

The Instructional Effect of Online Reading Strategies and Learning Styles on Student Academic Achievement

Pei-Hsuan Hsieh

Institute of Information Management, National Cheng Kung University, No. 1 University Road, Tainan 701, Taiwan
// pei.peace@gmail.com

Francis Dwyer

Instructional Systems Program, The Pennsylvania State University, University Park, PA 16802, USA

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, either internal or external locus of control styles, on tests measuring different learning objectives. Participants were 169 undergraduate students, randomly assigned to four online reading treatments: none, rereading strategy, keyword strategy, and question and answer strategy. Immediately after interacting with their respective instructions, students received four individual criterion measures. Analyses indicated an insignificant interaction between learning style and treatment type; however, comprehension tests reflect a significant main effect for students receiving the online rereading treatment ($F = 3.09$, $df = 3/169$, $p = .03$), with an effect size of .40. The rereading treatment also appears to be significantly more effective than the control for the comprehension test. Results indicate that not all types of reading strategies are equally effective in facilitating different types of learning objectives. The results indicate that, 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.

Keywords

Reading strategy, Learning style, Locus of control, Learning objectives

Introduction

Many studies have found reading strategies useful when implemented before, during or after reading (e.g., Brown, 2002; Ediger, 2005; Fagan, 2003; McGlinchey & Hixson, 2004; Millis & King, 2001; Sorrell, 1996). For example, reading strategies include rereading, scanning, summarizing, keywords, context clues, question-answer relationships, inferring, thinking aloud, activating prior knowledge, setting a purpose, and drawing conclusions. Online learning environments are becoming popular for most teachers and students. However, few studies focus on appropriate online reading strategies for different types of learners, and most studies focus only on the effectiveness of text-based reading strategies.

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). According to previous studies, some learners encounter difficulties learning online, since they have difficulty changing their learning habits to accept reading electronic texts (Aragon, 2004; Steinhauer & Friederici, 2001). 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, 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). The question remains: What is the best way to employ a text-based reading strategy in an online environment, so that the learners can maintain their confidence for learning?

In addition, students with their own learning styles may process information differently in an online environment (Atkinson & Shiffrin, 1969; Burton, Moore & Holmes, 1995; Huit, 2003). Different online reading strategies may influence the students' information processing methods (Driscoll, 2005; Schunk, 2004). This study seeks to discover the proper ways of employing online reading strategies and explores the effects of those online reading strategies and different learning styles on academic achievement. 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 (Cappella & Weinstein, 2001; Fehrenbach, 1991; Maguiness, 1999; Rotter, 1966). In order to consider readers of every learning style, this study focuses on *during* reading process and considers implementation of different *during* online reading strategies to complement different information processing. *During* reading strategies are varied, since more and more visual presentations occur in web learning environments for teachers and students. However, the effects of implementing *during* reading strategies for different learning styles in an online environment have not been investigated. In addition, not all reading strategies are equally effective methods in facilitating reading comprehension (Baumann et al., 2002). For example, rereading strategies ask readers to read a text more than one time to enhance reading comprehension before readers proceed to the next text. Context clue reading strategies, however, use phonic instructions to help readers gain speed and accuracy in identifying words as they read through a text. Readers may not sequentially comprehend the whole content at the same time as they recognize an unknown word under phonic instructions (Baumann et al., 2002; Ediger, 2005; McGlinchey & Hixson, 2004).

Not all *during* reading strategies are appropriate for an online environment. In this study, through tests measuring different learning objectives, students are required to acquire information relative to the physiology of the human heart, specifically circulation of blood during both the diastolic and systolic phases. 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 study contributes its findings to the field of distance education and the futures of e-learners. Prior studies substantiated that varied online reading strategies offer different ways to process information; the students' learning styles influence information processing methods. Therefore, this study focuses on two variables: online reading strategies and locus of control learning styles. The study methods applied in this study were described afterward with a report of the study results, followed by this study's contributions and conclusions. Proposed recommendations for future research appear as the final comment.

Reading strategies and learning styles

This section reviews and defines reading strategies and learning styles, and is followed by discussion of theoretical justification for exploring learning effects of locus of control and reading strategies on achievement. A literature review of three online reading strategies and learning styles is also included in this section. Finally, a brief summary ends this section.

Online reading strategies incorporate three reading strategies in an online environment. This study selects three online reading strategies: rereading strategy, keyword strategy, and question and answer (QA) strategy. The rereading strategy is a useful pedagogical tool and has potential benefit for enhancing readers' comprehension as well as enjoyment of literature (Faust & Glenzer, 2000). Faust and Glenzer concluded that the rereading strategy helps students obtain meaning of their favorite reading sections and makes meaning with texts. However, Short, Kane, and Peeling (2000) found that rereading a longer text may be time consuming, although using cues and rereading students' favorite sentences can help students familiarize themselves with the texts. Millis and King (2001) conducted research with 42 undergraduate psychology students who were recognized as good readers and found that rereading strategically improved their comprehension and retention of ill-structured information. Brown (2002) also found that female Japanese college students' reading comprehension improved through the use of rereading strategies.

The keyword strategy has been found, through research, to be useful in improving students' ability to comprehend. De Courcy and Birch (1993) conducted research through open-ended interviews, observation, and think-aloud protocol with four Japanese students and found that the students mainly used keywords and inference as their reading strategies to comprehend the whole text. Fagan (2003) found that English as second language learners need the keyword strategy as a scaffold during the reading process. Some researchers found significant effects on reading comprehension, such as employing keyword strategies before reading. For example, O'Donnell, Weber, and McLaughlin (2003) found that students obtained high comprehension scores when they previewed materials and discussed keywords before reading.

The question and answer strategy, which is usually called question-answer relationship (QAR), can increase readers' metacognition awareness (Benito et al., 1993; McIntosh & Draper, 1995; Raphael, 1982). Most research indicated

significant comprehension effects on reading while implementing this type of reading strategy. For example, Raphael (1982) reported that students were able to locate the information from the text and could properly respond to questions. Benito et al. (1993) also found that students could comprehend three different types of questions after employing QAR strategy. McIntosh and Draper (1995) found that QAR strategy helped students read, answer questions, and learn from texts.

Locus of control, a learning style variable, is commonly thought to be the degree to which an individual perceives personal responsibility for a specific outcome. Individuals possessing high levels of responsibility are generally labeled “internal control” while individuals possessing low levels of responsibility are labeled “external control” (Lefcourt, 1982). In situations that involve skills, internals generally spend more time on decision making than do externals. For tasks that require less skill-demand and are more by chance, internals exhibited carelessness and impulsiveness in their responses (Johnson & Kilmann, 1975; Kukul, Buldukoglu, Kuladaç & Köksal, 2006; Wheeler & Davis, 1978). Data from a number of studies 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, Tovar, & Brauer, 1993; Coker, Coggins, & Flaitz, 1989; Maguiness, 1999; Whitney, 1992). For example, Coker et al. (1989) reported that internal locus of control learning style readers have better performance in reading and, as good readers, they are able to use many reading strategies during the reading process. This enhances internals’ understanding of the meaning of unknown words, as compared to poorer readers (Arden-Close, 1993). Contrarily, poor readers, regarded as using external locus of control learning styles, might need support before, during, and after their reading process (Coker et al., 1989; Coldevin et al., 1993).

Rotter’s Social Inventory Scale (Rotter, 1966) separates individuals into two perceptual groups based on individuals’ perception of personal, causal role in the outcome of specific events, either internal or external. Internals are individuals who perceive personal responsibility for success or failure, whereas externals attribute luck, chance, or another factor for the reason for success or failure (Jonassen & Grabowski, 1993; Lefcourt, 1982). Prior research indicated differences in situations which facilitate increased achievement among internals and externals. Externals have been shown to perform best in situations of external reinforcement and a controlled instructional environment (Daniels & Stephens, 1976; Wesley, Krockover, & Devito, 1985). Internals interact intensely with whatever instructional treatment they receive, and this interaction results in maximum information acquisition and subsequent performance (Buckley & Dwyer, 1987). Internals score consistently higher than externals on uncued instruction (Brooks & McKelvie, 1986; Bursik & Martin, 2006). Externals prefer teacher-controlled method in a traditional educational setting as opposed to independent instruction, and have higher achievement scores in that preferred setting (Daniels & Stephens, 1976).

A commonly accepted view of internal and external locus of control is 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 potential 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 and are more chance-based, internals exhibited carelessness and impulsiveness in their responses (Johnson & Kilmann, 1975; Wheeler & Davis, 1979). 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 participated in a joint reading problem program at Westerns Springs College in Auckland, New Zealand.

The literature indicates that different types of reading strategies may vary in effectiveness in facilitating student achievement of different types of learning objectives and that students may be dichotomized into levels of learning styles (locus of control) each having specific characteristics which differentially influence the potential to profit from instructional structures. Specifically, the purpose of this study is to examine: a) the instructional effectiveness of different types of reading strategies in facilitating student achievement of different types of learning objectives, b) the effect of different types of reading strategies on students, identified as either internal or external locus of control,

by tests measuring different learning objectives, and c) whether an interaction exists between type of reading strategy and learning style.

In sum, this study explores the relationship between locus of control and reading strategy in an online environment. By reviewing information processing theory, three reading strategies presenting different effects on students' comprehension are clearly presented. Most researchers have also confirmed that three online reading strategies have significant effects on comprehension. The theoretical justification section presents a number of prior studies which examine the relationship between learning styles and online reading strategies. The next section describes the study methods applied in this study.

Study methods

This section includes three sub-sections: Participants, Instrumentations and Research Design. Beginning in the spring of 2006, the study used an open-source programming language to recruit participants. Detailed information about subject variables appear in the Participants section. The Instrumentations section details learning materials, criteria of achievement measures, and locus of control measures. The Research Design section describes how the study was conducted in the preparation, implementation, and analysis stages.

Participants

Participants were 169 undergraduates from English, statistics, and education psychology programs, recruited at the Pennsylvania State University. They were all college-level undergraduates in their first or second university year. Most of them from the English program were freshmen and pre-service teachers. Although most participants from English and education psychology programs were female, the locus of control measures used in this study to determine learning styles and to randomly assign the students to different experimental group assignments were not gender sensitive. All participants were reminded to read the participation directions before starting the study. Because of their instructors' high level of support for the study, participants were motivated to participate. All of them signed a consent form ensuring that they were over 18 years old. They received an incentive to participate, which consisted of obtaining one or three credit point(s) for their final course scores, based on their instructors' grading policies. None of the participants had a medical education background nor did any participant have known psychological, personal, or academic risks that could influence this study.

Instrumentation

Learning materials

This study used a 2,000-word instructional module focusing on the physiology of the human heart and the related processes occurring during systolic and diastolic phases (Dwyer, 1972). The original instructional content was converted to a 20-page, web-based online instructional module. A description of the experimental treatments is:

- Treatment 1 (control group): Students in the control treatment interacted with the online instructional content in the conventional manner (Figure 1). Students were told that they would be tested on the content. They progressed through the content at their own rate and could move forward and backward depending on need.
- Treatment 2 (rereading group): In the rereading treatment, students received the same information more than one time; however, in this treatment, selected sentences related to specific learning objectives and test questions were repeated (Figures 2 & 3). When students finished reading the first web page and then clicked on a "Next" button, the selected sentences or paragraphs from the first web page showed on the second web page word by word in teleprompter fashion until the "CONTINUE" button appeared. The sentence to be reread was not presented all at once; words appeared sequentially and created the sense of animation. After the rereading was complete, participants then clicked on the "CONTINUE" button to proceed to the rest of the web pages. They could have also clicked on the "Previous" button to go back to the first web page. The participants in this online instructional set were forced to view the same sentences or paragraphs twice. In this study, the rereading strategy was added to the original 20 web pages.

- Treatment 3 (keyword group): Students receiving this treatment received bolded keywords related to key learning objectives as well as test questions (Figures 4 & 5). Some terminologies referred to the names of the parts of human heart. The keywords were bolded and in larger font than the rest of the text so that they would stand out. In this study, 31 facts, concepts, and procedures were emphasized in this way.
- Treatment 4 (question and Answer [QA] group): This treatment comprised 29 questions and answers (Figure 6). The questions' design focused students' attention on specific learning objectives and related criterion measures.

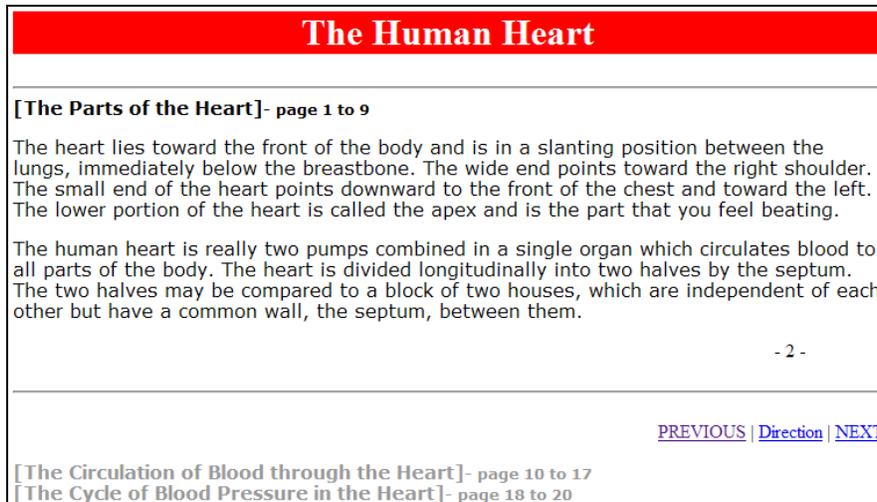


Figure 1. Screen shot of the first treatment: control group

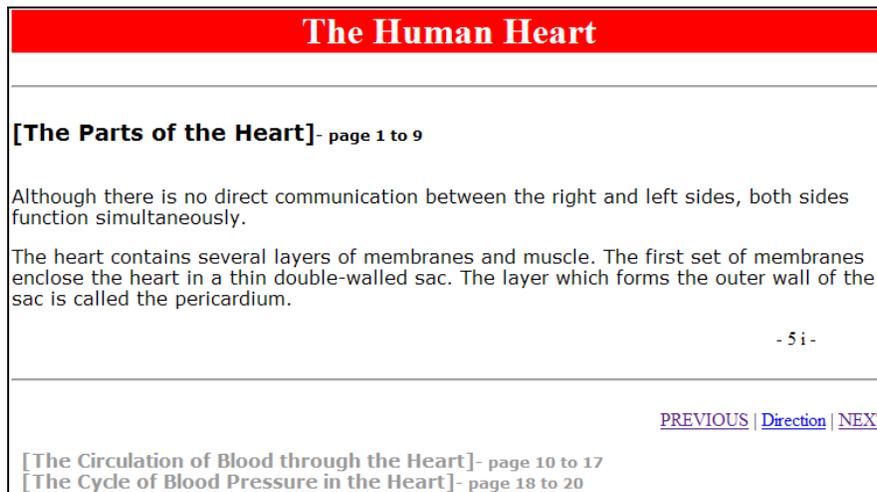


Figure 2. Screen shot of the second treatment: rereading

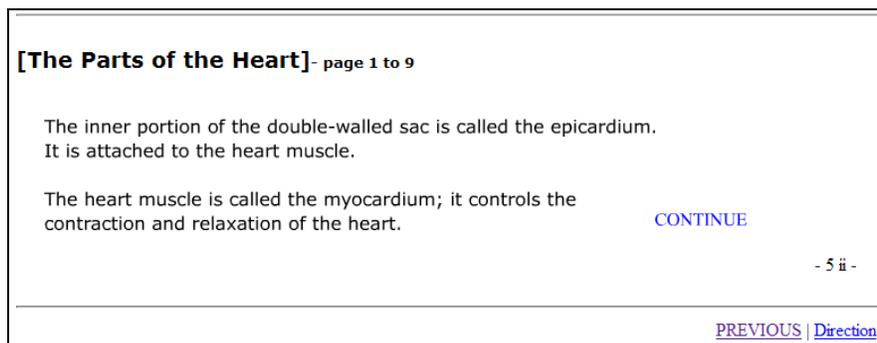


Figure 3. Screen shot of important sentences for rereading

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.

- 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](#)

Figure 4. Screen shot of the third treatment: keyword (I)

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.

- 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](#)

Figure 5. Screen shot of the third treatment: keyword (II)

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.

- 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](#)

Figure 6. Screen shot of the fourth treatment: Q & A

Criteria of achievement measures

The criterion measures correspond to the different knowledge acquisition domains: facts, concepts, rules/principles, and procedures. Each criteria measure contains 20 test items.

- Drawing test (Kuder-Richardson Formula 20 [KR-20] = .84): The objective of the drawing test was to evaluate student ability to construct and/or reproduce items in their appropriate contexts. The drawing test provided the students with a numbered list of terms corresponding to the parts of the heart discussed in the instructional presentation. The students were 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 was on the correct positioning of the verbal symbols with respect to one another and with respect to their concrete referents.
- Identification test (KR-20 = .80): The objective of the identification test was to evaluate student ability to identify parts or positions of an object. This multiple-choice test required students to identify the numbered parts on a detailed drawing of a heart. Each part of the heart, which had been discussed in the presentation, had a number on a drawing. The objective of this test was to measure the ability of the student to use visual cues to discriminate one structure of the heart from another, and to associate specific parts of the heart with appropriate names.
- Terminology test (KR-20 = .75): This test consisted of items designed to measure knowledge of specific facts, terms, and definitions. The objectives measured by this type of test are appropriate to all content areas which have an understanding of the basic elements as a prerequisite to the learning of concepts, rules/principles, and procedures.
- Comprehension test (KR-20 = .74): Given the location of certain parts of the heart at a particular moment of its functioning, students had to determine the position of other specified parts or positions of other specified parts of the heart at the same time. This test required 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. The comprehension test design measured a type of understanding in which the individual can use the information being received to explain some other phenomena.

Locus of control measures

Rotter's internal-external locus of control scale (1966) uses 23 forced-choice items to measure personal belief. The participants can be divided into internal and external locus of control learning styles. The higher the score, the more external a person measures (Lefcourt, 1982). The participants, identified with one of the two styles, enter a randomly assigned process and receive an assignment to one of the four treatment groups. This study helps explain how likely the participants are to follow their learning styles when reacting to the reading strategies provided in the online learning environment. The reliability of Rotter's internal-external locus of control scale has a range of .6 to .9, depending upon the population (Jonassen & Grabowski, 1993; Lefcourt, 1982). This study's reliability rated .63 (KR-20).

Research design

According to the study purpose, a two-way multivariate analysis of variance (MANOVA) analyzed the null hypothesis in the research design. The null hypothesis has two independent variables (reading strategy and learning style) and four dependent variables (drawing, identification, terminology, and comprehension learning objective tests). Some extraneous variables, such as gender and education background, had no significant effects on the study results. Overall, this study contains three stages: preparation, implementation, and analysis. In the preparation stage (summer and fall of 2005), we conducted a pilot study, which was purely experimental; its purpose was to identify response difficulty for all test items. In the spring of 2006, after revising the learning materials and adding different online reading strategies, we conducted the actual study and analyzed the study results.

Preparation stage

A pilot study, conducted with 27 students, was subjected to an item analysis to identify response difficulty for all test items (with item difficulty of less than .6). This information identified students who were having difficulty. The

experimental reading strategies were positioned to facilitate the acquisition of the information necessary to perform the specific criteria measures. The test items (80 test items in total) with less than .6 correct-response rates had been given one or more frame numbers identifying where the instructions occur. Overall, 16 out of 20 frames referred to 59 difficult items needing instructional enhancement. Revision of the learning materials resulted in the addition of different online reading strategies for the next stage of the study.

Implementation stage

In the actual study, students received a random assignment to treatment groups, and after interacting with their respective treatments, completed the four learning criteria measures. Since larger numbers better represent a normal distribution of learning outcomes, the study used an open-source programming language to create dynamic hypertext preprocessor (PHP) web pages to recruit participants. PHP made it easier to recruit students online. Finally, 169 participants were invited to take part in the study. All participants completed the study within about 70 minutes.

Figure 7 is the concept map for the implementation stage of the study procedure. The letter C represents the control group. The three online reading strategy groups are: rereading (R), keyword (K), and question and answer (QA). The two locus of control learning styles are internal and external (I and E, respectively).

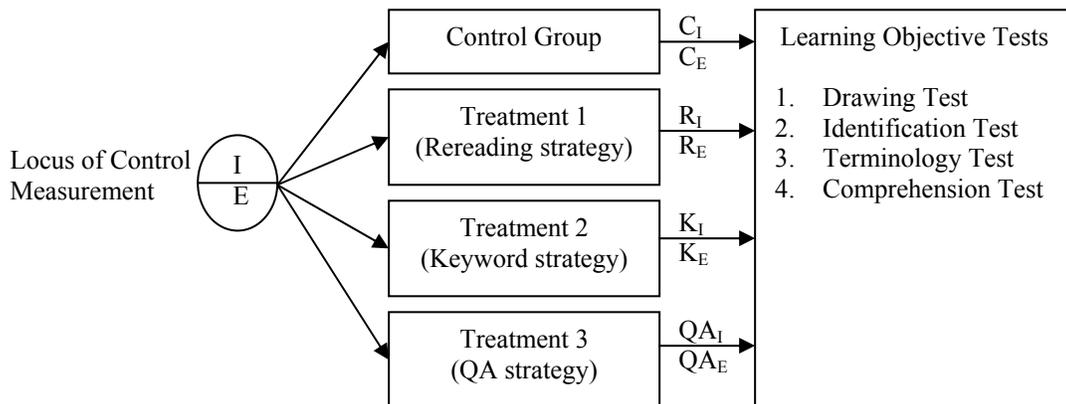


Figure 7. Concept map of the study procedure

Analysis stage

Descriptive analysis occurred first, followed by correlational analysis to determine the relationship among the four criteria measures of achievement (dependent measures) and 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 study, the categorical independent variables are the reading strategies, and the multiple interval-dependent variables are the criterion measures of achievement scores. If any significant differences of a dependent measure yielded in favor of a certain online reading strategy over the control, a follow-up analysis, such as Tukey's honest significant difference (HSD) tests, is available for verification. HSD provides boundary on differences between independent and dependent group averages (Ramsey & Schafer, 2002). Other pair-wise comparison methods, such Fisher's protected least significant difference (LSD) and the Bonferroni correction, are not appropriate, since the former cannot control experiment-wide error, and the latter can, conservatively, produce a very small coefficient (Ramsey & Schafer, 2002).

Study results

This section presents the results of the analyses of the study. The reliability test results reported in the previous section 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 first analysis

results. 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 a 2 x 4 MANOVA and an additional 2 x 1 ANOVA end this section.

Descriptive analysis

Descriptive analysis was the first investigation for this study, in which the control group had 43 participants, the rereading group had 42 participants, the keyword group had 41 participants, and the QA group had 43 participants. Overall, all 169 participants obtained, on average, 11.46 points (SD = 3.50) in the locus of control measurement. Therefore, the two categories became: internal (obtaining more than 12 points) and external (obtaining less than 12 points). In the control group, 24 participants were of the internal locus of control type (external $N = 19$). In the rereading group, 17 participants were the internal locus of control type (external $N = 25$). In the keyword group, 20 participants were the internal locus of control type (external $N = 21$). In the QA group, 25 participants were the internal locus of control type (external $N = 18$). Overall 86 participants were the internal locus of control type, and 83 were the external type (see Table 1). The former, on average, obtained 30.33 points (SD = 14.41) in the composite test. The external locus of control type of student (83) obtained 33.82 points (SD = 16.83).

Table 1. Distribution of participants (internals and externals) in treatment groups

Treatment groups	Numbers of internals	Numbers of externals	Numbers of participants
T1: Control	24	19	43
T2: Rereading	17	25	42
T3: Keyword	20	21	41
T4: QA	25	18	43
Total Numbers	86	83	169
Total Composite Scores (M/SD)	(30.33/14.41)	(33.82/16.83)	(32.04/13.75)

In addition, all participants, on average, obtained 5.98 points (SD = 4.17) in the drawing test; 8.83 points (SD = 3.97) in the terminology test; 9.00 points (SD = 4.30) in the identification test, and 8.23 points (SD = 3.98) in the comprehension test (see Table 2). All participants had an average of 32.04 points (SD = 13.75) for all four tests. Of all participants, students in the rereading strategy groups performed well in every test and equally well with composite test scores (M = 36.26, SD = 15.13). The students assigned in the control group received, on average, 32.02 points (SD = 13.80). In the keyword group, students averaged 31.66 points (SD = 14.36). The QA group performed the least well (M = 28.30, SD = 10.66).

Table 2. Means and standard deviation for students in each treatment on each criteria measure

Treatments	Criteria measures				Total composite scores (M/SD)
	Drawing (M/SD)	Identification (M/SD)	Terminology (M/SD)	Comprehension (M/SD)	
T1: Control $N = 43$	5.81/4.24	9.09/3.59	9.19/3.93	7.93/4.49	32.02/13.80
T2: Rereading $N = 42$	7.02/4.61	9.71/4.50	9.79/4.56	9.74/3.88	36.26/15.13
T3: Keyword $N = 41$	5.76/4.04	8.49/4.32	9.29/4.76	8.12/3.87	31.66/14.36
T4: Q&A $N = 43$	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

Correlational analysis

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. Table 3 illustrates the correlation coefficients among the four tests achieved at the .01 level of significance. The relationship among different measures is moderate and even strong, providing justification for using MANOVA in this study.

Table 3. Pearson correlations among different measures

	Drawing	Identification	Terminology	Comprehension
Drawing	1	.643**	.523**	.487**
Identification		1	.667**	.606**
Terminology			1	.685**
Comprehension				1

** $p < 0.001$

MANOVA

Consequently, a 2 x 4 MANOVA table (see Table 4) indicates that no significant interaction exists between reading strategy and level of locus of control learning styles ($F = 1.31$, $df = 3/169$, $p = .27$). A significant main effect ($F = 3.09$, $df = 3/169$, $p = .03$), with an effect size of .40, exists on the comprehension test; however, insignificant differences exist on the drawing test ($F = 1.37$, $df = 3/169$, $p = .30$), identification test ($F = 1.69$, $df = 3/169$, $p = .17$), and terminology test ($F = 1.76$, $df = 3/169$, $p = .16$) criterion measures.

Table 4. Reading strategies on learning objective tests

Source (Groups)	Type III			<i>F</i>	Sig.	Grand mean	
	sum of squares	df	Mean square			Mean	Standard error
Drawing	69.052	3	23.017	1.368	.255	6.041	.319
Identification	81.527	3	30.844	1.686	.172	8.888	.306
Terminology	92.533	3	27.176	1.755	.158	9.037	.332
Comprehension	142.943	3	47.648	3.091	.029*	8.272	.305

* $p < 0.05$

Table 5 is a follow-up analysis (LSD), conducted on the comprehension test, which yielded a significant difference in favor of T2, the rereading treatment, over T1, the control ($T = 1.99$, $df = 2/83$, $p = .05$). A significant difference also appears between T2, rereading, and T4, QA treatment, in favor of T2 ($T = 3.33$, $df = 2/83$, $p = .001$). Analyses also indicate an insignificant interaction between reading strategy and learning style (level of locus of control) on each criterion measure.

Table 5. LSD analysis on comprehension test

Source (Groups)	<i>t</i> -value	df	Sig. (2-tailed)	Mean difference	Standard error
Rereading (M = 9.74, SD = 3.88) & Control (M = 7.93, SD = 4.49)	1.985	83	.05*	1.81	.85
Rereading & Keyword (M = 8.12, SD = 3.87)	1.898	81	.061	1.62	.86
Rereading & QA (M=7.16, SD=3.23)	3.328	83	.001**	2.58	.85

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

A 2 x 1 ANOVA analyzed the effect of reading strategy and student learning style for the composite test scores. No interaction appears between the reading strategy and the student learning style. However, the main effect of the reading strategy treatments had an approaching significance ($F = 2.541$, $p = .058$, see Table 6) on the composite test scores. The student learning style (or the locus of control type) still had no main effect on the composite test scores.

Table 6. Reading strategies on learning objective tests

Source (Groups)	Type III sum of squares	df	Mean square	F	Sig.	Grand mean	
						Mean	Standard error
Corrected model	2407.389	7	343.913	1.887	.075		
Intercept	172187.316	1	172187.316	944.881	.000		
Group	1389.335	3	463.112	2.541	.058		
Control						32.520	2.073
Rereading						36.493	2.122
Keyword						31.602	2.109
QA						28.338	2.086
LCTP	322.058	1	322.058	1.767	.186		
External						33.632	1.493
Internal						30.844	1.473
Group * LCTP	717.484	3	239.161	1.312	.272		
Control — external						36.789	3.097
Control — internal						28.250	2.756
Rereading — external						35.280	2.700
Rereading — internal						37.706	3.274
Keyword — external						33.905	2.946
Keyword — internal						29.300	3.019
QA — external						28.556	3.182
QA — internal						28.120	2.700
Error	29339.321	161	182.232				
Total	205251.000	169					
Corrected total	31746.710	168					

Discussion

This experimental study shows evidence that reading strategies can be applied in web-based or online learning environments to support students with different learning styles for processing information, such as comprehending a text. Specifically, this study explores the effects of three *during* online reading strategies (rereading, keyword, and QA) and two kinds of locus of control learning styles (internal and external) on students' academic achievement. Different data analysis methods (reliability, descriptive statistics, correlational analysis and MANOVA) employed in this study support information processing theory that the students with different locus of control learning styles process information differently. The following explains the rationale for the conclusions according to the study methods, analyses, and study results presented in the previous sections.

First, this study examines the interaction between locus of control types of students and online reading strategies. The assumption is that a certain type of locus of control students obtains more benefits from using a certain type of *during* reading strategy for learning online content. However, no interaction is discernable between the locus of control types and the reading strategies in the four learning objective tests. The students, regarded as internal locus of control types, did not perform significantly well on each test as compared to the external locus of control type of students' test performance. Encouragingly, those internals assigned to the rereading strategy obtained higher scores for the four learning objective tests than did the students regarded as external locus of control type. Also uncovered is that the students assigned to the rereading strategy obtained significantly higher scores than did others, regardless

of their status as internal or external. Previous studies also found that rereading is a useful pedagogical strategy (Olmscheid, 1999; Nathan & Stanovich, 1991) and yields the most significant effect on student achievement since it helps increase students' reading fluency and creates a critical connection with reading comprehension. Faust and Glenzer's (2000) study concluded that the rereading strategy helps students intensify their impression of favorite reading sections and engenders a deeper connection with texts. The study results again upheld an assumption about rereading which allows individuals to employ it differently for comprehending a text. 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.

Conclusions and implications

Overall, the conclusion of this study is that different reading strategies have different instructional structures and functions in facilitating student achievement of different types of learning objectives. Rereading strategy, implemented on the web in teleprompter fashion, resulted in students having greatly improved comprehension. In addition, practical implications of implementing rereading strategy are like using an online supervisory system in counseling centers. For example, Klitzke and Lombardo (1991) suggested using "bug-in-the-eye" (BITE) technology to assist clinical training. BITE is computer-assisted supervision with a one-way communication process. It allows supervisors to effectively provide prompt, on-screen, with a few words, *during* counseling sessions for their trainees (Miller, Miller, & Evans, 2002). In the past, the supervisors used telephone call-in or knock-on-the-door approaches, which easily interrupted the counseling process.

Today, increased computer-assisted supervision has proven effectiveness for providing feedback to trainees. Smith, Mead, and Kinsella (1998) reviewed several live supervision techniques and found that direct supervision with computer monitors is the most effective method. A prompt shown on the computer monitor can include words and/or visual icons. Scherl and Haley's (2000) clinical notes also had positive comments for placing two 14-inch color computer monitors separately, one in the therapy room and the other in the supervisor's room. They conducted a qualitative investigation with six master's-level students during a 10-week practicum training. The students' clients knew of the purpose of using the monitors and eight live-supervision sessions were videotaped. The students found computer-assisted supervision less disruptive. They received, on average, six to seventeen messages in the one-hour sessions. In addition, only one client with very wide peripheral vision indicated awareness of the prompts. Computer-assisted reading strategies may be best during instructional support for students. This study encourages investigation into ways of strengthening online, rereading strategy effects on students' learning comprehension. For example, animated effects can be incorporated into online rereading strategy utilized by language learners. Students with different learning styles also need further consideration. Investigating their other learning styles or reading habits, conducting interviews, and distributing questionnaires are ways to obtain participatory information as well as assistance for interpreting a study's statistical results.

Three limitations of this study exist. College-level undergraduates perceive completing the study to be more important than trying their best to perform well in the study. Hence, the participants, having an internal locus of control learning style, can demonstrate the same performance as those with an external locus of control. The amount of time required for reading should be less than 30 minutes to prevent the participants assigned to the control, keyword, and QA groups from reading the materials more than twice. Some factors may also influence study results that need further investigation, such as drawing skills and ability to view texts on a computer screen.

Finally, future research should include online reading strategies for *before* and *after* student learning processes. For example, the teleprompter-type online rereading strategy can effectively enhance students' comprehension during their learning processes. Some databases, which are full-text web pages, might need other types of online reading strategies before students download too many resources to read. In addition, even though the study setting is the same, a new finding results from dual- or multi-reading strategies and learning styles on reading. Perhaps varied measurements can help make appropriate instructional decisions for both study and instructional designs. In sum, educators can encourage students to be aware of their own strengths in varied learning situations. A continued focus on exploring varied ways of using online reading strategies for different e-learners will enhance reading performance results.

References

- Aragon, S. R. (2004). Information processing patterns of postsecondary American Indian/Alaska native students. *Journal of American Indian Education, 43* (3), 1–21.
- Arden-Close, C. (1993). NNS readers' strategies for inferring the meanings of unknown words. *Reading in Foreign Language, 9* (2), 867–893.
- Atkinson, R. L., & Shiffrin, R. M. (1969). Storage and retrieval processes in long-term memory. *Psychological Review, 76* (2), 179–193.
- Benito, Y. M., Foley, C. L., Lewis, C. D., & Prescott, P. (1993). The effect of instruction in question-answer relationships and metacognition on social studies comprehension. *Journal of Research in Reading, 16* (1), 20–29.
- Baumann, J. F., Edwards, E. C., Font, G., Tereshinski, C. A., Kame'enui, E. J., & Olejnik, S. (2002). Teaching morphemic and contextual analysis to fifth-grade students. *Reading Research Quarterly, 37* (2), 150–176.
- Brooks, P. E. & McKelvie, S. I. (1986). Effects of locus of control, cueing and relevance on memory for passages. *Canadian Journal of Behavioural Sciences, 18*, 278–286.
- Brown, S. (2002). What happens when people reread? Paper presented at the 13th Annual World Congress of the Association Internationale de Linguistique Appliquee, Singapore, (ERIC Document Reproduction Service No. ED 473 080).
- Buckley, K. A., & Dwyer, F. M. (1987). Effect of level of locus of control and types of rehearsal strategy on students' ability to profit from visualized instruction. *International Journal of Instructional Media, 14* (1), 33–40.
- Bursik, K., & Martin, T. A. (2006). Ego development and adolescent academic achievement. *Journal of Research on Adolescence, 16* (1), 1–18.
- Burton, J. K., Moore, D. M., & Holmes, G. A. (1995). Hypermedia concepts and research: An overview. *Computers in Human Behavior. Special Issue: Hypermedia: Theory, Research, and Application, 11* (3–4), 345–369.
- Cappella, E., & Weinstein, R. (2001). Turning around reading achievement: Predictors of high school students' academic resilience. *Journal of Educational Psychology, 93* (4), 758–771.
- Cavana, R. Y., Delahaye, B. L., & Sekaran, U. (2001). *Applied business research: Qualitative and quantitative methods*, Brisbane: John Wiley & Sons.
- Coker, L., Coggins, J., & Flaitz, J. (1989). "Success in nursing": A primary intervention course, (ERIC Document Reproduction Service No. ED 314 127).
- Coldevin, G., Tovar, M., & Brauer, A. (1993). Influence of instructional control and learner characteristics on factual recall and procedural learning from interactive video. *Canadian Journal of Educational Communication, 22* (2), 113–130.
- Daniels, R. L., & Stephens, J. P. (1976). The interaction between the internal locus of control and two methods of college instruction. *American Educational Research Journal, 13* (2), 103–113.
- De Courcy, M., & Birch, G. (1993). *Reading and writing strategies used in a Japanese immersion program*, Eric database (ERIC Document Reproduction Service No. ED 388 097).
- Driscoll, M. P. (2005). *Psychology of learning for instruction*, Boston: Pearson.
- Dwyer, F. M. (1972). The effect of overt responses in improving visually programmed science instruction. *Journal of Research in Science Teaching, 9* (1), 47–55.
- Ediger, M. (2005). Themes to emphasize in the geography curriculum. *Journal of Instructional Psychology, 32* (1), 160–163.
- Ehrlich, M.-F., Kurtz-Costes, B., & Loidant, C. (1993). Cognitive and motivational determinants of reading comprehension in good and poor readers. *Journal of Reading Behavior, 25* (4), 365–381.
- Fagan, B. (2003). Scaffolds to help ELL readers. *Voices from the Middle, 11* (1), 38–42.

- Faust, M. A., & Glenzer, N. (2000). "I could read those parts over and over": eighth graders rereading to enhance enjoyment and learning with literature. *Journal of Adolescent & Adult Literacy*, 44 (3), 234–239.
- Fehrenbach, C. R. (1991). Gifted/average readers: Do they use the same reading strategies? *Gifted Child Quarterly*, 35 (3), 125–127.
- Ferguson, E. (1999). A facet and factor analysis of Typical Intellectual Engagement (TIE): Associations with locus of control and the five factor model of personality. *Social Behavior and Personality*, 27 (6), 545–562.
- French, A., & Poulsen, J. (2002). *Multivariate analysis of variance (MANOVA)*, Retrieved January 18, 2009, from <http://online.sfsu.edu/~efc/classes/biol710/manova/manova.htm>.
- Glass, G. V., & Hopkins, K. D. (1996). *Statistical methods in education and psychology* (3rd Ed.), London: Allyn & Bacon.
- Huitt, W. (2003). *The information processing approach to cognition. Educational Psychology Interactive*, Retrieved January 28, 2009, from <http://chiron.valdosta.edu/whuitt/col/cogsys/infoproc.html>.
- Johnson, B. L., & Kilmann, P. R. (1975). Locus of control and perceived confidence in problem solving abilities. *Journal of Clinical Psychology*, 31, 54–55.
- Jonassen, D. H., & Grabowski, B. L. (1993). *Handbook of Individual Differences, Learning and Instruction*, Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Jung, I. (2001). Building a theoretical framework of web-based instruction in the context of distance education. *British Journal of Educational Technology*, 32 (5), 525–534.
- Kukulu, K., Buldukoglu, K., Kuladaç, Ö., & Köksal, C. D. (2006). The effects of locus of control, communication skills, and social support on assertiveness in female nursing students. *Social Behavior and Personality*, 34 (1), 27–40.
- Klitzke, M. J., & Lombardo, T. W. (1991). A "bug-in-the-eye" can be better than "bug-in-the-ear": A teleprompter technique for on-line therapy skills training. *Behavior Modification*, 15, 113–117.
- Lefcourt, H. M. (1982). *Locus of Control*, Hillsdale, NJ: Lawrence Erlbaum.
- McIntosh, M. E., & Draper, R. J. (1995). Applying the question-answer relationship strategy in mathematics. *Journal of Adolescent & Adult Literacy*, 39 (2), 120–131.
- Maguiness, C. (1999). Show us how: A school-wide programme for reluctant readers. *Paper presented at the Biennial Conference of the International Federation for the Teaching of English*, England, UK: University of Warwick (ERIC Document Reproduction Service No. ED 442 076).
- McGlinchey, M. T., & Hixson, M. D. (2004). Using curriculum-based measurement to predict performance on state assessments in reading. *School Psychology Review*, 33 (2), 193–203.
- Miller, K. L., Miller, S. M., & Evans, W. J. (2002). Computer-assisted live supervision in college counseling centers. *Journal of College Counseling*, 5, 187–192.
- Millis, K. K., & King, A. (2001). Rereading strategically: The influences of comprehension ability and a prior reading on the memory for expository text. *Reading Psychology*, 22 (1), 41–65.
- Nathan, R. G., & Stanovich, K. E. (1991). The causes and consequences in differences in reading fluency. *Theory into Practice*, 30 (3), 176–184.
- O'Donnell, P., Weber, K. P., & McLaughlin, T. F. (2003). Improving correct and error rate and reading comprehension using key words and previewing: A case report with a language minority student. *Education and Treatment of Children*, 26 (3), 237–254.
- Olmscheid, C. (1999). *Reading fluency: A critical component of reading instruction* (ERIC Document Reproduction Service No. ED 430 208).
- Ramsey, F. L., & Schafer, D. W. (2002). *The statistical sleuth, a course in methods of data analysis* (2nd Ed.), Belmont, CA: Duxbury Press.

- Raphael, T. (1982). *Improving question-answer performance through instruction*. Center for the Study of Reading, Illinois University, Urbana, Eric database (ERIC Document Reproduction Service No. ED 215 303).
- Rotter, J. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs*, 80 (1, whole no. 609).
- Romero, V. L., Berger, D. E., Healy, M. R., & Aberson, C. L. (2000). Using cognitive learning theory to design effective on-line statistics tutorials. *Behavior Research Methods, Instruments & Computers*, 32 (2), 246–249.
- Scherl, C. R., & Haley, J. (2000). Computer monitor supervision: A clinical note. *The American Journal of Family Therapy*, 28, 275–282.
- Schommer-Aikins, M., & Easte, M. (2006). Ways of knowing and epistemological beliefs: Combined effect on academic performance. *Educational Psychology*, 26 (3), 411–423.
- Schunk, D. H. (2004). *Learning theories: An educational perspective* (4th Ed.), Upper Saddle River, NJ: Prentice-Hall.
- Short, R. A., Kane, M., Peeling, T. (2000). Retooling the reading lesson: Matching the right tools to the job. *Reading Teacher*, 54 (3), 284–295.
- Smith, R. C., Mead, D. E., & Kinsella, J. A. (1998). Direct supervision: Adding computer-assisted feedback and data capture to live supervision. *Journal of Marital and Family Therapy*, 24 (1), 113–125.
- Sorrell, A. L. (1996). *Triadic Approach to Reading Comprehension Strategy Instruction*. Paper presented at the 32nd Annual Conference of the Learning Disabilities Association of Texas. Austin, TX (ERIC Document Reproduction Service No. ED 400 670).
- Steinhauer, K., & Friederici, A. D. (2001). Prosodic boundaries, comma rules, and brain responses: The closure positive shift in ERPs as a universal marker for prosodic phrasing in listeners and readers. *Journal of Psycholinguistic Research*, 30 (3), 267–295.
- Wesley, B. E., Krockover, G. H., & Devito, A. (1985). The effects of computer-assisted instruction and locus of control upon preservice elementary teachers' acquisition of the integrated science process skills. *Journal of Research in Science Teaching*, 22 (8), 687–692.
- Wheeler, R. W. & Davis, J. M. (1979). Decision making as a function of locus of control and cognitive dissonance. *Psychological reports*, 44, 499–502.
- Whitney, P. (1992). *Children's out-of-school activities*. Paper presented at the 42nd annual Meeting of the National Reading Conference. San Antonio, TX (ERIC Document Reproduction Service No. ED 358 408).