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THE EFFECT OF VARIOUS ONLINE READING STRATEGIES AND LEARNING STYLES ON STUDENT ACHIEVEMENT OF DIFFERENT LEARNING OBJECTIVES

A Thesis in

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ABSTRACT

The purpose of this study was to examine the instructional effectiveness of different online reading strategies for students identified as possessing different learning styles (internal or external locus of control) on tests measuring different learning objectives. Participants were 128 undergraduate students, randomly assigned to four online reading treatments (control, rereading, keyword, and question-answer). Immediately after interacting with their respective instruction, students received four individual criterion measures. Analyses indicated an insignificant interaction between learning style and treatment type. No significant main effect of reading strategies was found on students' learning objective scores. Students' different learning styles did not have significant main effect on the scores. Keyword strategy, however, appeared to be the most cost-effective design and encourages learning efficiency in the online environment. Results also indicated that not all the three types of reading strategies were equally effective in facilitating different types of learning objectives. Even though different reading strategies may be structurally different, they are functionally identical for raising questions relative to the cost and amount of time required for student interaction.

CHINESE ABSTRACT

此研究目的在探討對於不同學習特質的學生使用不同線上閱讀策略的學習成效。共有 128 位大學生參與此研究填寫內外在控制評量問卷，並隨機分配到四種線上閱讀策略的實驗情境〈控制組、重複閱讀組、關鍵字組、問答形式組〉。學生使用不同的閱讀策略在線上學習大約一個小時的內容之後必須完成四種考試題型。研究結果發現，線上閱讀策略及學生學習特質沒有顯著的相互影響力。學生在不同線上閱讀策略之下表現在不同學習目標的測驗上，所得的分數無顯著差異。不同學習特質的學生之間比較所得的分數亦無顯著差異。然而，關鍵字策略對於網路學習是最經濟也最能加快學習速度的設計。此研究指出，並非每一種閱讀策略皆能有效地幫助學生學習。不同的閱讀策略因在網路上設計的結構不同，對學生學習有不同的影響力，尤其在學生與學習內容互動時需花費的時間及專注力是不同的。

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Chapter 1

INTRODUCTION

The online learning environment has become more and more popular for educators and learners, due to its multiple visual and audio representations. Online learning is a trend that has the potential to enhance learning and increases the importance of knowledge of new teaching methods which apply to new learning environments (Jung, 2001; Romero, Berger, Healy & Aberson, 2000). Some learners encounter difficulties learning online, since they have difficulty changing their learning habits to accept reading electronic texts (Aragon, 2004; Steinhauer & Friederici, 2001). According to previous studies, some learners feel doubtful about their learning abilities and believe that they are not as skilled as readers who can overcome the changes in the learning process. Some learners, contrarily, maintain positive beliefs toward modifying their ability to change their learning habits. They always try their hardest to adapt to the current learning environment, since they believe that they will eventually become comfortable with reading electronic materials (Ehrlich, Kurtz-Costes, Loridant, 1993; Ferguson, 1999; Schommer-Aikins & Easte, 2006).

Reading is a communication skill. Present reading studies concluded that each reading strategy had advantages for implementation before, during and/or after reading. For example, Sorrell (1996) reviewed varied strategies before, during and after reading for improving comprehension. His research specifically involved students regarded as having difficulties in this reading skill. He presented examples of how to apply different

reading strategies such as structured questions, advanced organizers, story mapping, and question-answer relationship (QAR). Finally, Sorrell highlighted three reading strategies (QAR, story mapping, and TELLS which means Title, Examine, Look for important words, Look for hard words, Setting) and suggested teachers examine the effect of implementing those strategies systematically. Studies such as these prompt examination of the necessity for effectiveness of varied online reading strategies for enhancing student comprehension. Millis and King (2001) conducted two experimental studies with undergraduates studying psychology and found significant improvement in the students' comprehension and memory of ill-structured information as they reread, strategically, after they completed the initial reading. Fagan's (2003) observational study implemented three reading interventions (i.e. T-chart, sticky notes and key words) for English language learners. Fagan concluded that "…reading is an active process, and include comprehension is a result of engagement" (p. 42). Other text-based reading strategies are: rereading, scanning, summarizing, keywords, context clues, question answer relationship, inferring, thinking aloud, activating prior knowledge, setting a purpose, and drawing conclusions.

However, some reading strategies are not properly implemented in Web-based or online environments. For example, Sorrell's review (1996) highlighted a reading strategy, called story mapping, also called a schema-building technique. This strategy required a teacher, as a model, to demonstrate finding the structure of the text during students' reading processes as well as providing immediate feedback to students. This strategy was too complicated to implement on web-based environments due to design and technical

constraints. Furthermore, most studies did not investigate the effectiveness of adding text-based reading strategies in the newer online environments (Jung, 2001).

In addition, students, with their own learning styles, process information differently. For example, locus of control measurement can examine a personal belief in taking action during learning process (Rotter, 1966). As students perceive things differently, they employ different amounts of effort to achieve a learning objective and are regarded as having an internal or external locus of control learning style. In addition, they have different expectations for learning outcomes. Most studies indicated that students regarded as having an internal locus of control learning style used significantly more reading strategies than students having an external locus of control learning style (Fehrenbach, 1991). The internal locus of control learning style students' learning success can also be easily predicted, since they have the advantages of knowing and finding better reading strategies for comprehending texts. Maguiness (1999) implemented a sustained silent reading model for students at Westerns Springs College, Auckland, New Zealand. After random selection and interviews, eight secondary students were classified as reluctant readers and as having an external locus of control learning style. These learners needed support in every phase of the reading process. Cappella and Weinstein's (2001) study found that female Caucasians, having an internal locus of control learning style in 8th grade, New Basic academic curriculum, possessed significantly more advantages for converting their at-risk learning situation into competitive academic achievement.

In summary, this dissertation explores the effectiveness of incorporating reading strategies to the online reading environment for students with different learning styles *during* their reading process. A careful discussion is included in the last chapter.

Problem Statement

Various reading strategies have varied instructional effects on reading comprehension (Bimmel, 2001; Jung, 2001). Different reading strategies implemented *during* students' learning processes may result in different effects on their information processing methods. For example, context clue strategies using phonic instructions can significantly increase readers' reading speed and accuracy in identifying words as they read through the text. However, they may not sequentially comprehend the whole content at the same time as they recognize an unknown word by using phonic instruction (Baumann, et al., 2002; Kucer, 1992). Some non-academic factors may also need consideration before adding *during* reading strategies in the online environment for students. Whitney's (1991) research found that the environment was the primary factor in students' learning processes. Whitney (1992) also investigated students' locus of control, family backgrounds, and reading attitudes. She found that most frequent readers were female who have an internal locus of control learning style and whose parents encourage them to spend more time on reading. Therefore, what environmental factors need to be considered for online reading?

This dissertation begins by looking at students' learning styles that may influence them to process information differently as it passes from sensory memory and short

term-memory to long-term memory (Aragon, 2004; Burton, Moore & Holmes, 1995). According to Rotter (1966), some students having an internal locus of control learning style believe that the more effort they expend the greater rewards they will obtain. These students are positive learners and are easily motivated to use different strategies for pursuing positive outcomes. Contrarily, students having external locus of control learning styles are often negative learners and afraid of failure. They need substantial support and motivation for some techniques, such as online reading strategies. Generally speaking, internal locus of control learning style students nearly always perform better than external locus of control learning style students (Cappella and Weinstein, 2001; Whitney, 1992).

What kinds of online reading strategies are effective to internal or external locus of control learning style students? This dissertation examines the effectiveness of varied online reading strategies. Although more and more visual presentations populate the Web, the effect of implementation strategies for different learning style students *during* reading has yet to be investigated. Finding a useful and a proper online reading strategy for certain learning style students, especially *during* their learning process, is necessary.

Purpose of Study

The purpose of this experimental study is to examine the relative effectiveness of different types of reading strategies in measuring different learning objectives for students with different learning styles *during* their reading process in an online environment. Rotter's (1966) Locus of Control Scale is the measurement employed in this dissertation to identify readers' learning styles. Dwyer's (1972) four objective tests

measure learning performance for students with different reading strategies across different learning objectives. Three reading strategies are used in the online environment *during* the learning process: rereading, keywords, and question and answer. Specifically, the purposes of this dissertation are:

1. To examine the instructional effectiveness of different types of reading strategies in facilitating student achievement of different types of learning objectives.

2. To examine the effect of different types of reading strategies on students identified as having internal or external locus of control learning styles on tests measuring different learning objectives.

3. To examine whether or not an interaction exists between types of reading strategies and two kinds of learning styles.

Research Questions

Based on the study purposes described above, this dissertation addresses the following research questions:

1. Do significant differences exist in achievement among students receiving different reading strategies?

2. Do test results measuring different learning objectives significantly increase between and among students identified as either internal or external locus of control learners?

3. Does a significant interaction exist between learning styles and reading strategies on the different learning objectives?

Null Hypotheses

To answer the research questions described above, the following research null hypotheses need to be tested (C, R, K, and Q&A represent one control and three reading strategies: rereading, keywords and question and answer; I and E represent two locus of control learning styles: internal and external):

H_0 1. No significant differences exist in achievement tests measuring different learning objectives among students receiving different reading strategies.

$C = R = K = Q\&A$

H_0 2. No significant increases occur in tests measuring different learning objectives between and among students identified with I/E learning styles.

$C_I = R_I = K_I = Q\&A_I$ and $C_E = R_E = K_E = Q\&A_E$

H_0 3. No significant interaction exists between I/E learning styles and different reading strategies on tests measuring different learning objectives.

$C_I = C_E$; $R_I = R_E$; $K_I = K_E$ and $Q\&A_I = Q\&A_E$

Overall, the assumption is that, provided with proper reading strategies in the online environment, students identified as having internal locus of control learning styles still achieve higher test scores than the other group. The students identified as having external locus of control learning styles can obtain learning scaffolds, reading strategies, for enhancing reading comprehension.

Significance of the Study

Today, more and more materials appear in the online environment where teachers must help students comprehend information in a proper way. Teachers also need to know which reading strategy fits students' perceptions as well as learning styles *during* the process of their reading online information. As Chen and Dwyer (2003) concluded, after they reviewed the existing research of hypermedia on learning, future research has to consider students' prior knowledge and varied learning styles.

From the information processing views proposed by Atkinson and Shiffrin, learning relates to people's memories (Atkinson & Shiffrin, 1969; Burton, Moore & Holmes, 1995; Huitt, 2003). A multi-store/stage model presents learners' mental operations as they receive stimulation from the outside world. First, the sensory register (or memory) helps learners unconsciously receive information (Driscoll, 2005). Second, control (or executive) processes regulate the amount and the types of information flowing to learners from short-term, working to long-term memory (Driscoll, 2005; Schunk, 2004).

In addition, most previous research concluded that both good and poor readers were able to locate important information and retain it for a long period of time (Schunk, 2004). Therefore, to distinguish a good or a poor reader needs to review Craik and Lockhart's levels of information processing, which can explain different subsequent processes and comprehension for different readers (Schunk, 2004; Craik & Lockhart, 1972). Types of information processed by different readers vary with their comprehension

abilities, such as physical (surface), acoustic (phonological, sound), semantic (meaning), and learning efforts (Schunk, 2004). Both information processing and levels of information processing theories have confirmed that learners having different learning styles process information differently.

From cognitive views of the learning process, people usually develop or form concepts during the learning process (Burton, Moore & Holmes, 1995; Ehrlich, Kurtz-Costes & Loridant, 1993; Huitt, 2003). In a reading event, readers try to think how they can organize information for later recall with a specific strategy, such as elaboration, self-monitoring, mnemonics and so on (Romero, Berger, Healy & Aberson, 2000). In this dissertation, students receive one reading strategy to process information. Each provided reading strategy intends to enhance comprehension abilities of students with different learning styles *during* their reading processes. The intent is to examine each reading strategy's effect on students' learning achievements, especially for different locus of control learning styles.

Jung (2001) stated that only a few studies have attempted to address the theoretical or conceptual framework of Web-based instruction. Not many studies of implemented reading strategies investigated instructional effects on different learning objectives. Therefore, this dissertation contributes its findings to the field of distance education and to future e-learners.

Generalizability

Maintaining a consistent experimental study setting for each treatment group requires selecting a homogeneous group. In this dissertation research participants were undergraduate students from English, Education Psychology, and Instructional Systems classes at Pennsylvania State University in the United States (US). All students were above 18 years old, and most were in their first or the second year of study at the University. Since this dissertation was to examine a group of students' perceptions in learning rather than field independent or dependent variable effects on learning, the students had no prior medical or biological training background. They were all at the stage of establishing their generalized expectancies and learning paradigms (Rotter, 1966). In other words, these students' perceptions about learning were not solidified as compared to graduate students or senior adult learners.

This dissertation employs Rotter's locus of control measurement which allows the experimental design to obtain equal numbers of internal and external locus of control learning style students. The learning content was an expository text describing the physiology of the human heart and circulation of blood during both the diastolic and systolic phases. The content was in an online environment. In addition, prior studies had substantiated that varied online reading strategies offer different ways to process information; the students' learning styles influence information processing methods. Therefore, this dissertation focused on two variables: online reading strategies and locus of control learning styles. This dissertation also recruited the students who had interests in or were encouraged to participate in this dissertation.

Overall, the generalization of the study has limitations to participants' study year at the University, the online environment, types of reading strategies, learning content employed, and the types of locus of control learning styles.

Definition of Terms

Reading strategies are tools helpful in understanding what is read. Some learners need support only *during* reading, such as these with internal locus of control learning styles, while external style learners need support before, during, and after reading. This dissertation only involves *during* reading strategies. According to Montgomery County Public Schools (Online resources), Sorrell (1996) and Fehrenbach (1991), varied effective reading strategies can be implemented before, during, and/or after reading.

Figure 1.1 indicates that question-answer relationship, also called question and answer (Q&A), surveying and thinking aloud can be used during reading. Keywords and predicting can be used before and during reading. Summarizing, inferring and evaluating can be used during and after reading. The remainder of reading strategies can only be used either before, during or after reading. Also more *during* reading strategies exist than other processes, such as clarifying, context clues, rereading, restating, skimming/scanning, visualizing, summarizing, inferring, evaluation, keywords, predicting, question answer relationship, surveying, and thinking aloud.

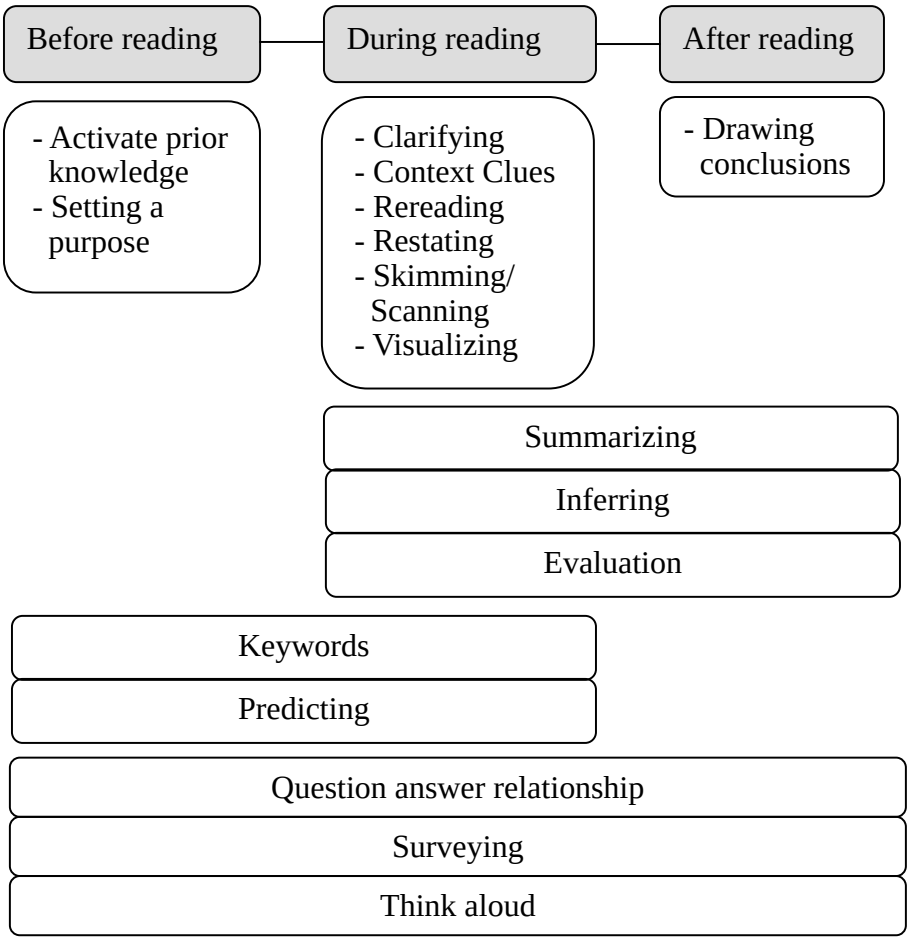

Figure 1.1. Types of reading strategies implemented in learning processes

However, not every *during* reading strategy is appropriate for the online environment based on the learning objectives determined in advance for this dissertation. This dissertation implements three *during* reading strategies: rereading, keywords, and Q&A for the online text about the human heart. Below are the explanations for not considering other types of *during* reading strategies:

- Clarifying means to restate the text by using visualization; however, this dissertation requires students to memorize the facts about the parts of the heart and comprehend the circulation of the heart instead of clarifying any learning objectives which have been clearly stated at the beginning of learning.
- Context clue means to use phonic instruction to gain speed and accuracy in identifying words; however, this strategy has disadvantages for comprehending the whole text.
- Restating means to summarize the text; however, the purpose of the study is not to encourage students to draw conclusions.
- Scanning is to increase reading speed and to decrease reading time; however, this dissertation study encourages students to spend as much time as they need.
- Inferring is similar to thinking aloud or predicting during learning process; these are appropriate for pure qualitative research; however, this dissertation is an experimental study with descriptive data support.
- Evaluation measures the quality of the learning process; however, this dissertation has four tests measuring students' learning achievement. The validity and the reliability of the four tests have been validated.

Online reading strategies mean adding the selected three reading strategies in the online environment. The definitions of three online reading strategies implemented *during* reading are:

1. The rereading strategy allows students to receive the same information twice; some sentences related to specific learning objectives and test questions have repetition and presentation on two different Web pages. The students review the same sentences on the second Web page.

2. The keyword strategy allows students to view highlighted words related to key learning objectives and test questions. Some keywords are the names of the parts of the human heart (i.e. factual concepts); some are procedures. The terms are highlighted with bold and large font styles.

3. The Question and Answer (Q&A) strategy allows students to focus attention on specific learning objectives and related criterion measures with a question-and-answer format. The format is like a label connecting the learning content to the specific test questions.

Learning styles are locus of control types based on learners' perceptions. Rotter's (1966) social-learning perspectives led to an explanation of personal beliefs in taking actions for something, such as learning. He created a 29-item questionnaire to differentiate internal and external locus of control learning style students.

1. Internal locus of control learning style students perceive that the outcomes of life events result from an individual's own decisions or efforts.

2. External locus of control learning style students perceive that others control everything, so they tend to ask others for learning support.

Achievement reflects the students' academic performance measured by the overall test criteria. In this dissertation, drawing, identification, terminology, comprehension tests and the total scores of these tests are the students' learning achievement at different levels: factual, conceptual, principal/procedural, and comprehensive.

Learning objectives are the statements that provide evidence of a student's cognitive changing processes, so that the teacher can determine from which segment of instruction the students have learned (Smith & Ragan, 1999). In this dissertation four learning objectives are: facts, concepts, principles/procedures, and comprehension (or problem-solving skills).

Summary

More and more learning materials are presented in a Web-based or online environment. Students and teachers look for varied strategies to enhance reading comprehension in that environment. Since different reading strategies have different structures, not all of them are proper to implement in an individual environment. The students' learning styles also need to be considered in the process of creating an online environment. In this experimental study, three research questions and three null hypotheses were addressed. The purpose of the study was to examine reading strategy effects on different learning objectives for different learning style students. Internal-External Locus of Control Scale was employed to determine the students' learning styles. Three reading strategies (rereading, keyword and Q&A), convenient to design and used by either internal or external locus of control learning style students *during* reading, were implemented in the online environment. Based on information processing theory, levels of processing and cognitive views of the learning process, this study obtained theoretical foundations of Web-based instructions with the reading strategies and types of learning styles. Although the generalization of the study had limitations, finding significant differences in achievement tests measuring different learning objectives were the main purpose of the study. The definitions of the terms (reading strategies, online reading strategies, learning styles, achievement, learning objectives) were at the end of this chapter.

Chapter 2

REVIEW OF LITERATURE

This chapter discussed information processing theory as the foundation for developing an online instructional module. Present studies about learning styles and reading strategies were also reviewed, followed by the discussion of theoretical justification for exploring learning effects of locus of control and reading strategies on achievement. A summary of the literature review ended this chapter.

Information Processing Theory

Information processing theorists focus on how people attend to, encode, store, and then retrieve information. The Atkinson and Shiffrin (1969) multi-stage model described three human memory stages (the sensory, the short-term, and the long-term) that can retrieve and store information as parallel processes. Learning occurs during a process by which each memory stage is internally activated. The process results in people being able to exhibit what they have learned in an acceptable way to the external world, such as reading a text.

However, individual differences, such as age, beliefs, interests, habits, and prior knowledge, may cause people to have different ways of processing information. Learning environment and content also influence the way people process information. Another perspective on explaining how people process information is through levels of processing proposed by Craik and Lockhart (1972). They presented varied types of information

(declarative, procedural, and conditional knowledge) stored in people's minds. Also, cognitive theories address how and why students store information in this way.

The following sections provide the definition of each memory stage and its effects on learning. The concepts of levels of processing also intertwine in each stage.

Sensory Register

Knowledge acquisition starts with sensory register and only lasts about .5 to 2 seconds. Many kinds of received sensory inputs (e.g. vision, hearing, touch, taste, and smell) stimulate learners' next action, such as viewing keywords in a reading task. However, unimportant information is quickly filtered (Schunk, 2004), thus not entering the next stage. All sensory registers work simultaneously and independently, but functionality still depend learners' attention capabilities which are relevant to their ages or the processing context. If the learners are motivated or aware, they can locate important information and become attentive to learning. Some learners' own skills and capabilities for attending to appropriate information allow levels of processing to extend beyond this stage.

Working Memory

Knowledge integration starts with working memory in approximately 20 seconds. Miller's "seven plus or minus two" for meaningful items described the limited capacity of working memory (Schunk, 2004). This interval is also called the short-term memory stage. By activating prior knowledge stored in the long-term memory, learners quickly

connect new and old information (Driscoll, 2005). In this stage, learners make decisions as to how to organize information into the long-term memory, such as chunking (or segmenting to store a portion of the information by using the short-term memory), elaborating (create meaningful connections among different new and old information), and other mnemonic strategies. The types of processing can vary; the main point is that the new information is meaningful to the learners and is easily retrieved after a while. However, some learners need instruction for some metacognitive activities, such as monitoring, and rehearsing.

Long-Term Memory

Knowledge generation starts with long-term memory within an unlimited time frame. The learners can retain information for a long time for their own purposes (goals/objectives); however, forgetting often occurs (Driscoll, 2005). The organized knowledge, called the propositional network, is easily retrieved by the learners, so applying different information processing strategies, such as hierarchy, mnemonic, mental imagery, elaboration, and schemata used by learners to organize knowledge is useful. The three types of propositions within long-term memory are declarative, procedural, and conditional knowledge in which learners encode and retrieve information (Schunk, 2004), so the learners can generate their own meanings for the information. Levels of processing can also help explain the structures of knowledge stored in long-term memory.

Information processing theory needs to be considered in developing an online instructional module. For example, the simple and clear direction on Web pages stimulates learners' visual processes. Different built-in strategies on Web pages help learners establish more links with prior knowledge and meaningful leanring. Providing achivement measurement or feedback encourages learners to reflect on how they organize their knowledge and consider revising some links for future leanring.

Learning Styles

In the 1920s, Carl G. Jung proposed personality typologies to distinguish different human processing information styles (Harrison & Lester, 2000; Loo, 2002; Reed, 2001; Sadler-Smith, 2001; Salter et al., 2006). The term “learning styles” and its concept come from Jung’s psychological views which have been applied in various contexts or instructional models (Karn, 2006; Reed, 2001). Lynn Curry, in 1983, demonstrated an onion model (the inner layer-cognitive personality; the outer layer-information processing/learning preference) to define learning style as a construct standing between learning preferences and cognitive styles (Sadler-Smith, 2001). “Style,” then, can be regarded as what Sternberg and Grigorenko in 1997 said is a bridge between some psychological components, such as personality and cognitive styles (Sadler-Smith, 2001). Sadler-Smith (2001) regarded learning style as “a proxy, perhaps unintentionally, for cognitive style or some other individual difference construct” (p. 294).

Some researchers viewed learning styles as individual, stable and predictable (Fahy & Ally, 2005; Salter et al., 2006). Some researchers, such as David Kolb, viewed learning styles as the parts of personality that change over time (Smith, 2002; Salter et al., 2006; Wintergerst et al., 2003) or that unconsciously adapt to match learning contexts (Honigsfeld & Dunn, 2003; Wintergerst et al., 2003; Smith, 2002). Both views seem acceptable, since Cassidy in 2004 stated that learning styles are regarded as comprising three fundamental learning components— information processing, instructional preference, and learning strategy (Fahy & Ally, 2005; Sadler-Smith, 2001; Yazici, 2005).

Some researchers explored the relationships between learning styles and other factors, such as learning preferences, learning experiences, learning strategies, cognitive styles, personalities, instructional types and so on (Buckley & Dwyer, 1987; Neils-Strunjas et al., 2001; Reed, 2001; Reed et al., 2000; Sadler-Smith, 2001). Some researchers collected other data, such as age, gender, beliefs and educational backgrounds to explore participants' characteristics. Based on the concepts of Jungian personality typologies, learning styles are individual perceptual modes (Karns, 2006). In most Aptitude-Treatment Interaction (ATI) research, the researcher can examine treatment effects on academic achievement (or knowledge acquisition performance) by administering an aptitude scale, such as learning style measurement (Daniels & Stevens, 1976). Researchers use it as an independent variable and investigate how it interacts with other variables, such as academic performance, time management and reading comprehension abilities. Overall, individual differences or learning styles explain how people process information in varied ways.

Three Commonly-Used Inventories

Most studies commonly use three inventories for examining students' learning. The first one, Group Embedded Figures Test (GEFT), developed by Herman A. Witkin, measures individual field independence/dependence learning styles, especially comprehension abilities (DeBell & Crystal, 2005; Price, 2004). In 1950 the Embedded Figures Test (EFT), with 24 figures, was developed to measure individual differences, and then the Group Embedded Figures Test (GEFT) was used to find simple geometric figures from eight complicated patterns. The two individual difference types are: (1) field

independence and (2) field dependence. Field-independent students will not be distracted by a similar or a complicated background and visually detect a simple figure in it; these students tend to have deep learning with a sequential learning style (DeBell & Crystal, 2005; Reed et al., 2000; Smith, 2002). Contrarily, field-dependent students tend to have surface learning with a global or holistic learning style (Reed et al., 2000).

Bernardi's (2003) study used GEFT to measure students' learning styles in accounting and its association with other variables. He found students' effort, verbal scores of Scholastic Aptitude Test or Scholastic Assessment Test (SAT), and perceptions of stress differently associate with the learning styles. DeBell and Crystal (2005) also used GEFT to examine its relationship, among youth, with other variables, such as sensory learning preference, cognitive learning style, personality, interpersonal trust, attributions of responsibility for solving social problems, and attitude regarding citizenship. These variables were assessed by six measurements. Their research results showed that field independence associated only with some variables, not all of them, and no association was found in field dependence. The test is a verbal-imagery construct (Price, 2004) associated with academic achievement, efficient learning, intelligence, and moral judgment. Through the test, the researcher can easily identify individuals' perception of the learning context, especially their information comprehension abilities (DeBell & Crystal, 2005; Price, 2004). However, researchers may not be able to explain how and why EFT or GEFT can measure individuals' general intelligence or some specific ability (Online Resource [1]). Smith (2002) also found that this instrument is not value free.

The second inventory is Dunn, Dunn, and Price's Learning Style Inventory (LSI) — Productivity Environmental Preference Survey (PEPS), developed in 1975 and then revised in 1996. It has 21 constructs (in total, 100 true-or-false test items) identifying multiple learning dimensions (Terry, 2002; Searson & Dunn, 2001; Online Resource [2]): (1) Immediate environment - noise level, light, temperature, formal or informal learning environment design, emotionality, motivation, persistence, responsibility, and need for external structure; (2) Sociological needs- learning alone or peer oriented, authority figures present, and learn in several ways, and (3) Physical needs- auditory, visual, tactile, kinesthetic, needs mobility, requires intake, and evening-morning/late morning/afternoon.

In short, this instrument presents five categories of stimuli (Searson & Dunn, 2001): environmental, emotional, sociological, physiological, and psychological. The instrument can measure broad audiences from the third grade to adults, and most studies have confirmed its validity (Honigsfeld & Dunn, 2003). For example, Honigsfeld and Dunn (2003) applied the Dunn and Dunn Learning Style Model to investigate gender differences in learning across five countries. They found a significant interaction between gender and country with medium effect size. In addition, a significant gender main effect on three elements (self-motivation, persistence, responsibility) appeared in the Dunn and Dunn Learning Style Model. However, this instrument is also self-administered, and it has too many constructs to explain how individuals will react to those constructs while providing new and difficult academic information (Burke & Dunn, 2002; Searson & Dunn, 2001).

The third inventory is David A. Kolb's Experiential Learning Model (ELM). Based on Jung's ideas, Kolb, in 1976, first developed the Learning Style Inventory (LSI), having 24 Likert-type test items; then, in 1985 Kolb revised the original instrument and developed LSI-II, which has 12 items, describing four interdependent constructs related to learning preferences (feeling, doing, thinking, watching) (Brew, 2002; Buch & Bartley, 2002; Kayes, 2005; Sadler-Smith, 2001; Salter et al., 2006): (1) the concrete perceiving pole, CE, (2) the abstract perceiving pole, AC, (3) the active processing pole, AE, and (4) the processing alternative pole, RO. In the continuum between two bipolar dimensions (perceiving and processing), four learning styles can be determined: CE-RO divergent, RO-AC assimilative, AC-AE convergent, and AE-CE accommodative (Salter et al., 2006; Towler & Dipboye, 2003). Kolb's LSI has been adopted in business and education fields and has been used as a measure for abstract-concrete or active-reflective learning styles (Brew, 2002; Harrison & Lester, 2000). However, Kolb's LSI has test-retest reliability and validity problems, such as the issue of ipsativity (the use of force-ranking scoring), and is sensitive to gender (Brew, 2002; Coker & Pedersen, 2004; Duff, 2004; Henson & Hwang, 2002; Towler & Dipboye, 2003).

Overall, a learning style inventory is a useful tool to predict students' performance; however, the measurements used in previously mentioned research do not purely measure the students' perceptual level of thinking, such as awareness of their own learning styles while learning new information. Some measurements are not free of value, sensitive to gender, or have many constructs. Some can only be used in a specific context. Rotter's Internal-External Locus of Control Scale, however, directly measures individual's

perceived control over learning outcomes in the learning context (Johnson & Kilmann, 1975). This measurement presents generalized expectancy for internal or external control of reinforcement (Whitney, 1991). Some ATI researchers also found a strong interaction between locus of control types and instructional methods (Daniels & Stevens, 1976).

Rotter's Internal-External Locus of Control Scale

Rotter's Internal-External Locus of Control scale (Rotter, 1966) divided individuals into two heterogeneous groups based on their perception of personal, causal roles in the outcome of specific events, either internal or external. During more than 20 years, this scale has been used for conducting varied experimental studies with varied audiences, such as college students, upper level high school students, Peace Corps volunteers, and prisoners. Prior research provided its insignificant effects on motivation, low correlation with intelligence, gender, and social desirability, and an unclear correlation with eastern-western sectional differences. In addition, prior research indicated differences in situations for facilitating increased achievement for internals and externals (Rotter, 1966).

For example, Cappella and Weinstein's (2001) research concluded that students' locus of control maintained an independent relationship with resilience beyond courses taken in high schools. Resilience in their research specifically indicated academic resilience, which was predicted by multiple domains of experience, such as the students' demographic, psychological backgrounds, and school environments. In their study, female, Caucasians, 8th graders who believed they had control over their future, and students who took an academic curriculum in high school were more likely to overcome proximal risk and become academically resilient. Therefore, one suggestion Cappella and Weinstein made was to help the students develop an internal locus of control before they enter high schools. The next two paragraphs describe the characteristics of internal and external locus of control learners. In addition, this dissertation emphasizes individual beliefs in learning, which influence the students' information processing methods.

Therefore locus of control scale is useful to substantiate the effectiveness of different learning situations (i.e. varied online reading strategies).

Internals are individuals who perceive personal responsibility for success or failure; whereas, the externals attribute luck, chance or other factors as the reasons for success or failure (Anderson, Hattie & Hamilton, 2005; Jonassen & Grabowski, 1993; Kukulu, Buldukoglu, Kuladaç & Köksal, 2006; Lefcourt, 1982; Wang & Newlin, 2000). Internals score consistently higher than externals on uncued instruction (Brooks & McKelvie, 1986; Bursik & Martin, 2006). Buckley and Dwyer's (1987) study found whatever rehearsal strategies internals received did not significantly affect their performance on two types of criterion measures (drawing and comprehension tests). A significant interaction exists between locus of control and rehearsal strategy type. This result reveals that internals intensely process information and then execute it in subsequent performance.

Externals have been shown to significantly perform better in situations where reinforcement is controlled by teachers (Daniels & Stevens, 1976). The interaction between locus of control and instructional methods was also highly significant in Daniels and Stevens' (1976) study. The same result found in Buckley and Dwyer's (1987) study is that different types of rehearsal strategies, indeed, have significant effects on the performance of externals who engaged in both drawing and comprehension criterion measures. However, an opposite result was found in Wesley, Krockover, and Devito's (1985) study. They did not find any significant interaction effects between locus of

control types and instructional models (printed or computer-assisted) on the Test of the Integrated Science Process developed by Tobin and Capie in 1982. Conclusively, externals preferred traditional educational or teacher-controlled settings, as opposed to independent instruction, and had higher achievement scores in the preferred setting (Daniels & Stevens, 1976; Wang & Newlin, 2000). Most studies stated that externals significantly performed best in situations where reinforcement was external and the instructional environment was controlled (Anderson, Hattie & Hamilton, 2005; Bursik & Martin, 2006; Daniels & Stevens, 1976; Wesley, Krockover, & Devito, 1985).

Generally speaking, Rotter's Internal-External Locus of Control Scale has yielded a common conclusion that internal learners have significantly better performance than external learners. The construct of this kind of inventory is more stable compared with other inventories mentioned earlier. In Rotter's scale, internal learners always performed better than external learners. They were easily motivated to use different strategies for pursuing positive outcomes. External learners were afraid of failure because they believed their capability for learning was naturally low. They needed motivation by using other strategies.

Online Reading Strategies

Learning activities occur in different contexts. Reading is an example, since it is a type of communication skill which can be evaluated by a certain assessment tool. If a study is related to learning, researchers can divide people into different reading style groups and evaluate how they learn. Reading strategies can then be explored as to whether or not students can enhance reading comprehension abilities.

Reading strategies can be also used as scaffolds for before, during, and after reading. Some researchers found that certain kinds of readers used certain kinds for reading strategies. For example, Sharma and Hannafin's (2004) study clearly stated the necessity of considering different learning styles while facilitating online scaffolding strategies. Some studies only focused on the strategy effects on comprehension. Some studies (e.g., ATI) even examined the effects of reading styles and reading strategies on comprehension performance. A way to interpret student reading comprehension performance is classification. John R. Kirby (1988) proposed a theory of reading, specifically identifying two levels of reading comprehension performance: meaning memorization and meaning generation (Amer & Khouzam, 1993).

Classifying student reading performance can also refer to how many strategies they use and when they use those strategies. For example, Arden-Close's (1993) study asked thirty-nine second year students (from two classes) to answer a series of questionnaires during a five-month period with six reading materials. Then, three students (regarded as good, medium, and poor readers) were selected to start a case study. An analysis of the

questionnaires concluded that good readers, indeed, used a wider range of reading strategies than did poor readers and medium readers. Fehrenbach (1991) also found that gifted secondary level readers have different reading strategies from average readers. Therefore, the learners had different needs when applying reading strategies to different reading processes. Based on the information processing theory, reading strategies can be regarded as the inputs that stimulate the students' sensory register. The reading strategies can also be stored in long-term memory as the students become familiar with them.

By reviewing existing research articles about reading, most researchers point to the implementation of varied reading strategies. Montgomery County Public Schools (Online resources), Sorrell (1996) and Fehrenbach (1991) all suggested varied reading strategies, such as rereading, scanning, summarizing, keywords, context clue, question answer relationship (also called question and answer, Q&A), inferring, thinking aloud, activating prior knowledge, setting a purpose, and drawing conclusions.

However, as previously mentioned, the learning content (i.e., expository text about the human heart) can determine which reading strategies are appropriate to implement in a Web-based environment in this study. In addition, based on the study design, examining reading performance of internal and external locus of control learning style students, this present study focused on employing reading strategies during learning processes. Hence, this study selected three online reading strategies (rereading, keyword, and Q&A) to help learners comprehend online texts.

Rereading

What does “rereading” mean? Flexible definition includes rereading a word, a sentence, a passage or a whole text, depending on individuals’ varied reading purposes, such as for enhancing comprehension or enjoyment of literature (Faust & Glenzer, 2000). Rereading is a useful pedagogical strategy, which obviously helps increase student reading fluency and has a critical connection to reading comprehension (Olmscheid, 1999; Nathan & Stanovich, 1991). For example, Louisel’s (2006) study found that reading fluency was a valuable predictor for third graders’ reading comprehension, especially for their oral language comprehension where single word reading speed was examined.

Paris and Oka in 1986 stated, “A belief that textual material is inconsistent serves as a cue for rereading to determine whether the author is inconsistent or whether the reader has failed to comprehend the content. . . . Being able to paraphrase is a cue that rereading is unnecessary” (Schunk, 2004, p. 233). The rereading strategy is similar to reading aloud with a different scaffolding model. As a middle school reading teacher, Green (1998) suggested a type of rereading instruction called rapid retrieval of information to encourage students reading aloud. While reading aloud, the students became motivated to activate higher-order thinking skills and then quickly determine whether they need to revisit words, sentences, or passages. Evidently, the students’ competence in completing a task was increased. At the end of study, the students were satisfied with this reading process. Finally, Green suggested adding some evaluation methods during the process of reading aloud for improving students’ comprehension

skills, skimming/scanning information abilities and fluencies. In Brown's (2002) study, two female Japanese college students were asked to think aloud for exploring how they improve comprehension ability with rereading strategies. The whole study process presented evidence of their increased comprehension with rereading strategies.

Glenzer (2000) explored how students reread a text and for what purposes by interviewing eighteen fifth-grade students. Glenzer's study concluded that the rereading strategy helps students intensify their impression of favorite reading sections and make deeper connection with texts. The study results again upheld an assumption about rereading which allows individuals to employ it differently for comprehending a text. Some mature students could even connect reading content to their daily experiences. Smith (2000) conducted a readership survey with 154 adults, 20 to 84 years old, from highly skilled to unskilled nonreaders, and found that most of them relied on activation of prior knowledge, rereading of texts, and note taking. Faust and Glenzer (2000) and Millis and King (2001) conducted two experimental studies with undergraduate psychology students who were asked to read short passages, twice, from computer screens. Both study results showed a significant main effect on readers' memory scores, especially when they, to some extent, strategically reread texts. A significant difference was also found from good and poor readers' reading time (not medium ability readers), since they incorporated new information into long-term memory during the second reading event with different levels of reading abilities for comprehending the texts.

Short, Kane, and Peeling (2000) found that rereading a longer text may be time consuming. Using cues and rereading students' favorite sentences, however, can help students familiarize themselves with the texts.

Keyword

The keyword strategy is a way of identifying the focus of the text. Most studies that employed keyword strategy indicated significant effects on reading comprehension. McDaniel and Pressley (1989) found similar effects as they conducted an experimental study with 75 undergraduates at the University of Notre Dame. Among the three groups (control, keyword, and semantic context groups), the undergraduates assigned in the keyword group performed significantly better in comprehension and memory tests than did others assigned in control or semantic context groups.

The keyword strategy is useful in vocabulary learning and is regarded as being a verbal label for concepts (Sadoski, 2005). Avila and Sadoski (1996) and McDaniel and Pressley (1989) both indicated keyword strategy yields superior recall and comprehension either immediately or after one week, since learners feel a sense of control of the entire content when they read. The keyword strategy is also a mnemonic, which helps enhance students' recall abilities. In McCarville's (1993) article, she stated that keyword mnemonics are also helpful in comprehension, especially for college students' vocabulary acquisition. Rekrut (1996) regarded the keyword strategy as a direct vocabulary instruction, which needs a two-step process. Readers first create a list of keywords and then connect them in a meaningful way. Speaking generally, most studies

have confirmed keyword strategy effectiveness for learning other new vocabularies and increasing comprehension test scores. Positive research results usually come from the studies which are related to learning foreign languages or conducted by English as Second Language programs.

For example, De Courcy and Birch (1993) conducted research through open-ended interviews, observations and think-aloud protocols with four Japanese students and found that the students first familiarized themselves with the sound of keywords and then were guided to understand their meaning. The students mainly used keywords and inference as their reading strategies to comprehend the whole text. In a video-viewing study, Guillory (1998) applied keyword captions. He also found students easily identified words from the full text and outperformed others in comprehension. Fagan (2003) found that English as second language learners need the keywords strategy as a scaffold during the reading process. Some studies tried to improve reading disabilities while in other research, language minorities found keywords useful in significantly improving comprehension abilities. For example, O'Donnell, Weber and McLaughlin (2003) conducted a single-case study with a male fifth grader born in Hong Kong. By identifying keywords on a text in each session (for a total of ten sessions) when the student previewed materials before reading, a discussion of keywords helped the student to finally achieve reading 186-191 words per minute and to correctly answer a total of fifteen questions pertinent to three passages.

Question and Answer (Q&A)

The Q&A strategy, as used in this dissertation, means a question-answer label helpful for highlighting text to relate answers previously posed questions. This term derives from the concepts of question answer relationship (Q&AR), developed by Taffy Raphael in 1982 (McIntosh & Draper, 1995). Q&A has four implementation methods: Right There, Think and Search, Author and Me, and On My Own. Teachers usually obtain positive results with this reading strategy in class.

For example, Raphael (1982) found that students, using Q&A, were able to locate information in a text, and they could properly respond to questions. Benito et al. (1993) found that students could comprehend different question types after employing Q&A. McIntosh and Draper (1995) found that Q&A helps students read, answer questions and learn from texts. They even clearly described rationales and ways to integrate Q&A for teaching mathematics (McIntosh & Draper, 1996). Mesmer and Hutchins (2002) used this strategy in a science classroom to help their students read charts, tables, and figures, as well as answer multiple- choice questions.

In another fifth-grade science classroom, Finch (2003) also found Q&A effects for encouraging, as well as motivating, students to take responsibility for their learning. The students were able to generate questions and then answer them by themselves. Interestingly, once students learn Q&A, they are able to maintain use of this reading skill (Ezell, Hunsicker & Quinque, 1996; Ezell & Kohler, 1992). Teachers can apply Q&A with different approaches (e.g. students answer or generate their own comprehension

questions), and still find positive instructional effects (Ezell, Hunsicker & Ouinque, 1997). In addition, Q&A can increase students' metacognitive awareness (Benito et al., 1993).

Overall, different reading strategies have different instructional effects on students' knowledge acquisition processes. Based on information processing theory, different reading strategies encourage students to produce different levels of processing for presenting different types of knowledge, and simultaneously, the students can store that knowledge (or information) by activating their memory storage spaces from sensory registers, working memory to long-term memory for later use. Table 2.1 displays different instructional effects that occurr among different reading strategies based on information processing theory and levels of processing. Other than information processing, Table 2.2 presents some circumstances when cognitive views of learning interact with each memory storage space of information processing theory during the students' learning process. Motivation, which relates to students' cognitive activities, plays an important role in learning, regardless of which reading strategy is provided.

Table 2.1.
Reading Strategies' Different Instructional Effects

Reading Strategies	**Information Processing Theory**		
	Sensory Registry	**Working Memory**	**Long-term Memory**
Rereading	- Stimulate students' vision by presenting important sentences word-by-word	- Force to decide soon if new information is in the sentences	- Elaborate on the new information to add to prior knowledge base
	Levels of Processing: In the beginning, students attend to re-reading declarative, procedural or conditioning knowledge, twice. This strategy encourages them to memorize different types of important knowledge. However, prior knowledge stored in long-term memory helps them decrease processing load. They can quickly add new information to the prior knowledge base. Elaboration can help recall as well as generate new knowledge.		
Keyword	- Stimulate students' vision by highlighting (font size change) keywords	- Encourage quickly creating connections for old-new words	- Imagine functions and hierarchical relations of keywords
	Levels of Processing: Students start paying attention to the pronunciation and spelling of highlighted keywords. In order to acquire factual knowledge about the definition of some keywords or to form a conceptual knowledge for all highlighted keywords, students have to read text with the keywords together. By scanning previous learned vocabularies, if the keywords are new to them, they need to revise old connections for adding new vocabularies with the right connections. To enhance recall, mental imagery strategy helps link keywords with some functions and hierarchical relations.		
Q&A	- Stimulate student's vision by restructuring text in a question-answer format	- Chunk a portion of information to help quick processing	- Utilize schemata to take information in a large organized way
	Levels of Processing: By viewing questions, students begin to process text from a high level (e.g., problem-solving knowledge). Chunks of information including facts, concepts, principles/procedures, problem-solving skills, help them quickly determine if they need to use other strategies to enhance recall. They combine several chunks into a schema. Several schemas become a large body of schemata.		

Table 2.2.
Cognitive Views of Learning Interact with Information Process Theory and Motivation

	Information Processing Theory		
Cognitive Views	**Sensory Registry**	**Working Memory**	**Long-term Memory**
	- Students need to be aware of enough new information (high attention capabilities) in the manner matching the design purposes of using different reading strategies - Students' ages have effects on awareness abilities for locating important information - Students' learning styles may influence ability to capture different types or levels of information	- Students may lose some information if they spend time connecting two types of knowledge - Students may need some metacognitive activities as well as monitoring and rehearsing, so they know why they link information in this way and become attentive to revising their knowledge network	- Students may find that they forget some information in the process of acquiring knowledge - Students may know the necessity of encoding/decoding pieces of information for strengthening their knowledge network - Students may want to verify instructional effects with some measurements
	Motivation		
	- Students' motivation may decrease throughout the whole learning process, since they feel tired of using the same, given, reading strategies. - Changing the learning environment may help increase students' motivation; however, they still can decide how they want to respond to the information. - High prior knowledge or low self-efficacy influences students' low motivation. High self-regulation, perhaps, helps them maintain high learning motivation.		

Theoretical Justification

Prior research indicated that readers regarded as having external or internal locus of control learning styles need to apply certain reading strategies to comprehend a text (Cappella & Weinstein, 2001; Coldevin et al., 1993; Coker et al., 1989; Maguiness, 1999; Whitney, 1992). In addition, the literature reviewed in this chapter indicates that different types of reading strategies may vary in their effectiveness in facilitating student achievement of different types of learning objectives.

Common acceptance of views of internal and external locus of control are that locus of control, as a learning style variable, is the degree with which an individual perceives personal responsibility for a specific outcome. That is, the expectancy of being personally responsible for achievements is the measurement of the degree to which a person feels responsible for the outcome of a behavior. The students may be dichotomized into two learning styles (internal or external locus of control); each style has specific characteristics which influence the potentials for profiting from instructional structures. Individuals possessing high-levels of responsibility are generally labeled as internal locus of control; while individuals possessing low-levels of responsibility are labeled external locus of control (Lefcourt, 1982). When in a situation that involves skill, internals generally spend more time on decision making when compared to externals. For tasks that require less skill-demand and are more chance-based, internals elicited carelessness and impulsiveness in their responses (Johnson & Kilmann, 1975; Wheeler & Davis, 1978).

For example, Coker et al. (1989) successfully assisted 62 nursing students to enhance their reading and math abilities, and to improve their self-acceptance and internal locus of control. After this interventional study conducted in a laboratory form, most students had increased self-acceptance and became internal locus of control. Their academic performance improved greatly, as well, after the study was conducted. Coker et al. (1989) also suggested providing early intervention courses for at-risk students to increase their self-acceptance and enhance an internal locus of control style. Whitney (1992) conducted a pilot study and found that most female fifth graders were frequent readers. They were regarded as having an internal locus of control learning style and spent more time on recreational reading than students regarded as having an external locus of control learning style.

Contrarily, poor readers, regarded as having an external locus of control learning style, might need all supports *before, during, and after* their reading processes (Coker et al., 1989; Coldevin et al., 1993). Those students believe their behaviors to be unaffected by rewards and are generally hard to control. Therefore, they need support from their teachers and even doubt their learning abilities. Maguiness (1999) identified some external locus of control students still needed support, even though they had a joint reading problem program at Westerns Springs College in Auckland, New Zealand.

In sum, this dissertation explores the relationship between locus of control and reading strategy in an online environment.

Summary

By reviewing information processing theory (from sensory register, working memory, to long-term memory), three reading strategies (rereading, keyword, and Q&A) presenting different effects on students' comprehension are clearly presented. Cognitive views of learning interacting with information processing theory and motivation are included. The introduction of learning styles and the most commonly-used inventories (i.e., Herman A. Witkin's GEFT, Dunn, Dunn, and Price's LSI, and David A. Kolb's ELM) proceed next. However, each inventory has its own weakness in terms of measuring students' perceptual level of thinking. The construct of Internal-External Locus of Control scale is more reliable than the above three inventories in determining students' learning styles. Most researchers have also confirmed that three online reading strategies (rereading, keyword, and Q&A) have significant effects on comprehension. Finally, the theoretical justification section presents numbers of prior studies which examine the relationship between learning styles and online reading strategies.

Chapter 3

RESEARCH METHODS

This chapter describes the research methods applied in this dissertation. Descriptions of learning materials, locus of control measurement, and criteria of achievement measures appear in the beginning of this chapter. Rationale and the results of two pilot studies conducted in 2005 follow. Finally, the rationale for revising the research methods for this dissertation concludes the chapter.

Learning Materials

This dissertation utilizes a 1,871-word expository text focusing on the physiology of the human heart and the related processes occurring during systolic and diastolic phases of heart function (see Appendix A). The whole text is a typical instructional module, developed by Dwyer in 1965. This instructional module, reproduced in a paper-booklet format in 1977 by Dwyer, has been primarily used among college students.

Selection of this instructional module occurs because of its generalized learning objectives for regular classroom teaching events. Four learning objectives represent students' achievement: "(a)… to learn terminology and facts basic to the course content, (b) identify locations and/or positions, (c) construct and/or understand relationships, and (d) engage in problem solving activities" (Dwyer, 1978, p.44).

For the online environment, a conversion of the whole instructional module produced several Web pages (see http://www.personal.psu.edu/puh113/Education/Insys553/Content/).

Locus of Control Measures

Rotter's Internal-External Locus of Control scale (1966) is the measure of students' personal beliefs (see Appendix B) concerning their action-taking for learning. Therefore, this dissertation utilizes the Locus of Control scale to measure students' learning styles. This measurement contains 29 test items, including six filter questions, producing 23 forced choice items to measure personal belief. Each item counts one point. Overall scores range from 0 to 23. The higher the score, the more external a person measures (Lefcourt, 1982). Contrarily, the lower the score the student obtains the more internal is the student's locus of control learning style. Most studies employed Rotter's Internal-External Locus of control scale reported reliability ranges from .6 to .9, depending upon the study population (Jonassen & Grabowski, 1993; Lefcourt, 1982).

Criteria of Achievement Measures

The criteria measures correspond to different knowledge acquisition domains: facts, concepts, principles/procedures, and problem-solving skills developed by Dwyer (1972) (see Appendix C). The reliability coefficients of the four criteria measures are (Dwyer, 1978, p.47): drawing (Kuder-Richardson Formula 20 reliability, r= .83), identification (Kuder-Richardson Formula 20 reliability, r= .81), terminology (Kuder-Richardson Formula 20 reliability, r= .83), and comprehension (Kuder-Richardson Formula 20

reliability, r= .77). Each criterion measure consists of 20 test items (total: 80 measurement items, each counts one point, scores range from 0 to 80 points).

Drawing Test: to test conceptual knowledge. The purpose of developing this test is to evaluate students' ability of reproducing learning objects and the positioning of words on the objects. The students refer to a numbered list of 20 terms corresponding to the parts of the heart discussed in the instructional presentation. Then they have to draw a representative diagram of the heart and place the numbers of the listed parts in their respective positions. For this test the emphasis is on correct positioning of the verbal symbols with respect to one another and in respect to their concrete referents.

Identification Test: to test factual knowledge. The purpose of developing this test is to evaluate students' identification ability for using visual cues to discriminate one structure of the heart from another and to associate specific parts of the heart with their proper names. Each part of the heart, which had been discussed in the presentation, is numbered on a drawing. The students have to answer 20 multiple-choice test items to identify the numbered parts on a detailed drawing of a heart.

Terminology Test: to test further conceptual knowledge, rules, principles/procedures. The purpose of measuring this type of knowledge is the prerequisite for answering other test questions. This test consists of 20 multiple-choice test items designed to measure knowledge of specific facts, terms, and definitions.

Comprehension Test: to test problem-solving knowledge, rules, principles/procedures. In order to apply heart content knowledge in other situations, the participants have to comprehend the entire content. Given the location of certain parts of the heart at a particular moment of its functioning, the student is to determine the position of other specified parts of the heart at the same time. This test requires that the students have a thorough understanding of the heart, its parts, its internal functioning, and the simultaneous processes occurring during the systolic and diastolic phases. This test measures a type of understanding which the individual can use to explain some other phenomenon.

Pilot Study

The intent of two pilot studies, conducted in 2005, was to justify the research methods used in the major study. Other purposes for conducting these two pilot studies were:

1. To identify a less than .6 correct-response rate to test items in the learning materials, to allow adding different online reading strategies for the major study, thus to provide support for comprehending those potentially difficult sections of the materials.
2. To identify potential problems in the design of the online reading strategies and the whole research process, to enhance the possibility of high reliability in the major study.

3. To improve the instructional effectiveness of the online reading strategies for the major study.
4. To develop a familiarity with the research procedures to aid preparation for the beginning of the major study.

The First Pilot Study

The first pilot study, which was purely experimental, was conducted in the summer and fall of 2005 and had two stages. The first stage recruited 27 undergraduates from the Departments of Business, Industrial Engineering, and Education Psychology at Pennsylvania State University. Participants obtained three extra-credit points and/or earned five dollars (US), depending on their departmental instructors' grading policies. Some students could only earn five dollars without three extra-credit points. Recruitment occurred after receiving approval from instructors. For this pilot study, all participants completed four learning objective tests, online, in a reserved computer lab. Six participants living off campus did not take the drawing test. First, all participants read the texts of the learning materials, online, without any visual representations. Then, they submitted answers, online, from four learning objective tests (80 test items).

The results of data analysis indicated that those 27 participants on average gained 7.53 (S.D. = 1.17) in the drawing test, 12.93 points (S.D. = .82) in the identification test, 10.56 points (S.D. = .97) in the terminology test, and 10.04 points (S.D. = .61) in the comprehension test. Overall, they gained 10.43 average points (S.D.=2.95) from four

tests. At the end of the summer, the collected data was subjected to an item analysis to identify which sections of the learning materials created comprehension difficulties. Therefore, eighty test items in four different learning objective tests were analyzed. Test items with less then .6 correct-response rate were considered difficult items. Table 3.1 is a summary of the item analysis for the first pilot study. The test items with low correct-response rates have been given one or more frame numbers identifying where the instructions occur. Overall, 16 out of 20 frames referred to fifty-nine difficult items needing instructional enhancement. Revision of the learning materials added different online reading strategies for the second stage of the first pilot study.

Table 3.1.
Item Analysis Summaries for the First Pilot Study

DRAWING TEST			IDENTIFICATION TEST			TERMINOLOGY TEST			COMPREHENSION TEST		
Item #	Item Diff. (N=21)	Frame #	Item #	Item Diff. (N=27)	Frame #	Item #	Item Diff. (N=27)	Frame #	Item #	Item Diff. (N=27)	Frame #
1	0.43	5	21	0.52	9	41	0.52	3	61	0.74	-
2	0.24	9, 14	22	0.59	5, 11	42	0.70	-	62	0.15	13
3	0.38	6	23	0.78	-	43	0.78	-	63	0.52	15
4	0.38	8	24	0.59	7	44	0.67	-	64	0.52	12
5	0.57	2	25	0.56	5,11	45	0.41	9	65	0.59	18
6	0.19	4	26	0.59	6	46	0.52	8	66	0.22	19
7	0.29	9, 14	27	0.81	-	47	0.70	-	67	0.70	-
8	0.19	14	28	0.48	4	48	0.19	9	68	0.70	-
9	0.19	5	29	0.63	-	49	0.41	9	69	0.44	12
10	0.19	7, 14	30	0.85	-	50	0.59	4	70	0.56	5
11	0.38	4	31	0.41	4	51	0.37	4	71	0.67	-
12	0.38	4	32	0.89	-	52	0.56	4	72	0.48	13
13	0.38	8	33	0.33	4	53	0.56	5	73	0.59	19
14	0.67	-	34	0.81	-	54	0.37	4	74	0.48	14
15	0.57	3	35	0.85	-	55	0.89	-	75	0.22	17
16	0.67	-	36	0.48	8	56	0.59	6	76	0.19	13, 14
17	0.62	-	37	0.63	9, 14	57	0.41	8	77	0.48	19
18	0.29	2	38	0.89	-	58	0.37	19	78	0.59	19
19	0.19	6, 8	39	0.59	8, 11	59	0.41	4	79	0.70	-
20	0.38	4	40	0.63	7, 15	60	0.56	9, 14	80	0.48	12

Identifying the instructional effects of online reading strategies required recruitment of another group of students in the middle of the fall semester, 2005. Sixty-eight (68) undergraduates from statistics and literacy programs participated in the study. Some obtained one or three extra-credit points for their final grades according to their instructors' policies. All participants completed the whole study with different online reading strategy treatments in a reserved computer lab. As they entered the lab, they were randomly assigned to the control group or one of three treatment groups:

rereading, keywords, or question and answer (Q&A). They also read through the text of the learning materials online with or without a specific type of reading strategy, followed by four learning objective tests using an answer sheet. Finally, they were given Rotter's Internal-External Locus of Control measurement which has 29 test items. All participants were able to complete the study within 70 minutes.

Figure 3.1 is the concept map of the second stage of the pilot study procedure. The letter C represents the control group. The three online reading strategy groups are: rereading (R), keywords (K) and question and answer (Q&A). The two locus of control learning styles are: internal and external (I and E).

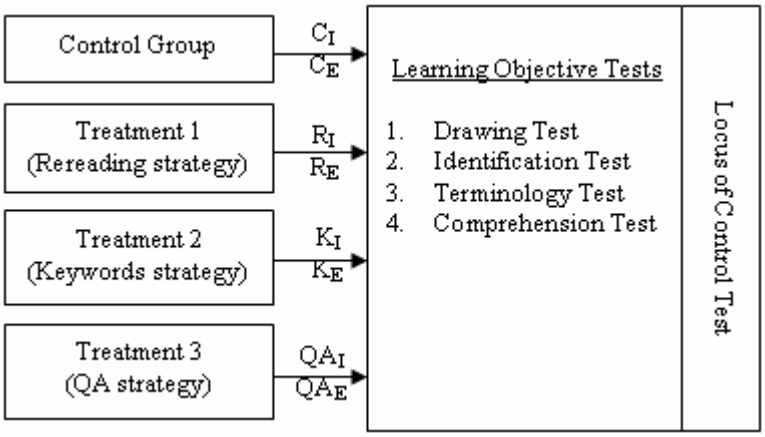

Figure 3.1. The concept map of the pilot study procedure

Overall, the control and rereading groups both have 17 participants in this pilot study. The Keywords group has 16 participants and the Q&A group has 18 participants. Each group has about equivalent numbers of external or internal locus of control type students. Table 3.2 lists descriptive statistics for each treatment group for each criteria measure.

Table 3.2.
Descriptive Statistics of First Pilot Study (Second Stage)

Treatments	Criteria Measures (M* S.D.) Drawing (M S.D.)		Identification (M S.D.)		Terminology (M S.D.)		Comprehension (M S.D.)		Total Composite Scores (M S.D.)	
T1: Control	5.41	3.89	8.24	4.04	8.65	3.69	7.59	4.42	29.88	13.77
T2: Rereading	7.53	5.04	9.82	4.39	9.24	4.02	9.41	3.76	36.00	14.40
T3: Keyword	5.31	3.75	8.75	5.31	8.50	4.44	8.31	4.24	30.88	15.76
T4: Q&A	5.17	4.12	7.28	3.95	7.89	3.77	6.72	4.07	27.06	13.31
Total	5.85	4.25	8.50	4.43	8.56	3.92	7.99	4.16	30.90	14.36

* M stands for Mean Scores

Several analyses followed in sequence: a descriptive analysis, a correlational analysis, and then a 2x4 MANOVA. However, no significant interaction between online reading strategies and locus of control learning styles was exhibited. No significant main effect (online reading strategy or locus of control learning style) on any criteria measures was found. Several decisions arose from the second-stage of the first pilot:

1. The numbers of participants needed to be greatly increased to a total of at least 112, based on the power analysis for the 2x4 MANOVA design if the expectation for one treatment group to obtain .25 or more points than the control group's mean scores for the total tests is to be accomplished. In other words, larger numbers better represent a normal distribution of learning outcomes.
2. The recruitment process needed to be changed to a more efficient method. Many emails per day and significant time were required to accommodate every participant's date and time to visit the reserved computer lab. The Hypertext Preprocessor (PHP) program assisted recruiting students, online, more easily.

3. The participation directions published in the front of the learning materials needed to be clearly stated. Most participants skipped reading them and quickly clicked on the START button. Some of them finished reading, answering 80 test questions, and locus of control measurement questions in approximately a half hour.
4. All participants obtained one or three extra credit points after they participated in this experimental study. However, this did not appear to be sufficient incentive to encourage them to try their best at comprehending the text and then carefully answering the questions.

The Second Pilot Study

The second pilot study, conducted in the spring of 2006, used an open source programming language to create dynamic PHP Web pages to recruit participants from the departments of literacy, statistics, and education psychology. Prospective participants were reminded to read the participation directions before starting the study. Most participants were motivated to participate in this study. Since the research design did not change, combining the first pilot study with the second allowed meeting the requirements for power analysis results. Finally, 169 participants made possible conducting the Multivariate Analysis of Variance (MANOVA). The following paragraphs present the results of descriptive, correlational, and MANOVA analyses. Finally, an item analysis helped decisions regarding final revision.

Table 3.3 shows the numbers of participants, means, and standard deviation obtained for each group for each criteria. Overall, 169 participants, on average, obtained 11.46 points (S.D.=3.50) in the locus of control measurement; therefore, categorizing them into two types: internal (obtained less than 12 points) and external (obtained 12 or more points) locus of control learning style students. In the control group, 24 participants were of the internal locus of control type (external N = 19). In the rereading group, 17 participants were of the internal locus of control type (external N = 25). In the keywords group, 20 participants were of the internal locus of control type (external N = 21). In the Q&A group, 25 participants were of the internal locus of control type (external = 18). Overall, the numbers of internal and external locus of control learning style students are 86 and 83. Different from the previous study results, this study's internals, on average obtained, 30.33 points (S.D.=14.41) in the composite test. The externals obtained 33.82 points (S.D.=16.83).

Table 3.3.
Descriptive Statistics of Second Pilot Study

	Criteria Measures (M* S.D.)								Total Composite Scores (M S.D.)	
	Drawing		Identification		Terminology		Comprehension			
Treatments	(M	S.D.)	(M	S.D.)	(M	S.D.)	(M	S.D.)		
T1: Control	5.81	4.24	9.09	3.59	9.19	3.93	7.93	4.49	32.02	13.80
T2: Rereading	7.02	4.61	9.71	4.50	9.79	4.56	9.74	3.88	36.26	15.13
T3: Keyword	5.76	4.04	8.49	4.32	9.29	4.76	8.12	3.87	31.66	14.36
T4: Q&A	5.35	3.69	8.02	3.32	7.77	3.79	7.16	3.23	28.30	10.66
Total	5.98	4.17	8.83	3.97	9.00	4.30	8.23	3.97	32.04	13.75

* M stands for Mean Scores

To sum up, students in the rereading strategy group performed well in every test, and they obtained, on average 36.26 points (S.D.=15.13) in composite test scores. Students assigned to the control group obtained, on average, 32.02 points (S.D.=13.80). In the keyword group, students obtained, on average, 31.66 points (S.D.=14.36). The Q&A group performed worse than other groups (M=28.30, S.D.=10.66).

Correlational analysis determines the relationship among four criteria measures of achievement (dependent measures) to verify the appropriateness of conducting MANOVA. MANOVA examines the main and the interaction effects of one or more categorical independent variables which are predictors for multiple interval dependent variables (Ramsey & Schafer, 2002). For this pilot study, categorical independent variables are reading strategies, multiple interval-dependent variables are criteria measures of achievement scores. Table 3.4 illustrates the correlation coefficients among the four tests achieved at the .01 level of significance.

Table 3.4.
Pearson Correlations among Different Measures

	Drawing	Identification	Terminology	Comprehension
Drawing	1	0.643**	0.523**	0.487**
Identification		1	0.667**	0.606**
Terminology			1	0.685**
Comprehension				1

** $p < 0.001$

Then, a 2x4 MANOVA (see Table 3.5) indicates no significant interaction between reading strategy and locus of control learning style (F=1.31, df=3/169, $p < .27$) on each learning objective test. A significant main effect (F=3.09, df=3/169, $p<.03$) arose from the comprehension test; the effect size for the comprehension test is 0.40. The rereading treatment proves to be significantly more effective than the control group in the comprehension test.

Table 3.5.
Reading Strategies on Learning Objective Tests

Source (Groups)	Type III Sum of Squares	df	Mean Square	F	Sig.
Drawing	69.052	3	23.017	1.368	0.255
Identification	81.527	3	30.844	1.686	0.172
Terminology	92.533	3	27.176	1.755	0.158
Comprehension	142.943	3	47.648	3.091	0.029*

*$p < 0.05$

However, no significant differences appear on the Drawing (F=1.37, df=3/169, $p<$ .30), Identification (F=1.69, df=3/169, $p<$ .17), or Terminology (F=1.76, df=3/169, $p<$ .16) criteria measures.

Table 3.6 is the follow-up analysis results for the comprehension test, which yields a significant difference in favor of the rereading treatment over the control (T=1.99, df= 2/83, $p = .05$). Tukey's Honest Significant Difference (HSD) Tests provide boundary on differences between independent and dependent group averages (Ramsey & Schafer, 2002). Other pair-wise comparison methods, Fisher's Protected LSD (Least Significant Difference) and Bonferroni Correction, are not appropriate, since the former can not control experiment-wide error and the latter can, conservatively, produce a very small

coefficient. A significant difference also appears between the rereading and the Q&A treatments in favor of the rereading treatment (T=3.33, df=2/83, *p*=.001).

Table 3.6.
LSD Analysis for the Comprehension Test

Source (Groups)	t-value	df	Sig. (2-tailed)
Rereading (M=9.74, S.D.=3.88) & Control (M=7.93, S.D.=4.49)	1.985	83	0.05*
Rereading & Keyword (M=8.12, S.D.=3.87)	1.898	81	0.061
Rereading & Q&A (M=7.16, S.D.=3.23)	3.328	83	0.001**

*$p < 0.05$ **$p < 0.001$

Finally, conducting a 2 x 1 ANOVA analyzes the effect of the reading strategy and the student learning style on the composite test scores (see Table 3.7). However, no interaction appears between either of them. Encouragingly, the reading strategy's main effect approaches a significant F-value 2.541 (p = .058) on the composite test scores. The student learning style (or locus of control style) still has no major effect on the composite test scores.

Table 3.7.
2x1 ANOVA Results for Composite Test Scores

Source (Groups)	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2407.389	7	343.913	1.887	.075
Reading Strategy	1389.335	3	463.112	2.541	.058
Learning Style	322.058	1	322.058	1.767	.186
Interaction: Reading Strategy and Learning Style	717.484	3	239.161	1.312	.272
Error	29339.321	161	182.232		
Corrected Total	31746.710	168			

*$p < 0.05$

The students recognized as having internal locus of control learning styles and assigned to the rereading strategy obtained significantly higher scores in four learning objective tests than the students regarded as externals. Also, the students assigned to the rereading strategy obtained significantly higher scores than others, no matter whether they were internals or externals. Table 3.8 is the summary of the item analysis for the second pilot study. Although the study finds some significant effects, more difficult items need instructional enhancement, when compared to the item analysis of the first pilot study. Sixty difficult items have less than .6 correct-response rate.

Table3.8.
Item Analysis Summaries for the Second Pilot Study

DRAWING TEST			**IDENTIFICATION TEST**			**TERMINOLOGY TEST**			**COMPREHENSION TEST**		
Item #	Item Diff.	Frame #	Item #	Item Diff.	Frame #	Item #	Item Diff.	Frame #	Item #	Item Diff.	Frame #
1	0.36	5	21	0.32	9	41	0.40	3	61	0.65	-
2	0.20	9, 14	22	0.48	5, 11	42	0.69	-	62	0.29	13
3	0.25	6	23	0.57	3	43	0.75	-	63	0.51	15
4	0.15	8	24	0.28	7	44	0.43	7	64	0.41	12
5	0.67	-	25	0.46	5,11	45	0.44	9	65	0.53	18
6	0.15	4	26	0.30	6	46	0.31	8	66	0.26	19
7	0.17	9, 14	27	0.54	15	47	0.57	19	67	0.48	19
8	0.20	14	28	0.30	4	48	0.21	9	68	0.43	8, 11
9	0.15	5	29	0.48	4	49	0.43	9	69	0.33	12
10	0.12	7, 14	30	0.79	-	50	0.46	4	70	0.44	5
11	0.22	4	31	0.35	4	51	0.27	4	71	0.40	17
12	0.27	4	32	0.76	-	52	0.51	4	72	0.38	13
13	0.22	8	33	0.31	4	53	0.43	5	73	0.49	19
14	0.62	-	34	0.65	-	54	0.38	4	74	0.43	14
15	0.59	3	35	0.57	6, 8	55	0.70	-	75	0.18	17
16	0.62	-	36	0.30	8	56	0.43	6	76	0.37	13, 14
17	0.59	8	37	0.30	9, 14	57	0.29	8	77	0.40	19
18	0.36	2	38	0.54	8, 11	58	0.28	19	78	0.43	19
19	0.02	6, 8	39	0.37	8, 11	59	0.36	4	79	0.34	17
20	0.09	4	40	0.31	7, 15	60	0.50	9, 14	80	0.47	12

The completion of the second pilot study revealed several needed decisions which impact of the major study:

1. The PHP program is helpful in recruiting subjects by enhancing and increasing the level of convenience for students to participate in the study.
2. Most participants, again, skipped reading the direction page, even if notified as to its importance at the time of recruitment.
3. The Q&A treatment added to the learning materials has a question-answer structure on Web pages that increase the length of the page. So, while adding Q&A structure, validating the proper length for each page is necessary.
4. The research procedure needs to be revised to signify the instructional treatment and the locus of control effects. The participants' locus of control styles can be measured, first. Then, the participants can be divided into internal and external locus of control learning styles. The participants, identified with one of the two styles, enter a randomly-assigned process separately to obtain one of the four treatment groups. This research procedure helps explain how likely the participants are to follow their learning styles when acting upon the reading strategies that they are given in the online learning environment.
5. The process of having every participant sign the informed consent form needs to be different because of the research procedure change. Designing a page in a course management system (i.e. ANGEL) to accept an electronic signature, such as by clicking on an AGREE button, is preferable.
6. The participants need to spend more time reading the learning materials, at least 30 minutes. A log of their reading time, such as on the back of their study ID

cards, allows recording their start times.

7. The font type in the whole research design needs to be changed to Verdana instead of Times New Roman for easier reading and greater familiarity. Currently, more and more Web sites use Verdana as their default font.
8. The participants assigned in different treatment groups might spend significantly different amounts of time on completing the four learning objective tests.

The Major Study

This dissertation (the major study) utilizes tests measuring four different learning objectives. The locus of control measurement identifies the students' learning styles (internal or external). The three reading strategies implemented in an online environment are: rereading, keywords, and Q&A. Conducting an experimental study with descriptive data support, provides a method for examining the reading strategy effects on different learning styles, students' learning achievement, and exploration of the degree to which the students' past reading experiences influence their online learning processes.

The major study occurred in the fall of 2006. The following descriptions include study participants, reading strategy treatments, interview emphases, study procedures, and data analysis methods. The learning materials and the locus of control measures have their descriptions earlier in this chapter.

Study Participants

Based on power analysis, the expected participant number is 120. As expected, the 128 participants were over 18 years old, undergraduates, in their first or the second university year. Most recruitment is from the departments of English, Education Psychology, and Instructional Systems classes. Most students from the department of English were freshmen and pre-service teachers.

Reading Strategy Treatments

The major study revises the directions page for each treatment design by changing the font type to Verdana and adding two bullet points (see Appendix D). The participants, in the beginning, can be easily informed as to how many tasks they will encounter and what they have to do in each task. All instructional pages have also undergone significant redevelopment, such as changing the font type from Times New Roman to Verdana and the template color (see Appendix E-H). In addition, the structure and the amount of instruction in one Q&A treatment Web page has been validated by the materials' developer.

Treatment 1: Control Group

Participants interact with the learning materials in the conventional manner. They progress through 20 Web pages of learning content at their own paces and move forward and backward depending on need. Figure 3.2 is the sample screen shot of the first treatment, control group, on a 640 x 480 monitor. The students can find the first topic of the top of the screen below the title bar, "The Human Heart". They can also find the page range of this topic. The screen shot displays the second Web page where the students can either click on PREVIOUS or NEXT button. The "Direction" button can bring them to view the direction page. Other topics contained in this online instructional module are listed at the bottom of the screen and also inform the students of page counts.

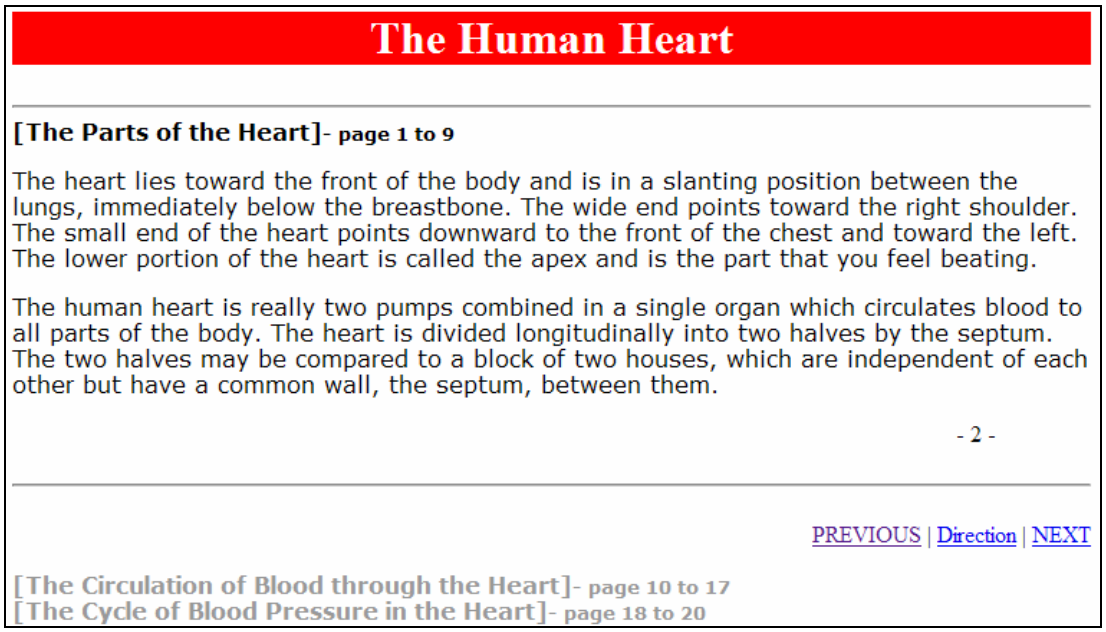

Figure 3.2. Example screen shot of the first treatment- control group

Treatment 2: Rereading Strategy

The participants find a repetition of selected sentences related to specific learning objectives and test questions. This repetition allows them to process information twice. So, an additional 24 web pages were designed for this treatment (total: 51 Web pages). When participants finish reading the first Web page and then click on a “Next” button, the selected sentences or paragraphs from the first Web page appear on the second Web page word-by-word in teleprompter fashion until a “CONTINUE” button appears. The sentence to be reread will not appear all at once; words will appear sequentially and create the sense of animation. After completing the rereading, the participants then can click on the CONTINUE button to proceed to the rest of the Web pages. They can also click on a “PREVIOUS” button to go back to the first Web page. Figure 3.3 and 3.4 are the sample screen shots of the second treatment, rereading, on a 640 x 480 monitor.

As the students view the first Web page, they may be unaware that varied importance levels exist among sentences. However, as they click on the NEXT button, they are forced to read the important sentences again on another Web page. No NEXT button appears on that page, only PREVIOUS, Direction and CONTINUE buttons. The title and other two topics are also removed. The students' visual attention is on the repeated sentences shown on the screen word by word. They can decide how they can elaborate on the new information in the second visit of the sentences for adding to their prior knowledge base in their long-term memory storage. The topic belonging to the sentences and the page range for that topic are still on the top of the screen.

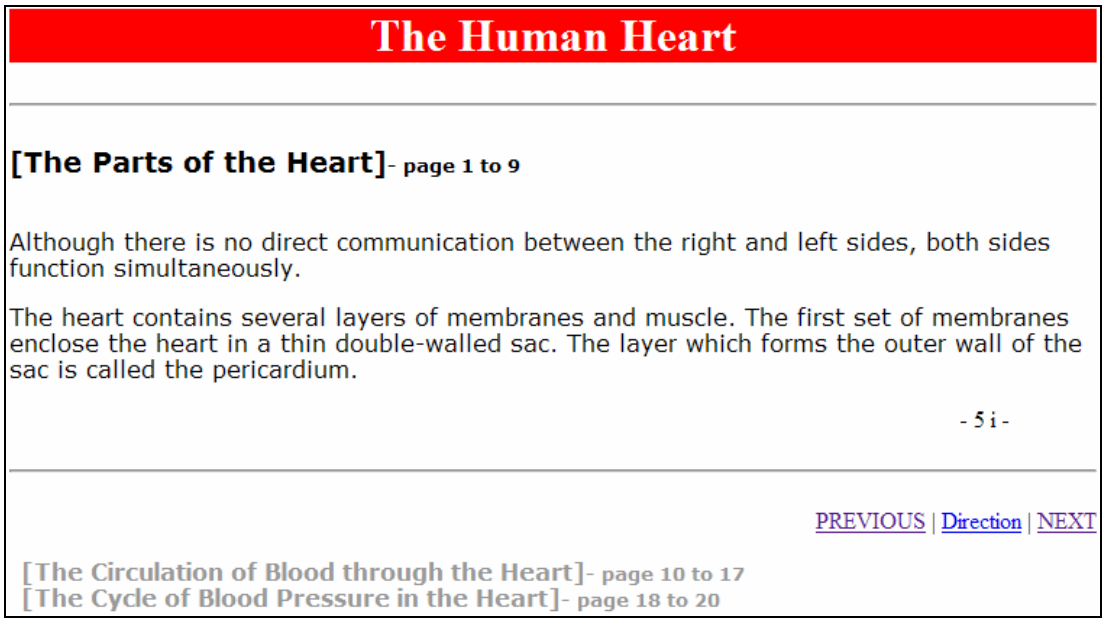

Figure 3.3. Example screen shot of the second treatment-rereading

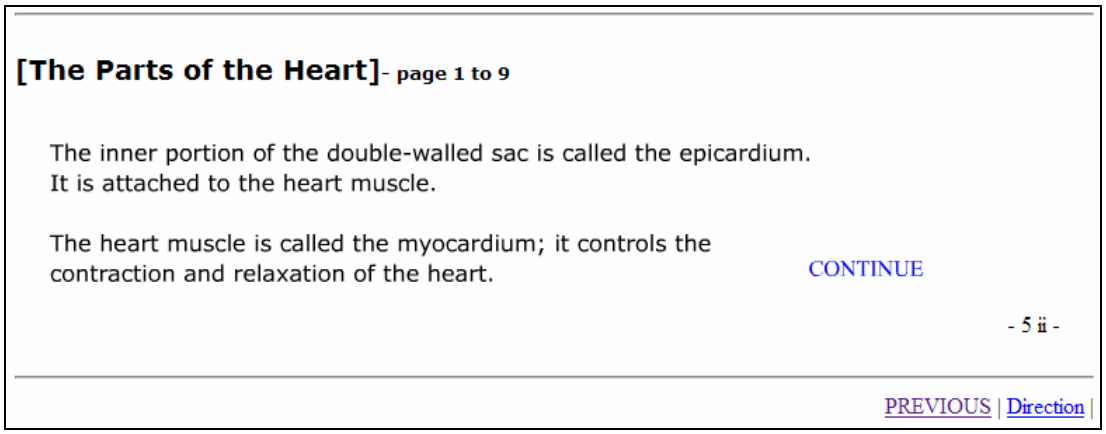

Figure 3.4. Example screen shot of important sentences for rereading

Treatment 3: Keyword Strategy

The participants are encouraged to view highlighted keywords related to key learning objectives and test questions. With the highlighted keywords, visual stimuli bring their attention to either activate prior knowledge or to create new connections for meaningful information. Highlights include 31 facts, concepts and procedures in bold and a large font for this treatment (total 20 Web pages). Figures 3.5 and 3.6 are sample screen shots of the third treatment, keyword, on a 640 x 480 monitor. The structure of the page is the same as in the control and rereading treatment groups. However, in this treatment, the students may attend to viewing the highlighted words and then read the rest information related to them.

Keyword strategy was also implemented in this study to highlight important factual, conceptual, principal, or procedural information. Therefore, the students also view a segment of the sentences highlighted with a larger, bold font style. Imagining how to store varied types of information into a functional or hierarchical relationship is necessary here.

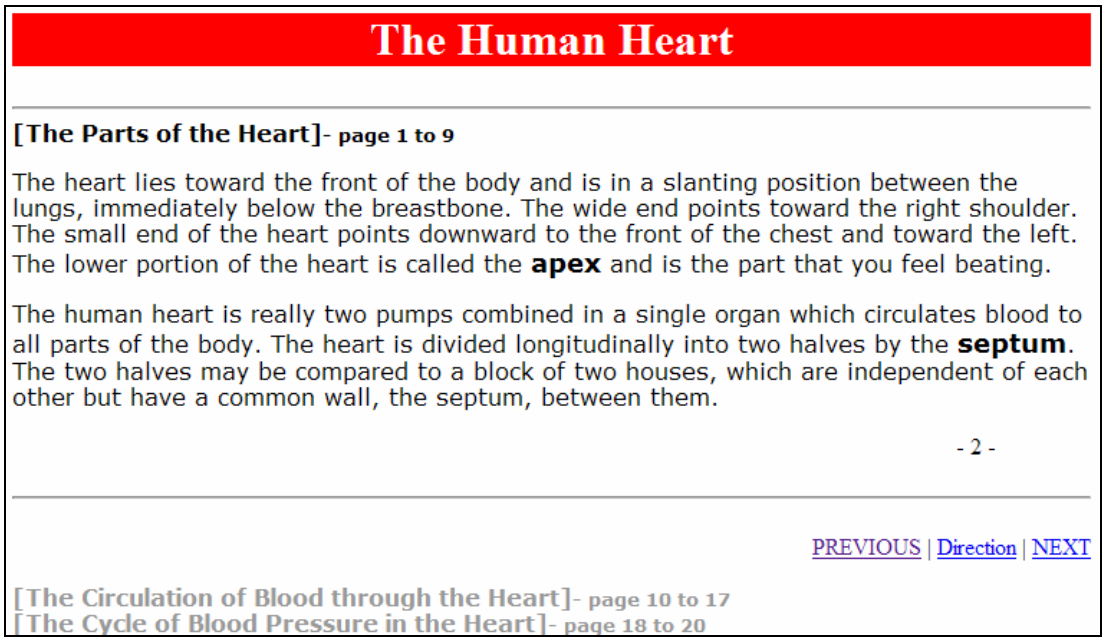

Figure 3.5. Example screen shot of the third treatment-keyword (I)

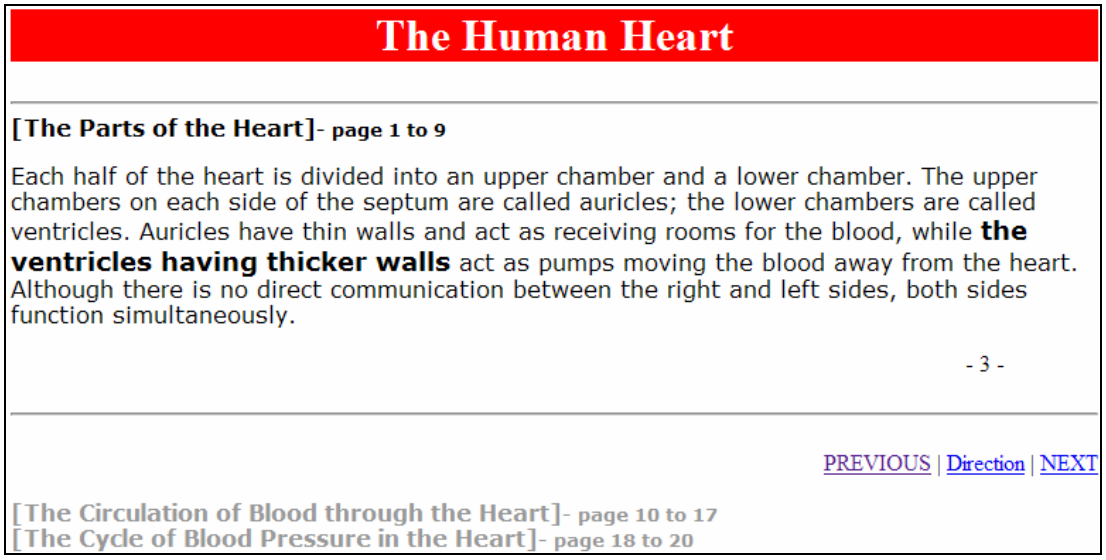

Figure 3.6. Example screen shot of the third treatment-keyword (II)

Treatment 4: Question and Answer (Q&A) Strategy

The participants find some sections of the learning materials are structured in a Q&A format. The revised Web design has a proper length for each page. Students are able to view a chunk (or a segment) of information and then process it in an organized way. This treatment presented 29 Q&A formats for the participants to concentrate on specific learning objectives and related criteria measures. Figure 3.7 is the sample screen shot of the fourth treatment, Q&A, on a 640 x 480 monitor. As previously stated, the page layout is the same as in the other three treatments. However, the structure of the text is different. The students' attention is on the question and answer format, which allows them to process information in a chunk. They then can organize or start developing a schema for the new information.

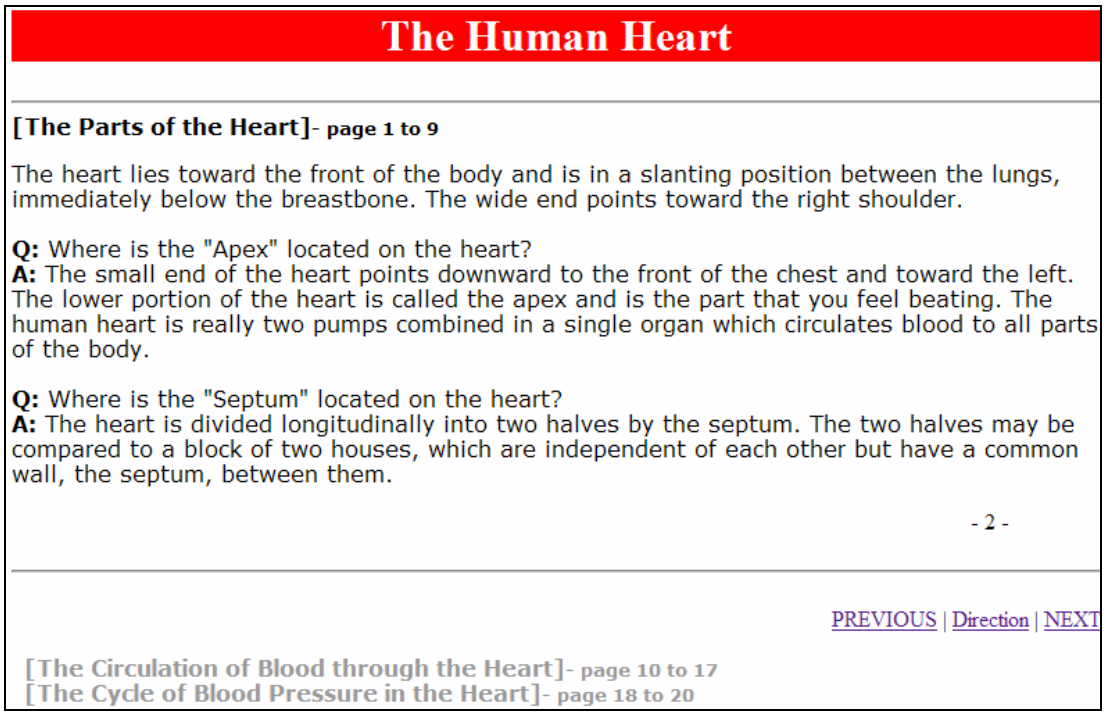

Figure 3.7. Example screen shot of the fourth treatment-Q&A

Table 3.9 contains summaries of different reading strategies' different instructional effects from the viewpoints of information processing theory and levels of processing.

Table 3.9.
Different Reading Strategies' Different Instructional Effects

Reading Strategies	**Information Processing Theory**		
	Sensory Registry	**Working Memory**	**Long-term Memory**
Rereading	Repeated visual stimulus (show the same sentences twice on the screen)	Deciding whether or not to process the repeated sentences	Additional concepts added after elaboration on new information
Keyword	Highlighted visual stimulus (change font styles)	Creating connection for old-new words	Words in functional or hierarchical relations
Q&A	Structural visual stimulus (text in a Q&A format)	Chunking information to speed up processing	Schemata largely (re)organized

Experimental Study Procedures

This major study contains three stages (preparation, implementation, and analysis) similar to the procedures of the pilot studies described earlier. Figure 3.8 illustrates the design and the procedures of the major study. Appendix I lists step-by-step study procedures.

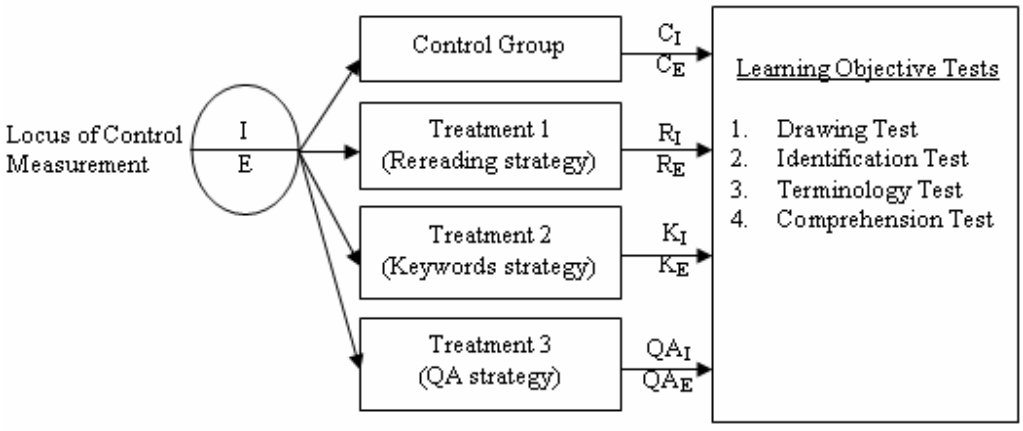

Figure 3.8. Design and procedure of the major study

Preparation Stage: Recruitment of participants occurred in a class and used a large poster which has the topic of the study, an email address, and numbers of credit points the participants can obtain after the study. If the students agreed to participate in this major study, they could immediately sign their names and write down their access accounts on the hard-copy informed consent forms (see three types of forms in Appendix J) which appeared on their desks. The students who did not appear during the recruitment time were still able to express their participation interests, afterwards. Then, all of their access accounts were enrolled on an ANGEL site. They needed to complete the locus of control measurement test within 20 minutes. Next they were guided to select a time to complete the study in a reserved computer lab. Calculation of mean scores from the measurement test allows immediate division of participants into internal or external locus of control types. The participants who obtained lower mean scores were designated as having internal locus of control learning styles and were randomly assigned to one of four different groups.

Then, the remainder of the participants, designated as having an external locus of control learning style, was also randomly assigned to four different groups. A PowerPoint slide was prepared to divide the two learning styles. The slide had a blue background on the left with some access accounts which belonged to the internal locus of control students, and a white background on the right had the external locus of control students' access accounts. Preparing other logistical items, pencils, check-in sheets, drawing sheets, answer sheets, copies of criteria measures, and numbered ID cards for the study completed preparation.

Implementation Stage: Prior to the actual reserved time, the PowerPoint slide showed on a large screen. The pencils, check-in sheets, answer sheets and the numbered ID cards were placed in the proper places. When the participants entered the lab, they looked for their access accounts from the large screen in the lab to determine whether they were in the blue or white group. The participants did not know their learning styles during the study. Then they wrote their access account number on the check-in sheet and were immediately assigned to different treatment groups within the division of locus of control measurement. The participants read through the learning materials in the online environment with or without the treatments. Once complete, after around thirty minutes, they signified their readiness to receive the first criteria measure, the drawing test, which involves using a pencil to draw a human heart and identify the position of its parts on the given drawing sheets. After they finished the drawing test, an assistant checked for appropriate ID number on the drawing sheets. Then participants signified their readiness to receive three criteria measures and one answer sheet to answer identification, terminology, and comprehension test questions. A time tracker also recorded the participants' time spent completing the drawing test through the last comprehension test. The participants finally wrote their access account numbers, again, on the same check-in sheet before leaving the lab.

Analysis Stage: First, the reliability test for the four criteria measures and the locus of control measures were conducted. Then the descriptive analyses of the four different treatment groups provided an overview of the participants' achievement. The mean scores and standard deviations of both internal and external locus of control learning styles were

included in the analyses. Correlational analysis analyzed the appropriateness of running MANOVA. The expectation was to run a 2x4 MANOVA and, if possible, Tukey's HSD post hoc analysis for measuring the effects of different online reading strategies and locus of control types on the four criteria measures. Finally, the analyses of the null hypotheses for the study and an additional time-effect hypothesis completed the analysis stage.

Data Analysis Method

MANOVA was conducted in the beginning for data analysis. The Statistical Package for the Social Sciences (SPSS) version 14.0 provides the MANOVA. This major study had two nominal independent variables, reading strategy and locus of control type, and four interval dependent variables: criteria measures of achievement scores.

Summary

For validating the procedures of implementing reading strategies and locus of control measures, two pilot studies were conducted to diagnose necessary changes. The first pilot study initially utilized an expository text which has converted to a Web version and four learning objective tests (drawing, identification, terminology, and comprehension) to identify which caused most participants to have difficulties in comprehending the text. Then, another group of participants were assigned to read the text with different reading strategies and asked to complete locus of control measures. However, reading strategies or locus of control learning styles or both did not yield any significant effects on learning objective test scores, possibly due to the numbers of participants were insufficient to achieve power analysis results. In the second pilot study, in total, 169 participants were recruited. The study found significant main effect on the comprehension test. Rereading treatment is significantly more effective than the others. Some suggestions are provided, afterward, for improving the major study. This dissertation (the major study) underwent significant redevelopment as a result of the pilot studies. A new set of participants was recruited and first asked to complete locus of control measures. The revised study procedures consist of three stages: preparation, implementation, and analysis. Data analysis methods appear in the last section of this chapter.

Chapter 4

RESULTS OF THE RESEARCH

This chapter presents the results of the quantitative analyses of the major study. The reliability test results are first reported to verify the proper test-item designs for the four criteria of achievement measures (i.e., drawing, identification, terminology, and comprehension tests) and locus of control measures. The descriptive statistics are the next analysis results followed by analyses of the null hypotheses. A correlational analysis determines the validity of the measurements as well as the relationships among the dependent variables for verifying the appropriateness of conducting MANOVA. Finally, the results of 2x4 MANOVA end this chapter.

Test Reliabilities

In this major study, 128 undergraduates taking English (72), Education Psychology (31), or Instructional Systems (25) college-level courses at Pennsylvania State University demonstrate their participation interest by completing the first study task, the locus of control measures in ANGEL. Most of them are freshmen. As a result, all scored, on average, 11.11 points out of 23, the highest possible points for the locus of control measures. An analysis of independent-samples T-test ($t= 14.85$, $df = 2/126$, $p < .001$) validates the division for the students into internal/external locus of control learning style groups.

Therefore, fifty-seven participants who obtained lower than 11 points were regarded as having an internal locus of control learning style. The remaining 57 participants were regarded as having an external locus of control learning style.

Then, the internals and the externals were randomly assigned to one of the four treatment groups as they entered a reserved computer lab. Table 4.1 lists the distribution of internal and the external locus of control learning style participants for the four treatment groups. According to Roscoe (1979), a successful experimental study needs to control the sample size to be no larger than 20 in each sub-group, so that the results of MANOVA tests can be robust. This study fulfills this requirement.

Table 4.1.
Distribution of Participants (Internals and Externals) in Treatment Groups

Treatment Groups	Numbers of Internals	Numbers of Externals	Numbers of Participants
T1: Control	15	18	33
T2: Rereading	15	16	31
T3: Keyword	13	19	32
T4: Q&A	14	18	32
Total	57	71	128

To check the reliability of the measurements, an analysis of all participants' responses at once, as one measurement, is necessary. The reliability analysis determines the internal consistency of the measurements if they consist of homogeneous items (Cronbach, 1990; Urbina, 2004). Table 4.2 summarizes the Kuder-Richardson Formula 20 (KR-20) reliability coefficients for the four criteria of achievement measures, the total composite scores obtained from 128 participants, and the locus of control measures.

In four criteria of achievement measures and the total composite scores, the test reliabilities range from .8 to 1.0, substantiating that all test items have proper design. The test reliability of the locus of control measures rates at .68, corresponding to past study results; also, using Rotter's Internal-External Locus of Control scale reports the reliability range to be from .6 to .9. In sum, the variance of the measurement scores comes from true differences between or among group/individual participants, not from subjectivity or measurement error (Cronbach, 1990; Urbina, 2004). Each measure has good reliability, adequate to further discuss other statistical results.

Table 4.2.
Test Reliability Coefficients

Measures	Numbers of Items	Numbers of Participants	KR-20
1. Drawing	20	128	.91
2. Identification	20	128	.87
3. Terminology	20	128	.84
4. Comprehension	20	128	.82
Total Composite Scores (add 1-4)	80	128	.95
Locus of Control Measures	29	126*	.68

* 2 missing

Descriptive Statistics

Each participant in this major study is regarded as having either an internal or external locus of control learning style. Fifty-seven internal locus of control learning style students obtained, on average, 7.70 points (S.D. = 2.10) in the locus of control measures. Seventy-one external locus of control learning style students, on average, obtained 13.78 points (S.D. = 2.44) in the locus of control measures. As mentioned before, T-test has validated the division for the students into internal/external locus of control learning style groups.

In approximately thirty minutes all 128 participants read through the learning materials in the online environment, with or without the treatments. They then completed four criteria measures (drawing, terminology, identification, and comprehension) in a computer lab. All participants, no matter which treatment group, received an average of 38.93 points (S.D. = 17.59) for all four criteria measures. In addition, all of them, on average, obtained 6.72 points (S.D. = 5.21) in the drawing test, 11.07 points (S.D. = 5.12) in the identification test, 11.20 points (S.D. = 4.88) in the terminology test, and 9.94 points (S.D. = 4.69) in the comprehension test.

Table 4.3 lists the mean scores and standard deviation for each treatment group for each criteria measure. The mean composite scores and the standard deviation obtained by the participants assigned in different treatment groups are also listed in the same table. The highest achievable points for each criteria measure is 20. The highest possible points for the composite scores is 80. Overall, the participants assigned in the control group (M = 42.36, S.D. = 17.96), the Q&A group (M = 39.44, S.D. = 15.72) and the Keyword

group (M = 37.25, S.D. = 18.71) performed better than others assigned to the rereading group. In addition, all participants performed well in the identification (M = 11.07, S.D. = 5.12) and the terminology (M = 11.20, S.D. = 4.88) criteria measures. However, the participants scored very low in the drawing criteria measure (M = 6.72, S. D. = 5.21).

Table 4.3.
Mean Scores and Standard Deviation for Each Treatment Group on Each Criteria Measure

	Criteria Measures (M* S.D.)								Total Composite Scores (M S.D.)	
	Drawing		Identification		Terminology		Comprehension			
Treatments	(M	S.D.)	(M	S.D.)	(M	S.D.)	(M	S.D.)		
T1: Control	8.15	5.62	11.55	4.68	11.76	4.63	10.91	5.02	42.36	17.96
T2: Rereading	4.90	5.54	10.48	5.54	11.81	5.13	9.29	5.09	36.48	18.06
T3: Keyword	6.31	5.37	10.66	5.89	10.50	5.22	9.78	4.45	37.25	18.71
T4: Q&A	7.41	4.94	11.56	4.40	10.75	4.62	9.72	4.21	39.44	15.72
Total	6.72	5.21	11.07	5.12	11.20	4.88	9.94	4.69	38.93	17.59

* M stands for Mean Scores

Figures 4.1 to 4.5 show graphic representations of mean scores for each criteria measure and for the total composite scores among all treatment groups. Figure 4.6 displays the combination of all four criteria measures.

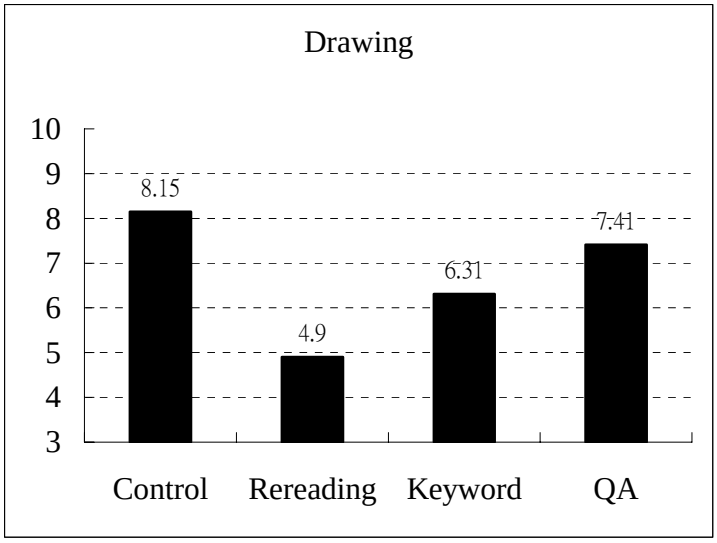

Figure 4.1. Means per treatment for drawing test

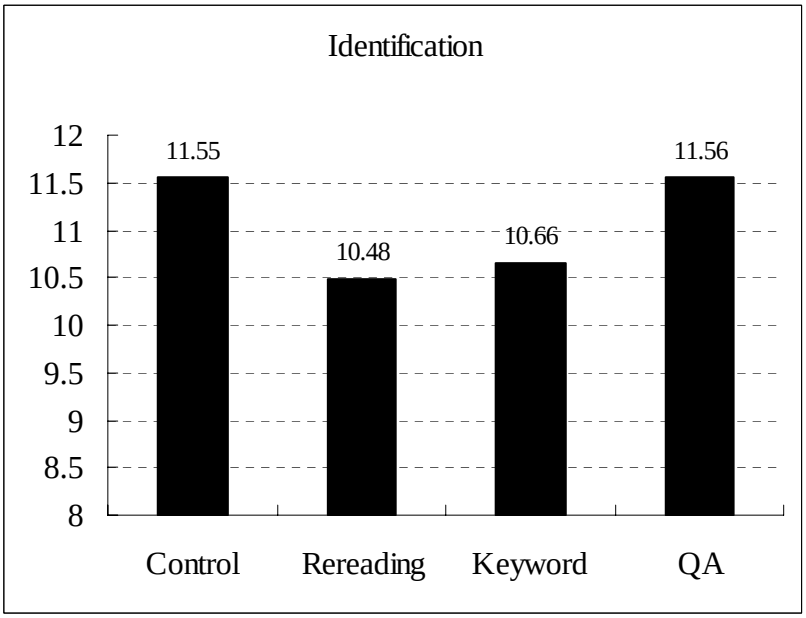

Figure 4.2. Means per treatment for identification test

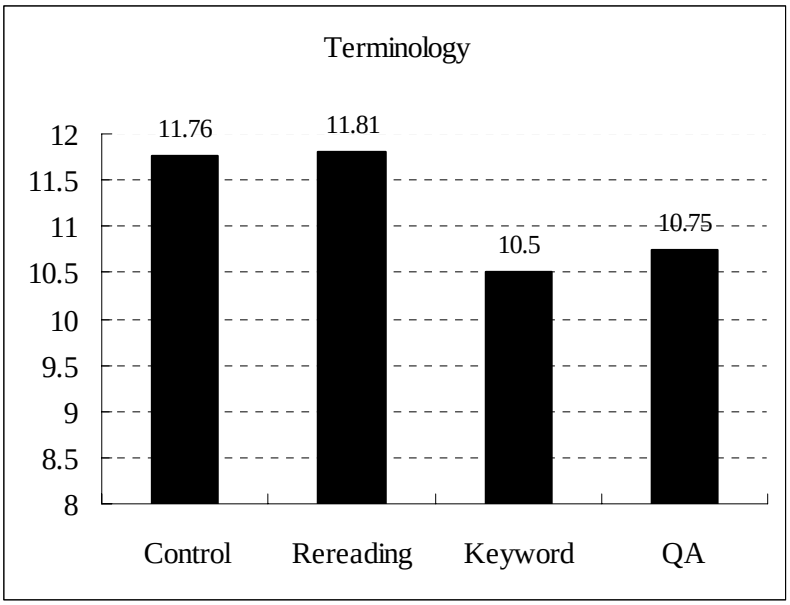

Figure 4.3. Means per treatment for terminology test

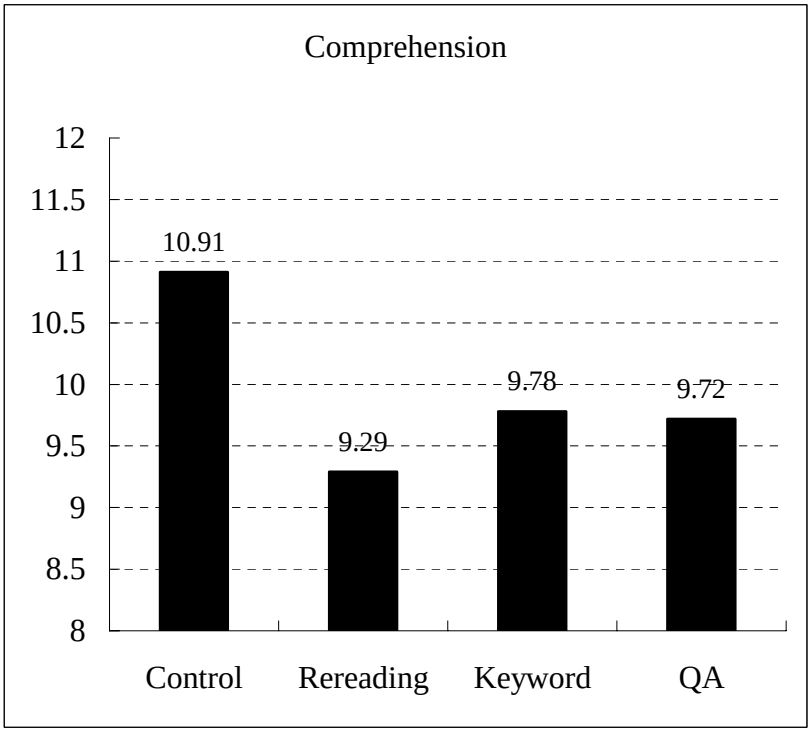

Figure 4.4. Means per treatment for comprehension test

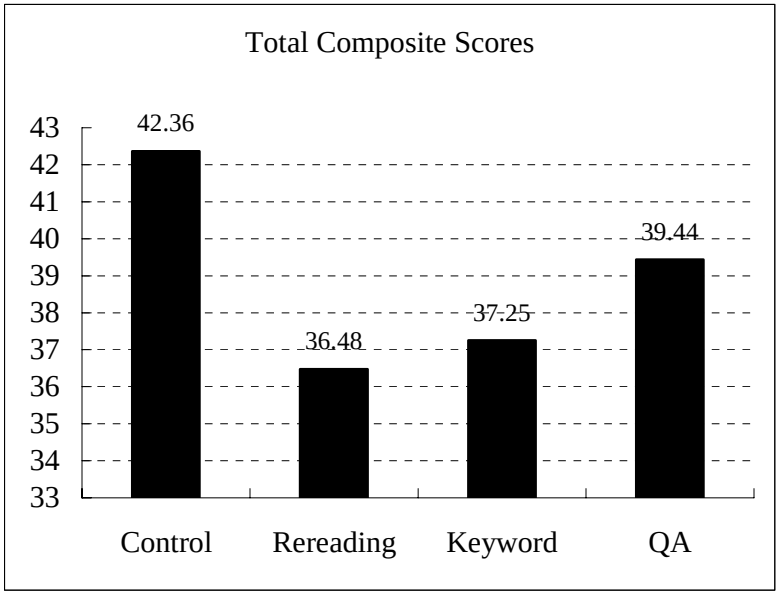

Figure 4.5. Means per treatment on total composite scores

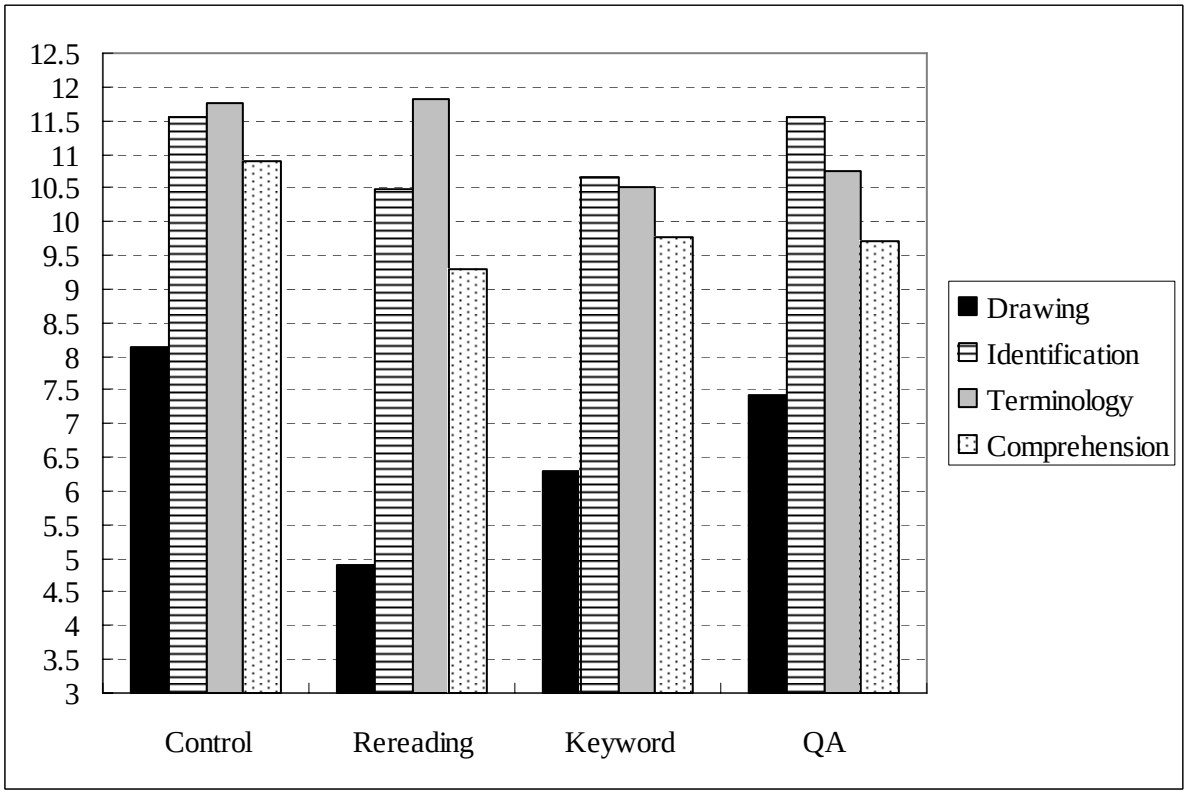

Figure 4.6. Means per treatment of all four measures

An item analysis result is presented in Table 4.4 for the major study. In general, the revised instructional design helps students perform better in the drawing, the identification, and the terminology tests, compared to the item analysis results in the second pilot study. However, only one test item in the comprehension test has a high correct-response rate (.70). Overall, 61 difficult test items have less than .6 correct-response rate. More analyses are needed to explain the possible effects of reading strategy treatments, locus of control learning styles or their interactions.

Table 4.4.
Item Analysis Summaries for the Major Study

DRAWING TEST			**IDENTIFICATION TEST**			**TERMINOLOGY TEST**			**COMPREHENSION TEST**		
Item #	Item Diff. (N=21)	Frame #	Item #	Item Diff. (N=27)	Frame #	Item #	Item Diff. (N=27)	Frame #	Item #	Item Diff. (N=27)	Frame #
1	0.44	5	21	0.58	9	41	0.56	3	61	0.70	-
2	0.09	9, 14	22	0.40	5, 11	42	0.78	-	62	0.36	13
3	0.38	6	23	0.30	3	43	0.78	-	63	0.50	15
4	0.23	8	24	0.35	7	44	0.52	7	64	0.52	12
5	0.72	-	25	0.53	5,11	45	0.52	9	65	0.57	18
6	0.17	4	26	0.52	6	46	0.50	8	66	0.37	19
7	0.09	9, 14	27	0.68	-	47	0.59	19	67	0.52	19
8	0.09	14	28	0.50	4	48	0.41	9	68	0.55	8, 11
9	0.29	5	29	0.61	-	49	0.51	9	69	0.45	12
10	0.06	7, 14	30	0.83	-	50	0.65	-	70	0.56	5
11	0.17	4	31	0.41	4	51	0.44	4	71	0.55	17
12	0.23	4	32	0.75	-	52	0.54	4	72	0.48	13
13	0.34	8	33	0.28	4	53	0.59	5	73	0.56	19
14	0.63	-	34	0.67	-	54	0.45	4	74	0.54	14
15	0.62	-	35	0.74	-	55	0.73	-	75	0.27	17
16	0.61	-	36	0.54	8	56	0.57	6	76	0.48	13, 14
17	0.60	-	37	0.48	9, 14	57	0.44	8	77	0.47	19
18	0.47	2	38	0.64	-	58	0.40	19	78	0.51	19
19	0.12	6, 8	39	0.43	8, 11	59	0.61	-	79	0.45	17
20	0.37	4	40	0.44	7, 15	60	0.62	-	80	0.52	12

Correlations between Dependent Variables

Correlational analysis establishes the validity of the measurements (Cavana, Delahave, & Sekaran, 2001), since it determines the relationship among the dependent variables. To verify the appropriateness of conducting MANOVA, correlational analysis is necessary. Glass and Hopkins (1996) mentioned that if a correlation coefficient value is less than .3, the dependent variables are less correlated with each other (a weak or low relationship); however, if the value is between .3 and .7, the relationship is moderate (French & Poulsen, 2002). With the same rationale, a strong or high correlation has a value of more than .7. MANOVA functions well in the situation where moderate correlation exists among dependent variables (French & Poulsen, 2002). In addition, MANOVA can control false positive results when the dependent variables are correlated. Hence, instead of doing separate analysis for each dependent variable to conclude false, significant results (Type I error), MANOVA decreases the possibility of obtaining the Type I error where significant results are due to chance (i.e., rejecting null hypotheses).

The level of significance is also important, because it determines another possibility for rejecting a true null hypothesis (Huck, 2004). The selected alpha level is usually set to the traditional ones of .05 or .01 (a chance, 5 or 1 out of 100, to make a Type I error). If the alpha level is more than .05 (e.g., .2), the probability of making a Type I error equals to more than 5 times out of 100. Oppositely, according to Huck (2004), if the alpha level is extremely small (e.g., .001), a wrong null hypothesis may be accepted and result in a Type II error. Table 4.5 illustrates the Pearson correlation coefficients among the four criteria measures achieved at the .01 level of significance. In each cell, the Pearson

correlation coefficient is .6 or higher, providing justification for using MANOVA in this study.

Table 4.5.
Correlations (Pearson Correlations) among Four Criteria Measures

	Drawing	Identification	Terminology	Comprehension
Drawing	1	.724**	.622**	.624**
Identification		1	.761**	.724**
Terminology			1	.800**
Comprehension				1

** $p < .001$

Analyses of Null Hypotheses and MANOVA Results

This study addresses three null hypotheses as stated in Chapter 1. A 2x4 MANOVA, also called two-way MANOVA, analyzes the null hypotheses in the study design which has two independent variables (reading strategy and learning style) and four dependent variables (drawing, identification, terminology and comprehension learning objective tests). The two-way MANOVA has the same assumption as the one-way MANOVA (having a single independent variable), but slightly different from ANOVA which has one dependent variable to analyze for various independent variables (Ramsey & Schafer, 2002). The assumptions of the two-way ANOVA are multivariate normality for the dependent measures, linearity and homogeneity of variance-covariance.

To test the normality assumption, drawing a histogram to view its skewness and kurtosis or conducting F-test (robust to non-normality caused by skewness rather than outliers) are two fundamental methods (Everitt & Dunn, 1991). The assumption of the

linearity is satisfactory when the dependent measures seem to fall on an invisible straight line on a scatter plot (Everitt & Dunn, 1991). Finally, achieving the assumption of the homogeneity of variance-covariance means that all box plots' mean values are about equivalent or a residual versus fitted value, displayed has a tunnel shape (Everitt & Dunn, 1991). Consequently, this study meets all MANOVA assumptions allowing further analyses for the study's three null hypotheses.

H_0 1. No significant differences exist in achievement measuring different learning objectives among students receiving different reading strategies.

H_0 2. No significant increases occur on tests measuring different learning objectives between and among students identified with I/E learning styles.

H_0 3. No significant interaction exists between I/E learning styles and different reading strategies on tests measuring different learning objectives.

Table 4.6 shows the overall MANOVA results of the study. "A" means four reading strategies; "B" means locus of control learning styles. The table also includes the analysis of A and B interaction effects. In addition, Pillai's Trace provides multivariate F values, and it is more robust than two common criteria, Wilk's lambda and Hotelling's Trace (Tabachnick & Fidell, 1996).

Table 4.6.
Overall MANOVA Results

Effects	Pillai's Trace	df	F	Sig.
A- Reading Strategy	.166	12	1.745	.056
B- Learning Styles	.017	4	.509	.729
A and B Interaction	.098	12	1.009	.440

Based on the above overall MANOVA results, no significance exists among treatment groups (A), locus of control learning styles (B) or interaction (A and B) on any criteria measures at the .05 significance levels. Thus, the null hypotheses (**H_0 1**, **H_0 2** and **H_0 3**) cannot be rejected. However, quickly drawing a conclusion from the analysis results may risk a Type II error (i.e., fail to reject a wrong null hypothesis).

Table 4.7 shows the detailed MANOVA results (or Tests of Between-Subject Effects) where the main effect of the treatment groups has an approaching significance on drawing test (F = 2.58, p = .057). If the level of significance changes to .06, the analysis of the results will not increase the possibility of Type I errors; however, a post hoc analysis can be conducted to determine which treatment group has significant effects on students' drawing.

Table 4.7.
Detailed MANOVA Results (Tests of Between-Subject Effects)

Sources	Sum of Squares	df	F	Sig.
A- Reading Strategy				
Drawing	202.985	3	2.579	.057[a]
Identification	38.927	3	.488	.691
Terminology	47.406	3	.668	.573
Comprehension	53.474	3	.809	.491
B- Learning Styles				
Drawing	13.131	1	.500	.481
Identification	.258	1	.010	.922
Terminology	5.147	1	.218	.642
Comprehension	2.590	1	.118	.732
A and B Interaction				
Drawing	92.147	3	1.171	.324
Identification	108.771	3	1.365	.257
Terminology	139.418	3	1.964	.123
Comprehension	101.210	3	1.531	.210

a. the p-value is significant if at the .06 level

Table 4.8 shows the post hoc analysis results where the students assigned to the control group received significantly higher scores in the drawing test than the students in the rereading group (p = .009 < .01). The keyword group also has an approaching significant effect on the drawing test, as well (p = .061). Overall, revisiting MANOVA tables are useful to make a complete report during the analysis process.

However, in order to maintain consistency in using the same significant level as that of the previous two pilot studies, this study adopts the .05 level. Therefore, the students' learning objective test scores do not have significant differences as they are assigned in different reading strategies (**H_0 1**). The learning styles do not significantly influence the students' four learning objective test scores (**H_0 2**). Finally, no significant interaction exists between two independent variables (**H_0 3**).

Table 4.8.
Post Hoc Analysis for the Treatment Groups

Comparison Groups	Mean Difference	Sig.
Control-Rereading	3.407	.009**
Control-Keyword	2.012	.120
Control-Q&A	.958	.455
Rereading-Keyword	-1.395	.286
Rereading-Q&A	-2.449	.061[b]
Keyword-Q&A	-1.054	.418

** the *p*-value is significant if at the .01 level
b. the *p*-value is approaching significant level

Additional Findings

Differences may exist for time spent for completing all four criteria measures among the participants as a result of different learning styles in different treatment groups. Therefore, the study tracked eighty-five participants' time spent for completing all four criteria measures. The remainder of the participants' time-spent data was lost as a result of an improperly established tracking system.

Table 4.9 presents descriptive statistics about time effects in each treatment group. Overall, the students took an average of 26.31 minutes (S.D. = 9.22) to complete all the criteria measures. Specifically, the students assigned to the Q&A group spent more minutes (M = 27.64, S.D. = 8.04) than other students assigned in other treatment groups.

Table 4.9.
Descriptive Statistics about Time Effects in Each Treatment Group

Treatments	Mean Minutes	Standard Deviation	Numbers of Participants
T1: Control	25.95	7.17	21
T2: Rereading	26.65	13.64	20
T3: Keyword	25.00	7.33	22
T4: Q&A	27.64	8.04	22
Total	26.31	9.22	85

Table 4.10 is a two-way ANOVA result analyzing time effects. Two independent variables (reading strategy and learning style) and one dependent variable (the total amount of time in minutes) entered the ANOVA analysis procedure. However, no significant interaction exists between treatment groups and learning styles. No significant differences exist in either treatment groups or learning styles.

Table 4.10.
Two-way ANOVA Results for Analyzing Time Effects

Sources	Sum of Squares	df	F	Sig.
A- Reading Strategy	63.053	3	.232	.874
B- Learning Styles	7.963	1	.088	.768
A and B Interaction	68.296	3	.251	.860

Summary

Data analyses for this major study include reliability test, descriptive statistics, correlational analysis, and MANOVA. Reliability test proves that all participants' responses to four criteria of achievement measures and locus of control measures have internal consistency. Descriptive statistics provide mean scores and standard deviations (SDs) of two groups (internal and external) locus of control learning style students. The average points and SDs obtained by the participants, randomly assigned to control, rereading, keyword or Q&A treatment groups, are reported in the tables as well as presented in diagrams. Correlations between four dependent variables (drawing, identification, terminology and comprehension tests) are moderate and allow conducting MANOVA. However, no significant effect was found from the main effect or the interaction of two independent variables (reading strategies and locus of control learning styles). All three null hypotheses proposed in the study are not rejected. Finally, an additional finding about time effects on completing all four criteria of achievement measures ends the chapter.

Chapter 5

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The previous chapter presents the results of the major study from different data analysis methods (reliability, descriptive statistics, correlational analysis and MANOVA). This chapter begins with reporting findings by restating the acceptance of the null hypotheses. Then, the discussion of findings proceeds to raise issues pertinent to Web-based instructional designs and study methodologies. The contributions that this dissertation makes are addressed next, as conclusions. Finally, based on the conclusions, proposed recommendations for future research appear at the end of the chapter.

Findings

The major study cannot reject the three hypotheses based on not finding significant differences in the statistical analyses of MANOVA.

> **H_0 1.** No significant differences exist in achievement measuring different learning objectives among students receiving different reading strategies.
>
> **H_0 2.** No significant increases occur on tests measuring different learning objectives between and among students identified with I/E learning styles.
>
> **H_0 3.** No significant interaction exists between I/E learning styles and different reading strategies on tests measuring different learning objectives.

Hence, the students assigned to different treatment groups (reading strategies: control, rereading, keyword and Q&A) do not score significantly high in four criteria measures (drawing, identification, terminology and comprehension tests) ($p > .05$) in the

environment, which contains expository text instructions describing the physiology of the human heart, and circulation of blood during both the diastolic and systolic phases. The environment is Web-based, and revised according to decisions made from the second pilot study. Also, the students' learning styles (internal or external locus of control) yield no significant differences in the criteria measures ($p > .05$). All MANOVA results provide no evidence that the two main effects (reading strategy and learning style) have significant interaction with the criteria measures ($p > .05$).

No significant interaction existing in the major study indicates the possibility that the main effects are significant in a certain criteria measure. However, unlike the second pilot study, in which rereading has effective main effects on student comprehension criteria measure, the major study's findings cannot determine which reading strategy is more effective in an online environment. Neither can the findings identify which strategy effectively enhances which learning objective tests (facts, concepts, rules/principles, or procedure). The discussion of findings describes all study procedural issues which might influence the study results.

Discussion of Findings

All reading strategy treatments in this study may be equally effective for learning; therefore, the study does not find any statistically significant differences in measuring students' achievement. From a design perspective, designers have to consider both effectiveness and efficiency factors for Web-based instructional materials, so that learners

can effectively process information from the material and efficiently complete criteria measures. In addition, the design process should be cost-effective.

Although the participants assigned in the control group obtained the highest scores (M = 10.91, S.D. = 5.02) in the comprehension test, the most cost-effective treatment is keyword. The participants assigned in the keyword group spent much less time (M = 25.00 minutes, S.D. = 7.33) to complete four criteria measures, and scored higher (M = 9.78, S.D. = 4.45) in the comprehension test than the participants assigned to the rereading, and Q&A groups. In addition, creating a keyword strategy which does not have animation only requires about an hour. Surprisingly, the participants assigned to the rereading group obtained the highest average scores (M = 11.81, S.D. = 5.13) only in the terminology test, and they ranked second for time spent (M = 26.65 minutes, S.D. = 13.64) in this study. However, this strategy requires approximately twenty hours to create and then test rereading animation features for the Web-based instructional materials when compared to the keyword strategy. The Q&A reading strategy also requires approximately twenty hours to create question and answer formats. However, the participants performed well in almost all tests; especially, they obtained the highest scores (M = 11.56, S.D. = 4.40) in the identification test. Therefore, adding keywords to Web-based instructional materials is the most cost-effective design.

Another possible outcome of the findings is that no significant differences in the treatments might be the result of the participants' reading ability which has achieved college level for study at Pennsylvania State University. They may have already

identified and adopted a personal reading strategy for texts in a Web-based environment, so adding a reading strategy is a distraction, not an enhancement. More and more, since the 1980s, state-level policies focus on enhancing undergraduate education (Hearn & Holdsworth, 2002). Caboni, Mundy and Duesterhaus' (2002) study even tried practicing seven theoretical principles proposed by Chickering and Gamson in 1987 to provide empirical evidence for enhancing learning in undergraduate education.

In addition, more than half of the participants (72, 56.25%) were students from English courses. They may have been taught to try comprehending a text under any circumstances by their instructors, since they may enter teacher education programs after the course. Kaplan (2001) revealed that pre-service teachers' self-awareness of knowledge acquisition plays a motivational role in reading. For example, the purpose of adding rereading strategy is to force the participants to process the important information twice, and the Q&A strategy is to help them structure the text. Both are designed for enhancing reading comprehension. However, the strategies might interrupt the participants' reading flow. In the keyword strategy, the participants may not pay attention to the font style change. With good readers, adding reading strategies on Web-based instructional materials seems to be unnecessary.

Participants' prior knowledge may also have some effect on criteria measure scores. Thompson and Zamboanga's (2003) study found that prior knowledge does have an effect on the students' later achievement. As they stated, "…prior understanding has a significantly positive association with subsequent learning" (p. 100). In this study, most

participants graduated from senior high schools and then immediately entered colleges, so they may still be familiar with the heart content. Some participants from Education Psychology and Instructional Systems courses are in different majors, so they may participate in the study to obtain extra-credit points for courses, without revealing whether or not they are in a biology field or have taken a related class (or a similar study) in the last semester.

In addition, almost all the participants recruited from the Instructional Systems course (25, 19.53%) have good computer skills which perhaps help them read any texts in a Web-based environment. For example, the participants assigned in the control group gained benefits from reading texts in their own ways. Despite having low or high prior knowledge, they obtained the highest total composite scores for the criteria measures (M = 42.36, S.D. = 17.96). The participants, assigned in Q&A (M = 39.44, S.D. = 15.72), Keyword (M = 37.25, S.D. = 18.71) or rereading (M = 36.48, S.D. = 18.06) group, may have low prior knowledge to process information. They may not gain benefits from the help of additional reading strategies.

Unexpected results obtained in this study may result from participants' diverse learning styles, not only internal or external locus of control types. According to Anderson (2005), the outcomes associated with learning style need to be interpreted with caution, since other factors influence individual academic achievement. Some studies do not find any significant instructional effects when learning styles are taken into consideration. For example, Busato et al. (2000) investigated how certain factors

(intellectual ability, learning style, personality and achievement motivation) relate to academic success. As a result, learning style was not positively related to academic success in their study. Karns' (2006) research, with marketing educators who invest time and money in designing online courses, find students' learning styles have no significant effects on learning; rather, the research suggested educators provide diverse cases and active learning pedagogies for the students.

In addition, since this study only adopts Rotter's Internal-External Locus of Control Scale to divide participants into two types of learning styles, another possibility for having unexpected results is that the external learning style students gain benefits from the reading strategy effects. They then performed well in four criteria measures as did internal locus of control learning style students. Varied learning style inventories containing different measuring purposes may be helpful in selecting proper reading strategies for students (Beck, 2001).

Therefore, this study may need to investigate the effects of participants' high-low reading ability in a Web-based environment (or high-low prior knowledge in reading heart content) and then identify their locus of control learning styles before they enter different reading strategy treatment groups. However, this study needs to revise methodologies to recruit a large number of participants, adjust recruitment procedures, and modify analysis methods.

Another issue is also related to this study's methodologies. Since most participants could finish reading the heart content within twenty minutes. Their assignments to control, keyword, or Q&A groups also allow around ten more minutes to reread the content within the thirty-minute time restriction. Some participants having external locus of control learning style may benefit from re-reading the content with keyword or Q&A reading strategies. This study may find an effect from dual reading strategies on criteria measures. However, this study did not intend to investigate this type of effect. Hence, this study finds no significant single effect from reading strategies or learning styles.

Motivation may still play a role in this study, since the heart content is irrelevant to the courses participants attend. In addition, regardless of the participants' study performance, as long as they completed the study, they could obtain extra-credit points. So, most participants may not try their best to comprehend the content. For example, participants needed to spend at least thirty minutes to read through the heart content, so most of them also completed four criteria measures within thirty minutes (according to eighty-five time tracking records, M = 26.31; S.D. = 9.22). Their criteria measure scores can also prove this situation. On average, 128 participants obtained less than ten points in two tests where the highest possible points are twenty (drawing test: M = 6.72, S.D. = 5.21; comprehension test: M = 9.94, S.D. = 4.69). The reading strategy and learning style effects may be restricted by time effects.

Therefore, the study environment may become another factor for unexpected results. Strategies may crystallize in a situation (Sadler-Smith, 2001); however, learning styles

provide information about personal preferences or self-beliefs in a situation, and they can be a temporary or a partial response to a specific situation (Kratzig & Arbuthnott, 2006). In this study, participants' performances (or learning behaviors) may be observable through how they use reading strategies in the Web-based learning environment; however, the participants can decide whether or not they want to follow the way reading strategies are implemented in this study.

Conclusions

The previous discussions of study findings give rise to conclusions in three dimensions.

First, in the study design dimension, recruiting college-level undergraduates for a reading task can not easily determine the effectiveness of strategies implemented in a Web-based environment. Even if some reading strategies are effective for them, they have perceived that completing the study to be more important than trying their best to perform well in the study. Hence, internal locus of control learning style participants can demonstrate the same performance as do externals. In addition, the requirement for reading instructional materials for at least thirty minutes allows the participants to read several times (plus an assigned reading strategy) similar to the participants assigned in the rereading group. The amount of time required to spend on reading can be less than thirty minutes to avoid the participants assigned to the control, keyword and Q&A groups reading the materials more than twice.

Second, in an instructional design dimension, educators can further explore students' learning styles, such as high-low reading ability (or prior knowledge) for increasing learning motivation. Low study motivation is obvious, since the participants had to read content irrelevant to their majors. However, in a real setting, the educators can encourage the students to be aware of their own strengths in varied learning situations. For example, the educators can not only integrate reading strategies in a Web-based environment, but also customize Web-page designs by providing a personalized program, such as one-to-one computing techniques (i.e. an ubiquitous environment where each student owns a laptop to manage the learning progress with responsibility to increase self-learning abilities).

Third, in the evaluation design dimension, using varied measurements can help make good instructional decisions for both study and instructional designs. This study tests four types of learning objectives (facts, concepts, rules/principles, and procedures) by using four types of criteria measures (drawing, identification, terminology and comprehension). Some factors may influence study results that need further investigation, such as drawing skills and ability to view texts on a computer screen.

Recommendations for Future Research

Based on the study's findings, discussion of possible explanations for insignificant results and conclusive descriptions in three dimensions, result in several recommendations for future research:

1. Study the effects of reading strategies on reading with another group of participants (e.g., undergraduates or younger students identified as having low reading ability).
2. Study the effects of learning styles on reading and other factors, such as instructional motivation and reading environment.
3. Investigate participants' other learning styles or reading habits to help interpret any study statistical results. For example, conducting several interviews or distributing questionnaires are ways to obtain other participatory information.
4. Study the effects of dual- or multi-reading strategies and learning styles on reading in the same study setting. Combined rereading, keyword and Q&A strategies may result in the same effects from the rereading-keyword strategy or the Q&A-keyword strategy.
5. Implement a pre-test to identify participants' prior knowledge at the beginning of the whole study process. Participants, having low prior knowledge in heart content, can continue the study.
6. Study the effects of similar or different reading strategies and learning styles in the same Web-based environment on different content, such as history and geography.

7. Replicate the study to recruit a large number of participants to allow dividing them into three groups. Only the participants getting high or low locus of control learning style measurement scores can continue the study to investigate the reading strategy and learning style effects on reading.
8. Conduct the study with different amounts of required reading time to avoid participants reading the heart content twice if they are assigned to keyword or Q&A group and then investigate which reading strategy is most effective.

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Appendix A: Learning Materials

By Francis M. Dwyer

The Parts of the Heart

In order to better comprehend the following instruction, it will be helpful to visualize a cross-sectional view of a human heart in a position such that you are facing a person. Therefore, the right side of the person's heart is to your visual left, as shown in the above diagram. Likewise, the left side of the person's heart would be illustrated on the right side in the diagram.

The human heart is a hollow, bluntly conical, muscular organ. Its pumping action provides the force that circulates the blood through the body. In the average adult, the heart is about five inches long and about two and one half inches thick. A man's heart weights about 11 ozs. And a woman's heart weighs about 9 ozs.

The heart lies toward the front of the body and is in a slanting position between the lungs, immediately below the breastbone. The wide end points toward the right shoulder. The small end of the heart points downward to the front of the chest and toward the left. The lower portion of the heart is called the apex and is the part that you feel beating.

The human heart is really two pumps combined in a single organ which circulates blood to all parts of the body. The heart is divided longitudinally into two halves by the septum. The two halves may be compared to a block of two houses, which are independent of each other but have a common wall, the septum, between them. Each half of the heart is divided into an upper chamber and a lower chamber. The upper chambers on each side of the septum are called auricles; the lower chambers are called ventricles. Auricles have thin walls and act as receiving rooms for the blood, while the ventricles having thicker walls act as pumps moving the blood away from the heart. Although there is no direct communication between the right and left sides, both sides function simultaneously.

The heart contains several layers of membranes and muscle. The first set of membranes enclose the heart in a thin double-walled sac. The layer which forms the outer wall of the sac is called the pericardium. It is composed of a tough, transparent elastic tissue. It protects the heart from rubbing against the lungs and the walls of the chest. The inner portion of the double-walled sac is called the epicardium. It is attached to the heart muscle.

The heart muscle is called the myocardium; it controls the contraction and relaxation of the heart. The myocardium constitutes by far the greatest volume of the heart and its contraction is responsible for the propulsion of the blood through the body. The muscle varies in thickness; for example, the muscle in the auricle walls are thin when compared to the thickness of the muscle in the ventricle walls.

Finally the endocardium is the name given to the membrane lining inside of the heart wall. Blood enters the heart through veins. Only veins carry blood to the heart. The superior and inferior vena cavas are the two veins which deposit blood in the right auricle; there are no valves at the opening of these veins.

The superior vena cava deposits blood into the right auricle from all body parts above heart level, for example, the head and arms. The inferior vena cava carries blood from parts of the body below heart level, for example, the trunk and legs, depositing the blood in the right auricle.

As blood from the body fills the right auricle, some of it begins to flow into the right ventricle immediately, through a common opening.

This common opening, between the right auricle and right ventricle, is called the

tricuspid valve. This valve consists of three triangular flaps on thin, strong, fibrous tissue. These flaps permit the flow of blood into the right ventricle, but prevent it from flowing backward into the right auricle because the ends of the flaps are anchored to the floor of the right ventricle by slender tendons.

Thus, blood passes from the right auricle through the tricuspid valve into the right ventricle. As the right ventricle is filled with blood, both ventricles begin to contract creating pressure.

While the blood pressure behind the tricuspid valve brings the flaps together and prevents the flow of blood between the right auricle and the right ventricle, the contraction of the right ventricle continues until the blood presses hard enough to open the pulmonary valve.

The pulmonary valve, located between the right ventricle and the pulmonary artery, consists of three flaps like the tricuspid valve. As soon as the right ventricle begins to relax from its contraction, the valve flaps are filled with blood backing up from the pulmonary artery. The flaps are pressed together stopping the blood flow back into the right ventricle. The pulmonary valve only opens when the pressure in the right ventricle is greater than the pressure in the pulmonary artery, forcing the blood into the artery.

In the pulmonary artery the blood is carried away from the heart to both the left and right lungs where it is cleansed and oxygenated.

Returning from the lungs, the blood enters the heart through four pulmonary veins and collects in the left auricle; these vein openings, like the vena cavas, have no valves. The left auricle then contracts when it is full, squeezing blood through the mitral valve into the left ventricle.

The mitral valve, located between the left auricle and the left ventricle, it is similar in construction to the tricuspid valve. As the left ventricle contracts simultaneously with its mate, the right ventricle, it forces blood behind the flaps of the valve thereby closing the passageway back to the left auricle. Like the tricuspid valve, the ends of the mitral valve flaps are anchored to the floor of the left ventricle by slender tendons.

The contraction of the left ventricle pumps the blood through the entire body. For this reason it is the largest, strongest, and most muscular section of the heart. When the left ventricle is filled with blood, it contracts resulting in the pressure opening the aortic valve. The aortic valve is similar to the other flap like valves; the valve stops the backward flow of blood to the left ventricle and opens for the forward flow of blood to the aorta.

The aorta is the large artery which carries the blood away from the heart back to the various parts of the body.

The Circulation of Blood Through the Heart

The directional flow of blood in the heart is determined by valves which allow the blood to flow in only one direction. These sets of valves are the tricuspid and mitral valves, which control the flow of blood from the auricles to the ventricles, and the pulmonary and aortic valves which control the flow of blood from the ventricles to the arteries.

Both auricles receive blood simultaneously through vein openings which have no valves. The right auricle receives its blood through the superior and inferior vena cavas, while the left auricle receives its blood through the pulmonary veins.

A wave of muscular contraction starts at the top of the heart and passes downward, simultaneously, over both sides of the heart; that is, both auricles contract at the same time and then relax as the contraction passes down to the ventricles. When the auricles are caused to contract, they become small and pale and in doing so the blood in their chambers is subjected to increased pressure which forces blood to the ventricles through the opened tricuspid and mitral valves.

As the ventricles fill, eddies of the blood float the flaps on both the tricuspid and mitral valves back to a partially closed position.

The instant that the contraction of the auricles has been completed, the ventricles are stimulated to contract. This contraction increases the pressure in the ventricle chambers forcing the tricuspid and mitral valves completely closed, thereby preventing blood from being forced backwards into the auricles.

The auricles, relaxing from their contraction, receive a continuous blood flow from the vena cavas and the veins.

As the ventricles continue to contract, pressure in these chambers force the pulmonary and aortic valves to open. The pulmonary valve, leading from the right ventricle, guards the entrance to the pulmonary artery. The aortic valve, leading from the left ventricle, guards the entrance to the aorta or aortic artery.

Both are 3 flapped valves, and are together known as the semi-lunar valves. Prior to ventricle contraction, the valves are closed by back pressure provided by blood already in the exit arteries. When pressure in the ventricles becomes greater than that in the exit arteries due to ventricle contraction, the semi-lunar valves open.

With the semi-lunar valves open, blood flows from the right ventricle into the pulmonary artery on route to the lungs for cleaning and oxygen. Simultaneously, blood flows from the left ventricle into the aorta for distribution throughout the entire body.

Immediately following the pumping of blood into the arteries, the ventricles begin to relax. This relaxation lowers the pressure within their chambers and the greater pressure in the arteries close the semi-lunar valves. Pressure within the ventricles is sufficient, however, to maintain closure of the tricuspid and mitral valves against the already increasing auricle pressure.

As the ventricles relax further, pressure within them rapidly decreases. At the same time blood flowing into the auricles from the veins increases the auricle pressure. Due to the differential pressure between the auricles and ventricles, the tricuspid and mitral valves are forced partially open.

The circulation of blood through the heart begins again with the next auricle contraction. Auricle pressure fully opens the tricuspid and mitral valves resulting in a rapid flow of blood into the ventricles.

The Cycle of Blood Pressure in the Heart

The cycle of blood pressure in the heart consists of two distinct phases. One of these phases is called the diastolic or relaxation phase.

In the diastolic phase, the heart relaxes between contractions. Blood flows into the heart, filling both auricles. While blood is flowing into the auricles, the arteries still maintain

part of the pressure developed by a prior ventricle contraction. This is the time of lowest pressure in the arteries, or what is called the diastolic pressure.

During this phase the ventricles are also relaxing. The ventricles are slowly being filled with blood, due to the full auricles and partially opened tricuspid and mitral valves.

The second phase, the systolic or contraction phase, begins when the auricles contract. The blood is forced through the tricuspid and mitral valves into the ventricles. The ventricles then contract forcing the blood through the semi-lunar valves into the pulmonary and aortic arteries.

The blood leaves the ventricles under terrific pressure and surges through the arteries with a force so great that it bulges their elastic walls. At this point, arterial blood pressure is greatest; we refer to this pressure as the systolic pressure.

The heart begins to relax again. The semi-lunar valves are closed; blood flows into the auricles from the veins; and the tricuspid and mitral valves are forced partially open.

The diastolic phase begins, and the cycle of blood pressure starts again.

Appendix B: Locus of Control Measures

By Julian Rotter

1. a. Children get into trouble because their parents punish them too much.
b. The trouble with most children nowadays is that their parents are too easy with them.
2. a. Many of the unhappy things in people's lives are partly due to bad luck.
b. People's misfortunes result from the mistakes they make.
3. a. One of the major reasons why we have wars is because people don't take enough interest in politics.
b. There will always be wars, no matter how hard people try to prevent them.
4. a. In the long run people get the respect they deserve in this world.
b. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.
5. a. The idea that teachers are unfair to students is nonsense.
b. Most students don't realize the extent to which their grades are influenced by accidental happenings.
6. a. Without the right breaks one cannot be an effective leader.
b. Capable people who fail to become leaders have not taken advantage of their opportunities.
7. a. No matter how hard you try some people just don't like you.
b. People who can't get others to like them don't understand how to get along with others.
8. a. Heredity plays the major role in determining one's personality.
b. It is one's experiences in life which determine what they're like.
9. a. I have often found that what is going to happen will happen.
b. Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.
10. a. In the case of the well prepared student there is rarely if ever such a thing as an unfair test.
b. Many times exam questions tend to be so unrelated to course work that studying is really useless.
11. a. Becoming a success is a matter of hard work, luck has little or nothing to do with it.
b. Getting a good job depends mainly on being in the right place at the right time.
12. a. The average citizen can have an influence in government decisions.
b. This world is run by the few people in power, and there is not much the little guy can do about it.
13. a. When I make plans, I am almost certain that I can make them work.
b. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.
14. a. There are certain people who are just no good.
b. There is some good in everybody.
15. a. In my case getting what I want has little or nothing to do with luck.
b. Many times we might just as well decide what to do by flipping a coin.
16. a. Who gets to be the boss often depends on who was lucky enough to be in the right place first.
b. Getting people to do the right thing depends upon ability; luck has little or nothing to do with it.
17. a. As far as world affairs are concerned, most of us are the victims of forces we can

neither
understand, nor control.

b. By taking an active part in political and social affairs the people can control world events.

18. a. Most people can't realize the extent to which their lives are controlled by accidental happenings.

b. There really is no such thing as "luck."

19. a. One should always be willing to admit his mistakes.

b. It is usually best to cover up one's mistakes.

20. a. It is hard to know whether or not a person really likes you.

b. How many friends you have depends upon how nice a person you are.

21. a. In the long run the bad things that happen to us are balanced by the good ones.

b. Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.

22. a. With enough effort we can wipe out political corruption.

b. It is difficult for people to have much control over the things politicians do in office.

23. a. Sometimes I can't understand how teachers arrive at the grades they give.

b. There is a direct connection between how hard I study and the grades I get.

24. a. A good leader expects people to decide for themselves what they should do.

b. A good leader makes it clear to everybody what their jobs are.

25. a. Many times I feel that I have little influence over the things that happen to me.

b. It is impossible for me to believe that chance or luck plays an important role in my life.

26. a. People are lonely because they don't try to be friendly.

b. There's not much use in trying too hard to please people, if they like you, they like you.

27. a. There is too much emphasis on athletics in high school.

b. Team sports are an excellent way to build character.

28. a. What happens to me is my own doing.

b. Sometimes I feel that I don't have enough control over the direction my life is taking.

29. a. Most of the time I can't understand why politicians behave the way they do.

b. In the long run the people are responsible for bad government on a national as well as on a local level.

Appendix C: Criteria Measures of Achievement

By Francis M. Dwyer

Study ID Number: _____

TEST 1 --- DRAWING TEST

Directions: Draw a simple line picture of a heart and place the corresponding number of the 20 identified parts, where they would be located on the heart.

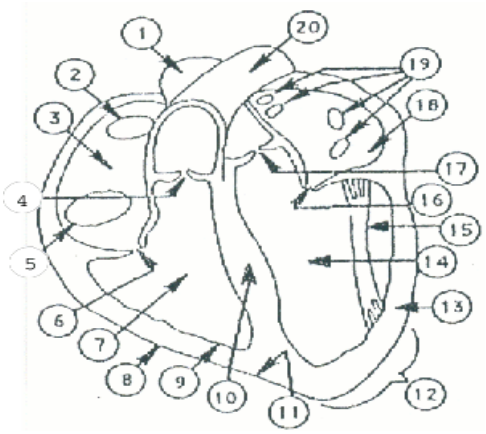
1. Superior Vena Cava
2. Aorta
3. Tricuspid Valve
4. Pulmonary Veins
5. Septum
6. Epicardium
7. Aortic Valve
8. Pulmonary valve
9. Inferior Vena Cava
10. Pulmonary Artery
11. Myocardium
12. Endocardium
13. Mitral Valve
14. Right auricle
15. Right ventricle
16. Left auricle
17. Left ventricle
18. Apex
19. Tendons
20. Pericardium

When you finish, Please **raise your hand** again. An assistant will collect this yellow paper and give you the final test sheets. Thank you!"

Study ID Number: _____

TEST 2 --- IDENTIFICATION TEST

Directions: Please use the answer sheet and answer you feel best identifies the part of the heart indicated by the numbered arrows.



1. Arrow number one (1) points to the
A.Septum
B. Aorta
C. Pulmonary Artery
D. Pulmonary Vein
E. None of These

2. Arrow number two (2) points to the
A.Superior Vena Cava
B.Inferior Vena Cava
C.Pulmonary Artery
D.Tricuspid Valve
E.Aorta

3. Arrow number three (3) points to the
A.Right Ventricle
B.Right Auricle
C.Left Ventricle
D.Left Auricle
E.Heart Muscle

4. Arrow number four (4) points to the
A.Pulmonary Valve
B.Pulmonary Vein
C.Aortic Valve
D.Tricuspid Valve
E.Mitral Valve

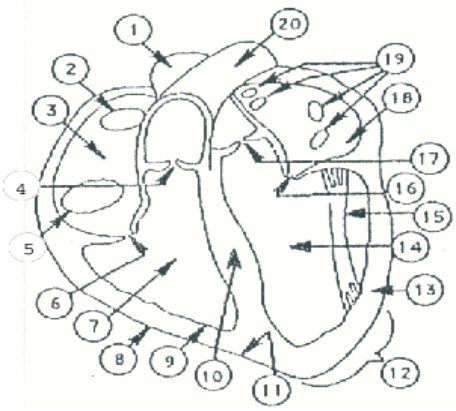
5. Arrow number five (5) points to the
A.Aorta
B.Pulmonary Artery
C.Superior Vena Cava
D.Inferior Vena Cava
E.Pulmonary Vein

6. Arrow number six (6) points to the
A. Aortic Valve
B.Pulmonary Valve
C.Mitral Valve
D.Tricuspid Valve
E.Semi-Lunar Valve

7. Arrow number seven (7) points to the
A.Left Ventricle
B.Right Ventricle
C.Right Auricle
D.Left Auricle
E.Vascular Space

8. Arrow number eight (8) points to the
A.Myocardium
B.Ectoderm
C.Pericardium
D.Endocardium
E.Epicardium

Continue



9. Arrow number nine (9) points to the
A.Endocardium
B.Myocardium
C.Pericardium
D.Ectoderm
E.Septum

10. Arrow number ten (10) points to the
A.Endocardium
B.Pericardium
C.Septum
D.Myocardium
E.Aortic Base

11. Arrow number eleven (11) points to the
A.Epicardium
B.Pericardium
C.Endocardium
D.Myocardium
E.None of These

12. Arrow number twelve (12) points to the
A.Pericardium
B.Myocardium
C.Endocardium
D.Endoderm
E.Apex

13. Arrow number thirteen (13) points to the
A.Pericardium
B.Endocardium
C.Ectocardium
D.Endoderm
E.Myocardium

14. Arrow number fourteen (14) points to the
A.Right Ventricle
B.Left Ventricle
C.Left Auricle
D.Right Auricle
E.Apex

15. Arrow number fifteen (15) points to the
A.Pulmonary Veins
B.Tendons
C.Aortas
D.Pericardium
E.None of These

16. Arrow number sixteen (16) points to the
A.Venic Valve
B.Pulmonary Valve
C.Tricuspid Valve
D.Mitral Valve
E.Aortic Valve

17. Arrow number seventeen (17) points to the
A.Superior Vena Cava
B.Tricuspid Valve
C.Aortic Valve
D.Pulmonary Valve
E.Mitral Valve

18. Arrow number eighteen (18) points to the
A.Right Auricle
B.Right Ventricle
C.Left Auricle
D.Left Ventricle
E.Semi-lunar Chamber

19. Arrow number nineteen (19) points to the
A.Inferior Vena Cava
B.Superior Vena Cava
C.Aortas
D.Pulmonary Veins
E. Pulmonary Arteries

20. Arrow number twenty (20) points to the
A.Inferior Vena Cava
B.Aorta
C.Pulmonary Artery
D.Septum
E.Superior Vena Cava

Continue

TEST 3 --- TERMINOLOGY TEST

Directions: Please use the answer sheet and answer you feel best completes the sentence.

21. _____ is(are) the thickest walled chamber(s) of the heart.
A.Auricles
B.Myocardium
C.Ventricles
D.Pericardium
E.Endocardium

22. The contraction of the heart occurs during the _____ phase.
A.Systolic
B.Sympathetic
C.Diastolic
D.Parasympathetic
E.Sympatric

23. Lowest blood pressure in the arteries occurs during the _____ phase.
A.Sympatric
B.Sympathetic
C.Diastolic
D.Systolic
E.Parasympathetic

24. Blood from the right ventricle goes to the lungs through the _____.
A.Tricuspid Valve
B.Aortic Artery
C.Pulmonary Artery
D.Pulmonary Veins
E.Superior Vena Cava

25. The _____ is(are) the strongest section(s) of the heart.
A.Left Ventricle
B.Aorta
C.Septum
D.Right Ventricle
E.Tendons

26. When blood returns to the heart from the lungs, it enters the _____.
A.Left Auricle
B.Pulmonary Valve
C.Left Ventricle
D.Right Ventricle
E.Pulmonary Artery

27. Vessels that allow the blood to flow from the heart are called the _____.
A.Veins
B.Arteries
C.Apex
D.Tendons
E.Valves

28. Blood passes from the left ventricle out the aortic valve to the _____.
A.Lungs
B.Body
C.Aorta
D.Pulmonary Artery
E.Left Auricle

29. The chamber of the heart which pumps oxygenated blood to all parts of the body is the _____.
A.Right Auricle
B.Left Auricle
C.Aorta
D.Left Ventricle
E.Right Ventricle

30. The _____ is another name for the part of the heart called the heart muscle.
A.Apex
B.Epicardium
C.Endocardium
D.Myocardium
E.Septum

Continue

31. _____ is(are) the part(s) of the heart which controls its contraction and relaxation.
A.Myocardium
B.Endocardium
C.Ventricles
D.Auricles
E.Septum

32. The _____ is the name given to the inside lining of the heart wall.
A.Epicardium
B.Endocardium
C.Pericardium
D.Myocardium
E.Septum

33. Blood from the body enters the heart through the _____.
A.Aortic Artery
B.Pulmonary Veins
C.Pulmonary Artery
D.Superior and Inferior Vena Cavas
E.Superior Vena Cava Only,

34. The membrane which borders on the inside lining of the pericardium and is connected to the heart muscle is called the _____.
A.Extoxim
B.Epicardium
C.Endocardium
D.Myocardium
E.Ectocardium

35. The _____ allow(s) blood to travel in one direction only.
A.Septum
B.Valves
C.Arteries
D.Veins
E.Tendons

36. The _____ is the common opening between the right auricle and the right ventricle.
A.Mitral Valve
B.Tricuspid Valve
C.Septic Valve
D.Pulmonary Valve
E.Aortic Valve

37. The _____ is the triangular flapped valve between the left auricle and the left ventricle.
A.Aortic Valve
B.Pulmonary Valve
C.Septic Valve
D.Tricuspid Valve
E.Mitral Valve

38. The semi-lunar valves are located at the entrance to the _____.
A.Pulmonary Veins
B.Superior and Inferior Vena cavas
C.Pulmonary and Aortic Arteries
D.Mitral and Tricuspid Valves
E.ventricles

39. The outside covering of the heart is called the _____.
A.Endocardium
B.Epicardium
C.Pericardium
D.Myocardium
E.None of These

40. Immediately before entering the aorta, blood must pass through the _____.
A.Left Ventricle
B.Mitral Valve
C.Lungs
D.Superior Vena Cava
E.Aortic Valve

Continue

TEST 4 --- COMPREHENSION TEST

Directions: Please use the answer sheet and answer feel best answers the question.

41. Which valve is most like the tricuspid in function?
A.Pulmonary
B.Aortic
C.Mitral
D.Superior Vena Cava

42. When blood is being forced out the right ventricle, in which position is the tricuspid valve?
A.Beginning to open
B.Beginning to close
C.Open
D.Closed

43. When the blood is being forced out the aorta, it is also being forced out of the.
A.Pulmonary Veins
B.Pulmonary Arteries
C.Superior Vena Cava
D.Cardiac Artery

44. The contraction impulse in the heart starts in
A.The Right Auricle
B.Both ventricles simultaneously
C.Both Auricles Simultaneously
D.The Arteries

45. In the diastolic phase the ventricles are
A.Contracting, full of blood
B.Contracting, partially full of blood
C.Relaxing, full of blood
D.Relaxing, partially full of blood

46. During the first contraction of the systolic phase, in what position will the mitral valve be?
A.Begging to open
B.Open
C.Beginning to close
D.Closed

47. During the second contraction of the systolic phase, blood is being forced away from the heart through the
A.Pulmonary and Aortic Arteries
B.Superior and Inferior Vena Cavas
C.Tricuspid and Mitral Valves
D.Pulmonary Veins

48. When blood is entering through the vena cavas, it is also entering through the
A.Mitral Valve
B.Pulmonary Veins
C.Pulmonary Artery
D.Aorta

49. When the heart contracts, the
A.Auricles & Ventricles contract simultaneously
B.Ventricles contract first, then the auricles
C.Right side contracts first, then the left side
D.Auricles contract first, then the ventricles

50. While blood from the body is entering the superior vena cava, blood from the body is also entering through the
A.Pulmonary Veins
B.Aorta
C.Inferior Vena Cava
D.Pulmonary Artery

Continue

51. When the blood leaves the heart through the pulmonary artery, it is also simultaneously leaving the heart through the
A.Tricuspid Valve
B.Pulmonary veins
C.Aorta
D.Pulmonary Valve

52. When the pressure in the right ventricle is superior to that in the pulmonary artery, in what position is the tricuspid valve?
A.Closed
B.Open
C.Beginning to Close
D.Confined by pressure from the right auricle

53. When the ventricles contract, blood is forced out the
A.Superior and Inferior Vena Cavas
B.Pulmonary veins
C.Tricuspid and Mitral Valves
D.Pulmonary and Aortic Valves

54. Blood leaving the heart through the aorta had left the heart previously through the
A.Vena cavas
B.Pulmonary veins
C.Pulmonary artery
D.Tricuspid and Mitral Valves

55. When the blood in the aorta is exerting a superior pressure on the aortic valve, what is the position of the mitral valve?
A.Closed
B.Open
C.Beginning to open
D.Confined by pressure from the right ventricle

56. When the tricuspid and mitral valves are forced shut, in what position is the pulmonary valve?
A.Closed
B.Beginning to open
C.Open
D.Beginning to close

57. During the second contraction of the systolic phase, in what position is the aortic valve?
A.Fully open
B.Partially open
C.Partially closed
D.Fully closed

58. Blood is being forced out the auricles simultaneously as blood is
A.Entering only the vena cavas
B.Being forced out the pulmonary and aortic valves
C.Passing through the tricuspid & mitral valves
D.Being forced out through the pulmonary artery

59. If the aortic valve is completely open, the
A.Second contraction of the systolic phase is occurring
B.Diastolic phase is occurring
C.Tricuspid & mitral valves are completely open
D.Blood is rushing into the right & left ventricles

60. When the heart relaxes, the
A.Auricles relax first, then the ventricles
B.Right side relaxes first, then the left side
C.Left side relaxes first, then the right side
D.Ventricles relax first, then the auricle

Appendix D: Direction Page

For each reading strategy treatment

Participation Directions

Thank you for your participation in this study!

You are required to use at least 30 minutes to read through an instructional module that deals with the human heart, its parts and their funtions. Then at the end of the instructional module you may spend as much time you want to complete:

- one (1) drawing test
- three (3) multiple choice tests each containing twenty items to test your knowledge of the human heart

Most people finish the whole study around one hour. If at anytime you have questions raise your hand and a researcher will be with you shortly. When you are ready, please click on the "START" button below to start the instructional module.

START

Appendix E: Treatment 1

Control Group

The Human Heart

[The Parts of the Heart]- page 1 to 9

In order to better comprehend the following instruction, it will be helpful to visualize a cross-sectional view of a human heart in a position such that you are facing a person. Therefore, the right side of the person's heart is to your visual left. Likewise, the left side of the person's heart would be illustrated on the right side in the diagram.

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The Human Heart

[The Parts of the Heart]- page 1 to 9

The heart lies toward the front of the body and is in a slanting position between the lungs, immediately below the breastbone. The wide end points toward the right shoulder. The small end of the heart points downward to the front of the chest and toward the left. The lower portion of the heart is called the apex and is the part that you feel beating.

The human heart is really two pumps combined in a single organ which circulates blood to all parts of the body. The heart is divided longitudinally into two halves by the septum. The two halves may be compared to a block of two houses, which are independent of each other but have a common wall, the septum, between them.

The Human Heart

[The Parts of the Heart]- page 1 to 9

Each half of the heart is divided into an upper chamber and a lower chamber. The upper chambers on each side of the septum are called auricles; the lower chambers are called ventricles. Auricles have thin walls and act as receiving rooms for the blood, while the ventricles having thicker walls act as pumps moving the blood away from the heart. Although there is no direct communication between the right and left sides, both sides function simultaneously.

The Human Heart

[The Parts of the Heart]- page 1 to 9

The heart contains several layers of membranes and muscle. The first set of membranes enclose the heart in a thin double-walled sac. The layer which forms the outer wall of the sac is called the pericardium. It is composed of a tough, transparent elastic tissue. It protects the heart from rubbing against the lungs and the walls of the chest. The inner portion of the double-walled sac is called the epicardium. It is attached to the heart muscle.

The heart muscle is called the myocardium; it controls the contraction and relaxation of the heart. The myocardium constitutes by far the greatest volume of the heart and its contraction is responsible for the propulsion of the blood through the body. The muscle varies in thickness; for example, the muscle in the auricle walls are thin when compared to the thickness of the muscle in the ventricle walls.

Finally the endocardium is the name given to the membrane lining inside of the heart wall.

- 4 -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

Blood enters the heart through veins. Only veins carry blood to the heart. The superior and inferior vena cavas are the two veins which deposit blood in the right auricle; there are no valves at the opening of these veins.

The superior vena cava deposits blood into the right auricle from all body parts above heart level, for example, the head and arms. The inferior vena cava carries blood from parts of the body below heart level, for example, the trunk and legs, depositing the blood in the right auricle.

As blood from the body fills the right auricle, some of it begins to flow into the right ventricle immediately, through a common opening.

- 5 -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

This common opening, between the right auricle and right ventricle, is called the tricuspid valve. This valve consists of three triangular flaps on thin, strong, fibrous tissue. These flaps permit the flow of blood into the right ventricle, but prevent it from flowing backward into the right auricle because the ends of the flaps are anchored to the floor of the right ventricle by slender tendons.

Thus, blood passes from the right auricle through the tricuspid valve into the right ventricle. As the right ventricle is filled with blood, both ventricles begin to contract creating pressure.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

While the blood pressure behind the tricuspid valve brings the flaps together and prevents the flow of blood between the right auricle and the right ventricle, the contraction of the right ventricle continues until the blood presses hard enough to open the pulmonary valve.

The pulmonary valve, located between the right ventricle and the pulmonary artery, consists of three flaps like the tricuspid valve. As soon as the right ventricle begins to relax from its contraction, the valve flaps are filled with blood backing up from the pulmonary artery. The flaps are pressed together stopping the blood flow back into the right ventricle. The pulmonary valve only opens when the pressure in the right ventricle is greater than the pressure in the pulmonary artery, forcing the blood into the artery.

In the pulmonary artery the blood is carried away from the heart to both the left and right lungs where it is cleansed and oxygenated.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

Returning from the lungs, the blood enters the heart through four pulmonary veins and collects in the left auricle; these vein openings, like the vena cavas, have no valves. The left auricle then contracts when it is full, squeezing blood through the mitral valve into the left ventricle.

The mitral valve, located between the left auricle and the left ventricle, it is similar in construction to the tricuspid valve. As the left ventricle contracts simultaneously with its mate, the right ventricle, it forces blood behind the flaps of the valve thereby closing the passageway back to the left auricle. Like the tricuspid valve, the ends of the mitral valve flaps are anchored to the floor of the left ventricle by slender tendons.

- 8 -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

The contraction of the left ventricle pumps the blood through the entire body. For this reason it is the largest, strongest, and most muscular section of the heart. When the left ventricle is filled with blood, it contracts resulting in the pressure opening the aortic valve. The aortic valve is similar to the other flap like valves; the valve stops the backward flow of blood to the left ventricle and opens for the forward flow of blood to the aorta.

The aorta is the large artery which carries the blood away from the heart back to the various parts of the body.

- 9 -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

The directional flow of blood in the heart is determined by valves which allow the blood to flow in only one direction. These sets of valves are the tricuspid and mitral valves, which control the flow of blood from the auricles to the ventricles, and the pulmonary and aortic valves which control the flow of blood from the ventricles to the arteries.

- 10 -

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

Both auricles receive blood simultaneously through vein openings which have no valves. The right auricle receives its blood through the superior and inferior vena cavas, while the left auricle receives its blood through the pulmonary veins.

- 11 -

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

A wave of muscular contraction starts at the top of the heart and passes downward, simultaneously, over both sides of the heart; that is, both auricles contract at the same time and then relax as the contraction passes down to the ventricles. When the auricles are caused to contract, they become small and pale and in doing so the blood in their chambers is subjected to increased pressure which forces blood to the ventricles through the opened tricuspid and mitral valves.

As the ventricles fill, eddies of the blood float the flaps on both the tricuspid and mitral valves back to a partially closed position.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

The instant that the contraction of the auricles has been completed, the ventricles are stimulated to contract. This contraction increases the pressure in the ventricle chambers forcing the tricuspid and mitral valves completely closed, thereby preventing blood from being forced backwards into the auricles.

The auricles, relaxing from their contraction, receive a continuous blood flow from the vena cavas and the veins.

- 13 -

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

As the ventricles continue to contract, pressure in these chambers force the pulmonary and aortic valves to open. The pulmonary valve, leading from the right ventricle, guards the entrance to the pulmonary artery. The aortic valve, leading from the left ventricle, guards the entrance to the aorta or aortic artery.

Both are 3 flapped valves, and are together known as the semi-lunar valves. Prior to ventricle contraction, the valves are closed by back pressure provided by blood already in the exit arteries. When pressure in the ventricles becomes greater than that in the exit arteries due to ventricle contraction, the semi-lunar valves open.

- 14 -

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

With the semi-lunar valves open, blood flows from the right ventricle into the pulmonary artery on route to the lungs for cleaning and oxygen. Simultaneously, blood flows from the left ventricle into the aorta for distribution throughout the entire body.

- 15 -

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

Immediately following the pumping of blood into the arteries, the ventricles begin to relax. This relaxation lowers the pressure within their chambers and the greater pressure in the arteries close the semi-lunar valves. Pressure within the ventricles is sufficient, however, to maintain closure of the tricuspid and mitral valves against the already increasing auricle pressure.

- 16 -

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

As the ventricles relax further, pressure within them rapidly decreases. At the same time blood flowing into the auricles from the veins increases the auricle pressure. Due to the differential pressure between the auricles and ventricles, the tricuspid and mitral valves are forced partially open.

The circulation of blood through the heart begins again with the next auricle contraction. Auricle pressure fully opens the tricuspid and mitral valves resulting in a rapid flow of blood into the ventricles.

- 17 -

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The cycle of blood pressure in the heart consists of two distinct phases. One of these phases is called the diastolic or relaxation phase.

In the diastolic phase, the heart relaxes between contractions. Blood flows into the heart, filling both auricles. While blood is flowing into the auricles, the arteries still maintain part of the pressure developed by a prior ventricle contraction. This is the time of lowest pressure in the arteries, or what is called the diastolic pressure.

During this phase the ventricles are also relaxing. The ventricles are slowly being filled with blood, due to the full auricles and partially opened tricuspid and mitral valves.

- 18 -

PREVIOUS | Direction | NEXT

[The Parts of the Heart]- page 1 to 9
[The Circulation of Blood through the Heart]- page 10 to 17

The Human Heart

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The second phase, the systolic or contraction phase, begins when the auricles contract. The blood is forced through the tricuspid and mitral valves into the ventricles. The ventricles then contract forcing the blood through the semi-lunar valves into the pulmonary and aortic arteries.

The blood leaves the ventricles under terrific pressure and surges through the arteries with a force so great that it bulges their elastic walls. At this point, arterial blood pressure is greatest; we refer to this pressure as the systolic pressure.

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PREVIOUS | Direction | NEXT

[The Parts of the Heart]- page 1 to 9
[The Circulation of Blood through the Heart]- page 10 to 17

The Human Heart

[The Cycle of Blood Pressure in the Heart]- **page 18 to 20**

The heart begins to relax again. The semi-lunar valves are closed; blood flows into the auricles from the veins; and the tricuspid and mitral valves are forced partially open.

The diastolic phase begins, and the cycle of blood pressure starts again.

PREVIOUS | Direction | NEXT

[The Parts of the Heart]- **page 1 to 9**
[The Circulation of Blood through the Heart]- **page 10 to 17**

End of Instruction

Please make sure that you have read the heart content at least 30 minutes before you raise your hand. If you want to review anything, click the navigation buttons to access the previous content pages. If you are satisfied with what you have learned, click "CLOSE" button to close this window and please ***raise your hand*** to start assessment.

CLOSE

Appendix F: Treatment 2

Rereading Strategy

The Human Heart

[The Parts of the Heart]- page 1 to 9

In order to better comprehend the following instruction, it will be helpful to visualize a cross-sectional view of a human heart in a position such that you are facing a person. Therefore, the right side of the person's heart is to your visual left. Likewise, the left side of the person's heart would be illustrated on the right side in the diagram.

The human heart is a hollow, bluntly conical, muscular organ. Its pumping action provides the force that circulates the blood through the body. In the average adult, the heart is about five inches long and about two and one half inches thick. A man's heart weights about 11 ozs. And a woman's heart weighs about 9 ozs.

- 1 -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

The lower portion of the heart is called the apex and is the part that you feel beating.

CONTINUE

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

The human heart is really two pumps combined in a single organ which circulates blood to all parts of the body. The heart is divided longitudinally into two halves by the septum.

- 2 -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

The heart is divided longitudinally into two halves by the septum.

CONTINUE

- 2 -

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

The two halves may be compared to a block of two houses, which are independent of each other but have a common wall, the septum, between them. Each half of the heart is divided into an upper chamber and a lower chamber. The upper chambers on each side of the septum are called auricles; the lower chambers are called ventricles.

- 3 -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

The upper chambers on each side of the septum are called auricles;
the lower chambers are called ventricles. CONTINUE

- 3 -

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

Auricles have thin walls and act as receiving rooms for the blood, while the ventricles having thicker walls act as pumps moving the blood away from the heart.

- 4 -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

Auricles have thin walls and act as receiving rooms for the blood,
while the ventricles having thicker walls act as pumps moving the
blood away from the heart. CONTINUE

- 4 -

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

Although there is no direct communication between the right and left sides, both sides function simultaneously.

The heart contains several layers of membranes and muscle. The first set of membranes enclose the heart in a thin double-walled sac. The layer which forms the outer wall of the sac is called the pericardium.

- 5 i -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

The layer which forms the outer wall of the sac is called the pericardium.

CONTINUE

- 5 i -

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

It is composed of a tough, transparent elastic tissue. It protects the heart from rubbing against the lungs and the walls of the chest. The inner portion of the double-walled sac is called the epicardium. It is attached to the heart muscle.

The heart muscle is called the myocardium; it controls the contraction and relaxation of the heart.

- 5 ii -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

The inner portion of the double-walled sac is called the epicardium. It is attached to the heart muscle.

The heart muscle is called the myocardium; it controls the contraction and relaxation of the heart.

CONTINUE

- 5 ii -

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

The myocardium constitutes by far the greatest volume of the heart and its contraction is responsible for the propulsion of the blood through the body. The muscle varies in thickness; for example, the muscle in the auricle walls are thin when compared to the thickness of the muscle in the ventricle walls.Finally the endocardium is the name given to the membrane lining inside of the heart wall.

Blood enters the heart through veins. Only veins carry blood to the heart. The superior and inferior vena cavas are the two veins which deposit blood in the right auricle; there are no valves at the opening of these veins.

- 6 i -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

Finally the endocardium is the name given to the membrane lining inside of the heart wall.

Blood enters the heart through veins. Only veins carry blood to the heart. The superior and inferior vena cavas are the two veins which deposit blood in the rightauricle; there are no valves at the opening of these veins.

CONTINUE

- 6 i -

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

The superior vena cava deposits blood into the right auricle from all body parts above heart level, for example, the head and arms. The inferior vena cava carries blood from parts of the body below heart level, for example, the trunk and legs, depositing the blood in the right auricle.

- 6 ii -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

The superior vena cava deposits blood into the right auricle from all body parts above heart level, for example, the head and arms. The inferior vena cava carries blood from parts of the body below heart level, for example, the trunk and legs, depositing the blood in the right auricle.

CONTINUE

- 6 ii -

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

As blood from the body fills the right auricle, some of it begins to flow into the right ventricle immediately, through a common opening.

This common opening, between the right auricle and right ventricle, is called the tricuspid valve.

- 7 -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

This common opening, between the right auricle and right ventricle, is called the tricuspid valve.

CONTINUE

- 7 -

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

This valve consists of three triangular flaps on thin, strong, fibrous tissue. These flaps permit the flow of blood into the right ventricle, but prevent it from flowing backward into the right auricle because the ends of the flaps are anchored to the floor of the right ventricle by slender tendons.

- 8-

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

flaps are anchored to the floor of the right ventricle by slender tendons.

CONTINUE

- 8-

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

Thus, blood passes from the right auricle through the tricuspid valve into the right ventricle. As the right ventricle is filled with blood, both ventricles begin to contract creating pressure.

While the blood pressure behind the tricuspid valve brings the flaps together and prevents the flow of blood between the right auricle and the right ventricle, the contraction of the right ventricle continues until the blood presses hard enough to open the pulmonary valve. The pulmonary valve, located between the right ventricle and the pulmonary artery, consists of three flaps like the tricuspid valve.

- 9 i-

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

The pulmonary valve, located between the right ventricle and the pulmonary artery, consists of three flaps like the tricuspid valve.

CONTINUE

- 9 i -

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

As soon as the right ventricle begins to relax from its contraction, the valve flaps are filled with blood backing up from the pulmonary artery.

- 9 ii -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

the valve flaps are filled with blood backing up from the pulmonary artery.

CONTINUE

- 9 ii -

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

The flaps are pressed together stopping the blood flow back into the right ventricle. The pulmonary valve only opens when the pressure in the right ventricle is greater than the pressure in the pulmonary artery, forcing the blood into the artery. In the pulmonary artery the blood is carried away from the heart to both the left and right lungs where it is cleansed and oxygenated.

Returning from the lungs, the blood enters the heart through four pulmonary veins and collects in the left auricle.

- 9 iii -

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

Returning from the lungs, the blood enters the heart through four pulmonary veins and collects in the left auricle.

CONTINUE

- 9 iii -

PREVIOUS | Direction |

The Human Heart

[The Parts of the Heart]- page 1 to 9

As the left ventricle contracts simultaneously with its mate, the right ventricle, it forces blood behind the flaps of the valve thereby closing the passageway back to the left auricle. Like the tricuspid valve, the ends of the mitral valve flaps are anchored to the floor of the left ventricle by slender tendons.

The contraction of the left ventricle pumps the blood through the entire body. For this reason it is the largest, strongest, and most muscular section of the heart. When the left ventricle is filled with blood, it contracts resulting in the pressure opening the aortic valve.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

[The Parts of the Heart]- page 1 to 9

The contraction of the left ventricle pumps the blood through the entire body. For this reason it is the largest, strongest, and most muscular section of the heart. When the left ventricle is filled with blood, it contracts resulting in the pressure opening the aortic valve. CONTINUE

The Human Heart

[The Parts of the Heart]- page 1 to 9

The aortic valve is similar to the other flap like valves; the valve stops the backward flow of blood to the left ventricle and opens for the forward flow of blood to the aorta.The aorta is the large artery which carries the blood away from the heart back to the various parts of the body.

[The Parts of the Heart]- page 1 to 9

The aortic valve is similar to the other flap like valves; the valve stops the backward flow of blood to the left ventricle and opens for the forward flow of blood to the aorta. The aorta is the large artery which carries the blood away from the heart back to the various parts of the body. CONTINUE

- 9 v -

PREVIOUS | Direction |

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

The directional flow of blood in the heart is determined by valves which allow the blood to flow in only one direction. These sets of valves are the tricuspid and mitral valves, which control the flow of blood from the auricles to the ventricles, and the pulmonary and aortic valves which control the flow of blood from the ventricles to the arteries.

- 10 -

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

Both auricles receive blood simultaneously through vein openings which have no valves. The right auricle receives its blood through the superior and inferior vena cavas, while the left auricle receives its blood through the pulmonary veins.

- 11 -

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

[The Circulation of Blood through the Heart]- page 10 to 17

The right auricle receives its blood through the superior and inferior vena cavas, while the left auricle receives its blood through the pulmonary veins. CONTINUE

- 11 -

PREVIOUS | Direction |

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

A wave of muscular contraction starts at the top of the heart and passes downward, simultaneously, over both sides of the heart; that is, both auricles contract at the same time and then relax as the contraction passes down to the ventricles.

- 12 -

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

[The Circulation of Blood through the Heart]- page 10 to 17

A wave of muscular contraction starts at the top of the heart and passes downward, simultaneously, over both sides of the heart; that is, both auricles contract at the same time and then relax as the contraction passes down to the ventricles. CONTINUE

- 12 -

PREVIOUS | Direction |

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

When the auricles are caused to contract, they become small and pale and in doing so the blood in their chambers is subjected to increased pressure which forces blood to the ventricles through the opened tricuspid and mitral valves.

As the ventricles fill, eddies of the blood float the flaps on both the tricuspid and mitral valves back to a partially closed position. The instant that the contraction of the auricles has been completed, the ventricles are stimulated to contract. This contraction increases the pressure in the ventricle chambers forcing the tricuspid and mitral valves completely closed.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

[The Circulation of Blood through the Heart]- page 10 to 17

This contraction increases the pressure in the ventricle chambers forcing the tricuspid and mitral valves completely closed thereby preventing blood from being forced backwards into the auricles. CONTINUE

- 13 -

PREVIOUS | Direction |

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

The auricles, relaxing from their contraction, receive a continuous blood flow from the vena cavas and the veins.

As the ventricles continue to contract, pressure in these chambers force the pulmonary and aortic valves to open.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

[The Circulation of Blood through the Heart]- page 10 to 17

As the ventricles continue to contract, pressure in these chambers force the pulmonary and aortic valves to open. CONTINUE

- 14 -

PREVIOUS | Direction |

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

The pulmonary valve, leading from the right ventricle, guards the entrance to the pulmonary artery. The aortic valve, leading from the left ventricle, guards the entrance to the aorta or aortic artery. Both are 3 flapped valves, and are together known as the semi-lunar valves.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

[The Circulation of Blood through the Heart]- page 10 to 17

The pulmonary valve, leading from the right ventricle, guards the entrance to the pulmonary artery. The aortic valve, leading from the left ventricle, guards the entrance to the aorta or aortic artery. Both are 3 flapped valves, and are together known as the semi-lunar valves. CONTINUE

- 15 -

PREVIOUS | Direction |

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

Prior to ventricle contraction, the valves are closed by back pressure provided by blood already in the exit arteries. When pressure in the ventricles becomes greater than that in the exit arteries due to ventricle contraction, the semi-lunar valves open.

With the semi-lunar valves open, blood flows from the right ventricle into the pulmonary artery on route to the lungs for cleaning and oxygen. Simultaneously, blood flows from the left ventricle into the aorta for distribution throughout the entire body.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

[The Circulation of Blood through the Heart]- page 10 to 17

With the semi-lunar valves open, blood flows from the right ventricle into the pulmonary artery on route to the lungs for cleaning and oxygen. Simultaneously, blood flows from the left ventricle into the aorta for distribution throughout the entire body. CONTINUE

- 16 -

PREVIOUS | Direction |

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

Immediately following the pumping of blood into the arteries, the ventricles begin to relax. This relaxation lowers the pressure within their chambers and the greater pressure in the arteries close the semi-lunar valves. Pressure within the ventricles is sufficient, however, to maintain closure of the tricuspid and mitral valves against the already increasing auricle pressure.

As the ventricles relax further, pressure within them rapidly decreases. At the same time blood flowing into the auricles from the veins increases the auricle pressure. Due to the differential pressure between the auricles and ventricles, the tricuspid and mitral valves are forced partially open.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

[The Circulation of Blood through the Heart]- page 10 to 17

Due to the differential pressure between the auricles and ventricles, the tricuspid and mitral valves are forced partially open. CONTINUE

- 17 -

PREVIOUS | Direction |

The Human Heart

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The circulation of blood through the heart begins again with the next auricle contraction. Auricle pressure fully opens the tricuspid and mitral valves resulting in a rapid flow of blood into the ventricles.

The cycle of blood pressure in the heart consists of two distinct phases. One of these phases is called the diastolic or relaxation phase.

- 18 i -

PREVIOUS | Direction | NEXT

[The Parts of the Heart]- page 1 to 9
[The Circulation of Blood through the Heart]- page 10 to 17

The Human Heart

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

In the diastolic phase, the heart relaxes between contractions. Blood flows into the heart, filling both auricles. While blood is flowing into the auricles, the arteries still maintain part of the pressure developed by a prior ventricle contraction. This is the time of lowest pressure in the arteries, or what is called the diastolic pressure.

During this phase the ventricles are also relaxing. The ventricles are slowly being filled with blood, due to the full auricles and partially opened tricuspid and mitral valves.

- 18 ii -

PREVIOUS | Direction | NEXT

[The Parts of the Heart]- page 1 to 9
[The Circulation of Blood through the Heart]- page 10 to 17

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

During this phase the ventricles are also relaxing. The ventricles are slowly being filled with blood, due to the full auricles and partially opened tricuspid and mitral valves. CONTINUE

- 18 ii -

PREVIOUS | Direction |

The Human Heart

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The second phase, the systolic or contraction phase, begins when the auricles contract. The blood is forced through the tricuspid and mitral valves into the ventricles. The ventricles then contract forcing the blood through the semi-lunar valves into the pulmonary and aortic arteries.

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PREVIOUS | Direction | NEXT

[The Parts of the Heart]- page 1 to 9
[The Circulation of Blood through the Heart]- page 10 to 17

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The second phase, the systolic or contraction phase, begins when the auricles contract. The blood is forced through the tricuspid and mitral valves into the ventricles. The ventricles then contract forcing the blood through the semi-lunar valves into the pulmonary and aortic arteries. CONTINUE

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PREVIOUS | Direction |

The Human Heart

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The blood leaves the ventricles under terrific pressure and surges through the arteries with a force so great that it bulges their elastic walls. At this point, arterial blood pressure is greatest; we refer to this pressure as the systolic pressure.

The heart begins to relax again. The semi-lunar valves are closed; blood flows into the auricles from the veins; and the tricuspid and mitral valves are forced partially open.

The diastolic phase begins, and the cycle of blood pressure starts again.

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PREVIOUS | Direction | NEXT

[The Parts of the Heart]- page 1 to 9
[The Circulation of Blood through the Heart]- page 10 to 17

End of Instruction

Please make sure that you have read the heart content at least 30 minutes before you raise your hand. If you want to review anything, click the navigation buttons to access the previous content pages. If you are satisfied with what you have learned, click "CLOSE" button to close this window and please ***raise your hand*** to start assessment.

CLOSE

Appendix G: Treatment 3

Keyword Strategy

The Human Heart

[The Parts of the Heart]- page 1 to 9

In order to better comprehend the following instruction, it will be helpful to visualize a cross-sectional view of a human heart in a position such that you are facing a person. Therefore, the right side of the person's heart is to your visual left. Likewise, the left side of the person's heart would be illustrated on the right side in the diagram.

The human heart is a hollow, bluntly conical, muscular organ. Its pumping action provides the force that circulates the blood through the body. In the average adult, the heart is about five inches long and about two and one half inches thick. A man's heart weights about 11 ozs. And a woman's heart weighs about 9 ozs.

The Human Heart

[The Parts of the Heart]- page 1 to 9

The heart lies toward the front of the body and is in a slanting position between the lungs, immediately below the breastbone. The wide end points toward the right shoulder. The small end of the heart points downward to the front of the chest and toward the left. The lower portion of the heart is called the **apex** and is the part that you feel beating.

The human heart is really two pumps combined in a single organ which circulates blood to all parts of the body. The heart is divided longitudinally into two halves by the **septum**. The two halves may be compared to a block of two houses, which are independent of each other but have a common wall, the septum, between them.

The Human Heart

[The Parts of the Heart]- page 1 to 9

Each half of the heart is divided into an upper chamber and a lower chamber. The upper chambers on each side of the septum are called auricles; the lower chambers are called ventricles. Auricles have thin walls and act as receiving rooms for the blood, while **the ventricles having thicker walls** act as pumps moving the blood away from the heart. Although there is no direct communication between the right and left sides, both sides function simultaneously.

The Human Heart

[The Parts of the Heart]- page 1 to 9

The heart contains several layers of membranes and muscle. The first set of membranes enclose the heart in a thin double-walled sac. The layer which forms the outer wall of the sac is called the **pericardium**. It is composed of a tough, transparent elastic tissue. It protects the heart from rubbing against the lungs and the walls of the chest. The inner portion of the double-walled sac is called the **epicardium**. It is attached to the heart muscle.

The heart muscle is called the **myocardium**; it controls the contraction and relaxation of the heart. The myocardium constitutes by far the greatest volume of the heart and its contraction is responsible for the propulsion of the blood through the body. The muscle varies in thickness; for example, the muscle in the auricle walls are thin when compared to the thickness of the muscle in the ventricle walls.

Finally the **endocardium** is the name given to the membrane lining inside of the heart wall.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

Blood enters the heart through veins. Only veins carry blood to the heart. The **superior and inferior vena cavas** are the two veins which deposit blood in the right auricle; there are no valves at the opening of these veins.

The **superior vena cava** deposits blood into the right auricle from all body parts above heart level, for example, the head and arms. The **inferior vena cava** carries blood from parts of the body below heart level, for example, the trunk and legs, depositing the blood in the right auricle.

As blood from the body fills the right auricle, some of it begins to flow into the right ventricle immediately, through a common opening.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

This common opening, between the right auricle and right ventricle, is called the **tricuspid valve**. This valve consists of three triangular flaps on thin, strong, fibrous tissue. These flaps permit the flow of blood into the right ventricle, but prevent it from flowing backward into the right auricle because the ends of the flaps are anchored to the floor of the right ventricle by slender **tendons**.

Thus, blood passes from the right auricle through the tricuspid valve into the right ventricle. As the right ventricle is filled with blood, both ventricles begin to contract creating pressure.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

While the blood pressure behind the tricuspid valve brings the flaps together and prevents the flow of blood between the right auricle and the right ventricle, the contraction of the right ventricle continues until the blood presses hard enough to open the pulmonary valve.

The **pulmonary valve**, located between the right ventricle and the pulmonary artery, consists of three flaps like the tricuspid valve. As soon as the right ventricle begins to relax from its contraction, the valve flaps are filled with blood backing up from the **pulmonary artery**. The flaps are pressed together stopping the blood flow back into the right ventricle. The pulmonary valve only opens when the pressure in the right ventricle is greater than the pressure in the pulmonary artery, forcing the blood into the artery.

In the pulmonary artery the blood is carried away from the heart to both the left and right lungs where it is cleansed and oxygenated.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

Returning from the lungs, the blood enters the heart through four **pulmonary veins** and collects in the left auricle; these vein openings, like the vena cavas, have no valves. The left auricle then contracts when it is full, squeezing blood through the **mitral valve** into the left ventricle.

The **mitral valve**, located between the left auricle and the left ventricle, it is similar in construction to the tricuspid valve. As the left ventricle contracts simultaneously with its mate, the right ventricle, it forces blood behind the flaps of the valve thereby closing the passageway back to the left auricle. Like the tricuspid valve, the ends of the mitral valve flaps are anchored to the floor of the left ventricle by slender **tendons**.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

The contraction of the **left ventricle** pumps the blood through the entire body. For this reason it is the largest, strongest, and most muscular section of the heart. When the left ventricle is filled with blood, it contracts resulting in the pressure opening the **aortic valve**. The **aortic valve** is similar to the other flap like valves; the valve stops the backward flow of blood to the left ventricle and opens for the forward flow of blood to the **aorta**.

The **aorta** is the large artery which carries the blood away from the heart back to the various parts of the body.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

The directional flow of blood in the heart is determined by valves which allow the blood to flow in only one direction. These sets of valves are the tricuspid and mitral valves, which control the flow of blood from the auricles to the ventricles, and the pulmonary and aortic valves which control the flow of blood from the ventricles to the arteries.

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

Both auricles receive blood simultaneously through vein openings which have no valves. The right auricle receives its blood through the **superior and inferior vena cavas**, while the left auricle receives its blood through the **pulmonary veins**.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

A wave of muscular contraction starts at the top of the heart and passes downward, **simultaneously**, over both sides of the heart; that is, **both auricles contract at the same time** and then relax as the contraction passes down to the ventricles. When the auricles are caused to contract, they become small and pale and in doing so the blood in their chambers is subjected to increased pressure which forces blood to the ventricles through the opened tricuspid and mitral valves.

As the ventricles fill, eddies of the blood float the flaps on both the tricuspid and mitral valves back to a partially closed position.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

The instant that the contraction of the auricles has been completed, the ventricles are stimulated to contract. This contraction increases the pressure in the ventricle chambers forcing the tricuspid and mitral valves completely **closed**, thereby preventing blood from being forced backwards into the auricles.

The auricles, relaxing from their contraction, receive a continuous blood flow from the vena cavas and the veins.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

As the ventricles continue to contract, pressure in these chambers force the pulmonary and aortic valves to **open**. The **pulmonary valve**, leading from the right ventricle, guards the entrance to the **pulmonary artery**. The **aortic valve**, leading from the left ventricle, guards the entrance to the aorta or **aortic artery**.

Both are 3 flapped valves, and are together known as the **semi-lunar valves**. Prior to ventricle contraction, the valves are closed by back pressure provided by blood already in the exit arteries. When pressure in the ventricles becomes greater than that in the exit arteries due to ventricle contraction, the semi-lunar valves open.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

With the semi-lunar valves open, blood flows from the **right ventricle into the pulmonary artery** on route to the lungs for cleaning and oxygen. Simultaneously, blood flows from the **left ventricle into the aorta** for distribution throughout the entire body.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

Immediately following the pumping of blood into the arteries, the ventricles begin to relax. This relaxation lowers the pressure within their chambers and the greater pressure in the arteries close the semi-lunar valves. Pressure within the ventricles is sufficient, however, to maintain closure of the tricuspid and mitral valves against the already increasing auricle pressure.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

As the ventricles relax further, pressure within them rapidly decreases. At the same time blood flowing into the auricles from the veins increases the auricle pressure. Due to the differential pressure between the auricles and ventricles, the tricuspid and **mitral valves are forced partially open**.

The circulation of blood through the heart begins again with the next auricle contraction. Auricle pressure fully opens the tricuspid and mitral valves resulting in a rapid flow of blood into the ventricles.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The cycle of blood pressure in the heart consists of two distinct phases. One of these phases is called the diastolic or relaxation phase.

In the diastolic phase, the heart relaxes between contractions. Blood flows into the heart, filling both auricles. While blood is flowing into the auricles, the arteries still maintain part of the pressure developed by a prior ventricle contraction. This is the time of lowest pressure in the arteries, or what is called the diastolic pressure.

During this phase the ventricles are also **relaxing**. The ventricles are slowly being filled with blood, due to the full auricles and **partially opened** tricuspid and mitral valves.

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PREVIOUS | Direction | NEXT

[The Parts of the Heart]- page 1 to 9
[The Circulation of Blood through the Heart]- page 10 to 17

The Human Heart

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The second phase, the systolic or contraction phase, begins when the auricles contract. The blood is forced **through the tricuspid and mitral valves** into the ventricles. The ventricles then contract forcing the blood **through the semi-lunar valves** into the pulmonary and aortic arteries.

The blood leaves the ventricles under terrific pressure and surges through the arteries with a force so great that it bulges their elastic walls. At this point, arterial blood pressure is greatest; we refer to this pressure as the systolic pressure.

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PREVIOUS | Direction | NEXT

[The Parts of the Heart]- page 1 to 9
[The Circulation of Blood through the Heart]- page 10 to 17

The Human Heart

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The heart begins to relax again. The semi-lunar valves are closed; blood flows into the auricles from the veins; and the tricuspid and mitral valves are forced partially open.

The diastolic phase begins, and the cycle of blood pressure starts again.

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PREVIOUS | Direction | NEXT

[The Parts of the Heart]- page 1 to 9
[The Circulation of Blood through the Heart]- page 10 to 17

End of Instruction

Please make sure that you have read the heart content at least 30 minutes before you raise your hand. If you want to review anything, click the navigation buttons to access the previous content pages. If you are satisfied with what you have learned, click "CLOSE" button to close this window and please ***raise your hand*** to start assessment.

CLOSE

Appendix H: Treatment 4

Question and Answer (Q&A) Strategy

The Human Heart

[The Parts of the Heart]- page 1 to 9

In order to better comprehend the following instruction, it will be helpful to visualize a cross-sectional view of a human heart in a position such that you are facing a person. Therefore, the right side of the person's heart is to your visual left. Likewise, the left side of the person's heart would be illustrated on the right side in the diagram.

The human heart is a hollow, bluntly conical, muscular organ. Its pumping action provides the force that circulates the blood through the body. In the average adult, the heart is about five inches long and about two and one half inches thick. A man's heart weights about 11 ozs. And a woman's heart weighs about 9 ozs.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

The heart lies toward the front of the body and is in a slanting position between the lungs, immediately below the breastbone. The wide end points toward the right shoulder.

Q: Where is the "Apex" located on the heart?
A: The small end of the heart points downward to the front of the chest and toward the left. The lower portion of the heart is called the apex and is the part that you feel beating. The human heart is really two pumps combined in a single organ which circulates blood to all parts of the body.

Q: Where is the "Septum" located on the heart?
A: The heart is divided longitudinally into two halves by the septum. The two halves may be compared to a block of two houses, which are independent of each other but have a common wall, the septum, between them.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

Each half of the heart is divided into an upper chamber and a lower chamber.

Q: Where is "Right Ventricle" located on the heart? What is (are) the thickest walled chamber(s) of the heart?
A: The upper chambers on each side of the septum are called auricles; the lower chambers are called ventricles. Auricles have thin walls and act as receiving rooms for the blood, while the ventricles having thicker walls act as pumps moving the blood away from the heart.

Although there is no direct communication between the right and left sides, both sides function simultaneously.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

The heart contains several layers of membranes and muscle. The first set of membranes enclose the heart in a thin double-walled sac.

Q: Where is the "Pericardium" located on the heart? What is the outside covering of the heart?
A: The layer which forms the outer wall of the sac is called the pericardium. It is composed of a tough, transparent elastic tissue. It protects the heart from rubbing against the lungs and the walls of the chest.

Q: Where is the "Epicardium" located on the heart? What is the membrane which borders on the inside lining of the pericardium and is connected to the heart muscle?
A: The inner portion of the double-walled sac is called the epicardium. It is attached to the heart muscle.

Q: Where is the "Myocardium" located on the heart? What is another name given to the heart muscle for the part of the heart? What is (are) the part(s) of the heart which controls its contraction and relaxation?
A: The heart muscle is called the myocardium; it controls the contraction and relaxation of the heart.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

The myocardium constitutes by far the greatest volume of the heart and its contraction is responsible for the propulsion of the blood through the body. The muscle varies in thickness; for example, the muscle in the auricle walls are thin when compared to the thickness of the muscle in the ventricle walls.

Q: Where is the "Endocardium" located on the heart? What is the name given to the inside lining of the heart wall?
A: Finally the endocardium is the name given to the membrane lining inside of the heart wall.

Q: Where are the "Superior VenaCava" and the "Inferior Vena Cava" located on the heart?
A: Blood enters the heart through veins. Only veins carry blood to the heart. The superior and inferior vena cavas are the two veins which deposit blood in the right auricle; there are no valves at the opening of these veins.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

Q: Through where blood can enter the heart from the body? While blood is entering the superior vena cava from the body, through where blood from the body is also entering?
A: The superior vena cava deposits blood into the right auricle from all body parts above heart level, for example, the head and arms. The inferior vena cava carries blood from parts of the body below heart level, for example, the trunk and legs, depositing the blood in the right auricle.

As blood from the body fills the right auricle, some of it begins to flow into the right ventricle immediately, through a common opening.

Q: Where is the "Tricuspid Valve" located on the heart? What is the common opening between the right auricle and the right ventricle?
A: This common opening, between the right auricle and right ventricle, is called the tricuspid valve.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

This valve consists of three triangular flaps on thin, strong, fibrous tissue. These flaps permit the flow of blood into the right ventricle, but prevent it from flowing backward into the right auricle because...

Q: Where is the "Tendons" located on the heart?
A: the ends of the flaps are anchored to the floor of the right ventricle by slender tendons.

Thus, blood passes from the right auricle through the tricuspid valve into the right ventricle. As the right ventricle is filled with blood, both ventricles begin to contract creating pressure.

While the blood pressure behind the tricuspid valve brings the flaps together and prevents the flow of blood between the right auricle and the right ventricle, the contraction of the right ventricle continues until the blood presses hard enough to open the pulmonary valve.

Q: Where is the "Pulmonary Valve" located on the heart?
A: The pulmonary valve, located between the right ventricle and the pulmonary artery, consists of three flaps like the tricuspid valve.

Q: Where is the "Pulmonary Artery" located on the heart?
A: As soon as the right ventricle begins to relax from its contraction, the valve flaps are filled with blood backing up from the pulmonary artery.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

The flaps are pressed together stopping the blood flow back into the right ventricle. The pulmonary valve only opens when the pressure in the right ventricle is greater than the pressure in the pulmonary artery, forcing the blood into the artery.

In the pulmonary artery the blood is carried away from the heart to both the left and right lungs where it is cleansed and oxygenated.

Q: Where is the "Pulmonary Veins" located on the heart? Where blood enters when it returns to the heart from the lungs?
A: Returning from the lungs, the blood enters the heart through four pulmonary veins and collects in the left auricle; these vein openings, like the vena cavas, have no valves.

Q: Where is the "Mitral Valve" located on the heart? What is the triangular flapped valve between the left auricle and the left ventricle?
A: The left auricle then contracts when it is full, squeezing blood through the mitral valve into the left ventricle. The mitral valve, located between the left auricle and the left ventricle, it is similar in construction to the tricuspid valve.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Parts of the Heart]- page 1 to 9

As the left ventricle contracts simultaneously with its mate, the right ventricle, it forces blood behind the flaps of the valve thereby closing the passageway back to the left auricle.

Q: Where is the "Tricuspid Valve" located on the heart?
A: Like the tricuspid valve, the ends of the mitral valve flaps are anchored to the floor of the left ventricle by slender tendons.

Q:What is the chamber of the heart which pumps oxygenated blood to all parts of the body? What is(are) the strongest section(s) of the heart?
A: The contraction of the left ventricle pumps the blood through the entire body. For this reason it is the largest, strongest, and most muscular section of the heart.

Q: To where blood passes from the left ventricle out the aortic valve? Immediately through where blood must pass before entering the aorta? Where are the "Aorta" and the "Aortic Valve" located on the heart?
A: When the left ventricle is filled with blood, it contracts resulting in the pressure opening the aortic valve. The aortic valve is similar to the other flap like valves; the valve stops the backward flow of blood to the left ventricle and opens for the forward flow of blood to the aorta. The aorta is the large artery which carries the blood away from the heart back to the various parts of the body.

PREVIOUS | Direction | NEXT

[The Circulation of Blood through the Heart]- page 10 to 17
[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

The directional flow of blood in the heart is determined by valves which allow the blood to flow in only one direction. These sets of valves are the tricuspid and mitral valves, which control the flow of blood from the auricles to the ventricles, and the pulmonary and aortic valves which control the flow of blood from the ventricles to the arteries.

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

Both auricles receive blood simultaneously through vein openings which have no valves.

Q: Where are the "Superior Vena Cava", "Inferior Vena Cava" and "Pulmonary Veins" located on the heart?
A: The right auricle receives its blood through the superior and inferior vena cavas, while the left auricle receives its blood through the pulmonary veins.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

Q: When does the contraction impulse in the heart start?
A: A wave of muscular contraction starts at the top of the heart and passes downward, simultaneously, over both sides of the heart; that is, both auricles contract at the same time and then relax as the contraction passes down to the ventricles.

Q: What will happen when the heart contracts or relaxes?
A: When the auricles are caused to contract, they become small and pale and in doing so the blood in their chambers is subjected to increased pressure which forces blood to the ventricles through the opened tricuspid and mitral valves.

As the ventricles fill, eddies of the blood float the flaps on both the tricuspid and mitral valves back to a partially closed position.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

The instant that the contraction of the auricles has been completed, the ventricles are stimulated to contract.

Q: When blood is being forced out the right ventricle, what is the tricuspid valve'sposition? When the pressure in the right ventricle is superior to that in the pulmonary artery, what is the tricuspid valve's position? When the tricuspid and mitral valves are forced shut, what is the pulmonary valve's position?
A: This contraction increases the pressure in the ventricle chambers forcing the tricuspid and mitral valves completely closed, thereby preventing blood from being forced backwards into the auricles.

The auricles, relaxing from their contraction, receive a continuous blood flow from the vena cavas and the veins.

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

Q: Immediately through where blood must pass before entering the aorta? When the tricuspid and mitral valves are forced shut, what is the pulmonary valve's position? Where are the "Aorta", the "Aortic Valve", the "Pulmonary valve" and the "Pulmonary Artery" located on the heart?
A: As the ventricles continue to contract, pressure in these chambers force the pulmonary and aortic valves to open. The pulmonary valve, leading from the right ventricle, guards the entrance to the pulmonary artery. The aortic valve, leading from the left ventricle, guards the entrance to the aorta or aortic artery.

Both are 3 flapped valves, and are together known as the semi-lunar valves. Prior to ventricle contraction, the valves are closed by back pressure provided by blood already in the exit arteries. When pressure in the ventricles becomes greater than that in the exit arteries due to ventricle contraction, the semi-lunar valves open.

PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

With the semi-lunar valves open, blood flows from the right ventricle into the pulmonary artery on route to the lungs for cleaning and oxygen.

Q: What is also being forced out when the blood is being forced out the aorta?
A: Simultaneously, blood flows from the left ventricle into the aorta for distribution throughout the entire body.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

Immediately following the pumping of blood into the arteries, the ventricles begin to relax. This relaxation lowers the pressure within their chambers and the greater pressure in the arteries close the semi-lunar valves. Pressure within the ventricles is sufficient, however, to maintain closure of the tricuspid and mitral valves against the already increasing auricle pressure.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Circulation of Blood through the Heart]- page 10 to 17

As the ventricles relax further, pressure within them rapidly decreases. At the same time blood flowing into the auricles from the veins increases the auricle pressure.

Q: What is the position of the mitral valve when the blood in the aorta is exerting a superior pressure on the aortic valve?
A: Due to the differential pressure between the auricles and ventricles, the tricuspid and mitral valves are forced partially open.

The circulation of blood through the heart begins again with the next auricle contraction. Auricle pressure fully opens the tricuspid and mitral valves resulting in a rapid flow of blood into the ventricles.

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PREVIOUS | Direction | NEXT

[The Cycle of Blood Pressure in the Heart]- page 18 to 20
[The Parts of the Heart]- page 1 to 9

The Human Heart

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The cycle of blood pressure in the heart consists of two distinct phases. One of these phases is called the diastolic or relaxation phase.

In the diastolic phase, the heart relaxes between contractions. Blood flows into the heart, filling both auricles. While blood is flowing into the auricles, the arteries still maintain part of the pressure developed by a prior ventricle contraction. This is the time of lowest pressure in the arteries, or what is called the diastolic pressure.

Q: What will happen to the ventricles when they are in the diastolic phase?
A: During this phase the ventricles are also relaxing. The ventricles are slowly being filled with blood, due to the full auricles and partially opened tricuspid and mitral valves.

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PREVIOUS | Direction | NEXT

[The Parts of the Heart]- page 1 to 9
[The Circulation of Blood through the Heart]- page 10 to 17

The Human Heart

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

Q: During the first contraction of the systolic phase, what will be the mitral valve's position? During the second contraction of the systolic phase, what is the what will be the aortic valve's position?
A: The second phase, the systolic or contraction phase, begins when the auricles contract.

Q: Where is blood forced out when the ventricles contract?
A: The blood is forced through the tricuspid and mitral valves into the ventricles.

Q: What will happen simultaneously while blood is being forced out the auricles?
A: The ventricles then contract forcing the blood through the semi-lunar valves into the pulmonary and aortic arteries.

The blood leaves the ventricles under terrific pressure and surges through the arteries with a force so great that it bulges their elastic walls. At this point, arterial blood pressure is greatest; we refer to this pressure as the systolic pressure.

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PREVIOUS | Direction | NEXT

[The Parts of the Heart]- page 1 to 9
[The Circulation of Blood through the Heart]- page 10 to 17

The Human Heart

[The Cycle of Blood Pressure in the Heart]- page 18 to 20

The heart begins to relax again. The semi-lunar valves are closed; blood flows into the auricles from the veins; and the tricuspid and mitral valves are forced partially open.

The diastolic phase begins, and the cycle of blood pressure starts again.

- 20 -

PREVIOUS | Direction | NEXT

[The Parts of the Heart]- page 1 to 9
[The Circulation of Blood through the Heart]- page 10 to 17

End of Instruction

Please make sure that you have read the heart content at least 30 minutes before you raise your hand. If you want to review anything, click the navigation buttons to access the previous content pages. If you are satisfied with what you have learned, click "CLOSE" button to close this window and please ***raise your hand*** to start assessment.

CLOSE

Appendix I: Step-by-step study procedures

Preparation Stage:

1. Send emails to English, Education Psychology and Instructional Systems course instructors about visiting class dates and locations
2. Obtain an approval from Dr. Julian Rotter to put his Internal-External Locus of Control Scale on the Pennsylvania State University's course management site
3. Create Internal-External Locus of Control Scale on ANGEL site
4. Obtain IRB approval
5. Prepare 200 copies of Doc # 1 informed consent form and one copy of Doc # 2 and one copy of Doc # 3 informed consent form for visiting classes
6. Create a poster to explain how to participate in the study for visiting classes
7. Visit classes for recruiting participants for five minutes
8. Collect signed informed consent forms after five-minute visit
9. Send reminder emails to the participants who completed Internal-External Locus of Control Scale on ANGEL and ready to complete the whole study Create PHP page to recruit participants
10. Send confirmation emails to the participants to arrive at a reserved computer lab on time
11. Send reminder emails to the participants who are going to complete the whole study soon
12. Calculate participants' locus of control mean scores for determining internal and external locus of control learning styles
13. Divide participants into blue and white groups (internals and externals)
14. Prepare copies of blue and white group check-in sheets
15. Create a slide (half blue, half white, see below) for participants viewing which group they belong to in the reserved computer lab

Blue Group	White Group
Aaa111 – aaa222 – aaa333 – aaa444 – aaa555 bbb111 – bbb222 – bbb333 – bbb444 – bbb555 – bbb666 – bbb777 Ccc111 – ccc222 – ccc333 Ddd111 – ddd222 – ddd333 – ddd444 – ddd555 Eee111 – eee222 Ggg111 Hhh111 Jjj111 – jjj222 – jjj333 – jjj444 – jjj555 – jjj666 – jjj777 – jjj888 – jjj999 – jjj000 Kkk111 – kkk222 – kkk333 – kkk444 LLL111 – LLL222 Mmm111 – mmm222 – mmm333 – mmm444 – mmm555 – mmm666 – mmm777 – mmm888 Nnn111 Ppp111 Rrr111 – rrr222 Sss111 – sss222 – sss333 – sss444 Ttt111 – ttt222 – ttt333	Aaa111 – aaa222 – aaa333 – aaa444 – aaa555 – aaa666 – aaa777 – aaa888 – aaa999 – aaa000 Bbb111 – bbb222 Ccc111 – ccc222 – ccc333 – ccc444 – ccc555 Ddd111 – ddd222 – ddd333 – ddd444 – ddd555 Eee111 – eee222 – eee333 – eee444 – eee555 Ggg111 – ggg222 – ggg333 Hhh111 Jjj111 – jjj222 – jjj333 – jjj444 – jjj555 – jjj666 – jjj777 – jjj888 Kkk111 – kkk222 – kkk333 – kkk444 – kkk555 – kkk666 – kkk777 LLL111 – LLL222 – LLL333 Mmm111 – mmm222 – mmm333 – mmm444 Nnn111 – nnn222 – nnn333 – nnn444 – nnn555 Rrr111 – rrr222 – rrr333 – rrr444 Ssss111 – sss222 – sss333 – sss444 – sss555 Ttt111 – ttt222 Vvv111

16. Create Participation ID sheets in white, green, pink and purple colors

17. Prepare 200 scan sheets for participants answering four learning objective questions
18. Identify 100 scan sheets for blue group and 100 scan sheets for white sheets
19. Prepare 200 copies of drawing test answering sheet in yellow color
20. Prepare 30 copies of identification, terminology and comprehension test sheets
21. Prepare “Research in Progress” letter-size sign in blue color
22. Prepare “1”, “2”, “3”, “4” letter-size signs in blue color
23. Prepare 30 pencils
24. Create a folder to include four links to treatment groups on a computer lab’s desktop

Implementation Stage:

1. Bring pencils, Participation ID sheets, check-in sheets, scan sheets, copies of drawing test answering sheets, copies of identification, terminology and comprehension test sheets, copies of informed consent forms
2. Put “Research in Progress” sign on the door
3. Put “1”, “2”, “3”, “4” signs on different tables as below:

Front			
Control group (Group 1)	1	2	Rereading (Group 2)
Keyword (Group 3)	3	4	QA (Group 4)

4. Ask participants to find whether they are in blue or white groups from the slide
5. Ask participants to sign on a blue or a white check-in sheet
6. Ask participants whether they have signed the informed consent form during the last visit in class; if not, ask them to take two copies of the forms
7. Collect informed consent forms after participants sign them
8. Ask participants to take a pencil
9. Ask participants to take a Participation ID and a scan sheet from blue or white sides
10. Lead participants to sit in front of computers on different tables numbered 1, 2, 3, or 4
11. Ask participants to read the content at least thirty minutes
12. Write down the beginning reading time on participants’ scan sheets
13. Double check if participants spend at least thirty minutes on reading the content once they raise their hands for obtaining the first test (drawing test)
14. Write down the time on the scan sheets again once participants finish reading the content
15. Distribute drawing test answering sheets if participants finish reading the content more than thirty minutes

16. Collect drawing test answering sheets
17. Double check if participants put Participation IDs on the top of the sheets
18. Distribute the rest of three tests (identification, terminology, comprehension) once they complete the drawing test
19. Ask participants to answer test questions on scan sheets by using pencils
20. Write down the time on the scan sheets after participants complete four tests
21. Collect scan sheets and three tests
22. Send appreciation emails to participants and instructors

Analysis Stage:

1. Obtain scan sheet scores from Schreyer institute at the Pennsylvania State University
2. Score participants' drawing test scores
3. Encode all scores in an excel file
4. Run Internal-External Locus of Control Scale reliability in SPSS 14.0
5. Run reliability for four tests in SPSS 14.0
6. Run descriptive statistics in SPSS 14.0
7. Run correlational analysis in SPSS 14.0
8. Run MANOA in SPSS 14.0
9. Interpret data
10. Analyze null hypotheses
11. Analyze time effects

Appendix J: Informed Consent Forms

Informed Consent Form for Social Science Research
The Pennsylvania State University

Title of Project: The Effect of Learning Styles and Reading Strategies on Student Achievement

Principal Investigator: Pei-Hsuan Hsieh, Graduate Student
College of Education
315 Keller Building, University Park, PA 16802
(814) 880-1910; puh113@psu.edu

Advisor: Priya Sharma, Assistant Professor
College of Education
314C Keller Building, University Park, PA 16802
(814) 865-4374; pus3@psu.edu

1. **Purpose of the Study:** The purpose of this research is to examine the instructional effects of different online reading strategies for undergraduate students who obtain different learning styles (or locus of control types).

2. **Procedures to be followed:** After you reply the researcher's invitation letter by email, you will be able to enter an ANGEL group, called Online Reading Study 1/2. You will take Locus of Control measurement within 20 minutes. Then you can schedule a time to visit the assigned computer labs. You come into the lab and are randomly assigned to one of the treatment groups, using a specific reading strategy to study the parts and function of the heart. Then you will be asked to complete drawing, identification, terminology and comprehension tests (four achievement tests).

3. **Duration:** The time commitment is approximately one hour (around 70 minutes) in total for this study.

4. **Statement of Confidentiality:** Your participation in this study is confidential. Only the researcher and her advisor will know your identity. The data will be stored and secured at *(Pei-Hsuan's personal laptop)* in a *(password protected)* file. In the event of a publication or presentation resulting from the research, no personally identifiable information will be shared. The following may review and copy records related to this research: The Office of

Human Research Protections in the U.S. Department of Health and Human Services, Penn State University's Social Science Institutional Review Board, and Penn State University's Office for Research Protections. In addition, your confidentiality will be kept to the degree permitted by the technology used. No guarantees can be made regarding the interception of data sent via the Internet by any third parties.

5. **Right to Ask Questions:** Please contact Pei-Hsuan Hsieh at (814)880-1910with questions or concerns about this study. Also, if you have questions about your rights as a research participant, you may contact the Office for Research Protections at 814-865-1775.

6. **Payment for participation:** Participants will receive 3 extra-credit points on their final scores for participating in this study. Those who decide not to participate in this study during the study or recruitment process, your final grades will not be affected, since you would be provided an equitable alternative to participating in the research. The general nature of the alternatives to complete an alternative independent assignment. For additional information and instructions for completing and submitting the alternative extra credit, please see your course instructor.

7. **Voluntary Participation:** Your decision to be in this research is voluntary. You can stop at any time. You do not have to answer any questions you do not want to answer. That is, refusal to take part in this research will involve no penalty or loss of benefits you would receive otherwise or are entitled.

You must be 18 years of age or older to take part in this research study.

If you agree to take part in this research study and the information outlined above, please sign your name and indicate the date below. You will be given a copy of this form for your records.

_____ _____

Participant Signature Date

_____ _____

Person Obtaining Consent Date

Informed Consent Form for Social Science Research
The Pennsylvania State University

Title of Project: The Effect of Learning Styles and Reading Strategies on Student Achievement

Principal Investigator: Pei-Hsuan Hsieh, Graduate Student
College of Education
315 Keller Building, University Park, PA 16802
(814) 880-1910; puh113@psu.edu

Advisor: Priya Sharma, Assistant Professor
College of Education
314C Keller Building, University Park, PA 16802
(814) 865-4374; pus3@psu.edu

1. **Purpose of the Study:** The purpose of this research is to examine the instructional effects of different online reading strategies for undergraduate students who obtain different learning styles (or locus of control types).

2. **Procedures to be followed:** Your child will receive an invitation letter via email from the researcher (Ms. Pei-Hsuan Hsieh). The your child will be able to enter a course management system, called ANGEL (http://cms.psu.edu/) and login to a group "Online Reading Study 1/2". Your child will take Locus of Control measurement within 20 minutes first. Then you child can schedule a time to visit the assigned computer labs. As your child comes into the lab and are randomly assigned to one of the treatment groups, using a specific reading strategy to study the parts and function of the heart, he/she will be asked to complete drawing, identification, terminology and comprehension tests (four achievement tests).

3. **Duration:** The time commitment is approximately one hour (around 70 minutes) in total for this study.

4. **Statement of Confidentiality:** Your child's participation in this study is confidential. Only the researcher and her advisor will know your identity. The data will be stored and secured at *(Pei-Hsuan's personal laptop)* in a *(password protected)* file. In the event of a publication or presentation resulting from the research, no personally identifiable information will be

shared. The following may review and copy records related to this research: The Office of Human Research Protections in the U.S. Department of Health and Human Services, Penn State University's Social Science Institutional Review Board, and Penn State University's Office for Research Protections. In addition, your confidentiality will be kept to the degree permitted by the technology used. No guarantees can be made regarding the interception of data sent via the Internet by any third parties.

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6. **Payment for participation:** Your child will receive 3 extra-credit points on their final scores for participating in this study. Those who decide not to participate in this study during the study or recruitment process, their final grades will not be affected, since they would be provided an equitable alternative to participating in the research. The general nature of the alternatives to complete an alternative independent assignment. For additional information and instructions for completing and submitting the alternative extra credit, your child can talk to the course instructor.

7. **Voluntary Participation:** Your child can voluntarily decide to be in this research. He/she can stop at any time during the research process. He/she does not have to answer any questions if he/she does not want to answer. That is, refusal to take part in this research will involve no penalty or loss of benefits he/she would receive otherwise or are entitled.

If you agree to have your child take part in this research study and the information outlined above, please sign your name and indicate the date below. You will be given a copy of this form signed by the researcher (Ms. Pei-Hsuan Hsieh) for your records.

I give permission for my child _____ to participate in this research.

_____ _____

Parent Signature **Date**

_____ _____

Person Obtaining Consent Date

Child Assent for Social Science Research

The Pennsylvania State University

Title of Project: The Effect of Learning Styles and Reading Strategies on Student Achievement

Principal Investigator: Pei-Hsuan Hsieh, Graduate Student
College of Education
315 Keller Building, University Park, PA 16802
(814) 880-1910; puh113@psu.edu

Advisor: Priya Sharma, Assistant Professor
College of Education
314C Keller Building, University Park, PA 16802
(814) 865-4374; pus3@psu.edu

1. **Purpose of the Study:** The purpose of this research is to examine the instructional effects of different online reading strategies for undergraduate students who obtain different learning styles (or locus of control types).

2. **Procedures to be followed:** After you reply the researcher's invitation letter by email, you will be able to enter an ANGEL group, called Online Reading Study 1/2. You will take Locus of Control measurement within 20 minutes. Then you can schedule a time to visit the assigned computer labs. You come into the lab and are randomly assigned to one of the treatment groups, using a specific reading strategy to study the parts and function of the heart. Then you will be asked to complete drawing, identification, terminology and comprehension tests (four achievement tests).

3. **Duration:** The time commitment is approximately one hour (around 70 minutes) in total for this study.

4. **Statement of Confidentiality:** Your participation in this study is confidential. Only the researcher and her advisor will know your identity. The data will be stored and secured at *(Pei-Hsuan's personal laptop)* in a *(password protected)* file. In the event of a publication or presentation resulting from the research, no personally identifiable information will be shared. The following may review and copy records related to this research: The Office of

Human Research Protections in the U.S. Department of Health and Human Services, Penn State University's Social Science Institutional Review Board, and Penn State University's Office for Research Protections. In addition, your confidentiality will be kept to the degree permitted by the technology used. No guarantees can be made regarding the interception of data sent via the Internet by any third parties.

5. **Right to Ask Questions:** Please contact Pei-Hsuan Hsieh at (814)880-1910 with questions or concerns about this study. Also, if you have questions about your rights as a research participant, you may contact the Office for Research Protections at 814-865-1775.

6. **Payment for participation:** Participants will receive 3 extra-credit points on their final scores for participating in this study. Those who decide not to participate in this study during the study or recruitment process, your final grades will not be affected, since you would be provided an equitable alternative to participating in the research. The general nature of the alternatives to complete an alternative independent assignment. For additional information and instructions for completing and submitting the alternative extra credit, please see your course instructor.

7. **Voluntary Participation:** Your decision to be in this research is voluntary. You can stop at any time. You do not have to answer any questions you do not want to answer. That is, refusal to take part in this research will involve no penalty or loss of benefits you would receive otherwise or are entitled.

Your parent must sign a separate consent form before you may participate.

If you agree to take part in this research study and the information outlined above, please sign your name and indicate the date below. You will be given a copy of this form for your records.

_____ _____

Participant Signature Date

_____ _____

Person Obtaining Consent Date

VITA
Hsieh, Pei-Hsuan

EDUCATION

Ph.D., Instructional Systems, Pennsylvania State University, 2007.
M.A., Learning Technologies, University of Michigan, 2004.
M.S., Educational Administration, National Chengchi University, 2003.
B.S., Industrial Technology Education, National Taiwan Normal University, 2001.

EXPERIENCES

2005-2007 Pennsylvania State University University Park, PA
Research Assistant, Information Technology Service Consultant

- Solved campus-wide technical problems via emails
- Provided immediate assistant to all students, faculty and staff members
- Answered phone calls to all campus computer users

2006-2007 Pennsylvania State University University Park, PA
Teaching Assistant, Undergraduate INSYS100 and Graduate INSYS522 Courses

- Facilitated weekly online discussion.
- Commented on students' case papers.

2006-2007 Pennsylvania State University University Park, PA
Researcher, E-Portfolio Initiatives Project

- Created a questionnaire about students' Web publishing perceptions.
- Reviewed empirical studies and practical journal articles.

2006-2007 Pennsylvania State University University Park, PA
Instructional Designer, Intern at World Campus

- Developed Spanish online course.
- Communicated with graphic and template designers.

2005-2006 Pennsylvania State University University Park, PA
ANGEL Tutor, Course Management System Teacher

- Taught faculty members to use technologies in teaching.
- Helped faculty members develop personal Web pages

2003-2004 University of Michigan Ann Arbor, MI
Web Site Assessor, Intern at Research and Outreach Office

- Created an online questionnaire.
- Collected and then analyzed data by SPSS.

2003-2004 National Chengchi University Taipei, Taiwan
Researcher, Action Research Project at Institute of Teacher Education

- Classified action research articles, dissertations and educational news.
- Managed an online chat room.