case study module students produced significantly higher scores than before. Null hypothesis one was rejected.

Table 5

Student Pre-test/Post-test Means and Standard Deviations

	Number	Mean	Std. Deviation
Pre-test	111	13.94	3.25
Post-test	111	17.62	2.89
Valid Number	111		

Table 6

Student Pre-test/ Post-test Paired Samples T-Test Results

	Paired Differences				t	df	Sig.	
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre-test Post-test	-3.68	2.75	.26	-4.20	-3.17	-14.12	110	.00

### *Research Question Two*

Previous research studies showed inconsistent results about students' learning style preferences in relation to knowledge acquisition. Kraus's (1996) study showed that there was no significant effects of learning styles on students' knowledge and on the total time spent using the hypermedia case-based learning program. On the contrary, Rouke and Lysynchuk's (2000) study indicated that learning styles affected students' learning achievement through hypertext learning environments.

Research question two analyzed whether there is a significant difference between the learner groups with different learning style preferences (measured by Kolb's Learning Style Inventory) and their knowledge acquisition when using an online case study. The independent variable is students' learning style preferences, with the learners' knowledge gain through the online case study as the dependent variable.

The knowledge gain was calculated as the difference between post-test score and pre-test score. According to Kolb's theory, there are four different learning style preferences: accommodating, assimilating, converging, and diverging. Based on this, students were divided into four groups. Fifty-two students owned accommodating styles, 19 owned assimilating styles, 8 owned converging styles, and 32 owned diverging styles. The groups' sample sizes were not equal and did not meet the assumptions of ANOVA. An alternative method, the Games-Howell Post Hoc test was chosen to be used for the data analysis. Games-Howell (GH) is considered to be robust when sample sizes and variances are not equal across compared groups (Field, 2000). It is recommended to be used when group sizes



are greater than 5. The smallest group size in the study was 8. So the data met the assumption of using GH Post Hoc test.

It was hypothesized that there was no statistically significant difference between these four groups of students on their knowledge acquisition through the online case study. The GH Post Hoc test results showed that there is a statistically significant difference in students' performance between the accommodating learning style group ( $M_{\text{post-pre}} = 2.87$ ) and the diverging learning style group ( $M_{\text{post-pre}} = 4.81$ ). There is no statistically significant difference between other learning style groups on their performance through the online case study.

Table 7

Distribution of Student Numbers for Each of Kolb's Learning Style Preference

		Value Label	N
LSI	0	accommodating	52
	1	assimilating	19
	2	converging	8
	3	diverging	32

Table 8

Knowledge Acquisition ANOVA Test Results

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	82.37	3	27.46	3.92	.01
Intercept	1004.64	1	1004.64	143.41	.00
LSI	82.37	3	27.46	3.92	.01
Error	749.59	107	7.01		
Total	2339.00	111			
Corrected Total	831.96	110			

Table 9

## Games-Howell Post Hoc Test for Students' Knowledge Acquisition

(I) Learning Style	(J) Learning Style	Mean Difference (I-J)	Std. Error	Sig .	95% Confidence Interval	
					Lower Bound	Upper Bound
accommodating	assimilating	-1.35	.83	.39	-3.63	.94
	converging	-.38	.99	.98	-3.51	2.74
	diverging	-1.95	.58	.01	-3.48	-.41
assimilating	accommodating	1.35	.83	.39	-.94	3.63
	converging	.96	1.21	.86	-2.50	4.42
	diverging	-.60	.91	.91	-3.06	1.86
converging	accommodating	.38	.99	.98	-2.74	3.51
	assimilating	-.96	1.21	.86	-4.42	2.50
	diverging	-1.56	1.06	.48	-4.75	1.62
diverging	accommodating	1.95	.58	.01	.41	3.48
	assimilating	.60	.91	.91	-1.86	3.06
	converging	1.56	1.06	.48	-1.62	4.75

*Research Question Three**Quantitative Data Part*

Research question three examined whether there was a difference between the learner groups with different learning style and their reactions to the online case study. What

elements of the case study do learners find beneficial and distracting to their learning based on their learning styles? Descriptive analysis was used for answering this question. The results of the crosstabulations of students' overall reactions and students' reactions to the navigation, the content map, and the assistants by student groups with different learning style preferences are presented in Table 10 through 14.

#### *Students' General Reactions to the Case Study*

Part one of the survey questionnaire was designed to examine students' general reactions to the case study. Overall, there is no difference between learner groups with different learning style preferences and their reactions to the online case study. When asked whether the case study was difficult for them to use, sixteen percent of students felt that the case study was difficult for them to use; forty three percent of students felt it was easy for them to use; and forty one percent thought it was neither difficult nor easy for them to use. When asked whether the case study was satisfying for them to use, twenty eight percent of students felt that the case study was satisfying for them to use; sixty two percent of students expressed neutral opinions; and eighteen percent of students felt it was frustrating for them to use. When asked whether the case study was very entertaining for them to use, twenty eight percent of students agreed that the case study was very entertaining for them to use; fifty five percent kept neutral opinions; and eighteen percent did not find it to be entertaining.

Table 10

## Crosstab Results regarding Students' Overall Reactions to the Case Study

Overall Reaction	Group Total	Group 1	Group 2	Group 3	Group 4
Q1: Overall, the case study was					
Difficult for me to use	19	11	4	0	4
Neither difficult nor easy for me to use	49	23	6	4	16
Easy for me to use	51	21	10	5	15
Q2: Overall, the case study was					
Frustrating for me to use	21	12	3	1	5
Neither frustrating nor satisfying for me to use	74	31	13	7	23
Satisfying for me to use	25	13	4	1	7
Q3: The case study was very entertaining for me to use.					
Agree	33	17	3	3	10
Neither agree nor disagree	65	30	13	5	17
Disagree	21	9	4	1	7

Note. Group 1 = accommodating, Group 2 = assimilating, Group 3 = converging, and Group 4 = diverging

*Students' Reactions to the Navigation*

The case study addressed the topics of FCAT standardized testing and classroom assessment and, as mentioned earlier, incorporated scenarios with different branches or paths determined by student choices. When learning the case study, students could choose to follow different paths and read different scenarios based on their decisions. There is no difference between learner groups with different learning styles and their reactions to the navigation.

Sixty one percent of students tried to review same storylines they had chosen before; fifty nine percent of students tried to explore new storylines for the same character; and fifty eight students tried to explore all the possible storylines covered in the case study. Twenty eight students (22%) reported that they had tried all the possible ways of navigating the case study, including reviewing the same storylines they had chosen before, exploring new storylines for the same character, and exploring all the possible storylines covered in the case study. Sixty four students (53%) reported that they had tried two of the approaches ways described above. When asked whether the case study was easy for them to navigate through, fifty nine percent of students thought it was easy; thirty percent neither agreed nor disagreed; eleven percent thought it was difficult. Comparing students' reactions to the case study with their prior case study experience and prior WebCT online learning experience, no relationship was found either.

Table 11

Crosstab Results regarding Students' Reactions to the Navigation

Navigation	Group Total	Group 1	Group 2	Group 3	Group 4
Q1: Which case did you explore?					
Bob's case	15	9	1	1	4
Jane's case	23	12	3	0	8
Both Bob and Jane's case	78	33	16	8	21
None of the cases	4	2	0	0	2

Q2: When browsing a case scenario, did you go back and review the same story line you have chosen before?

Yes	73	32	15	4	22
No	47	24	5	5	13
Q3: When browsing a case scenario, did you select a new story line for the same character?					
Yes	70	30	15	7	18
No	49	25	5	2	17
Q4: Did you try to explore all the possible story lines for both characters?					
Yes	70	33	15	5	17
No	50	23	5	4	18
Q5: The case allowed you to take several different paths as you follow the stories. Please respond to the choice that best described your experience. Overall, the case study was:					
Difficult for me to navigate through	13	9	1	0	3
Neither difficult nor easy for me to navigate through	36	13	6	3	14
Easy for me to navigate through	71	34	13	6	18

*Note.* Group 1 = accommodating, Group 2 = assimilating, Group 3 = converging, and Group 4 = diverging

### *Students' Reactions to the Assistants*

In order to better connect the case scenarios with the concepts covered in the measurement and evaluation field, two assistants were designed for the case study. One is “Mr. Expert” who works as a subject expert for Bob’s case (see Figure 4) and the other is “Ms. Brooky” who is Jane’s coach (see Figure 5). As agents operating in the Flash environment, these assistants explained the concepts and provided extended knowledge related to the case scenarios, when users called on them. When users had questions related to

the content they were browsing, they called for help from these two assistants. Again, from the data, there was no difference between learner groups with different learning style and their reactions to the use of assistants. Not many students used the assistants when they browsed the case scenarios. About thirty six percent students reported that they used Mr. Expert and Ms. Brooky. Most of the students who had used these assistants thought that these assistants were helpful for their study, with eighty three percent and ninety three percent respectively for Mr. Expert and Ms. Brooky.

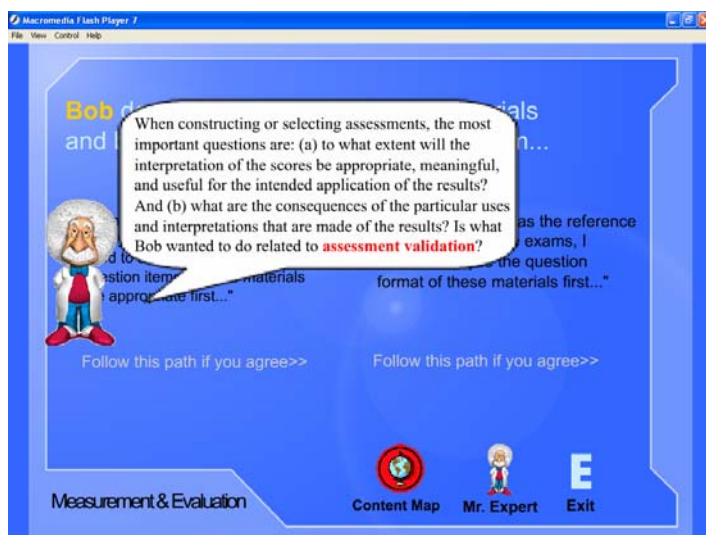


Figure 4: The assistant “Mr. Expert” and how it works in Bob’s case

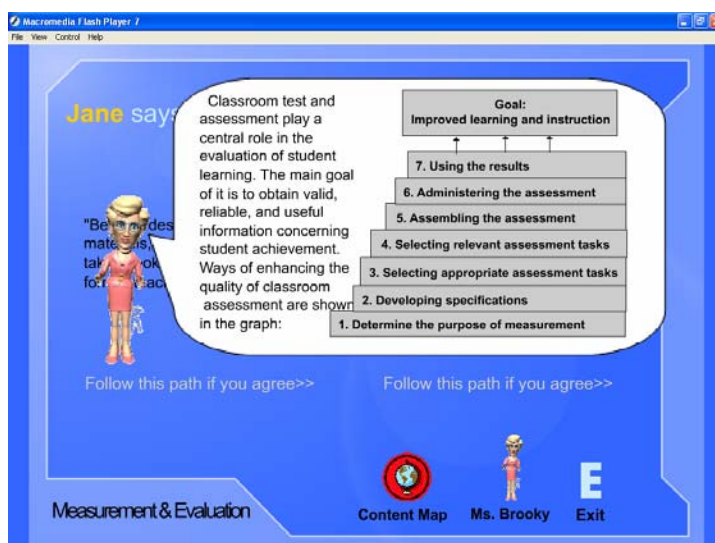


Figure 5: The assistant “Ms. Brooky” and how it works in Jane’s case



Table 12

## Crosstab Results regarding Students' Overall Reactions to the Assistants

Assistants	Group Total	Group 1	Group 2	Group 3	Group 4
Q1: Did you use the assistant: Mr. Expert when you browsed the case scenario?					
Yes	42	19	8	3	12
No	75	36	11	6	22
Q2: Do you think the assistant: Mr. Expert helped you?					
	35	15	8	3	9
Q3: Did you use the assistant: Ms. Brooky when you browsed the case scenario?					
Yes	42	19	8	3	12
No	75	36	11	6	22
Q4: Do you think the assistant: Ms. Brooky helped you?					
	39	17	8	3	11
Q5: Why did you use the assistant: Mr. Expert or Ms. Brooky?					
a. Because I was curious about what they would say	38	21	5	3	9
b. Because I wanted to know more information about the topic	17	6	7	2	2
c. Because I needed help for using the case	6	2	1	0	3
d. Because I wanted to do well on the quiz section	9	5	1	0	3
e. Because of another reason that is not listed above	20	5	3	1	11

*Note.* Group 1 = accommodating, Group 2 = assimilating, Group 3 = converging, and Group 4 = diverging

### *Students' Reactions to the Content Map*

To increase students' capability to monitor their coverage of the content presented in the case study, two content maps were added for these two cases. Students could review their process in the case study anytime they wanted by clicking the content map button. Using the maps, they could see where they were and what they had covered. The content map was provided to support students who needed a more structured visual guiding when browsing through the cases. Thirty five percent students used content maps to help them browse the cases. For those students who used content maps, seventy eight percent thought it was helpful. Students with different learning style preferences showed no difference in their reactions to the content map.

Table 13

#### Crosstab Results regarding Students' Reactions to the Content Map

Content maps	Group Total	Group 1	Group 2	Group 3	Group 4
Q1: Did you use the content map?					
Yes	41	19	11	2	9
No	78	37	9	7	25
Q2: Do you think the content map helped you?					
	32	14	8	2	8

*Note.* Group 1 = accommodating, Group 2 = assimilating, Group 3 = converging, and Group 4 = diverging

### *Students' Reactions to the Practice Quiz*

The practice quiz was another element set in the case study to help students self-check and revisit sections of the case study. At the end of the cases, the users were able to take a

low-stakes quiz that helped them to see which topics they had covered, and how well they recalled what they read. Feedback was shown immediately after students selected their answer. Students could read the feedback and understand more about the concepts and content covered in the case. From the data, there is no difference between student groups with different learning styles and their reactions to the practice quiz. Compared with other elements in the case study, more students chose to do the practice quiz. Eighty two percent of students used the practice quiz to self-check whether they understood the case study. Of these students, seventy six percent thought that the practice quiz was helpful.

Table 14

Crosstab Results regarding Students' Reactions to the Practice Quiz

Practice quiz	Group Total	Group 1	Group 2	Group 3	Group 4
Q1: Did you use the practice quiz?					
Yes	98	45	17	7	29
No	21	11	3	2	5
Q2: Do you think the practice quiz for Bob and Jane helped you?					
	74	30	12	6	26

*Note.* Group 1 = accommodating, Group 2 = assimilating, Group 3 = converging, and Group 4 = diverging

*Qualitative Data Part*

Qualitative research is any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification (Strauss & Corbin, 1990).

Interpretivism is a way to gain insights through discovering meanings by improving our comprehension of the whole. The central questions of interpretive research concern issues of

human choice and meaning (Erickson, 1986). In that sense, they concern issues of improvement in educational practice.

To identify and analyze students' reactions to their online case study experience, a series of subjective questions were used. There were five open-ended questions addressing students' opinions about the case study. Students' responses to each of the open-ended question were manually bracketed to the positive, neutral and negative feedback category with a code placed in the adjacent margin to facilitate sorting the data. Students' demographic information and test scores were also used in the analysis process for constructing meaning through induction. By analyzing the data, three assertions were generated through induction.

Assertion 1: Students who are in-service teachers and pre-service teachers preferred using case study while students who are not teachers are more willing to choose textbook reading.

Assertion 2: Most students feel that reading the characters' words and taking the practice quiz is helpful for their learning. Those students who used the content map and the assistants also found they are useful. But many students feel that the moving buttons in the case study distracts their learning.

Assertion 3: Students with high scores in the knowledge tests think the case study is interactive, interesting, challenging, and easier to read. They either want to use the cases or want to combine the case study with the textbook reading. On the other hand, students with low scores in the knowledge tests think that the case study is confusing.

*Assertion 1:*

To test the evidentiary warrant for the assertions, a systematic search of the entire data set was conducted. Students' writing responses to the open-ended questions in the survey questionnaire, their demographic information, and their knowledge scores were thoroughly reviewed. In the process, the researcher collected the items of data as analogous instances of the phenomenon for the assertion.

For example, to test assertion one, the researcher first searched the data base for all instances. When asked whether they would like to choose textbook reading or case study based on their learning experience, seventy four percent students said they would like to choose the case study. Among these students, most were pre-service teachers or in-service teachers. They thought that the case study was "interactive," "challenging," "involving more participation," "more practical," "more interesting," and "more hands on."

However, for other students who were not teachers, more than half of them wanted to use textbook for learning. This part of students thought that textbook reading was "easier for them to memorize the facts," "more convenient," and "easy for reference." The quotes from the students' responses were shown in the Table 16.

Table 15

Number of Students who Indicated Selected Judgments Regarding  
Whether to Choose the Case Study or the Textbook Reading

	Pre-service teachers	In-service teachers	Non-teachers
Prefer to choose the case study	63	12	4
Prefer to choose the textbook reading	12	3	12

Table 16

Students' Quotes about Their Opinions of the Case Study versus the Textbook reading

	Teachers	Non-teachers
Case study vs. Textbook	<p>“The case study is presented in a more interesting format than simply reading a textbook. The case study is easier to read and it keeps my attention better because it’s different from a textbook reading.”</p> <p>“I would use the case study. It was more interactive and easier to understand when placed in real life situations. I enjoyed the layout and it’s more interesting as well.”</p> <p>“Yes, I feel a case study has more validity to learning because you see what the next step will be based on the choices you make.”</p> <p>“Definitely a case study; it is more like a story than a bunch of facts.”</p> <p>“I think I would use the case</p>	<p>“I would use the book because it is more factual and easier to understand because it is more universal.”</p> <p>“I prefer a textbook. The textbook is straight and narrow, the information is provided and I know what to expect.”</p> <p>“No, because I like use books. I learn better when I have something in my hand and am able to flip through at my will. I can also keep track of what I am learning better with a book.”</p>

study. It is more hands on. It walks you through it step by step and it pretty much answers any questions you have.”

“Yes! It is much more interesting for me to learn this way. It kept my attention and because it was interactive, I think I learned more and quicker.”

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*Assertion 2:*

Assertion two addresses the elements students felt helpful or distracting in their case learning experiences. From reviewing the data, the researcher found that this was another topic mentioned often by students. It was obvious that students thought that the case characters’ opinions, in other words, the case scenarios helped them a lot. Of the ninety three students who answered this question, fifty two thought that what the characters said was most helpful to them when using the cases. Some of the students’ quotes included:

“Reading the characters’ words. Because it made it more interesting. Seemed like a play, instead of reading the actual study.”

“I think reading the characters words was most beneficial because it allowed me to see different perspectives of different people on the subjects being discussed.”

“Reading the characters’ words. This option was the most helpful because it provided you, the reader with their thoughts on what the situation was. This was like someone talking to you rather than you reading something.”

Besides, students also thought the practice quiz was very helpful. Forty three students chose this option as something helped them most in the case study. They thought that the

practice quiz summarized what they should take from the case study with clear answers and tested their comprehension. They especially liked the prompt feedback upon their choices of the answers. Some of the students' quotes included:

“Taking the practice quiz for Bob and Jane seemed to be the most helpful to me in using the cases. The questions were clear and the ones I got wrong were shown to me at the end of the quiz.”

“Taking the practice quiz because it stayed within the storyline incorporating the concepts being taught. It also let you know which answers were right/wrong and explained why.”

The content map and the assistants were set as optional elements in the case study. Students could choose to read them or not based on their own decisions. Some students did not choose them when doing the case study. However, for those students who had used these elements, they thought these elements were helpful. They also made some suggestions about how to revise these elements for better usage. For example, they liked the content map because “it allowed them to visually see how ideas fit together.” One student commented that “Seeing the content map of Jane and Bob’s case is important for me. This is because it helped me to organize the information with some order. For example, I could remember that that one topic was associated with Jane and her first choice because I could visually picture the concept map of ideas.” They also recommended that the content map would be more functional “if it offered the functions for them to trace the routine they had browsed.” Students also thought that the assistants were helpful. One student wrote that “I found that Mr.



Expert and Ms. Brooky were the most helpful to me. They clarified any questions that I had. They explained everything very clearly and it was pretty neat to have them there.”

Besides the positive feedback about these elements in the case study, students also listed the things they did not like in the case study. For the majority of the students, they did not like the moving button and too many animations in the case study. They thought those “flashing words or bouncing words” distracted their focus on the case study.

*Assertion 3:*

The review of students’ responses also revealed that those students with high scores in the knowledge tests have more positive reactions to the case study than those with low scores. For those students with high scores, they liked the options that they could choose to follow different paths and to see different scenarios based on their own choices. One student wrote that “I think the case study is more interactive. I had a choice about which option I wanted, so I was more interested in what it would say, in comparison to just reading what is placed in front of me in a text book. And when I was finished, I was still curious what the other option would say, so I checked that out as well.” Another student commented that “This was nice because it was hands on for me and although I had to read it, it was more visually stimulating and computer based which is great for me!”

But for those students with low scores, they thought it was confusing that there were so many paths in the cases and felt they lost the track sometimes. One student said that “It was a little confusing having the two comments on the page and then it asked you to agree with one or the other, and that was confusing.” Another student wrote that “Case studies seem childish. I would rather read one chapter and get it over with than spend forever on my computer going

through all the little modules and tests. Plus, my computer is super slow sometimes... it's just less of a hassle to browse the book.”

### *Summary*

This chapter presented the data as it was collected and analyzed for the intent of investigating the significant mean differences in scores on knowledge tests taken by students categorized by the Kolb's Learning Style Inventory as having accommodating, assimilating, diverging and converging learning style preferences. Students' performance reflected by the mean difference on their pre-test and post-test were also reviewed to examine whether or not the online case study module had an impact on the students' learning performance on the test. The students' feedback was also analyzed using descriptive statistics and interpretivism. No differences were found between students with different learning style preferences on their reactions to the case study experience. Using interpretivism, three assertions were generated which focused on students' reactions to the online case study.

## CHAPTER FIVE: DISSICUSION

### *Introduction*

The purpose of this study was to examine the relationship between learning styles and student performance on a pre and post test, using an online case study, while also documenting their reactions to the online case study. Kolb's learning style inventory and the learner feedback survey questionnaire were given to students as two surveys respectively before and after the case study. Scores on Kolb's learning style inventory were used to classify the students who participated in the study as having either accommodating, assimilating, diverging, or converging learning style preferences.

Within this study, two parallel tests were administered as timed multiple choice tests before and after the case study. As presented in chapter four, a paired samples t-test was used to analyze gain scores of the students in order to examine the possibility that the means of the pre-test and post-test were different among the students. The significant mean difference between gain scores of the accommodating, assimilating, diverging, and converging groups on the pre-test and post-test were also analyzed. Furthermore, differences in students' reactions to the case study were analyzed and reviewed using descriptive statistics and interpretivism (Erickson, 1986).

Table 17

Research Questions, Data Sources, and the Findings for Each Question

Research question	Data source	Findings
1. Is there a significant difference between learners' subject knowledge before and after using an online case study?	Students' pre-test and post-test results	There was a statistically significant mean difference between learners' performance before and after the online case study, $t(110) = -14.116, p = .00$ .
2. Is there a significant difference between the learner groups with different learning style preferences and their knowledge acquisition when using an online case study?	Students' learning style preferences and their pre-test and post-test results	There was a statistically significant difference on students' performance between the accommodating learning style group and the diverging learning style group.
3. Is there a difference between the learner groups with different learning style preferences and their reactions to the online case study? What elements of the case study do learners find beneficial and distracting to their learning based on their learning styles?	Students' learning style preferences and their feedback survey questionnaire results	There was no difference between the learner groups with different learning style preferences and their reactions to the online case study. Three assertions were generated drawing from the qualitative data.

This chapter provides a brief summary of the findings of the study, discussing the research questions, implications for practice, and recommendations for future research.

*Discussion*

The examination of scores and reactions among students who studied the online cases indicated that on average the students' performance on the knowledge test improved after using the case study. After studying the online cases, students' post-test scores were

significantly higher than their pre-test scores. Students with different learning style preferences showed some differences in their approach to learning in an online case study environment. However, differences in student' reactions to the online case study were not evident when analyzed according to their learning style preferences.

### *Research Question One*

Research question one asked: Is there a significant difference between learners' subject knowledge before and after using an online case study?

Of the 111 students who finished the two knowledge tests, the means for their pre-test and post-test scores were 13.94 and 17.62 (out of a possible 25). Using paired samples t-test, a significant mean difference was found between pre-test and post-test scores. This documented that on average students' performance on the test improved after using the online case study. There might be two reasons for scores that were below the highest possible score of 25. First, this research project was not part of students' course requirements and because it was an extra work for students, students' motivation might be affected and they might not devote enough time to work on it. Second, as long as students finished all the tests and survey questionnaires, they could get the five credits assigned to this case study project. Because the test results would not be counted in students' course grades, students might not take the tests as seriously as they should have.

The study supports the findings of prior studies involving case study and knowledge acquisition. Cunningham and Thorkildsen (1996) reported that case studies were effective for knowledge acquisition and transfer. In their study, educationally significant differences were shown in students' knowledge gain from pre-test to post-test. Carlson (1999) asserted that

case methods improved student learning. His study showed that students who scored high in the case projects also scored high on their examinations. Mayo (2004) also suggested that students who experienced a case study could readily relate course content to real-life scenarios. These students also outperformed those who studied in traditional settings in areas of comprehension and application of knowledge. He asserted that cases can be used to connect theoretical and applied knowledge (Mayo, 2004).

The study also supports the findings of Williams (1996) and Mizukami (2002) who examined case studies and their usage in teacher education. Williams (1996) suggested that cases can convey the true complexity of schooling. She advocated the use of cases and thought that they prepared pre-service teachers for the “real world” of schooling. After taking courses integrated with case studies, many pre-service teachers reported that they better understood the connections between research and practice. Mizukami (2002) analyzed the effectiveness of teaching and learning case studies in promoting teachers’ content knowledge. He asserted that analyzing cases more directly connected to teaching practice and helped teachers with knowledge acquisition. All these findings suggest that case studies can be used in education programs as an effective learning tool. Moreover, case studies can be used in teacher education programs to help teachers better connect theoretical knowledge to practice.

### *Research Question Two*

Research question two asked: Is there a significant difference between the learner groups with different learning style preferences (measured by Kolb’s Learning Style Inventory) and their knowledge acquisition when using an online case study?

Of the 111 students who finished the two knowledge tests, there were 55 accommodators, 19 assimilators, 8 convergers, and 32 divergers. Due to the different sample sizes between learning style groups, the Games-Howell Post Hoc test was used to analyze the data. Results showed that there was a statistically significant difference in students' performance between those students with the accommodating style and those with the diverging styles.

The study supported Rouke and Lysynchuk's (2000) study results. In their study, a significant difference was found between divergers and accommodators with divergers scoring higher than accommodators. The study partially supported Oughton and Reed's (2000) study. Oughton and Reed asserted that divergers and assimilators performed better in the knowledge test than students with other learning style preferences. In contrast to this research, Kraus (1996) indicated that learning styles had no significant effect on knowledge and the total time students spent using a case-based hypermedia program. McWilliams's 2001 study also found that there was no significant relationship between gain scores and students' learning styles. Although prior research showed mixed results, the findings from this research study suggest that learners may perform differently, relative to their learning styles, after studying related content using an online case study.

### *Research Question Three*

Research question three asked: Is there a difference between the learner groups with different learning style preferences (measured by Kolb's Learning Style Inventory) and their reactions to an online case study? What elements of the case study do learners find beneficial and distracting to their learning based on their learning styles?

Using descriptive statistics to analyze learners' survey questionnaires, there was no difference found between learner groups with different learning style preferences and their reactions to the online study. Overall, most students felt that the case study was not difficult for them to use. They thought that the case study was easy for them to navigate through and tried to explore different paths and browse different scenarios. Some of the optional functions like the assistants and the content map were not used as often as the others like the practice quiz. But to those students who had used them, they thought these elements were helpful. Most students chose to take the practice quiz after browsing the cases and thought the practice quiz was helpful too. Using interpretivism to analyze students' responses to the open-ended questions in the survey questionnaire, three assertions were generated.

Assertion 1: Students who are in-service teachers and pre-service teachers preferred using the case study while students who are not teachers are more willing to choose textbook reading.

Assertion 2: Most students feel that reading the characters' words and taking the practice quiz are helpful for their learning. Those students who used the content map and the assistants also found they are useful, however many students felt that the moving buttons in the case study distract their learning.

Assertion 3: Students with high scores in the knowledge tests think the case study is interactive, interesting, challenging, and easier to read. They either want to use the cases or want to combine the case study with the textbook reading. On the other hand, students with low scores in the knowledge tests think that the case study is confusing.



The study results support Harris, Dwyer, and Leeming's (2003) study results. Their research study indicated that students' learning styles had no significant impact on their reactions to the online module. It was shown that learners with higher scores on their online test had higher feedback on the online study. The findings seemed to suggest that compared with learning style preferences, learners' scores positively related to their feedback regarding the online study. In contrast, Du and Simpson (2002) found that learning style had a moderate positive relationship with the students' enjoyment level in a web-based learning environment.

#### *Discussion 1: Overall Reactions to the Case Study*

Although there was no difference found in the study regarding learners with different learning styles and their reactions to the online case study, the study results showed that many learners (74%) favored using the case study and developed positive reactions through their case study experiences. It indicated that a well-designed case study could be used to engage and motivate students with different learning styles. As Ma (1998) pointed out, one troublesome aspect of survey research is the large number of respondents who choose a neutral response on forced-choice questionnaires. In the survey feedback questionnaire, a number of students had neutral responses to the questions regarding their reactions to the online case study. There might be two explanations to this phenomenon. First, the neutral option allows respondents to state that they have no opinion or have not thought about a particular issue. Frequently, offering respondents a middle alternative in a survey question will make a difference in the conclusions that would be drawn from the data. Most of the time, the middle option of an attitudinal scale attracts a substantial number of respondents who

might be unsure of their opinions (Walonick, 2004). So, perhaps four choices would more clearly define the nature of participants' responses.

As described in the following discussion, students liked some of the elements in the case study and recommended that some elements could be better designed to assist their learning. On the other hand, most students didn't like the animated words in the case study. The researcher could only speculate that the conflict between liking the case and wanting to see improvements might be another reason students selected neutral responses on the survey questionnaire.

#### *Discussion 2: Storylines in the Case Study*

The case studies used in this research contained different storylines that showed multiple perspectives of case scenarios, giving students more choices to see what may happen in real school situations. "It prepared people to select, adapt, and combine knowledge and experience in new ways to deal with situations that are different than the ones they have encountered before" (Spiro, 2002). Students showed interest in exploring these story lines because they reported that the storylines were more interactive, more challenging, and more practical. They also liked the way that the case study was designed as a conversational case study. The case characters used dialogues to discuss the problems they met and how they solved them, step-by-step. The students felt it was interactive and interesting.

On the other hand, the case format still needs to be revised. In the current case study, students needed to follow different branches. When they finished browsing one storyline, they needed to choose whether they wanted to browse other story lines. Some students commented that they sometimes missed some storylines or forgot what they had just browsed

because there were too many choices for them to make. Although a content map was set in the study to help students navigate through each case, at the current phase the content maps were not linked to the storylines. Students commented that the content maps helped them with navigation, but were not as effective as they wanted them to be. Because some of the elements (e.g., the content map, the assistants) were optional, some students didn't realize their existence and didn't use them. Students also suggested that these elements should be mandatory so they wouldn't miss them.

For instructional designers, ways of better designing and constructing online case studies is an issue that needs to be considered carefully. Instead of developing different storylines and making students choose back and forth, an online case study can be designed as a topic-based case study. Each story line can be written as a mini-case. So students don't need to choose between different storylines. A revised online case study could include a case scenario introduction and multiple mini-cases describing different perspectives related to this case scenario. Students still need to decide which mini-case they want to browse and still get the chance to see different perspectives for each scenario. They, however, do not need to worry about whether they have missed a story line or not. The cases can be designed as supplemental materials too, for students who favor textbook reading.

### *Discussion 3: The Content Map, the Assistants, and the Practice Quiz in the Case Study*

The content map, the assistants, and the practice quizzes were optional functions in the case study. Not all students tried these elements. Thirty five percent of the students used content maps to help them browse the cases; thirty six percent of students used the assistants to help them understand the concepts covered in the cases; and eighty two percent of students

used the practice quizzes to self-check whether they understood the concepts and content covered in the cases. Although some elements like the content map and the assistants were not used as often as the practice quizzes, students who had used them thought these elements were helpful.

On the one hand, the content map helped students clarify the concepts covered in the cases and the topics they would browse. On the other hand, it is only a flow chart and is not linked to any storylines. Some students suggested that the content map should be designed as an advanced organizer (Woolfolk, 2001). When they click on a concept covered in the map, they want to be led to the corresponding storyline in the cases. In the future, the researcher wants to revise the content map and make it more functional, like an advanced organizer. The future content maps can still cover topics discussed in the cases and can still use flow charts to show the structure of the cases. Moreover, links can be set up between the map and case content to help students navigate.

There are two assistants in the case study: Mr. Expert (for Bob's case) and Ms. Brooky (for Jane's case). Students who used them thought they were very interesting. Of those students who had used the assistants (n=42), eighty three percent thought Mr. Expert was helpful and ninety three percent thought Ms. Brooky was helpful. In the current case study project, the assistants were set as small buttons on lower right corner of the interface. When students wanted to seek help from an assistant, they clicked the button and the assistant would appear in a pop-up window. Students reported that they sometimes missed the assistants because they focused on choosing the different storylines. They also said that they wanted the assistants to be mandatory so they wouldn't miss the information covered by them.

Instead of using pop-up windows, in the future the researcher can put the assistants and their words in a settled window and place it on the right side of the case study interface. When students read the content of a case they can always read what the assistants say about that certain scenario.

The practice quiz is the third optional element set in the case study. Compared with the other two elements, more students (82%) chose to do the practice quiz. Of these students, seventy six percent thought it was helpful. The value of the practice quiz lies in that it is a low-stakes quiz. Students can take it as many times as they want. They do not need to worry about whether the results are counted in their grades or not. Students thought that the practice quiz was very effective in helping them to understand the case study and prepare for the post-test. They also liked the immediate feedback in the practice quiz because they could know whether they chose the right answer or not and why. In the future study, the practice quiz will still be used.

#### *Discussion 4: Students' Scores in Relationship to Their Reactions to the Case Study*

Assertion three showed that students' knowledge test scores were congruent with their reactions the case study module. Students with high scores thought the case study was interesting and interactive while those with low scores thought that the case study was confusing.

According to constructivism, students construct new knowledge actively. When they perceive valuable and meaningful learning tasks, they actively engage in the learning tasks and use effective learning strategies to integrate their existing knowledge with new experiences (Tuan, Chin, & Shieh, 2005). On the other hand, when students do not perceive

the value of learning tasks, they use surface learning strategies to learn (Pintrich & Schunk, 1996). For those students who liked the case study, it can be surmised that they had a higher motivation and thought that the case study was an effective way to learn the content. So they might be more engaged in learning the case study and spent more time on it. On the other hand, when students felt the case study was a confusing way of learning the content, they didn't perceive the value of the case study. Consequently, they might only use some surface learning strategies such as memorization to learn which eventually affected their test scores. The findings of the study seem to suggest that a more appealing designed case study can lead to better outcomes in terms of achievement. On the other hand, when students are less prone to achievement, they might be less engaged in the study.

#### *Discussion 5: Other Considerations Related to Students' Reactions*

The data did not indicate that students' previous online learning experiences and their previous case study experiences affected their reactions to the online case study. From students' written comments, however, the researcher found that some students mentioned that they would not choose case study simply because they did not want to sit before the computer for a long time or they did not like reading on the computer screen. This might be an extraneous variable affecting the research results and needed to be considered in future studies.

#### *Implications for Practice*

It was indicated in this study that students' performance to the test improved after using the cases and felt that the case study helped them connect those concepts to real school

situations. Using a paired samples t-test, all four groups of students with different learning styles showed significantly higher post-test scores than their pre-test scores. This means that no matter what learning styles students have, performance can be affected by the case study method.

From the students' perspective, they need abundant opportunities to reflect on their own experiences, to deepen their understanding of subject matter, and to gain a wider comprehension of pedagogical practices. Case studies offer them a particular approach to formulate "what teachers know and can do" (Merseth, 1999). Considering the findings of this study and the appeal of case studies, it is advisable to continue using them in the teacher education program.

For instructors and instructional designers, the results of the study can be used to help better design online case study materials. The constructive advice written by the students in the feedback survey questionnaire was especially helpful. For example, as mentioned earlier students pointed out that those optional functions like the content map and the assistants should be mandatory and when they click on certain links in the map, it would be helpful if the map could lead them to the certain paths for navigation. These suggestions are all very useful for better designing the case materials.

In the process of conducting this study, the researcher also realized that technology should only be used when necessary. In the study, the researcher used animated words in the cases to label different story lines and thought that it would attract students' attention. However, most students reported that these animated words distracted them from studying the cases. This result let the researcher think more about the usage of technology in the

instructional design process. It is suggested that when designing an online learning materials instructional designers should think carefully about which technology to use and why it should be used.

### *Recommendations for Future Research*

There are several possible areas for future research in this field. First, with the fast development of online learning in education and training, how to better incorporate case studies into teacher education programs needs to be further examined. Case studies can be used both in online learning environments and in face-to-face classroom settings. There are a number of studies addressing case studies and their usage in teacher education. Previous literature showed that case studies have been widely used in content areas such as psychology (Ormrod, 2005; Razvi & Allen, 2005; Sudzina, 1995) and medicine (Balslev, de Grave, Muijtjens, & Scherpbier, 2005; Hulsman, Mollema, Oort, Hoos, & de Haes, 2006; Shokar et al., 2005). However, for some content areas like measurement and evaluation, there have been only a few studies ever been conducted. More research should be conducted in this area to further examine the effectiveness of case studies.

Second, this study examined case studies in a totally online learning environment. Under this circumstance, students learned the cases at their own pace. There was no way to control how long students really spent on learning the cases. Using a pre-test and post-test to measure whether student learned from the case study is still not enough. How long will students remember what they learned from the case study? Did students integrate “new knowledge” they learned from the case study with their existing knowledge structure? These are some of the questions need to be considered and further examined. There are several ways to address



these questions. First, a second parallel post-test can be administered after a period of time (e.g., a month) to measure whether students still remember the knowledge they have learned from the cases. Second, researchers can ask students to write case analysis report or even write their own cases. By using different data sources, researchers can better understand students' learning when using online case studies.

Third, when researchers study the effectiveness of a case study, it is not only important for them to understand whether students learn from the case but it is also important for them to find out how students learn from it. In this study, the researcher tried to measure whether students with different learning style preferences performed differently on a test after using an online case study. The results showed that no matter what learning style preferences students had improved performance after engaging in the case study method. The next question the researcher would like to investigate would be how students learned from this method. Is it because the scenarios helped students memorize the concepts? Or, do students actually learn from the descriptions of those assistants and supplemental materials? To further examine this, an experimental design can be done in the future to test the difference between two conditions: with or without the assistants or supplemental materials when students are all required to use the case in specific ways for specific amounts of time.

Ways of incorporating and analyzing student generated case writings can be a fourth topic for the future study. Based on Spiro's cognitive flexibility theory (1987), multiple mini-cases should be presented to let students have a deeper understand of the topics being discussed. At the current phase, all the different case scenarios included in the study were designed as different storylines for students to choose based on their decisions. Although

students were given the freedom to learn the cases following different sequences, they didn't have the chance to reflect their own opinions about these scenarios and to generate their own scenarios based on what they have learned. The participants of the study include pre-service teachers, in-service teachers and people from other field. Due to their different career backgrounds and previous experiences, they may have different reflections on the case study. In the future, pre-evaluated student generated case scenarios can be put in a case library and used by other students as learning resources.

It is recommended that researchers focus on students' reactions to their online case study experience. The current study examined students' reactions to the online case study experience by using a feedback survey questionnaire. Although the students' feedback was very helpful and informative, relying on only one data source is not enough. To better understand why students have certain reactions to an online case study, multiple data sources should be used. Student interviews, their archival records, and other documents can all be used as data sources.

### *Summary*

This study is designed to explore online case studies and their potential for teacher preparation programs. Specifically, learners' learning style preferences, their learning performances and reactions to the online case study were examined. Although students' learning style preferences did not prove to be related to their performance and reactions to online cases, the advantage of a well designed case study and its effect to students' learning has been shown from the study. In conclusion, combining instructional design principles and innovative technologies, online case studies are effective to help teachers better connect

theory to practice. Based on the results of the current study, further research has also been suggested.

**APPENDIX A: INFORMED CONSENT FORM**



Office of Research & Commercialization

October 25, 2005

Ms. Rui Zeng  
12102 Napiers Circle  
Orlando, FL 32826

Dear Ms. Zeng:

With reference to your protocol #05-3002 entitled, "**The Analysis of the Relationship between Learning Styles and the Learners' Knowledge Acquisition and Reactions through the Online Case Study**," I am enclosing for your records the approved, expedited document of the UCFIRB Form you had submitted to our office. **This study was approved on 10/25/05 and the expiration date will be 10/24/06.** Should there be a need to extend this study, a Continuing Review form must be submitted to the IRB Office for review by the Chairman or full IRB at least one month prior to the expiration date. This is the responsibility of the investigator. **Please notify the IRB office when you have completed this research study.**

Please be advised that this approval is given for one year. Should there be any addendums or administrative changes to the already approved protocol, they must also be submitted to the Board through use of the Addendum/Modification Request form. Changes should not be initiated until written IRB approval is received. Adverse events should be reported to the IRB as they occur.

Should you have any questions, please do not hesitate to call me at 407-823-2901.

Please accept our best wishes for the success of your endeavors.

Cordially,

A handwritten signature in black ink that reads "Barbara Ward".

Barbara Ward, CIM  
UCF IRB Coordinator  
(FWA00000351, IRB00001138)

Copies: IRB File  
Laura Blasi, Ph.D.

BW:bw

12443 Research Parkway • Suite 302 • Orlando, FL 32826-3252 • 407-823-3778 • Fax 407-823-3299

An Equal Opportunity and Affirmative Action Institution

## APPENDIX B: IRB ADDENDUM/MODIFICATION REQUEST FORM

Revised 09/05



### UCF IRB Addendum/Modification Request Form

This addendum form does NOT extend the IRB approval period or replace the Continuing Review form for renewal of the study.

**INSTRUCTIONS:** Please complete the upper portion of this form and attach all revised/new consent forms, altered data collection instruments, and/or any other documents that have been updated. **The proposed changes on the revised documents must be clearly indicated by using bold print, highlighting, or any other method of visible indication. Attach a highlighted and a clean copy of each revised form.** This Addendum/Modification Request Form may be emailed to [IRB@mail.ucf.edu](mailto:IRB@mail.ucf.edu) or mailed to the IRB Office: ATTN: IRB Coordinator, 12443 Research Parkway, Suite 302, Orlando, FL 32826-3252 or campus mail 32816-0150. Phone: 407-823-2901 or 407-882-1139, Fax: 407-823-3299.

- **DATE OF ADDENDUM:** 02/09/2006 to IRB# 05-3002 IRB Addendum # 06-3278
- **PROJECT TITLE:** The Analysis of the Relationship between Learning Styles and the Learners' Knowledge Acquisition and Reactions through the Online Case Study
- **PRINCIPAL INVESTIGATOR:** Rui Zeng
- **MAILING ADDRESS:** 12102 Napiers Circle, Orlando, FL, 32826
- **PHONE NUMBER & EMAIL ADDRESS:** 407-666-0918; [rzeng@mail.ucf.edu](mailto:rzeng@mail.ucf.edu)
- **REASON FOR ADDENDUM/MODIFICATION:** Changed participant number and revised instruments
- **DESCRIPTION OF WHAT YOU WANT TO ADD OR MODIFY:**
  - 1) The student participants number has been changed to 200 students, maximum
  - 2) One research question has been added in the research proposal
  - 3) The sample of student feedback survey questionnaire has been revised.

#### SECTION BELOW - FOR UCF IRB USE ONLY

Approved       Disapproved  
Full Board      IRB Chair Signature: Tracy Richy Date: 2/12/06  
Reviewer      Date      IRB Member/Designated

## APPENDIX C: KNOWLEDGE PRE-TEST

1. Which of the following is stated as a learning objective?
  - a) All students should practice using maps.
  - b) I will teach the students how to use maps.
  - c) Maps should be provided for students to use.
  - d) The student should be able to use a map.
  
2. Which of the following statements concerning validity is **wrong**?
  - a) Validity is a matter of degree (e.g., high, low).
  - b) Validity is a general quality that applies to various uses of assessment results.
  - c) Validity refers to how consistently a test measures.
  - d) Validity refers to the interpretations of test scores.
  
3. Classify the following statement according to the type of evaluation. “How do the students rank in achievement at the end of the course?”
  - a) Diagnostic evaluation
  - b) Formative evaluation
  - c) Placement evaluation
  - d) Summative evaluation
  
4. Classify the following statement according to the type of evaluation. “Are students making satisfactory progress in learning to make connections among major mathematical concepts?”
  - a) Diagnostic evaluation
  - b) Formative evaluation

- c) Placement evaluation
  - d) Summative evaluation
5. Classify the following statement according to the type of evaluation. “Should Philip be encouraged to enroll in an advanced reading course?”
- a) Diagnostic evaluation
  - b) Formative evaluation
  - c) Placement evaluation
  - d) Summative evaluation
6. The following is an example of what kind of interpretation? “Which students have achievement mastery of this computational skill?”
- a) Criterion-referenced
  - b) Norm-referenced
  - c) Raw score
  - d) Scale score
7. The following is an example of what kind of interpretation? “Erik obtained the highest score on the reading test.”
- a) Criterion-referenced
  - b) Norm-referenced
  - c) Raw score
  - d) Scale score
8. The following is an example of what kind of interpretation? “Carlos can identify all of the parts of a sentence.”

- a) Criterion-referenced
  - b) Norm-referenced
  - c) Raw score
  - d) Scale score
9. What is the first step in measuring classroom learning?
- a) Decide on the types of test to use
  - b) Decide on the learning outcomes needed to be measured
  - c) Decide on the content areas needed to be covered
  - d) Decide on the assessment techniques should be used
10. Which of the following examples belongs to the cognitive domain of the Bloom's Taxonomy?
- a) Demonstrate an interest in science
  - b) Evaluate a book
  - c) Operate a slide projector
  - d) Write smoothly and legibly
11. Which of the following is among a teacher's goals when giving a test **during** instruction?
- a) To assign course grades
  - b) To determine student placement
  - c) To determine students' prerequisite skills
  - d) To improve and direct learning through ongoing feedback



12. When analyzing the evaluation materials, Mary was thinking “Hmm...the test was intended to assess student **reading comprehension**. Is this test really appropriate to measure it?” Which type of validity is she concerned with?
- a) Assessment-criterion relationship validity
  - b) Consequential validity
  - c) Construct validity
  - d) Content validity
13. Which of the following is concerned with the content validity?
- a) Do those students who have high score in this test also tend to have high scores on the departmental examination?
  - b) What are the consequences for the student based on this test score?
  - c) To what extent does this sample of 20 words represents the total domain of 200 spelling words.
  - d) Will the teacher's pronunciation affect the student' understanding of the words?
14. Which type of assessment is used to understand student strengths and weaknesses based on observation and documentation of recurring or persistent learning problems?
- a) Diagnostic assessment
  - b) Formative assessment
  - c) Placement assessment
  - d) Summative assessment

15. When interpreting test results for parents, you mention that the student has identified the meaning of 80% of the terms used to describe fractions. What information is most important in helping you to explain the students' performance to the parents?
- a) How the students' understanding of the terms relates to their comprehension of fractions.
  - b) How other students in the same class scored.
  - c) What percentile does students' performance represent.
  - d) Whether the students' performance is average compared to the group.
16. The cognitive domain of the Bloom's Taxonomy includes all of the following **except**:
- a) Analysis
  - b) Application
  - c) Evaluation
  - d) Value
17. A child in your class earned a score of 79 on an exam. You explained to her parents that she was in the 75th percentile when compared to students nationally. Which type of interpretation does this represent?
- a) Criterion-referenced
  - b) Norm-referenced
  - c) Raw score
  - d) Scale score

18. Jennifer found that most of the students' scores on one assessment are very high. She believes it is because the sample tasks selected for the test were too easy. What problem do you think the test has?
- a) Lack of **construct** validity
  - b) Lack of **content** validity
  - c) Lack of reliability
  - d) No serious problems
19. Ted wanted to design an in-class quiz to check whether the students can identify the terms he taught during the last class. Which of the following test items is most appropriate to be used for this purpose?
- a) Essay questions
  - b) Interpretive exercises
  - c) Matching exercises
  - d) Portfolio
20. What is the first step in designing a classroom assessment for students? The teacher should develop \_\_\_\_\_.
- a) The learning activity
  - b) The learning objectives
  - c) The rubric
  - d) The test
21. Which kind of test interpretation allows you to compare the performance of one student to another in the same grade?

- a) Criterion-referenced
- b) Norm-referenced
- c) Raw score
- d) Scale score

22. How is the reliability of test results affected when ambiguous test items are used?

Reliability is \_\_\_\_\_.

- a) Decreased
- b) Increased
- c) Not affected

23. Which of the following is the **first step** to consider when designing a test blueprint?

- a) Determine the item format
- b) Make an outline of the instructional content
- c) Prepare the list of instructional objectives
- d) Prepare the two-way chart

24. Which of the following reasons is the most important when choosing whether to use an objective test or a performance assessment in the classroom?

- a) Efficiency of grading
- b) Learning objectives
- c) The amount of test time
- d) The characteristics of the students

25. How are test results affected when students are not given enough time to consider the tasks and provide thoughtful responses?

- a) The reliability of the test will not be affected.
- b) The validity of interpretations of the results will be increased.
- c) The validity of interpretations of the results will be reduced.
- d) The validity of interpretations of the results will not be affected.

## APPENDIX D: KNOWLEDGE POST-TEST

1. Which of the following best represents a statement of a learning objective? The student should \_\_\_\_\_.
  - a) Be able to locate a position on a map
  - b) Be taught to use a map
  - c) Develop more favorable attitude toward reading maps
  - d) Practice charts and graphs
  
2. Which of the following statements concerning reliability is **wrong**?
  - a) Reliability is a matter of degree (e.g., high, low)
  - b) Reliability is a general quality that applies to various uses of test results
  - c) Reliability refers to how consistently a test measures
  - d) Reliability refers to the results of a test and not to the test itself
  
3. Classify the following statement according to the type of evaluation.

"What final grade should Lindsay receive in the science course?"

  - a) Diagnostic evaluation
  - b) Formative evaluation
  - c) Placement evaluation
  - d) Summative evaluation
  
4. Classify the following statement according to the type of evaluation.

"Is Michael have the prerequisite skills needed for the new unit?"

  - a) Diagnostic evaluation
  - b) Formative evaluation

- c) Placement evaluation
- d) Summative evaluation

5. Classify the following statement according to the type of evaluation.

"What types of persistent learning difficulties are students having in learning grammar?"

- a) Diagnostic evaluation
- b) Formative evaluation
- c) Placement evaluation
- d) Summative evaluation

6. The following is an example of what kind of interpretation?

"What type of remedial work would be most helpful for a slow-learning student?"

- a) Criterion-referenced
- b) Norm-referenced
- c) Raw score
- d) Scale score

7. The following is an example of what kind of interpretation?

"Tonia defined only 20 percent of the science terms."

- a) Diagnostic evaluation
- b) Formative evaluation
- c) Placement evaluation
- d) Summative evaluation

8. The following is an example of what kind of interpretation?

"John earned an average score on an arithmetic test."

- a) Criterion-referenced
- b) Norm-referenced
- c) Raw score
- d) Scale score

9. Which of the following statements about a test blueprint is **wrong**? A blueprint is used to \_\_\_\_\_.

- a) To ensure the test measure a representative sample of instructionally relevant tasks
- b) To guide the selection of test items and assessment tasks
- c) To help construct a test over a unit or course
- d) To help the teacher to grade students

10. Which of the following examples belongs to the cognitive domain of Bloom's Taxonomy?

- a) Adhere to the rules
- b) Appreciate the contribution of scientists
- c) Identify basic concepts
- d) Write smoothly and legibly

11. Which of the following is among your goals when you give a test at the beginning of instruction?

- a) To assign remedial work
- b) To detect students' misconceptions
- c) To determine student placement
- d) To improve and direct learning through ongoing feedback



12. When analyzing the evaluation materials, Bob was thinking that

"Hmm...most of students' scores are very high in this test...Was it possible that the subject matter covered in the assessment was too easy?"

Which type of validity is he concerned with?

- a) Assessment-criterion relationship validity
- b) Consequential validity
- c) Construct validity
- d) Content validity

13. Which of the following is concerned with construct validity?

- a) Do those students who have high score on this test also tend to have high scores on the departmental examination?
- b) What are the consequences for the student based on this test score?
- c) To what extent does the sample of 20 words can represent the total domain of 200 spelling words.
- d) To what extent does the sample of 20 words can represent the total domain of 200 spelling words.

14. Which type of assessment can be used for assigning course grades?

- a) Diagnostic
- b) Formative
- c) Placement
- d) Summative

15. When interpreting the results of an algebra test to the parents, the teacher converts the student's raw score into a description of the specific tasks that he can perform. Which information is most important in helping the teacher to explain his performance to the parents?

- a) How other students in the same grade scored
- b) How the student's understanding of algebra relates to his operation of the algebra tasks
- c) What percentile does student's performance represent
- d) Whether the student's performance is above average compared to the group

16. The cognitive domain of the Bloom's taxonomy includes all of the following **except**:

- a) Application
- b) Comprehension
- c) Knowledge
- d) Organization

17. A child in your class earned a score of 83 on an exam. You explained to his parents that he was in the 79th percentile when compared with students nationally. Which kind of interpretation did you use for the explanation about the 79th percentile?

- a) Criterion-referenced
- b) Norm-referenced
- c) Raw score
- d) Scale score

18. A colleague reviewed a geography test Annie created and found that the test didn't cover all the skills that were covered during instruction. What problem do you think the test has?
- a) Lack of **construct** validity
  - b) Lack of **content** validity
  - c) Lack of reliability
  - d) No serious problems
19. Robert wanted to design a classroom assessment to check whether the students can identify the capital of those countries in Europe. Which of the following test items is most appropriate to be used for this purpose?
- a) Essay questions
  - b) Interpretive exercises
  - c) Matching exercises
  - d) Portfolio
20. What is of the highest priority when a teacher plans to design a classroom assessment for students?
- a) Analyzing students' characteristics
  - b) Outlining the content to be included in a subject area
  - c) Clearly specifying what is to be assessed
  - d) Choosing appropriate test formats
21. Which kind of test interpretation allows you to compare students' test performance in your school to that of another school?

- a) Criterion-referenced
  - b) Norm-referenced
  - c) Raw score
  - d) Scale score
22. How is reliability of test results affected by guessing?
- a) Increase the reliability of the test
  - b) The reliability will not be affected
  - c) Decrease the reliability of the test
23. What does a teacher need to prepare first when designing a test blueprint?
- a) A brief sample test
  - b) The selection of item formats
  - c) The list of instructional objectives
  - d) The two-way chart
24. Which of the following determines whether to use objective tests or performance assessments in a particular situation?
- a) Amount of the test time
  - b) Characteristic of students
  - c) Purpose of the measurement
  - d) Teacher's skill in constructing test items
25. How are test results affected when a test that is appropriate only for measuring facts is used to measure more complex skills?
- a) The reliability of the test will be increased

- b) The validity of the results will be increased
- c) The validity of the results will be decreased
- d) The validity of the results will not be affected

## APPENDIX E: FEEDBACK SURVEY QUESTIONNAIRE

Directions: Now that you have completed the case study session, please answer the following questions regarding your experience taking the module. Please be honest and answer the questions to the best of your ability. There are no right or wrong answers.

1. Overall, the case study was:
  - a. Difficult for me to use
  - b. Neither difficult nor easy for me to use
  - c. Easy for me to use
2. Which case did you explore?
  - a. Bob's case
  - b. Jane's case
  - c. Both Bob and Jane's cases
  - d. None of the cases
3. When browsing a case scenario, did you go back and review the same story line you have chosen before?
  - a. Yes
  - b. No
4. When browsing a case scenario, did you select a new story line for the same character?
  - a. Yes
  - b. No
5. Did you try to explore all the possible story lines for both characters?
  - a. Yes

- b. No
6. Overall, the case study was:
- a. Frustrating for me to use
  - b. Neither frustrating nor satisfying for me to use
  - c. Satisfying for me to use
7. The case allowed you to take several different paths as you follow the stories. Please respond to the choice that best described your experience. Overall, the case study was:
- a. Difficult for me to navigate through
  - b. Neither difficult nor easy for me to navigate through
  - c. Easy for me to navigate through
8. As you know, you read about many concepts that are important in the measurement and testing field. The case study allows you to see how some of these concepts are applied in the real school situation. Do you think the cases demonstrate these concepts clearly?
- a. Difficult for me to understand the concepts
  - b. Neither difficult nor easy for me to understand concepts
  - c. Easy for me to understand the concepts
9. Did you use the assistant: Mr. Expert when you browsed the case scenario?
- a. Yes
  - b. No
10. If you used the assistant: Mr. Expert, to the best of your recollection, how often did you seek for help from Mr. Expert? Leave the answer blank if you didn't use Mr. Expert.
- a. Once

- b. One to two times
- c. More than two times

11. Did you use the assistant: Ms. Brooky when you browsed the case scenario?

- a. Yes
- b. No

12. If your used the assistant Ms. Brooky, to the best of your recollection, how often did you seek for help from Ms. Brooky? Leave the answer blank if you didn't use Ms. Brooky..

- a. Once
- b. One to two times
- c. More than two times

13. Do you think the assistant: Mr. Expert helped you?

- a. Yes
- b. No

14. Do you think the assistant: Ms. Brooky helped you?

- a. Yes
- b. No

15. Why did you use the assistant: Mr. Expert or Ms. Brooky? (Multiple response allowed)

- a. Because I was curious about what they would say
- b. Because I wanted to know more information about the topic
- c. Because I needed help for using the case
- d. Because I wanted to do well on the quiz section
- e. Because of another reason that is not listed above.



16. A map was provided to help you navigate the case studies. Some but not all students used this tool. We are trying to see how we can better design the cases so they are easy to use.

Did you use the concept map?

- a. Yes
- b. No

17. Do you think the content map helped you?

- a. Yes
- b. No

18. The practice quiz was provided to help you understand the content and some of the concepts covered in the case study. Some but not all students used this tool. We are trying to see how we can better design the case so it is more helpful to your study. Did you use the practice quiz?

- a. Yes
- b. No

19. Do you think the practice quiz for Bob and Jane helped you?

- a. Yes
- b. No

20. The case study was very entertaining for me to use:

- a. Agree
- b. Neither agree nor disagree
- c. Disagree

21. Additional comments. Please feel free to describe the ways you would want to change

the case aspects you really enjoyed, etc. (25 lines)

22. Please answer the following questions based on your overall experience in working through the case study: If you were given the option of using a case study versus a textbook reading, would you take the case study? Why or why not? (25 lines)

23. Which of the following was most helpful to you in using the cases? Why? (25 lines)

(Select all that apply)

- a. Reading the characters' (Jane and Bob) words
- b. Reading the assistant Mr. Expert's words
- c. Reading the assistant Ms. Brooky's words
- d. Seeing the content map of Jane and Bob's case
- e. Taking the practice quiz for Bob and Jane

24. What elements of the interactive case study distracted you most? What would change it and why? Feel free to mention aspects you did not like or did not use here. (25 lines)

25. What elements of the interactive case study helped you? How? (25 lines)

26. What year are you in your program?

- a. Freshman
- b. Sophomore
- c. Junior
- d. Senior
- e. Certification only
- f. Masters-level
- g. Doctoral-level

h. Not in a program at this time

27. What's your gender?

a. Male

b. Female

28. Is English your first language?

a. Yes

b. No

29. Do you have prior experience using case studies to learn?

a. Never

b. A few times

c. Occasionally

d. Frequently

30. Do you have prior experience in using WebCT for online learning?

a. Never

b. A few times

c. Occasionally

d. Frequently

31. Have you had any training in measurement/testing before?

a. Yes

b. No

32. The knowledge of measurement, assessment, and testing is important for you to learn.

a. Strongly agree

- b. Agree
- c. Disagree
- d. Strongly disagree

33. Which of the following best describes you?

- a. Pre-service teacher. I have not led my own classroom.
- b. In-service teacher, current. I currently lead my own (or provide educational services such as a reading coach).
- c. In-service teacher, past. I have led my own classroom (or provided educational services such as a reading coach)
- d. Other, related to education field
- e. Other, not related to education field

## APPENDIX F: LEARNING STYLE RESEARCH APPROVAL LETTER

Subject: LSI Research Approval

Congratulations! Your research request regarding use of the *Learning Style Inventory* (LSI) has been approved. Attached you will find two documents (.pdf files--Adobe Acrobat 4.05):

\* LSItest.pdf - This is a copy of the LSI test. You may print or copy this document as needed for your research.

\* LSIprofile.pdf - The profile sheet contains the answer key for the test as well as the profiling graphs for plotting scores. This document may also be reproduced as necessary for your research. The AC-CE score on the Learning Style Type Grid is obtained by subtracting the CE score from the AC score. Similarly, the AE-RO score = AE minus RO.

These files are for data collection only. This permission does not extend to including a copy of these files in your research paper. It should be sufficient to source it.

We wish you luck with your project and look forward to hearing about your results.

Please email a copy of your completed research paper to [Michelle\\_Levine@Haygroup.com](mailto:Michelle_Levine@Haygroup.com) or mail it to the following address:

LSI Research Contracts

c/o Michelle Levine

HayGroup

116 Huntington Avenue, 4th floor

Boston, MA 02116

If you have any further questions, please let me know.

Regards,

Michelle Levine

Hay Resources Direct

## LIST OF REFERENCES

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