

**REGULATING HYPERMEDIA: SELF-REGULATION LEARNING STRATEGIES
IN A HYPERMEDIA ENVIRONMENT**

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(ABSTRACT)

Students of all abilities and ranges of achievement have become familiar with a variety of hypermedia-based settings which offer information on virtually any content area. The concept of self-regulation implies that learners can initiate processes to facilitate learning regardless of their perceived learning ability or environment, two learning characteristics once thought to be immutable forces. The purpose of the study was to design and implement hypermedia components that provide various levels of user support based upon known self-regulatory learning strategies. The components were applied within an existing web-based learning environment which combined class lecture and presentation with web-based components. Student input provided impetus for the revision of existing components and suggestions for new components designed to promote regulatory behavior within the web-based environment. Through participant observation, student desires for hypermedia components which promote self-regulatory behaviors are described and compared with the actual usage patterns of these components. Significant differences were found in measures of students perceived level of self-efficacy for performance and learning, metacognitive self-regulation, and test anxiety. In addition, one of the added components was rated as "highly effective" by the participants and the second-most-used component of the web site. Discussion incorporates student input to provide support for incorporating components which promote self-regulatory learning strategies in a hypermedia instructional environment and offers generalizations for educators and instructional designers based on these findings.

“Couldn’t you do something with. . .computers?”

- Jean Ross

We are all students. We are all teachers.

We cannot always choose who must instruct us, but we can choose what and from whom we will learn. This work is dedicated to the two greatest teachers from whom I have learned. Everything I am, I am because of them.

To my parents, Tom and Jean Ross

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The ideal condition

Would be, I admit, that men should be right 'by instinct';

But since we are all likely to go astray,

The reasonable thing is to learn from those who can teach.

Sophocles (c. 495 – 406 B. C.)

Table of Contents

Table of Figures.....	viii
List of Tables.....	ix
Chapter One: Introduction and Need for the Study.....	1
Need for the Study.....	2
Purpose of the Study.....	3
Research Questions.....	5
Chapter Two: Literature Review.....	7
Self-regulation.....	7
Personal Determinants.....	8
Metacognition.....	9
Self-efficacy.....	9
Goal-orientation.....	10
Motivation.....	13
Environmental Determinants.....	17
Enactive outcomes.....	17
Structure of learning context.....	18
Behavioral Determinants.....	20
Self-observation.....	20
Self-judgement.....	21
Self-reaction.....	22
Self-regulation Strategies.....	23
Why Students Do Not Self-regulate.....	30
Summary of Self-regulation.....	30
Hypermedia.....	31
Definition and Features.....	31
Nodes and links.....	32
Learner control.....	33
Organizational structure.....	34
Types of hypermedia.....	35
Problems with Hypermedia.....	36
Disorientation.....	36
Scope.....	38
Learner control.....	38
Media characteristics.....	39
Learner characteristics.....	40
Transfer of knowledge.....	41
Navigation.....	41
Summary of Hypermedia.....	44
Chapter Three: Method.....	46
Participants.....	46
Materials.....	47
Course web site.....	47
On-line databases.....	49
Class listserv and electronic mail.....	49

Data Sources and Collection Procedures.....	50
MSLQ	50
Listserv questions	51
Exit questionnaire.....	51
Data Analysis.....	51
Self-regulation strategies	51
Domain analysis	52
Trustworthiness of the data.....	54
Procedure	56
MSLQ	57
Grades on-line	59
Goal checklist.....	60
Elaborative feedback on quizzes	62
Exit questionnaire.....	62
Chapter Four: Results	64
Question I.1.1.....	64
Question I.1.2.....	69
Question I.2.1.....	70
Question I.2.2.....	74
Chapter Five: Summary	75
References	82
Appendix A: Motivated Strategies for Learning Questionnaire	88
Appendix B: Listserv Questions.....	94
Appendix C: Exit Questionnaire	95

Table of Figures

Figure 1. Conceptual Framework	4
Figure 2. The Self-regulation Process.....	8
Figure 3. The GAME Plan	48
Figure 4. Domain Analysis Worksheet.....	54
Figure 5. MSLQ Results	58
Figure 6. MSLQ Further Elaboration	59
Figure 7. Grades On-line.....	60
Figure 8. Adding Goals to the Goal Checklist	61
Figure 9. Goal Checklist Reminder	62
Figure 10. On-line Presentation of the MSLQ	88

List of Tables

Table 1. Achievement Goal Terminology.....	12
Table 2. Self-regulation Learning Strategies	25
Table 3. Cognitive and Metacognitive Learning Strategies.....	29
Table 4. Semantic Relationship Types	52
Table 5. Chronology of Study	57
Table 6. Motivated Strategies for Learning Questionnaire.....	65
Table 7. Domain Analysis: Frequency of Learning Strategies	66
Table 8. Component Use for Exam Preparation On-line	68
Table 9. Helpfulness of Web Site Components	71

CHAPTER ONE: INTRODUCTION AND NEED FOR THE STUDY

Technology has often been incorporated to provide instruction, from the utilization of phonographs and radio to the current adoption of the personal computer and web-based technologies. Unlike many of the earlier attempts to incorporate technology, the new breed of personal computers dares to offer promises not kept by its predecessors: adaptable, dynamic information on unlimited topics from multiple sources--all available at the touch of a button. This promise is made to sound even more appealing with the introduction of web-based technologies into the classroom. Unfortunately, this promise of unlimited information brings with it many burdens, including that of providing relevant information in a timely manner that can be understood by the user. The confusion that results is often the actual, unwanted outcome.

Many early studies comparing the use of various technologies rarely resulted in support for their incorporation. Clark's (1983, p. 446) famous summation of technology was often validated, "The best current evidence is that media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition." This analogy is significant in that it emphasizes that technology has not been shown to replace traditional education. Yet, should the goal of new hypermedia systems be aimed at "replacing" instruction? Perhaps developments in technology are better suited to enhancing instruction, and like all instruction, it is the learner who is paramount to the process.

The emergence of computer technology coincided with a heightened awareness among educators of the importance of recognizing individual learning patterns among students (Heinich, Molenda & Russell, 1996). True individualization is a tremendous burden. The personal computer and emerging web-based technologies are predicted to provide true individualization for the benefit of the individual user. New technologies optimistically promise to accommodate individual differences in learning styles and abilities as well as the opposing and different student goals within a single "classroom." In addition, these differences can be addressed utilizing flexible presentation as well as observation times (Massy, 1996). Unlike the personal computer's predecessors such as interactive video, programmed instruction, or television, it is no longer necessary to promote technology (Barone, 1996; Stuckey, 1996). Students of all abilities and ranges of achievement have become familiar with a variety of hypermedia-based settings which offer information on virtually any content area. How can these hypermedia tools be geared toward this wide range of learner characteristics, needs, and ability levels without resulting in the confusion that has become the hallmark of the largest hypermedia system, the World-Wide Web?

Self-regulation in the learning process implies cognizance upon the part of the learner to employ both cognitive and behavioral responses and strategies to monitor and guide one's own learning. The concept of self-regulation implies that learners can initiate processes to facilitate learning regardless of their perceived learning ability or environment, two learning characteristics once thought to be immutable forces (Zimmerman, 1990). An often-cited definition presents three components of self-regulated learners, and that is that they are metacognitively, motivationally, and behaviorally active participants in their own learning (Zimmerman, 1989a). These components are dissected and interpreted uniquely by proponents of separate learning theories; however, many disparate camps have taken up the banner of self-regulation and have found means to interpret and expound upon the basic idea that learning can be guided by the individual within a wide spectrum of abilities, strategies, motivation, and

success (Bandura & Cervone, 1986; Corno, 1986; Zimmerman, 1989a, 1989b, 1990). What lessons learned from the self-regulation literature can address the problems inherent to hypermedia? Can components of hypermedia environments promote self-regulated behavior and enhance meaningful learning?

Need for the Study

“It seems apparent that hypermedia is not so much a breakthrough, panacea, fad, or ‘hype,’ as a next step in the evolution of computing as augmentation to the intellect” (Marchionini, 1988, p. 8). This statement, made over a decade ago, confirms the realization that hypermedia has been and will continue to be incorporated into the process of instruction. It is here to stay. Despite any problems that may exist in hypermedia products, instructional designers must focus on methods and components to improve dissemination of information through hypermedia across a wide array of learners who possess multiple variations of needs and skills. Writing at the same time, Jonassen (1988) presented questions for the development of hypertext. How should hypertext be structured for maximum learning? What methods should be used to structure hypertext? How can information from hypertext be integrated into the learner’s cognitive structures? These questions are still being addressed.

Self-regulation and its influence upon the design of hypermedia systems are addressed directly by Gay, Trumbull, and Mazur (1991). They state that designers must design tools that provide users with control and enable them to access information in a hypermedia system which may be in nonsequential form. Those users who are able to select information, make connections to existing knowledge, form goals and organize tasks to achieve them, and monitor their learning progress will be better suited to perform effectively in a nonsequential hypermedia system; however, the authors stress that some users are in the habit of accepting information passively or seeking external assistance consistently. These users may not make appropriate use of resources that are present, may make superficial, unwarranted, or unsuccessful attempts at achieving learning goals, and may lack sufficient strategies to acquire knowledge from systems that are not linear, constrained, or shaped by familiar routine. One remedy to these problems, according to the authors, is to build interfaces that adapt to various users’ abilities and styles and they further suggest that systems include simple and highly interactive search strategies.

Heller (1990) divides the research imperatives for hypermedia into two categories: those focusing on media techniques and those that will identify appropriate educational settings, types of students, and areas of education which will benefit from hypermedia instructional settings. She emphasizes that questions that combine technical feasibility with cognitive research must be addressed. She proposes the question, “How can we structure the system so that the user will continue to use it to discover the consequences of following a certain path, where it will lead, what types of information it will disclose, and how much information there will be when the system has been searched?” (Heller, 1990, p. 437). Finally, it is suggested that “strategies that add structure to cognitive tasks are of central interest” (Burton, Moore, & Holmes, 1995, p. 362). Trying to answer “Does hypermedia work?” is not so relevant as “How can hypermedia work?”

Purpose of the Study

The purpose of the study was to design and implement hypermedia components that provide various levels of user support based upon known self-regulatory learning strategies. The components were applied within an existing web-based learning environment which combined class lecture and presentation with web-based components. Student input provided impetus for the revision of existing components and suggestions for new components designed to promote regulatory behavior within the web-based environment. Through participant observation, student desires for hypermedia components which promote self-regulatory behaviors are described and compared with the actual usage patterns of these components.

Self-regulation strategies used by successful students are known to exist. These strategies are utilized to varying degrees by many students, regardless of their own perceived level of self-regulation in a variety of learning environments. In addition, strategy knowledge, not content knowledge, has been shown to have greater influence on learning outcomes in computer-based instruction (Yang, 1993; Young, 1996). A student's general strategy knowledge is dependent upon sufficient and appropriate training experiences with the given strategy and includes the refinement of the strategy through extended practice and recognition of its impact upon recall (Borkowski, Carr, & Pressley, 1987). Despite one's ability to incorporate self-regulation strategies in alternate learning environments, problems due to disorientation, inadequate concept of scope, amount of learner control, navigation options, or other characteristics of hypermedia can hinder even students with high levels of perceived self-regulation (Bieber, Vitali, Ashman, Balasubramanian, & Oinas-Kukkonen, 1997; Gay, Trumbull, & Mazure, 1991; Gleim & Harvey, 1992; Heller, 1990; Jonassen, 1988, 1992; Jonassen & Reeves, 1996; Marchionini, 1988; Shin, Schallert, & Savenye, 1994; Stanton & Baber, 1994; Tripp & Roby, 1990).

Miles and Huberman (1984) provide a method for building a conceptual framework to better define the relationships between dimensions in an area of study. Derived from existing theory or experience, the main dimensions of the area of study are graphically represented on paper and may include actors, settings, artifacts, processes, or theoretical constructs. The relationships between these dimensions are then represented by arrows drawn between the dimensions. The conceptual framework forces the researcher to identify the most important dimensions and relationships as well as the type of data that must be collected and analyzed. A conceptual framework of the current problem is represented in Figure 1. Relationships shown utilize Spradley's (1980) list of semantic relationships types which are presented in Table 4.

For the purpose of this study, key dimensions include the self-regulation process, hypermedia components and problems, as well as the following three key actor types: (a) the instructor, (b) the student, and (c) the instructional designer.

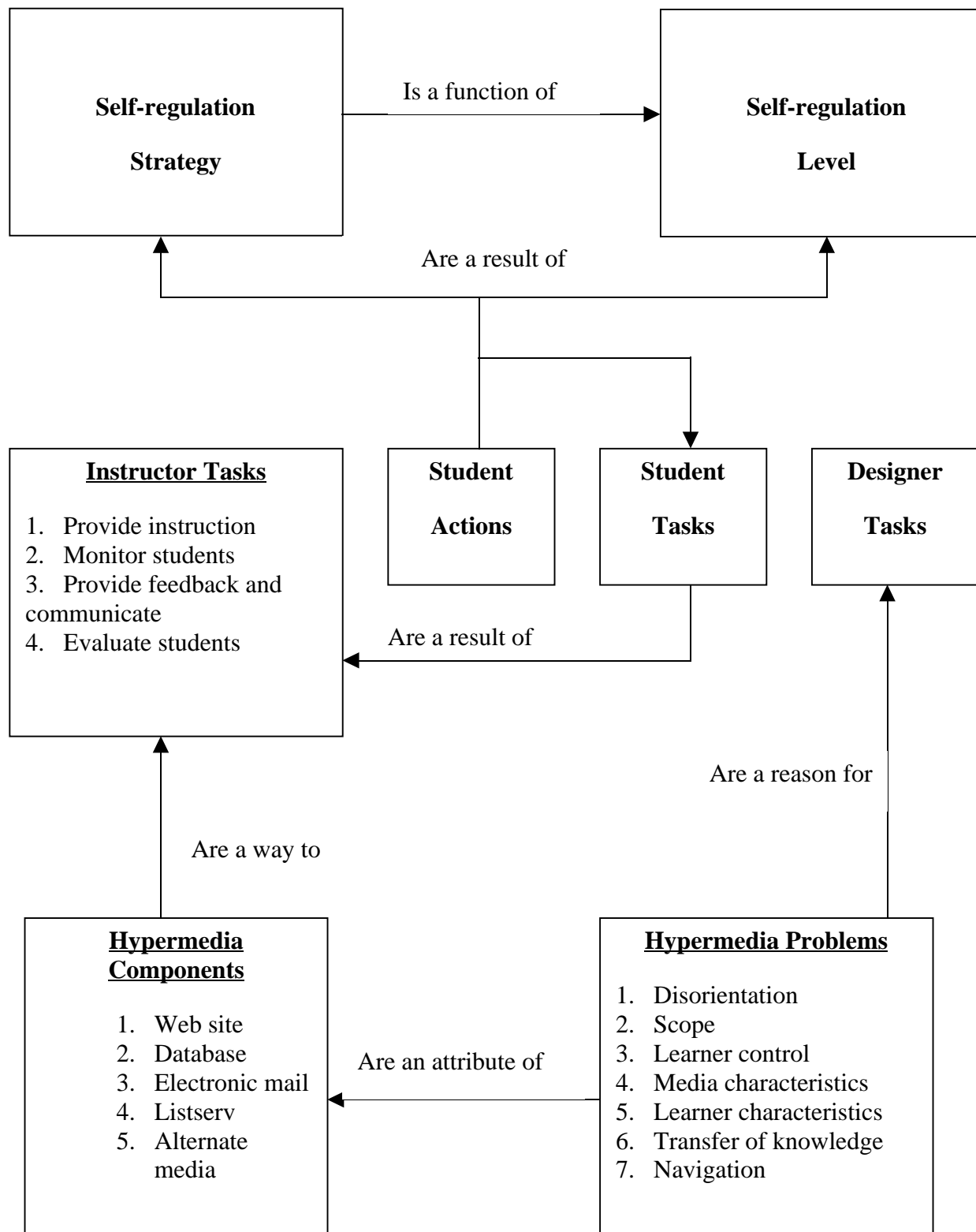


Figure 1. Conceptual Framework

Self-regulation is a theoretical dimension. It is a measurable learner characteristic and can be addressed both through specific observable actions and discerned through the analysis of the outcomes of these actions. These actions are called learning strategies. Student success in a learning task is dependent upon their perceived level of self-regulation and the strategies chosen as a function of this perception.

Hypermedia can be classified as both a process and an artifact and can be comprised of various electronic components in combination, many of which have similar problems associated with them. Hypermedia has become a popular medium for the dissemination of instruction; however, these inherent problems limit its value in instructional environments. It is a challenge to the instructional designer to provide hypermedia components that reduce the inherent problems in hypermedia and allow learners of various levels of self-regulation to succeed in these environments.

Research Questions

I. What hypermedia components, based on self-regulation learning strategies, should be included in an instructional hypermedia environment?

I.1 What influence does level of self-regulation have on student actions in an instructional hypermedia environment?

I.1.1 What influence does perceived level of self-regulation have upon self-regulation strategies employed in an instructional hypermedia environment?

I.1.2 What self-regulation strategies do students manifest off-line to accomplish learning tasks related to an instructional hypermedia environment?

I.2 What hypermedia components should be included in an instructional hypermedia environment?

I.2.1 What components do students desire to accomplish learning tasks?

I.2.2 What components do students utilize to accomplish learning tasks?

The current study addresses methods to evaluate and promote self-regulation learning strategy use in hypermedia instructional environment. Immediately following is a review of literature summarizing current thoughts and issues regarding the social cognitive theory of self-regulation as well as a description of hypermedia. In addition to describing the many facets of self-regulation, a summary of known self-regulation learning strategies is presented with the six most common of these strategies identified. These six strategies served as the basis for comparison in this study. After describing the components of hypermedia, a discussion of problems often associated with hypermedia is presented as well as current suggestions as to how these problems might be alleviated.

Following the review of literature is a description of the methods and procedures utilized in the current study. Also included in this chapter is a description of the various data collection procedures utilized during the study as well as a description of the process of domain analysis, which served as a major method of analysis during the development of components for the web site as well as in final evaluations of the web site. Results pertaining to the study are presented in relation to the four subquestions presented above: I.1.1, I.1.2, II.1.1, and II.1.2. Due to the overlap in the findings in regard to suggestions for future hypermedia development, the final chapter summarizes these findings and offers suggestions for instructors and designers of instructional hypermedia.

CHAPTER TWO: LITERATURE REVIEW

This literature review is divided into two main sections with summaries. Presented first is a definition of the social cognitive view of self-regulation. Three determinants which govern the self-regulation process are discussed along with component concepts and definitions. A description of self-regulation learning strategies is included as well as a brief discussion as to why students do not utilize self-regulation strategies. The second major section includes definitions and descriptions of hypermedia and its features. In addition, a discussion of problems commonly associated with hypermedia follows.

Self-regulation

The self-regulation process involves cognition and action by the learner. In describing key aspects of self-regulation and how they are interpreted in different learning theories, Zimmerman (1989a) includes the aspect that students who utilize self-regulation strategies are aware that these strategies may somehow enhance their ability to achieve desired goals or parts of goals prescribed by a learning activity. Setting goals is a metacognitive strategy, as are activities such as organizing, self-monitoring, and self-evaluating within a learning task (Butler & Winne, 1995; Zimmerman, 1989a, 1989b, 1990). Students monitor when they are involved in a learning task, interpret their current level of achievement, and choose strategies that might propel them to the successful conclusion of the task (Corno, 1986; Dharmadasa & Gorrell, 1996; Zimmerman 1989a, 1989b, 1990; Zimmerman & Martinez-Pons, 1986).

The social cognitive view of self-regulation involves the reciprocal influence of three areas of influence which determine the development and degree of application of self-regulation activities (Bandura, 1986; Schunk, 1989; Zimmerman, 1989b). Multiple elements comprise the three determinants of personal, environmental, and behavioral influences. These three influences interact with each other through a loop of enactive feedback. The degree of interaction and predominance of any one influential factor is determined by the learning context and activity, and any number of fluctuations may occur in the strength and timing of any one influence. Psychological functioning is “regulated by an interplay of self-generated and external sources of influence” (p. 336, Bandura, 1986). A large cadre of strategies may be utilized for the self-regulation of learning activities (Zimmerman, 1989; Zimmerman & Martinez-Pons, 1986), and the outcome of the incorporation of these activities may be measured in changes in achievement, skill development, or in the change in the level of self-regulation itself. Bandura (1986) warns that self-regulation is a process that requires judgment within a set of guidelines which are not completely prescriptive. These guidelines contain many variable elements and are situationally dependent; therefore, it is important to understand the complex relationships involved in the self-regulatory process.

Following is a description of this process and activities of self-regulation organized by the component elements comprising each of the three determining influences: personal, environmental, and behavioral. Included in the discussion of each influence upon self-regulation are descriptions of key subprocesses. Components of the enactive feedback loop that reciprocate interaction, self-regulating strategies, and reasons why students may choose not to self-regulate are also discussed. Figure 2 graphically presents the complex relationships of the tripartite

definition of the self-regulation process, identifying key subprocesses and learning strategies associated with these three determinants.



Figure 2. The self-regulation process

Personal Determinants

The “self-system” as described by McCombs (1986) is a complex hierarchical system of multiple cognitive structures that exert influence on attention, the organization and categorization of information, recall, and judgments. The self-system incorporates and organizes all new knowledge based on prior experience and existing knowledge structures. Knowledge is also weighed according to one’s capabilities and behavior choices, and the expenditures of effort are regulated from this determination. This process of evaluating knowledge and determining behavior is the central tenet of self-efficacy. According to McCombs (1986) the most important process in the self-system in terms of function is that of self-evaluation. Self-evaluation is the process determined by self-efficacy that allows one to evaluate one’s understanding of the self in relation to learning tasks, learning outcomes, expectations imposed by the self and others, the

importance of a task, as well as the effort required for completing a task. The litany of self-processes, including self-observation, self-reward, self-perception, and self-monitoring, underscore the importance of the self in constructing, interpreting, and encoding information (McCombs, 1986).

Metacognition. Metacognition represents knowledge one possesses about one's own cognitive states and processes (Borkowski, Carr, & Pressley, 1987). Metacognition not only generates strategies to be incorporated by an individual but monitors the subsequent use of those strategies and offers alterations or substitutions of the strategy in light of obstacles in order to attempt completion of the original task. Borkowski, Carr, and Pressley (1987) state that a component of metacognition, general strategy knowledge, produces an understanding in the individual that learning will improve if sufficient energy is deployed for appropriate strategy selection and use. Strategies stored and recalled by the general strategy knowledge component are dependent upon sufficient and appropriate training experiences with the given strategy. Ideal training in a strategy's use would include more than highlighting when and where to apply a technique, but would also incorporate refinement of the strategy through extended practice and a recognition of its impact on recall. Motivation also plays a key role in strategy use, and general knowledge about the efficacy of strategies has motivational properties. The motivational components of the metacognitive process include self-esteem, locus of control, and attributional beliefs about success or failure (Borkowski, Carr, & Pressley, 1987) and are discussed later.

Dirkes (1988) outlines a pedagogical plan to incorporate self-directed thinking into a curriculum. Self-directed thinking, according to the author, is the control factor in metacognition, and metacognition enables the students to recognize opportunities for learning and increasing the effects of instruction. The pedagogical plan contains five steps: state an objective or problem, select thinking strategies, select representations, choose time and accuracy, and monitor thinking. Instead of presenting these activities within the context of some content domain, it is proposed that the actual self-directed thinking plan be shown to be as appropriate as domain-specific knowledge and that the plan can be incorporated across disciplines. The plan focuses on the concept of metacognition and in a simplified manner outlines the complex interactions that occur in the learning environment. The author does not offer examples of the plan's effectiveness or incorporation (Dirkes, 1988).

Self-efficacy. Self-efficacy is a learner's perceived ability to implement necessary actions required to meet goals prescribed by a learning task, which in turn will determine the type, structure, and number of self-regulation strategies undertaken (Bandura & Schunk, 1986; Schunk, 1989, 1994; Zimmerman, 1989a, 1990). Self-efficacy is considered the underlying principle that allows one to make judgments regarding personal control. These judgments are then facilitated through the use of coping strategies, problem-solving skills, decision-making skills, goal setting, planning, self-monitoring, and self-reinforcement (McCombs, 1986). In addition to personal influences, one's perception of one's own level of self-efficacy is influenced by environmental and behavioral cues and is situationally dependent. Actual behaviors will modify one's efficacy beliefs (Bandura, 1997; Schunk, 1989). Efficacy information can be acquired through social comparison with similar models offering the best social comparison. In addition, authority figures such as teachers and parents can offer persuasive feedback which can result in enhanced self-efficacy (Schunk, 1994). Zimmerman (1995) states that the prediction of personal self-efficacy beliefs depend upon the validity of prior learning and testing experiences,

as well. While low perceptions regarding self-efficacy can be detrimental to achievement success, effective self-regulation does not require that self-efficacy be extremely high. If the learner feels efficacious enough to simply attempt a task, the reiterative influences of environment and behavior as well as personal influences such as motivation may actually promote increased effort and elicit the use of effective strategies to achieve success despite the perceptions of low self-efficacy (Schunk, 1994).

Bandura (1997) describes self-efficacy as a generative capability, and any one situation may draw upon the need for cognitive, social, emotional, and behavioral subskills, which may or may not be employed appropriately. The simple possession of these subskills does not guarantee that they will be employed appropriately; rather, one will behave according to what one believes one can do with these subskills in a given circumstance. Any individual, or two individuals that appear to have the same skills, may behave differently under what may be perceived to be two similar situations based upon fluctuations of their perception of self-efficacy. Self-efficacy is not a measure of skill but a belief about what one can do in different conditions with the skills one possesses. Perhaps more importantly, beliefs about self-efficacy influence cognition, the level and persistence of motivation, and affective states, all of which affect performance. Self-efficacy is not a global trait, and high perceived self-efficacy by an individual in one situation does not translate to the same levels of self-efficacy in other situations (Bandura, 1997).

In a review of research attempting to find causal and correlational relationships between self-efficacy and skillful performance, Schunk (1996) reports that many studies report such a positive relationship. In addition, most studies also have obtained positive correlations between self-efficacy and attributions towards ability. In relating the findings of Schunk and Gunn in a study of division skills, Schunk (1996) summarizes that the largest direct influence on changes in division skill was due to the use of effective strategies. Skill was also strongly affected by self-efficacy and attributions toward effort. Ability attributions for success exerted the strongest influence on self-efficacy, which suggests that increased self-efficacy as a result of instruction results in part through the influence of positive attributions, such as for ability (Schunk, 1996).

Goal orientation. Two types of goals adopted in achievement situations as described in Dweck's goal orientation theory are learning goals and performance goals (Ames & Archer, 1986; Bouffard, Boisvert, Vezeau, & Larouche, 1995; Butler, 1997; Dweck, 1986; Ertmer & Schunk, 1997; Meece, 1994; Miller, Behrens, Greene, & Newman, 1993; Zimmerman & Kitsantas, 1997). Learning goals lead to the acquisition of new skills or knowledge, while performance goals are concerned with an evaluation or comparison once obtained. Individuals with performance goals wish to receive a positive evaluation or avoid a negative evaluation. Individuals who have adopted either type of goal who also are highly motivated towards the task at hand will persist in an effort to complete the goal. It is when motivational levels are not high or doubt comes into play that behaviors differ between persons with these two types of goals. Individuals with a performance goal who doubt their ability may avoid tasks, show decreased performance and low persistence. Individuals with a learning goal who doubt their ability still may seek reasonable subgoals, face challenges, and persist, similar to those with high motivational levels with either goal type. Individuals undertaking a learning goal are more apt to employ self-regulation strategies, and monitor their progress and feedback from the situation in the attempt to master even challenging goals. This is not the case for performance goals since the goals do not imply the necessity to "learn" but simply rather to achieve or behave. Performance

goals may not illustrate the importance of the processes or strategies necessary for completing the task (Ames & Archer, 1986; Dweck, 1986; Ertmer & Schunk, 1997; Meece, 1994; Miller et al., 1993).

In a study of perceived ability in relation to goal type, Miller and colleagues (1993) investigated the influence of self-regulation activities such as monitoring and strategy use as well as persistence and perceived value of the goals. Their study provides qualified support for correlations implied within the goal orientation theory. It implies relationships between goal orientation and both perceived ability and self-regulation activities, but a small sample size resulting from a naturalistic setting limited statistical significance for most correlations. Monitoring was shown to be a significant activity for subjects with learning goals, while subjects with performance goals did not participate in significant self-monitoring. Even subjects with high motivational levels, as interpreted through perceived ability, did not participate in significant self-monitoring, perhaps because their level of motivation was so high it precluded their need to monitor. As predicted, learning goal achievement scores were positively correlated with persistence, while performance goal scores were not (Miller et al., 1993).

Bouffard, Boisvert, Vezeau, and Larouche (1995) state that although the two dimensions of learning goals versus performance goals are independent, they are not mutually exclusive. They identify four profiles of learners and the goals they pursue in achievement tasks. These four profiles include: (a) students who are strongly oriented toward both types of goals, (b) students strongly oriented to learning goals, (c) students who are strongly oriented toward performance goals, and (d) students who are strongly oriented toward one type of goal but weakly toward the other. Their study also validates that learning goals were more strongly related to components of self-regulation than performance goals and extends these consistencies to college students from the body of research on younger students. Students strongly oriented toward learning goals reported more frequent use of cognitive and metacognitive strategies and were more motivated. The researchers also found a link to self-regulation and academic achievement and propose that self-regulation was the best predictor of academic performance within their study. Further findings show that when learning orientation is low, students with a high performance orientation may still have significant achievement and report significant self-regulation use (Bouffard et al., 1995).

The determination of initial goals is affected by multiple influences such as the direct influence from others or the influence of others through social comparison or modeling. In addition, initial goals are often set close to the levels of past performance on similar but different tasks. Campion and Lord (1982) found that initial goals relating to grade achievement are positively and significantly associated with both ability and past performance in other classes. Curiously, they also found that not only were successful students likely to raise subsequent goals but unsuccessful students were also likely to raise subsequent goals. An interpretation of this fact may relate to the goal type used in the study. Students were engaged in learning goals, not performance goals, and the importance of these goals towards meeting a desired end--a grade signifying success--encouraged students to attempt to compensate for unsuccessful attempts by raising subsequent goals. The authors also found that the number of failures by students appeared to have little impact on goal reduction (Campion & Lord, 1982).

Learning and performance goals were incorporated with the self-regulation activity of self-evaluation in a computer-based task by Ertmer and Schunk (1993). Subjects were assigned programming activities in HyperCard and were monitored for competency and frequency measures (motivation and self-regulation strategy), types of performance outcomes, as well as social and environmental resources utilized during the task. Results support the goal orientation theory, with subjects in both learning goal groups, with or without self-evaluation, yielding significantly higher efficacy, strategy frequency and strategy competency scores. The study suggests that combining the self-regulation component of self-evaluation with learning goals will raise perceptions of efficacy and competency for utilizing self-regulation activities; however, the achievement findings were not consistent with Bouffard, et. al (1995) as described previously. There was no significant difference in skill measures among any of the four treatment groups (Ertmer & Schunk, 1997).

Zimmerman and Kitsantas (1997) identified four phases in students' development of complex cognitive-motor skills. Complex cognitive-motor skills include activities such as reading, writing, dance, music, or athletics. These four phases progress from observation, imitation, and self-control to self-regulation. The authors built upon one of their earlier studies and applied goal types to the learning of such a complex cognitive-motor skill, throwing darts. Learning goals (called process goals by the authors) were originally found to corroborate similar findings in the research in that learning goals were more effective than process goals (called outcome goals by the authors) in guiding achievement in complex cognitive-motor skills (see Table 1). Learning goals paired with self-recording increased dart-throwing mastery, positive self-reactions, and perceptions of self-efficacy. However, while learning goals paired with self-monitoring promoted learners to the third developmental stage of complex cognitive-skill development, self-controlled learning, it was insufficient to push them into the final stage of self-regulatory learning.

Table 1.

Achievement Goal Terminology

Dweck (1986)	Learner	Performance
Zimmerman & Kitsantas (1998)	Process	Outcome

In an effort to promote this further level of development, the authors replicated the study with additional goal type groups, adding a transformed outcome-process (performance-learning) goal and a shifting-goal group experimental group. Subjects in the transforming goal group were taught to self-react to outcome information by making strategic process adjustments. Subjects in the shifting goal group shifted from process (learning) goals to outcome (performance) goals once the strategy had become automatic. This final group resulted in the highest dart skill, the most positive self-reactions, and the greatest intrinsic interest in the game, even to the point of several subjects spontaneously mentioning their interest in purchasing their own dartboard and continued practice after the study had completed. These results show that the transforming goal procedure was effective in propelling the subjects into the final stage of complex cognitive skill

development, self-regulation (Zimmerman & Kitsantas, 1997). This final study also suggests that merely providing clearly demarcated learning goals over performance goals is not sufficient to promote the highest levels of self-regulation or achievement and that goal orientation, like the rest of the self-regulatory process, is subject to enactive feedback, evaluation, and reorientation.

Motivation. The cognizance of the learning process is also affected, either positively or negatively, through aspects of motivation (Campion & Lord, 1982; Dweck, 1986; Meece, 1994; Pintrich & De Groot, 1990; Schunk, 1989; Zimmerman, 1989, 1990). Motivation is a key concept relating to the initial level of one's perceived self-efficacy. Changes in motivation promoted through environmental or behavioral outcomes perceived through the feedback loop may alter subsequent levels of self-efficacy in regard to participation in repeated learning tasks or environments. Self-incentives established through evaluation of self-observed behavior can promote motivation. Self-incentives have been shown to be at least as effective if not better motivators than external incentives. People who are self-directed respond more positively to self-incentives rather than external rewards (Bandura, 1986). Motivation is also seen as more than cognitive competence and may serve to preserve self-worth. Students will choose to engage in and pursue activities that permit a positive perception of self-efficacy and that fulfill needs, goals, and values (McCombs, 1986). Garcia (1995) contends that while self-regulation strategies usually are presumed to relate to cognitive strategies, one can also regulate emotions through the use of motivational strategies. While cognitive strategies relate to the encoding of information, motivational strategies are related to one's expectancies, values, and goals for learning.

Schunk (1989) describes aspects of motivation as they relate to goals. The belief that one is making acceptable progress along with the anticipated satisfaction of accomplishing a goal can enhance self-efficacy of the individual and sustain motivation until task completion. If individuals believe they are capable of improving, motivation will not necessarily be decreased by negative evaluations, which may be self-evaluations. Conversely, if students believe they lack required ability or skills to achieve a goal and that no amount of effort will help them to perform better, motivation will not improve. Motivation can be affected when individuals are instructed to evaluate their performance. Whether one is instructed to evaluate one's own performance or do so on one's own, the same level of performance can be interpreted positively, neutrally, or negatively depending on one's goals (Schunk, 1989).

Dweck (1986) addresses motivation and its inclusion in the instructional process based on social-cognitive theory. By identifying and describing specific processes in the self, social-cognitive theory allows the characterization of adaptive and maladaptive motivational patterns based on these self-processes which offer focus during the instructional process. Motivation can be explained in terms of goal-oriented activity, and, as stated earlier, achievement goals can be categorized as learning goals or performance goals. Adaptive motivational patterns promote the establishment, maintenance, and attainment of personally challenging and valued achievement goals. The adaptive pattern is characterized by challenge seeking and effective persistence in the face of obstacles. Maladaptive motivational patterns are associated with goal failure. This failure may occur by not being able to establish reasonably challenging or valued goals, to cease striving toward those goals, or even to fail to attain valued goals that are potentially within one's reach. These patterns are characterized by avoiding challenge and low persistence in the face of obstacles. Motivational pattern adoption does not differ with students of various intellectual

abilities; therefore, these patterns can have a profound influence, both positively or negatively, on the learning process (Dweck, 1986).

As stated previously, learners pursuing performance goals are more likely to interpret failure to obtain goals in terms of their ability, while learners pursuing learning goals tend to increase their effort or employ different strategies when faced with difficulty. Despite ability level, this adaptive behavior in the process of learning goal pursuit often improves performance in the presence of difficulty. In addition, satisfaction from performance goals is based on attainment, while learning goals promote satisfaction through effort. The motivation that results from the pursuit of these two different types of goals provides important consideration for the designer of instruction. The popular belief in superfluous positive reinforcement may actually be misguided in light of the effects of goal-orientation. In addition, continued success on easy goals is ineffective in producing stable confidence, challenge seeking, and persistence. Instead, Dweck (1986) relates that the procedures that bring about more adaptive motivational patterns incorporate challenge--even failure--and explicitly address underlying motivational mediators. These mediators may be addressed by retraining attributions for failure, such as teaching learners to attribute failures to effort or strategy rather than ability. Motivational interventions, such as attributional retraining, should also benefit both low achievers and high achievers who have not yet been confronted with difficulty in their learning process (Dweck, 1986).

Meece (1994) relates motivation to the purposeful establishment of goals, as well. One's perception of ability drives the selection of achievement goals. Individuals who develop and maintain positive perceptions of their abilities report higher performance expectations, greater control over their learning, and greater interest in learning due to intrinsic motivators (Meece, 1994). Achievement goal orientation is shown to be determined by socialization experiences at home and in the learning environment. Instructional environments that promote learning provide activities which emphasize self-improvement, discovery of new information, and the usefulness of the material being learned. Placing students in environments of competition, tests of intellectual skills, or public learning situations that rely on norm-based competencies promote the development of outcome-based performance goals and can have deleterious effects on motivation.

All theories of self-regulation assume that students interpret the outcome of a learning task as having tangible or intangible personal implications (Zimmerman, 1990). Tangible outcomes are observable and may be material or social gains. Intangible outcomes may be described in terms of self-efficacy, self-actualization, or reduced cognitive dissonance and equilibrium. Closely linked to self-monitoring, motivational factors can help determine initial goals set by a student in a learning task; however, continued motivation is determined through constant self-awareness and interpretation of stimuli presented in the form of feedback.

Self-efficacy as a product of motivation uniquely focuses on personal ratings of success in task domains. This measure is also distinct in that it depends upon mastery criteria rather than on a comparison of success across other learners. Schunk (as cited in Zimmerman, 1990) proposes a reciprocal relationship between self-efficacy and the goal setting process of a learner. Students who set and obtain reasonable intermediate proximal goals create an increased sense of self-efficacy which then influences the creation of more challenging subsequent goals. According to Bandura and Cervone (1986), when students pursue explicit standards or goals,

their perception between negative performance and the standard creates self-dissatisfaction and serves as motivation for increased effort to obtain the standard. The greater the self-dissatisfaction with one's performance level, the more intense efforts will become to improve performance. This capacity to react to self-perceived conditions of performance is an important cognitive aspect of motivation.

Levels of self-efficacy and motivation also have a reciprocal influence. Self-efficacy helps to determine the initial challenges or goals one undertakes, the level of effort expended on the goal, and how long one perseveres in the face of difficulty. Students with low perceptions of self-efficacy are easily discouraged by failure while their high self-efficacy counterparts will intensify their efforts in the face of challenge and persevere until they succeed (Bandura & Cervone, 1986). Goals are likely to change based upon the level of progress by the student. Students may choose to maintain or decrease their original goals or even adopt a more challenging goal based upon their motivation in relation to their perceived level of success.

Bandura and Cervone's (1986) findings indicate that these self-reactive influences account for a substantial portion of the variation in motivation, with each component variation dependent upon the discrepancy between task status level and desired goal as well as the direction of this difference. Perceived self-efficacy proved a strong factor in influencing motivation across a wide range of discrepancy conditions. Some subjects never indicated a decrease in perceived self-efficacy even when presented with feedback indicating failure of the task. Even if perceived self-efficacy appeared to be reduced in similar situations, self-efficacy appears to be resilient and repeated failure may not decrease subsequent measures of self-efficacy. The more dissatisfied subjects were with not obtaining their goal, the more they increased their efforts. Subjects that are satisfied with their level of achievement, regardless of obtaining or surpassing the goal, do not increase their effort. Many of these subjects may then motivate themselves to more difficult challenges. Attainment of the goal provides temporary satisfaction, but new challenges are developed due to motivation for greater personal satisfaction. The combined influence of high perceived self-efficacy and self-set challenges had marked motivational effects when subjects exceeded their original goal. When both parameters were low, subjects failed to increase their effort (Bandura & Cervone, 1986).

In generating a goal-setting model, Champion and Lord (1982) incorporated both the influence of environmental feedback and self-set goals into a performance-monitoring and performance-determining motivational system. Their model views both goals and feedback as principal components of motivation, and motivation consequently influences behavior, goals, and the environment itself. This early model is consistent with the reciprocal influence of the three key determinants of self-regulation as developed in the self-regulation literature. The model also corroborates later findings about the goal-setting procedure. Accepted, specific and difficult goals produce better performance. The specificity of these goals elicits more precise feedback from the environment, while difficult goals are more likely to produce a more rapid cognizance of a discrepancy between achievement and the desired attainment level. Remediation is often the response of noting this discrepancy; however, goals can also be changed as a result of this feedback from the environment that is monitored and evaluated.

In terms of the motivation component of self-regulation, Pintrich and De Groot (1990) based their study on an adaptation of a general expectancy-value model of motivation. This

model proposes that there are three motivational components that may be linked to the metacognitive strategies, student management and control of their own effort, as well as cognitive strategies associated with self-regulated behavior in achievement tasks. These three components are: (a) expectancy, which includes student beliefs about their ability to perform a task (self-efficacy); (b) value, which includes student goals and beliefs about the importance and interest of the task; and (c) an affective component, which includes emotional reactions to the task. Students with strong positive beliefs about a task engage in more metacognition, use more cognitive strategies, and are more likely to persist at tasks than students who do not believe they can perform the task. Similar to students with strong positive beliefs, students with a greater motivation due to higher perceived value of a task will also engage in more metacognition and use more cognitive strategies, while they also use more effective management of their efforts. The third component addresses the question, “How do I feel about this task?” This early study found that these motivational components were linked to cognitive engagement and academic performance in the classroom. The study also implies that teaching students different self-regulation strategies may be important for improving academic achievement but that improving students’ self-efficacy beliefs may lead to more use of these strategies (Pintrich & De Groot, 1990).

Both models of cognition that rely on prior knowledge and self-regulatory strategies as well as models of motivation which act in conjunction with affective responses and attributional beliefs are combined in a single model by Garcia and Pintrich (1994). The authors feel that neither a cognitive nor a motivational model is sufficient to describe the complex process and influences of the learning process; therefore, a combined model offers to describe this process more fully. The authors suggest that the two models may be bridged through the incorporation of self-schema theory and that self-regulation strategies should not only include cognitive strategies but motivational strategies as well. Self-schemas refer to the perceptions of how an individual sees one’s self in various situations. Self-schema theory promotes the idea that it is the individual’s personal construct and the social context in which one is placed that promotes different behavioral responses (Schunk, 1994). These self-schemas are characterized by the following four dimensions: (a) an affective dimension (positive and negative self-conceptions), (b) a temporal dimension (past, present, and future), (c) an efficacy dimension, and (d) a value dimension. The bridge function that self-schemas can provide occurs in the suggestion that the schema, as a function of a cognitive model, guides individuals towards their beliefs about what they can be and what they can do (Garcia & Pintrich, 1994).

These authors use the term “strategy” to refer to processes or activities that are learned, and state that individuals may choose to change or apply different strategies in relation to both personal and contextual factors. Motivational strategies that may be used to maintain positive self-worth and influence the amount of effort expended include self-handicapping and defensive pessimism. Motivational strategies that regulate self-efficacy, attributions, and value include self-affirmation and attributional style. Self-handicapping and defensive pessimism may be detrimental in terms of achievement, but are factors which may influence an individual’s behavior when self-worth is more important than achievement. Likewise self-affirmation and attributional style may serve to promote positive self-worth in the light of poor or non-achievement. In addition to these motivational strategies, the authors provide descriptions of cognitive learning strategies such as rehearsal and elaboration, as well as metacognitive and self-regulatory strategies. Due to the description of a theoretical model, the authors make no attempt

to promote procedures to incorporate positive strategies or methods to mediate the motivational strategies that may counteract achievement; however, they do suggest that these factors must be considered in tandem and that the simple presentation of cognitive and metacognitive strategies may not be sufficient to promote achievement. These findings are further corroborated by Garcia (1995). The effects of the motivational strategies and their implications upon learning may be addressed by students through a process of “self-diagnosis” as well as instruction which addresses when both motivational and cognitive strategies may or may not be appropriately employed (Garcia & Pintrich, 1994).

Environmental Determinants

Not only can the environment influence the regulatory processes within the self, but people can influence their own environments as a result of their self-regulatory behavior (Bandura, 1986; Schunk, 1989). According to Bandura (1986) environmental influences can affect the self-regulatory process in the following three ways: (a) they can contribute to the development of functions of the behavioral subfunctions such as self-observation, self-judgment, and self-reaction, (b) they provide support for adherence to internal standards, and (c) they promote the individual to select or disengage various functions within the self-regulatory system. One learns to monitor the environment through experience. This encompasses not only learning how and what to observe but learning from one’s actions in the social milieu. This observation process affects and is effected by internal standards, as well. Beliefs and expectations affect what is perceived, and one’s self-concepts, moods, and values influence what people choose to observe about themselves as well as how often these observations are made and their accuracy. The bidirectional influence of environment and self is illustrated further when considering that the people with whom one socializes influence the internal standards and behavioral practices one adopts, while one’s values selectively influence with whom one chooses to socialize.

As presented earlier, Meece (1994) relates that the learning environment is a socializing factor that can orient students towards the adoption of goal types. In the discussion of a study on the influences of the classroom environment on student goal orientation and subsequent strategy-use patterns, she provides characteristics of classroom environments that are more likely to promote high mastery of tasks by students. Instructors in such an environment are more likely to promote learning that is meaningful to the students. Participation was increased in these environments by modification of the lessons to increase personal relevance, provide opportunities for peer collaboration, and to emphasize the intrinsic value of the material being learned. Strategies for instruction may include active engagement in the learning activities, lessons that proceed in small steps which allow the students to see the connection between ideas, offering guidance during problem-solving, and reducing social comparisons among students (Meece, 1994).

Enactive outcomes. The role of feedback in self-regulated learning is presented by Butler and Winne (1995). Although not exclusive to the environment, outcomes from the environment provide feedback to the learner which is monitored and utilized to set or change goals and consequently select strategies. Students may generate feedback internally during the monitoring process; however, external feedback is considered to be more effective in a learning situation. Outcome feedback, knowledge of results, is the simplest and most common type of external feedback, yet it provides the least amount of guidance for a learner. Cognitive feedback,

however, links cues and achievement and can promote self-regulation of the learning task (Butler & Winne, 1995). There are three types of cognitive feedback.

Task validity feedback describes the relation between a cue in a learning task and its possible influence upon achievement by an actor within the environment other than the learner. This outside agent may be readily apparent such as a teacher or implicit in the instruction such as the designer of the instruction. Cognitive validity feedback describes the learner's perception of the relation between existent cues and possible achievement in a learning task. It is the extent to which the learner perceives these cues and judges performance to be dependent upon them. Functional validity feedback describes the relation between the learner's estimates of achievement, through self-monitoring, and actual achievement. The interpretation of all feedback is further complicated by the learner's beliefs about learning (self-efficacy) as well as anomalies present in one's current domain knowledge. In addition, learners may ignore or reject feedback, judge the feedback to be irrelevant, reinterpret the feedback, or make superficial rather than fundamental changes to beliefs based on feedback interpretation (Butler & Winne, 1995).

Corresponding with the complex interdependence amongst the components of self-regulation proposed in the literature, Butler and Winne (1995) relate the diverse effects of feedback upon components in the self-regulating process. Feedback from the academic task determines goals set by the learner, and these goals will influence cognitive engagement. Instructional feedback must address the types of goals students adopt and support their prioritizing, selecting, protecting, or revising those goals. Feedback also influences the generation, selection, and adaptation of self-regulation strategies applied to a learning task. Feedback must indicate when strategies are to be employed, must help students match appropriate strategies to learning tasks, and supply motivation to continue the strategies to the fruition of the task. Feedback also influences self-monitoring which may produce internal feedback. Feedback should support the construction of positive motivational beliefs that support self-regulation activities (Butler & Winne, 1995).

Structure of learning context. Studies investigating levels of self-regulatory skills of students participating in computer-based instruction (Grabe, Petros, & Sawler, 1989; Yang, 1993; Young, 1996) have shown significance when considering the type of program control of the instruction. In two early studies incorporating self-regulation strategies within a computer-based instructional environment, Grabe, Petros, and Sawler (1989) found significance in achievement scores for students provided on-line study material relating to a course textbook. The authors provided this on-line help with the specific focus upon improving two aspects of self-regulated learning, the environment and self-monitoring behavior. The on-line help was designed to provide an effective study environment which helped the students to determine which ideas should be emphasized, rephrase these ideas in their own words, develop personal examples, and create a structure for relating ideas on a more general level. In terms of self-monitoring, the on-line help was developed to combat the propensity of students to poorly evaluate their own mental activities. Even college students had been shown to have low ability to assess their understanding of text. The significant effects of the on-line help were attributed to the interaction of the student with the computer, textbook, and written notes. This system also directed its influence on student comprehension instead of addressing the original presentation of information. Suggestions for future tools from these authors include the addition of on-line notetaking and student-generated questions while incorporating the impending development of

area networks—networks in theory a decade ago which have now reached fruition at many institutions (Grabe, Petros, & Sawler, 1989).

Studies by Yang (1993) and Young (1996) on the interaction between self-regulation and program-control of computer-based instruction provide similar findings. Both studies placed students measured as containing high or low self-regulation skills into computer-based instruction that differed only in its level of control. The findings seem to support that strategic knowledge, not content knowledge, appears to have a greater consequence on learning outcomes in learner-controlled computer-based instruction. When considering self-regulation, the effectiveness of computer-based instruction appears to owe more to developing or designing strategies that allow learners to improve their learning outcomes and environments rather than focusing upon learning abilities and accepting the influence of an inflexible learning environment.

Yang (1993) did find that students known as high self-regulatory skill users, as measured by a preexisting index, scored significantly higher than their counterparts, of low self-regulatory skill users, regardless of the level of control. There was no significant difference, however, between the two groups' level of self-regulatory skill employment within the two levels of control. It is also interesting to note that in the learner control condition, no significant difference was shown to exist between the amounts of time taken to complete the instruction, regardless of the level of self-regulation skill employment. Although the time required to complete the learner controlled instruction did not appear to differ between the two self-regulatory groups, the high self-regulatory group's postscores indicated that learning strategies were applied more effectively and efficiently to provide significant achievement. The low self-regulatory group's poor achievement in the learner controlled environment is associated with poor judgment in regard to their level of understanding as well as their tendency to terminate instruction prematurely.

In a later study, Young (1996) found similar results that indicate that low self-regulatory skill users may be unaware of when they need additional instructional support and may lack effective strategies to manage the learning environment. Low self-regulatory skill users were found to perform significantly lower in computer-based instruction that applied learner control of the sequencing. Surprisingly, low self-regulatory skill users scored higher than their high self-regulatory counterparts in the program control condition, although, the difference was not significant. Despite this finding, the total difference in achievement across both conditions was still significantly lower for the low self-regulatory skill users. This implies that some aspects of program control which influence the learning environment and force low self-regulatory students to participate in effective learning strategies may increase learning. Both of these studies confirm that students who already employ self-regulatory skills tend to perform better when allowed to utilize their own strategies, as in the learner control environments, rather than when they are forced to comply to imposed learner strategies exhibited by some aspects of program control. These studies suggest that the development of a variety of scaled learning activities which can be applied intuitively in a computer-based instructional unit may serve a variety of learners who utilize varying degrees of self-regulation activities.

Behavioral Determinants

Behavioral outcomes of the learning task, whether attempted strategies or observable responses, are determined by goals set by the learner which may be influenced through the constant monitoring of the self-processes and the environment as well as by sources of motivation (Bandura, 1986; Bandura & Schunk, 1986; Bouffard et al., 1995; Butler, 1997; Ertmer & Schunk, 1997; Miller et al., 1993; Schunk, 1989; Zimmerman & Kitsantas, 1997). Optimal self-monitoring shifts from strategic processes during a preliminary phase in the development of self-regulatory competence (self-control) to performance outcomes during a final self-regulatory phase. The self-control phase of development is similar to that of the development of declarative knowledge. Premature focusing on behavioral outcomes, such as the identification and training of a particular strategy, may hinder the routinization of that strategy as declarative knowledge progresses to procedural knowledge. Zimmerman (1995) suggests that self-monitoring can be a successful strategy even at the initial phases of learning, yet the focus of the self-monitoring should shift as the student's level of self-regulatory development develops in regard to the task. This constant monitoring of feedback provided by the learning environment and task experience will help students to determine the effect of their current strategies and can result in covert perceptual changes or observable behaviors, including the completion, elimination, or alteration of original goals or selection and intensity of self-regulation strategies (Butler & Winne, 1995; Ertmer & Schunk, 1997; Zimmerman 1989a, 1989b, 1990). Self-regulated strategies within a learning situation may include seeking advice or information as well as utilizing the processes of self-reinforcement and self-instruction (Zimmerman, 1990).

Self-observation. Self-observation is the deliberate monitoring of one's behavior (Schunk, 1994, 1996). People attend selectively to certain aspects of their behavior deemed relevant by the influence of values and motivation as well as by influences from the environment in terms of task as feedback from performance. If people are to exert influence over their actions, they must be aware of what these actions are (Bandura, 1986; Schunk, 1989). Two important criteria for self-observation are the regularity and proximity of the observations being made. Regularity refers to observing one's behavior frequently rather than sporadically, and proximity refers to observation of the behavior noted close to the time of its occurrence (Schunk, 1994). Bandura (1986) further states that successful self-regulation relies on the fidelity, consistency, and temporal proximity of self-monitoring to relevant behaviors, while Schunk (1989; 1994) confirms and extends that behaviors can be assessed on the dimensions of quantity, quality, rate, originality, sociability, morality, and deviancy. These dimensions can be applied to cognitive, motor, artistic, as well as social skills.

Student awareness of learning outcomes is critical to the use of a self-regulation strategy. Monitoring these outcomes has been shown to be a complex metacognitive task that involves directed attention and sophisticated reasoning, which further supports the developmental aspect of self-regulation. Self-observation may be enhanced through the strategy of self-recording (Schunk, 1989; 1994), which includes recording the time, place, and duration of the behavior under observation. Zimmerman (1990) suggests that multi-component training involving self-monitoring, and related decision-making is necessary to help students better interpret the feedback within a learning situation. It is not clear, however, which of the three specific components of self-regulation is most critical. Dirkes (as cited in Risemberg & Zimmerman, 1992) describes a five-step metacognitive model for training gifted students to utilize self-

regulation strategies. Students describe the goal of the task, select a previously discussed strategy, choose representations (drawings, symbols, charts) to help them learn, set a temporal and mastery level, and monitor their thinking by checking their steps along the way. This model may provide guidance in the development of self-regulated training.

An important point regarding self-monitoring is that it is not simply a mechanical audit of one's performances but is influenced by preexisting self-conceptions and mood states which determine which behaviors are focused upon, how they are perceived or evaluated, and how that performance information is organized in memory (Bandura, 1986). Self-observation is a required yet insufficient condition for effective self-regulation (Schunk, 1994, 1996). It provides at least two important functions in regard to self-regulation: (a) providing information necessary for setting realistic standards for performance, and (b) evaluating the ongoing changes in one's behavior (Bandura, 1986).

Self-judgment. Self-observation is the first step in promoting a behavioral change; however, reactions do not occur until evaluative judgments upon the observations are made in regard to preexisting personal standards (Bandura, 1986). Self-judgment is the comparison of one's present performance or level of achievement with a goal or a standard (Schunk, 1989; 1996). The process of self-judgment occurs through the interpretation of one's self-observations and is influenced by one's standards, goal orientation, and the relative importance placed upon achieving the goal. Goal orientation has already been discussed at length; however, standards are a key factor upon which evaluations of self-observations will be made. Standards can inform and motivate the learner, thus affecting the level of perceived self-efficacy towards the task at hand (Schunk, 1994). Standards inform and motivate the individual. Absolute standards are fixed, while normative standards of judgment are based on the performance of others and can be acquired by observing models (Schunk, 1989).

Bandura (1986) relates that internal standards are developed from different methods of social influence. Standards are formed through the influence of significant persons through direct teaching, modeling, as well as through others' evaluation of one's behavior. People of comparable or slightly higher ability provide the most influence on standard development. Significant persons can be parents, teachers, peers, or role models perceived through media; however, the direct teaching of standards is most effective when engaging in a supportive feedback loop with persons deemed to have shared values. Even occasional feedback, if consistent, can serve to influence standards through direct teaching (Bandura, 1986). Models may influence individuals to adopt standards when one judges one's own performance to be relative to the standards proffered by the model and one rewards one's self accordingly. The impact of modeling is increased when standards are supported by words as well as reflected in action, and the greatest effect is achieved when modeling and direct teaching are supplied in conjunction. Standards that are established must also be generalizable beyond the one activity to which they have been originally applied. Such adaptable standards can be developed by varying the types of activities that are performed but prescribing a similar performance standard for each activity (Bandura, 1986).

Observational learning through modeling is hypothesized to be comprised of four subprocesses, according to Schunk (1989). One must focus attention on relevant environmental stimuli in order to perceive meaning. Retention occurs when information provided by the model

is transformed and coded into memory. Representing knowledge in an imaginal form may also increase learner retention. Production involves translating visual and symbolic conceptions of modeled events over behaviors. Finally, motivation for repeating modeled actions can result from direct, vicarious, and self-produced experiences.

One's previous behaviors also serve as references for evaluation through the judgmental process of self-comparison. Internal performance standards are often increased after one experiences success, while repeated failure will promote the establishment of lower yet more realistic standards. In addition to self-comparison, the judgmental factor of self-regulation is influenced by the value one places upon activities. People expend little effort on activities which have little perceived self-value (Bandura, 1986; Schunk, 1989). People also act in accordance with internal standards (Schunk). Adding to the complexity of behavioral outputs as a result of the self-regulatory process, Bandura (1986) further states that self-regulatory capabilities are not fixed entities of control. Self-evaluation does not occur unless activated, and there are many factors that influence the activation or negation of the evaluative process. The same behavior repeated by an individual is not uniformly rewarded or punished even if presented with the same circumstances.

Self-reaction. Self-reactions are possible as the result of judgments regarding evaluation of self-observations or through the promise, either in tangible or intangible rewards, for the completion of goals or subgoals (Bandura, 1986; Schunk, 1994, 1996). The belief that one is making progress, in conjunction with the anticipated satisfaction of attaining a prescribed goal, enhances perceived self-efficacy and can sustain motivation through establishing self-incentives. Once goals are established, one evaluates the progress made towards those goals—often through self-observation—and reactions are made upon behavior contingent upon these evaluations. The influence upon self-reaction by goals depends upon the temporal proximity of the goals, the amount and quality of performance feedback, one's motivational level and the degree of value, or valence, placed upon the expected outcome and the amount of effort required for completion (Bandura, 1986). Motivation may not suffer when self-observation leads to negative evaluations of progress if the individuals still believe they are capable of improving. Self-reactions in the form of rewards serve to enhance perceived self-efficacy if the rewards are the result of achieving goals or subgoals. Self-efficacy is validated when the goal is achieved, and the actual reward may validate or increase self-efficacy in the pursuit of subsequent similar tasks (Schunk, 1989, 1994).

Schunk (1994, 1996) incorporates the influence of attribution theory upon the self-regulation process. The attributional theory of achievement behavior postulates that students attribute their success or failure to factors such as ability, effort, task difficulty, and luck. These attributions may be represented along a continuum of three dimensions: (a) internal or external to the individual, (b) relatively stable or unstable over time, and (c) controllable or uncontrollable by the individual. The feedback loop in the self-regulation process provides cues for people to form attributions regarding a task, and these attributions affect expectations, motivation and emotions. These effects of attributions influence the self-regulation process during the stages of self-judgment and self-reaction when comparisons are made of observations of performance and goal attainment. Students who contribute success to attributions over which they have no control may hold low perceptions of self-efficacy. Students who attribute success to ability, effort, and effective use of strategies should experience higher self-efficacy and greater sustained

motivation (Schunk, 1994, 1996). Attributional feedback studies attempt to modify one's attributions and achievement outcomes by providing feedback linking one's success or failure with one or more attributions. These studies show that the feedback can change one's attributions and can affect perceived self-efficacy. In studies of feedback types, feedback referring to ability promoted self-efficacy and skill more than feedback about effort, a combination of ability and effort feedback, or a no-feedback condition, while any of the combinations of feedback significantly promoted greater self-regulated learning over no feedback. Further studies which provided various feedback conditions show that when ability feedback is provided during the second half of instruction, self-efficacy was rated higher. Ability feedback appears to increase self-efficacy beliefs and skillful performance (Schunk, 1996).

According to Bandura (1986), after self-reactive capabilities are developed, two consequences of this behavioral development process are self-evaluative reactions and external outcomes. These personal and external outcomes may act as either complementary or opposing influences on behavior. Conflict can occur when one is socially or materially rewarded for behavior that is not valued or when one is punished for behavior that is highly valued. When external rewards for behavior are minimal or nonexistent, individuals may continue their behavior through self-encouragement. In this situation, however, one must be convinced that continued persistence is of high self-worth. The behavior of one who does not develop strong internal standards is highly susceptible to external influences and may result in radical shifts depending upon the social context in which one is placed (Bandura, 1986).

Self-regulation Strategies

The belief that applying a learning strategy to improve learning helps learners to perceive some control over achievement, which can raise their perceived self-efficacy (Schunk, 1989). Verbalization is suggested by Schunk, where learners overtly verbalize the steps in a learning strategy as they apply them. This verbalization focuses the students' attention to important task features, assists in the coding and retention of information, and promotes self-monitoring. In addition, in order to promote the continued use of a learning strategy, Schunk suggests that providing value information about how a strategy's use can improve performance will help encourage learners to use the strategy. This can be accomplished by telling learners the strategy will help them perform better and has benefited other students. Feedback linking the use of the strategy with improvements in performance should be provided as well. In a later report, Schunk (1996) states that the use of effective task strategies during self-regulated learning enhances skills. These same task strategies maintained positive attributional beliefs.

Zimmerman and Martinez-Pons (1986) developed a description of 14 self-regulation strategies through structured interviews with students in a comparison of gifted students to students not in an advanced academic track. These self-regulation strategies were compiled within six different learning contexts: (a) classroom situations, (b) at home, (c) when completing writing assignments outside of class, (d) when completing mathematics assignments outside of class, (e) when preparing for and taking tests, and (f) when poorly motivated. The study compared the use of these strategies as well as the frequency of use and consistency of use between the two achievement level groups. As might be expected, the gifted students not only used more self-regulating strategies in the given learning situations but used them more often and with greater consistency. Two activities, keeping records/monitoring and reviewing notes, were

most often cited by both levels of groups. Some of the more common strategies used by the gifted students alone are organizing/transforming, seeking information, seeking teacher assistance, and reviewing textbooks. The resulting 14 strategies discerned from this study have served as a basis for further study (Risemberg & Zimmerman, 1992; Zimmerman & Martinez-Pons, 1990) and have characterized self-regulating activities within the body of that literature. These strategies are listed and described below (see Table 2). Some of the categories are combined because the actual response is the same while the source or stimulus may differ within the response. A fifteenth category was utilized in the study to note strategies initiated by sources other than the student or unclear responses by the subjects but is not included here since it does not meet the criteria of being self-initiated (Zimmerman & Martinez-Pons, 1986).

Table 2.

Self-regulation Learning Strategies (Zimmerman and Martinez-Pons, 1986)

Strategy	Description
1. Self-evaluation	Student-initiated evaluations of the quality or progress of their work.
2. Organizing and transforming	Student-initiated overt or covert rearrangement of instructional materials to improve learning.
3. Goal-setting and planning	Setting of educational goals or subgoals and planning for sequencing, timing, and completing activities related to these goals by the student.
4. Seeking information	Student-initiated efforts to secure further task information from nonsocial sources when undertaking an assignment.
5. Keeping records and monitoring	Student-initiated efforts to record events or results.
6. Environmental structuring	Student-initiated efforts to select or arrange the physical setting to make learning easier.
7. Self-consequences	Student arrangement or imagination of rewards or punishment for success or failure.
8. Rehearsal and memorizing	Student-initiated efforts to memorize material by overt or covert practice.
9-11. Seeking social assistance	Student-initiated efforts to solicit help from peers (9), teachers (10), and adults (11).
12-14. Reviewing records	Student-initiated efforts to reread tests (12), notes (13), or textbooks (14) to prepare for class for testing.

The study does not attempt to categorize the most efficient or effective self-regulating activities, but attempts to discern the degree to which these activities are or are not employed by two disparate groups: low achievers and high achievers. The high achievement group displayed significantly greater use of 13 of the self-regulating strategies, with self-evaluation being the only strategy not significantly employed more often by high achievers over the low achievement group. The low achievement group did utilize all of the self-regulating strategies to some degree, although, their use was significantly less on all strategies except self-evaluation, and they used significantly more strategies that fell in the “other” category. Unfortunately, this category includes activities that may not be considered learning strategies as well as activities that are not self-initiated and are therefore not considered effective strategies for self-regulation. In terms of frequency, strategies used most often and consistently by the low achievement group include reviewing notes, keeping records and monitoring, and goal-setting and planning. The high achievement students also utilized the strategies of reviewing notes and keeping records and monitoring most often, although, they used these strategies significantly more often and consistently than their low achieving peers. Unlike the low achievement group, the high achievement group also utilized seeking information, seeking teacher assistance, reviewing texts, and organizing and transforming more often and with greater consistency than goal-setting and planning.

In a later study, Zimmerman and Martinez-Pons (1990) monitored the use of these strategies across a variety of grade levels, achievement groups, and both genders. In this later study, gifted students displayed greater use of the strategies of organizing and transforming, self-consequating, seeking peer assistance, and reviewing notes. The authors note that these strategies when taken together encompass all three aspects of self-regulated learning, including personal processes (organizing and transforming), behavioral processes (self-consequating), and environmental influences (reviewing notes and seeking peer assistance). Girls of both achievement types displayed more goal-setting and planning than boys. Goal-setting and planning also varied based on giftedness and grade with a decline in this strategy as students progressed through school. Additional grade level influences upon the use of self-regulating strategies include an increase in the review of notes with a significant decrease in the review of texts, which is possibly attributed to the shift in most pedagogies to increase note-taking by students as they progress through school. In support of this interpretation, students in the study in question reported a significant increase of keeping records and monitoring between the 5th and 8th grade, with record keeping and monitoring being sustained through the 11th grade. In addition, between the 8th and 11th grade there was a significant decrease in student reliance upon parental assistance and an increase in the seeking of assistance from teachers (Zimmerman & Martinez-Pons, 1990). In contrast to the earlier study, the one strategy utilized most frequently by all students was that of self-evaluation. This point is not elaborated upon by the authors; perhaps the differences in frequencies between the groups were not significant and it was the differences between groups that concerned the authors most.

These studies suggest that both low and high achievers may utilize self-regulation strategies, but the frequency and consistency of use differ amongst groups. Implications from the study indicate that perhaps low achievers could be taught or encouraged to utilize self-regulation strategies that currently exist in their learning repertoire. However, despite the classification of these 14 common self-regulation strategies, merely teaching these strategies to students has not resulted in a wave of highly self-regulated learners. The knowledge of general strategies does not

insure that one will employ them without being explicitly prompted to use them (Bransford, Sherwood, Vye, & Rieser, 1986). The hope that a majority of self-regulated learners will develop due to strategy installation in the classroom has cooled as it has become apparent that simply knowing a self-regulation strategy is not sufficient for utilizing a strategy (Risemberg & Zimmerman, 1992; Zimmerman, 1990). Further, as has been illustrated, any student's level of self-regulated learning is not absolute but varies due to the influence of the learning task and environment, personal metacognitive and affective factors, and behavioral feedback (Zimmerman & Martinez-Pons, 1990). Zimmerman (1995) cautions that study strategies and tactics work well only in specific conditions and on certain tasks. Learners must determine the suitability of a strategy dependent upon the task which they encounter. Zimmerman (1995) suggests that novice learners will benefit more from monitoring strategy outcomes and making alternate choices. Novices need specific information about the contextual conditions and will benefit from a strong sense of self-efficacy which may supply the motivation necessary to persist in an ambiguous or unfavorable task.

In a review of early studies on metacognition, Bransford, Sherwood, Vye, and Rieser (1986) reported literature that explored the degree to which previous knowledge was spontaneously applied in settings of transfer. One type of study, the training study, confronts subjects with different types of learning opportunities and assesses the effects on mastery tasks and transfer tasks. The poor result attributed to many of the early training studies hoping to result in transfer were later considered to have been caused by "blind training" in which subjects were taught to use strategies but were not helped to understand why they were useful and when they might be used. Opposed to blind training, later studies provided informed training in which subjects are helped to understand when and why to use various strategies. Informed training with self-control allowed subjects to practice the strategies and monitor their effects, both of which are metacognitive strategies. While informed training emphasizes the effects on metacognitive processes, it also affects the nature and organization of the knowledge acquired by learners. Emphasis on metacognitive processes does result in improvements in thinking and problem solving, and has shown to increase achievement in a variety of domains (Bransford et al., 1986), but merely acquainting students with strategies is not sufficient. Students must also be shown why strategies are important, when they should be used, as well as processes for practice and monitoring of the strategies themselves.

In a study of strategy application, Bielaczyc, Pirolli, and Brown (1995) incorporated self-explanation and self-regulation strategies in the attainment of the cognitive skill of computer programming. The authors found that their treatment group that incorporated the self-regulation strategies of self-monitoring and clarifying comprehension failures in conjunction with self-explanation strategies outperformed a control group that did not have the benefit of instruction in these strategies. Strategies used by the authors to help students clarify comprehension failures include reviewing at the end of a page and assessing comprehension difficulties at that time, clarifying what was understood in comparison to what was not understood, and returning to earlier pages to resolve comprehension failures. Similar to previous studies, both groups incorporated these strategies into their learning experience; however, the level of incorporation by the treatment group proved to be significantly higher than their control group peers. This study implies that in addition to knowledge acquisition strategies, students benefit from the incorporation of strategies which allow them to plan, monitor, and evaluate their comprehension and strategy use (Bielaczyc, Pirolli & Brown, 1995).

In a series of studies involving writing tasks with subjects of both average and gifted writing ability, Schunk (1994) confirmed the importance of process goals and progress feedback as strategies incorporated into instruction. In all three experiments, treatment groups consisted of four experimental conditions: process (learning) goals, process goal plus progress feedback, product (performance) goal, and a general goal group used as a control. The results of these studies confirm that orienting students of both average and gifted ability toward the process of writing provided higher perceptions of self-efficacy and greater writing skill. Combining process goals with feedback on the progress of the individual promoted the highest measures of self-efficacy and greatest measure of writing skill (Schunk).

Garcia and Pintrich (1994) review and describe effective cognitive and metacognitive strategies that may be incorporated into the instructional process (see Table 3). Important cognitive strategies related to academic performance include rehearsal, elaboration, and organization. Rehearsal strategies involve the reciting of items to be learned or saying words aloud as one reads text and help students attend to and select important information from lists or texts. Many tasks require more than the memorization of information and may be better addressed through elaboration and organizational strategies, both of which seem to be more useful for integrating and connecting new information with previous knowledge. Paraphrasing or summarizing material, creating analogies, as well as questioning and answering are elaborative learning strategies. In addition students may participate in elaboration by engaging in generative note-taking in which they actually reorganize material and connects ideas within their notes as well as by explaining ideas in the material to be learned to another individual. Organizational strategies include selecting the main idea from text, outlining the text or instructional material, sketching a network or map of important ideas, or identifying the prose or expository structures of texts (Garcia & Pintrich, 1994).

Metacognitive and self-regulatory strategies, according to Garcia and Pintrich (1994) can be classified into three types: planning, monitoring, and regulating. Planning activities include setting goals, skimming a text before comprehensive reading, generating questions before reading text, and completing a task analysis of a problem. Monitoring activities include tracking of attention while reading a text or listening to a lecture, self-testing, monitoring comprehension of a lecture, and the use of test-taking strategies in an exam situation, such as monitoring pace and adjusting to available time. Closely related to monitoring strategies, regulating strategies may require students to ask themselves questions as they read in order to monitor comprehension and then refer the student back to reread misunderstood portions of text. In addition, students may slow the pace of reading in the face of difficult text, skip questions in a testing situation, or incorporate the review of pertinent instructional materials. These behaviors may all be considered regulation strategies. The authors also note that learners may manage or reorganize resources through the adjustment of time, environment, and utilization of other human sources but that these are not cognitive strategies, per se. Garcia and Pintrich (1994) emphasize that mere knowledge of cognitive and metacognitive strategies may not be sufficient to promote strategy use. Their model of cognitive and motivational interaction suggests that actual strategy use is contingent upon student motivation.

Table 3.

Cognitive and Metacognitive Learning Strategies (Garcia & Pintrich, 1994)

Cognitive Strategies	
Strategy Type	Activity
Rehearsal	Reciting items, reading aloud
Elaboration	Paraphrasing, summarizing, creating analogies, questioning and answering, generative note-taking
Organization	Selecting main ideas, outlining, sketching a network or map, identifying expository structures
Metacognitive Strategies	
Strategy Type	Activity
Planning	Setting goals, skimming text, generating questions before reading, task analysis
Monitoring	Tracking attention in task, self-testing, monitoring comprehension, monitoring exam pace, adjusting to available time
Regulating	Self-questioning, rereading misunderstood material, adjusting pace due to difficulty of material, skipping questions, review

In incorporating attribution theory into the self-regulation process, Schunk (1996) makes the following suggestions for instruction. Attributional feedback given to the learner should be credible and salient. Attributions stressed in this feedback should correspond to one's perceptions of the factors that are actually contributing to performance. Offering feedback for effort when one does not perceive to be applying great effort is not be perceived as credible or salient. When feedback relates to two or more attributions, students may assess the credibility of the feedback and accept the most credible while discarding other information. Students can be encouraged to evaluate the credibility of their own attribution perceptions. During instruction, students can be cued to periodically make these observations, possibly by recording their

progress in an academic task, and evaluate their perceived efficacy and attributions. Model statements can be included as part of the instruction designed to teach self-observation and self-evaluation.

Why Students Do Not Self-regulate

Many learning theories indicate how and why students choose not to use specific strategies or response as well as why students do self-regulate. Zimmerman (1989a) lists reasons across several learning theories as to why students may not self-regulate. These reasons can be linked to inadequacies within one or all three components of the influential determinants of self-regulation, personal, environmental, or behavioral influences. Students may not have clear learning goals or desire to achieve the goal as presented. Students perceived to have low self-efficacy may not possess significant motivation or expend the effort and time required to apply self-regulation strategies. Even when students are presented with an effective model and know a self-regulation strategy may work, they may choose not to self-regulate if they perceive that they are somehow uncharacteristic of the model or the outcome of following the prescribed behavior is not attractive to the learner. Finally, many theorists believe very young children are not capable of self-regulation activities and that the components of metacognition and motivation develop through maturation (Zimmerman & Martinez-Pons, 1990), although, not all theories correspond as to how or when this maturation occurs.

Summary of Self-regulation

Centering epistemological beliefs within the tripartite definition of the self-regulation process as delineated by social cognitive theory illuminates the development of trends which can further provide implications for the instructional process. In terms of the personal influences of the self-regulatory process, results from beliefs about the metacognitive process have shown that general strategy knowledge and use are dependent upon sufficient and appropriate training experiences with a given strategy. Ideal training situations would incorporate refinement of strategies through extended practice and a recognition of strategy use impact upon recall (Borkowski, Carr & Pressley, 1987). Goal orientation is key to the success of any achievement-based activity, and individuals undertaking learning goals are more apt to employ self-regulation strategies, monitor their effects and progress, and apply effort to achieve these goals (Ames & Archer, 1986; Dweck, 1986; Ertmer & Schunk, 1997; Meece, 1994; Miller et al., 1993). Merely providing demarcated learning goals over performance goals is not sufficient to promote the highest levels of achievement or self-regulation. Being a part of the self-regulatory system, goal orientation is subject to enactive feedback, evaluation, and reorientation. Combining learning goals with the self-regulation component of self-evaluation can raise perceptions of self-efficacy and competency for utilizing self-regulation strategies (Zimmerman & Kitsantas, 1997), which readdresses metacognitive activity and helps to determine the type, structure, and number of self-regulation strategies undertaken (Bandura & Schunk, 1986; Schunk, 1989, 1994; Zimmerman, 1989).

The adoption of motivational patterns does not differ with students of various intellectual abilities, and students across the range of intellectual abilities may find benefit in motivational interventions, such as attributional retraining. Superficial positive reinforcement as well as continued success in learning goals that are too easy may not promote stable confidence,

challenge seeking, or persistence (Dweck, 1986). Learning environments which promote learning goals are defined by activities which emphasize self-improvement, discovery of new information, and the usefulness of the material being learned (Meece, 1994). Positive benefits from motivation may be obtained through the process of self-diagnosis and instruction regarding when both the motivational and cognitive strategies may or may not be appropriate (Garcia & Pintrich, 1994).

The learning environment is a socializing factor that can orient students towards the adoption of goal types (Meece, 1994). Cognitive feedback forms—either task validity feedback, cognitive validity feedback, or functional validity feedback—link cues from the environment and achievement and can promote self-regulation of the learning task. Feedback must indicate when strategies are to be employed, must help students match appropriate strategies to learning tasks, and supply motivation to continue the strategies until the fruition of the task (Butler & Winne, 1995). These findings are supported in computer-based environments as well, where strategic knowledge, not content knowledge, appears to have a greater consequence on learning outcomes (Yang, 1993; Young, 1996). The development of a variety of scaled learning activities which can be applied in computer-based instruction may serve a variety of learners who approach the learning task from different levels of successful self-regulation.

Strategies intended for improving the behavioral component of self-regulation address self-monitoring. Self-recording of actual behaviors focuses one's attention toward the type, number, and success of self-regulation activities. Standards are a key factor upon which evaluations of self-monitoring will be made and normative standards of judgment can be acquired based on the observation of models (Schunk, 1989), as well as by varying the types of activities that are performed but prescribing a similar performance standard for each activity (Bandura, 1986). While a variety of self-regulation strategies are identified in the literature, the suitability of strategy deployment is dependent upon the type of task encountered (Zimmerman, 1995). What types of tasks are suitable for presentation in a hypermedia environment? How can the inherent characteristics of hypermedia structure learning tasks and the subsequent choice of strategies which can effectively and appropriately influence achievement?

Hypermedia

Definition and Features

Hypermedia refers to the hyperlinking of a variety of communication media such as sound, graphics, and video utilizing the principles of hypertext (McKnight & Dillon, 1996). Burton, Moore, and Holmes (1995) propose that hypermedia is in fact the culmination of two diverse concepts and approaches to development. Multimedia refers to the incorporation of a variety of audio and visual media or experiences used in instruction and can be traced back prior to the existence of computers in the classroom. Before computers were used for instruction, various media were incorporated into the instructional process; thus multimedia is dependent upon the development of media. Hypertext, however, involves the linking of information that can be accessed freely through learner choice, often through making associations within the information that are either implied by the organizer or programmer or associations made by the user. Its development was driven by computer science. The concept of hypertext can be traced back to the conception of the Memex system, proposed by Bush but never developed (Burton,

Moore, & Holmes, 1995). Ted Nelson, who first coined the term “hypertext,” imagined a “docuverse” which essentially hyperlinked all of the literature in the world (McKnight & Dillon, 1996). Hypermedia, therefore, is a hybrid result of the advancements of multimedia and the incorporation of the linking through association process developed in hypertext systems (Burton, Moore, & Holmes, 1995).

Marchionini (1988) describes characteristics of hypermedia systems that have great potential for instruction. Great collections of information in a variety of media formats may be stored compactly and provide for rapid access from a variety of users. These materials can also be linked explicitly by the authors or managers of this information as well as implicitly by authors and users who create their own unique navigational sequences and connections between the materials stored. Hypermedia can also offer a wide variety of learner control, which has mixed effects depending upon the type of user accessing the information. Marchionini (1988), however, suggests that hypermedia offer new ways of learning “how to learn.” Inherent in its design, hypermedia allows users to diverge from a linear sequence, to combine multiple forms of media addressing a variety of senses, and to offer learning aids for reviewing, studying, and producing new interpretations of the content. Related to the process of self-regulation, Marchionini (1988) states that such a malleable environment requires the user to constantly make decisions and evaluate one’s own progress, offering the potential for new strategies of learning, studying, and creating.

Nodes and links. Hypertext is organized into chunks, called nodes, which are then linked together (Burton, Moore, & Homes, 1995; Jonassen, 1992; Marchionini, 1988; McKnight & Dillon, 1996; Shin, Schallert & Savenye, 1994; Tripp & Roby, 1990). There are no rules governing the size of nodes nor what each should contain, as there are no rules governing which nodes are linked together. Entire documents can be treated as nodes and linked together. Jonassen (1988) states that users may seek information in a hyperlinked system based upon personal relevance, interest level, curiosity, experience, information needs, or task demands which have originally brought the user to the system. He further proposes that the goal of hypermedia is to provide an environment that facilitates knowledge exploration by the user. Both authors and users of hypermedia may create unique navigation paths and should be able to capitalize on the technology by annotating the text through creating notes, explanations, and analogies, and by adding bibliographies or glossaries. Based on the concept of schema-theory, Jonassen (1988) further notes that the most distinct aspect of hypermedia is its ability to represent in its own structure the structure of the knowledge that it is attempting to convey.

Welsh, Murphy, Duffy, and Goodrum (1993) discuss linking in hypermedia from the perspective of the designer. The designer must somehow designate that a hyperlink node is available from the presentation. These marks must at least promote the following of links and they must be minimally disruptive to the visual presentation. These authors state that most users tend to start from a single node and return immediately to the same node. Locatis, Letourneau, and Banvard (1989) propose some confusing issues regarding hypermedia node structure and linking. When designing software, one should justify whether it is even desirable to let authors or users work with groups of nodes. How many nodes might be displayed at one time without being confusing? Should software have facilities for declaring and displaying node types so that node content might be indicated automatically in links referencing them? Marchionini (1988) states

that fundamental issues for the hypermedia designer regard how nodes and links will be differentiated and managed, both internally in the system and presented externally to the user.

Although no standards exist, patterns are emerging for indicating links to nodes. An early description by Conklin (1987) describes two types of links in hypermedia: (a) referential links which simply connect two nodes, and (b) organizational links which communicate the type of relationship that exists between the nodes (Jonassen, 1992). Shin, Schallert, and Savenye (1994) describe these two link types as network structures and hierarchical structures, respectively. They imply that the choice of links implies some type of structure within the hypermedia system. Welsh, Murphy, Duffy, and Goodrum (1993) state that nodes may be indicated through different screen manipulations such as boldface or underlined text, but this may complicate reading of text if used a great deal. In addition, the cursor may change shape when identifying a linked spot or text. This last linking mechanism may be disruptive to reading and learning as the user must concentrate on the cursor as well as the information presented. Linking may also be indicated by small icons, such as arrows or bullets, or the use of colors. These last options may also be distracting depending upon the density of linking markers presented in a screen display (Welsh et al., 1993).

Due to the importance of highlighting linking mechanisms, Welsh et al. (1993) compared three strategies of linking mechanisms to determine their effect on linking indicators and learner perceptions of their ease of use. The link types included no link type (NLT), utilizing different arrows to indicate a link and the type of the link (LT), and a link that presents a submenu (SM). Contrary to their expectations, the group utilizing NLT followed the largest number of links and spent the most time reviewing the information presented from the link. This suggested that a lack of link indicator does not discourage exploration of a hyperlinked database. In addition, the SM group utilized the linking mechanism the least and spent the smallest amount of time reviewing the exposed linked material. The authors suggested that the greater difficulty in accessing the linked material inhibited hyperlinking by the users.

Learner control. Grabinger (1996) suggests that educators need to identify the skills students need to perform independently to help them develop lifelong learning skills. The need to develop this learning independence extends to interactive media designs, which, he suggested, should function as scaffolds which build comprehension and offer support rather than always providing an option for full support. One of the main issues related to teaching students to become intentional learners is the issue of learner control.

Learner control of instructional systems essentially allows the user to make judgments as to what, when, and how learning will occur. The implications of instructional design are that emphasis upon learner control is typically focused on lesson navigation. Successful learning systems utilizing learner control require that a sufficient array of resources be available to enable students to both access and address knowledge and skills as they progress through the instruction. Hannafin (1992) suggests that this can be accomplished by providing an organizing theme or context for the instruction, and embedding aids and support in the form of help, elaboration and other resources that can be selected by the student.

Instructional systems under the learner's control have been shown most often to be as effective or less effective than treatments under more computer control (Williams, 1996).

Children show no less affinity for learner controlled environments than adults. Successful utilization of learner control and the choices ascribed to therein related rather to the complexity of the task(s) involved in the instructional unit as well as the user's prior knowledge of the topic addressed. In a review of learner control literature, Williams (1996) reported that complex outcomes were learned better under learner control of the order of presentation, while simpler outcomes were learned better under stricter control by the program. Traditional instruction which is controlled primarily through external forces, such as by an instructor, videotape, or computer program, may actually run counter to the educational philosophies promoted by teachers in the arts and humanities, which encourage student exploration and expression and must often address ill-structured knowledge acquisition (Williams, 1996).

Organizational structure. Kinzie and Berdel (1990) suggested that until users become familiar with the use of hypermedia, it may be necessary to explain how the system functions and to guide students through them utilizing structured experiences. This guidance can be offered in several ways. Users can be offered the opportunity to practice a particular hypermedia package. This practice can utilize a small part of the program so that users are not overwhelmed by the program's depth and complexity. A map of the system can be of particular importance and might prevent getting lost or disoriented within a large program. It might be appropriate to build a list of potential questions that could be addressed throughout the program to promote sound research strategies. Finally, "help" options should be included to minimize frustration and optimize learner control and student self-regulation.

Locatis et al. (1989) related that hypermedia may be more useful educationally when knowledge is represented with sufficient explanation for novices as well as experts. These representations may be sequenced in one of three ways. A linear sequence is suggested by incorporating learning hierarchies in which links are only established between nodes containing information prerequisite to others. The second sequencing paradigm imitates conversations. This seemingly nebulous sequencing may actually be easiest for the designer to organize since virtually all material would be linked and the linking sequence would be determined primarily by the user with a unique sequence possible every time the instructional system is attempted. This organization would reflect expert associations, but with additional topics aiding student understanding. Most topics in this conversation metaphor would be linked referentially on the assumption that students can begin learning some subjects when requisite knowledge is only partially grasped. Finally, sequencing might also contain elaborations in which content is explained from simple to complex by presenting the fewest fundamental ideas conveying the essence of a subject and adding detail. Hierarchical links can then be offered between topics at different levels of detail. Topics at the same level of detail might be linked referentially. This organization of sequence and linking is similar to the "tree branching" organization discussed below.

Hypermedia's effectiveness depends on the extent to which students can internalize the important conceptual structures in a subject matter as they browse. In their review of hypermedia research, McKnight and Dillon (1996) relate reasons why a nonlinear sequencing environment might be superior. Hyperlinked instruction allows for different levels of prior knowledge, encourages exploration, enables subjects to see a subtask as part of the whole task, and may allow users to adapt material to their own learning style. Locatis et al. (1989) reviewed steps an author may use to facilitate navigation through hypermedia. These include being able to back up

a node at a time, review and reaccess past nodes, search via key words or indices, access central points (title screen, start menu, table of contents) from anywhere in the program, use maps and tables of contents to see the overall structure of the program, and to get “fish eye” views indicating the names or contents of nodes prior to and following the one currently being displayed.

Simple, unstructured systems are defined only by the referential links to information located elsewhere in the system, while highly structured systems can be defined by limited links. Instead of following a graphic sequence, Jonassen (1992) relates that hypermedia can be structured via theoretical structures. Information can be structured within a knowledge base so that it reflects empirical structures or logical systems of conceptual or theoretical relationships. This type of structure would reflect content structures or learning sequences. Also called an expert system, knowledge-based organization allows a user to experience modeling by a best example which can then be mapped onto the user’s schema for the particular content in question. Relevance can be added by the user by creating personal links in the expert system. Jonassen (1992) continues this metaphor of structure by implying that different learning theories and instructional design models can be utilized for the structure of a hypermedia system. Examples are given for elaboration theory in which nodes emanate from an “epitome” node and traverse to nodes of varying levels of elaboration, Gagne’s Theory of Instruction which implies a linear sequence, and component display theory which would use different link structures for different learning outcomes. In a later summary of hypermedia systems utilizing expert semantic mapping, Jonassen (1993) concludes that merely providing structural cues in the interface will not result in significant increases in the structural knowledge of the user. Simply showing users the structural relationships is probably not sufficient to result in the user’s successfully encoding information. Learning from hypertext must rely on externally imposed or mediated learning tasks (Jonassen, 1993). Jonassen (1992) notes that regardless of the theoretical structure of a hypermedia system, the possibility exists for users to impose their own structure on the system, which essentially allows users to construct their own knowledge base. It is important to note, however, that users differ in their ability to impose structure upon hypermedia, or any learning environment for that matter, but allowing this manipulation can make content more relevant and meaningful for the user (Jonassen, 1992).

Jonassen and Reeves (1996) relate research by Spoehr regarding student format choices for hypermedia. Similar to the three types of hypermedia, organization included linear, star branching, and tree branching. Strict linear sequencing proved to be the least effective. Star branching allowed the user to see an entry point that was an overview containing links to two or more subtopics. These subtopics then appear as a linear sequence. Tree branching refers to one or more main branches off the initial overview which are then subdivided into further subtopics. This final form of branching showed more sophisticated understanding of the topic in the study described (Jonassen & Reeves, 1996).

Types of hypermedia. The most commonly accepted definition of hypermedia implies computer-driven learner interactivity with a variety of media formats, such as motion, voice, data, text, graphics, and still images (Burton, Moore, & Holmes, 1995). Four classes of hypermedia systems include browsing, problem-exploration tools, macro-literary systems, and general-purpose hypertext (Conklin, 1987). Browsing systems allow users to navigate and explore databases of information, such as encyclopedias and on-line “Help” programs. In

browsing systems, the user does not contribute to the system. Hypermedia can allow users to construct, organize, and convey personal representations of their knowledge. However, Jonassen (1993) also suggests that browsing through a knowledge base does not promote deep enough processing upon the part of the user in order to create meaningful learning. The active participation in the construction of knowledge promotes greater retention of information and is key to the instructional application of hypermedia systems such as those described by problem-exploration tools. These hypermedia systems are work-related systems that focus on information in a specific content domain and allow for user interaction to promote active learning. Macro-literary systems represent a collection of materials that are hyperlinked together, not a single system, and general-purpose hypermedia systems are designed to be general systems that can be tailored to a variety of needs, such as authoring systems (Conklin, 1987).

A unique type of hypermedia is the concept of hypervideo. As related by Locatis, Charuhas, and Banvard (1990), hypervideo is video prepared specifically for use in hypermedia projects and includes specific characteristics not often found in linear video or interactive video. Much like hypertext, the content in these video nodes is reduced to the most fundamental, most basic representative ideas that completely and concisely treat their topics. For the hypervideo to be well integrated within a larger project, it should appear to be the size of nodes presenting other information. Dwell time, or the amount of time a scene is shown, in linear video is sufficient so what is depicted can be understood. However, in hypervideo, dwell time may be reduced so that what is depicted can merely be recognized, since viewers often have multiple options on viewing scenes over, sometimes in slow motion, frame by frame, or even in reverse. Voice-over narration is more successful in hypermedia because it allows simultaneous verbal and visual information presentation. Some users may not even need to hear audio at all and this option may be toggled on or off.

Problems with Hypermedia

Disorientation. Several problems exist with hyperlinked media. Perhaps the most often reported problem with hypermedia is that users can become disoriented, unaware of the route they took or how to find their way out of the hypertext or to another topic of interest (Bieber, Vitali, Ashman, Balasubramanian & Oinas-Kukkonen, 1997; Gay, Trumbull, & Mazure, 1991; Gleim & Harvey, 1992; Heller, 1990; Jonassen, 1988, 1992; Jonassen & Reeves, 1996; Shin, Schallert, & Savenye, 1994; Stanton & Baber, 1994; Tripp & Roby, 1990). Disorientation can include both the problem of knowing where one is within a hypermedia system and discovering how to get somewhere else in the system that one knows or believes to exist (Heller, 1990). How and where do users access information in the hypertext? Most hypermedia fail to provide suggestions about where the user should begin, and the user's initial access may greatly affect understanding of both the material being presented and the instructional system itself (Jonassen & Reeves, 1996). Counter to this idea is that the growing number of hypermedia-literate users who are familiar with navigation on the Internet have become better at keeping track of their "location" and progress. The incorporation of bookmarks, backtracking and history lists, and the forward, back, and home buttons are purported to enhance navigation (Bieber et al., 1997).

Heller (1990) describes reasons for disorientation in hypermedia as being inherent to the types of learning which are applied in hypermedia systems. Discovery learning actually refers to an organization or structure of the learning environment that is richly embedded with context,

relationships, clues, and activities to help guide the user who actively explores and creates understanding. Opposed to learning from this complex, structured environment, unplanned learning can occur in any learning environment through incidental learning. Learning environments that do not support explicitly stated instructional objectives to help guide the learner often result in incidental learning, which may or may not meet greater user or instructional goals. In a review of the use of instructional objectives, Heller (1990) relates the evidence that specifically stated objectives presented prior to instruction significantly increased intended learning and had no significant loss of gains due to incidental learning. Learners provided with objectives exhibited the greatest amount of recall and incidental learning, even with the absence of feedback (Heller, 1990).

Stanton and Baber (1994) suggest convincingly that disorientation in hypermedia is most often the result of poor design. Indeed, the authors suggest, if disorientation is an inherent property of hypermedia, then its further use and development seem illogical; however, they do not subscribe to this notion of inherent disorientation in hypermedia and instead champion its possibilities. The authors review previous attempts to reduce disorientation in hypermedia, including the use of guided tours which essentially provide linear text and rob the hypermedia system of its great linking potential, as well as the presentation of progressive information by the user and the incorporation of bookmarks. Stanton and Barber (1994) appear to find bookmarks the most beneficial of these early treatments, because users can mark and later return to the sources of the most relevant information found; however, they further suggest that, from a development standpoint, the underlying principle of query languages which supports the development of bookmarks might more directly be incorporated into the design of hypermedia systems. The use of query languages can provide the benefits of marking and storing relevant source nodes while providing greater function to the user. They follow through this notion with the suggestion that rather than using links as programmable features, nodes themselves should be made more sophisticated. In this case, the authors have proposed a linking structure in which the properties of the nodes become the links, and navigation from these links is dependent upon such characteristics as inheritance and membership (Stanton & Barber, 1994). In terms of regulating one's use of the system, such a structure would allow an individual to structure the hypermedia environment to meet the prescribed goals, promoting and sustaining both motivation and increased perception of self-efficacy.

A browser interface which applies this concept of making linking within a hypermedia system dependent upon node characteristics is described by Tudhope and Taylor (1997) as it is applied in a browser interface utilized in a museum exhibit. The system is based on Semantic Hypermedia Architecture (SHA) where semantic relationships exist between index terms and where information units can be indexed by several terms. The architecture is based on "an extended binary relational model with a restricted set of basic relationships, which can...express notions of hierarchy" (p. 234, Tudhope & Taylor, 1997). An exploratory scenario is described without the assumption of user goals or knowledge of the system. Such a system allows for extreme flexibility and high accuracy in finding nodes of interest in a freely structured hypermedia system (Tudhope & Taylor, 1997). The incorporation of regulatory strategies such as goal setting and opportunities for monitoring within a semantically linked system offers powerful possibilities.

Scope. Related to the problem of disorientation within the system is the fact that users may not realize the size or scope of a system. Lack of orientation as to how much of the hypertext the user has accessed and how much remains to be revealed is a function of the system's scope (Heller, 1990; Jonassen, 1988; Jonassen & Reeves, 1996). Graphic maps are offered as a suggestion to help visualize components of a system; however, these graphic maps themselves can become difficult to understand in large hypermedia systems (Heller, 1990). In studying the linking architectures of hypermedia systems, Beasley and Waugh (1995) investigated the use of three mapping structures in an attempt to reduce user disorientation. Spider maps show subtopics radiating outward from higher-order links much like the legs of a spider radiating out from its body. Hierarchical linking places subtopics below superorder topics in the implied hierarchy. In addition to these two treatment types, the authors included the use of hotwords as linking referents and a no-map control. A significant difference was found between disorientation levels of users in the hotwords treatment group and the hierarchical map treatment group, indicating that the hierarchical map reduced disorientation better than the simple use of hotwords. However, no significant difference could be found between the hierarchical group and the spider map group, or between the spider map group and the hotword group. Although not emphasized by the researchers, disorientation was also decreased in all treatment groups when the users were provided with the task of having to recreate the organizational structure of the system with pencil and paper following their session. Subjects without this task indicated greater disorientation in all treatment groups. This last finding, although secondary to the original authors, appears to suggest that self-regulating tasks may be much more significant in reducing disorientation rather than programming constraints and "helper" items such as system maps.

Learner control. In reviewing learner control, Williams (1996) stated the dilemma that although there are good reasons to believe that learner control is a desirable instructional approach, students left on their own do not uniformly make good use of such strategies. Hannafin (1992) agreed, stating that since much of what mediates effective student choice is related to prior knowledge, student-centered environments may prove inefficient or ineffective.

Students often overestimate how much they know about a topic; therefore, when students are given control over their instruction, they often make poor choices regarding their own learning progress and success. Williams (1996) further suggested that students possibly do make appropriate decisions, but based on their own inadequate perceptions of the problem, not according to some optimal outside decision rules. Instruction designed for learner control should have as its goal the expansion and clarification of the students' own perception of the task as well as their progress toward it, particularly for those who are deficient in the accuracy of their self-monitoring. Increasing an individual's ability to accurately assess one's own learning state in relation to the instructional task should result in the individual's making more appropriate choices. If modifiable characteristics of students can be identified which produce dysfunctional interaction with instructional treatments, those characteristics might be altered so students and instruction are better matched.

Shin, Schallert, and Savenye (1994) laud the merits of the ideal networked hypermedia system which involves sophisticated users searching for information to meet their own goals. These self-motivated and self-directed users are matched in sophistication by an ideal system which is flexible and provides individualized instruction that allows users to actively participate in their own knowledge construction. The authors suggest that this hypothetical setting is not

often the case, however, especially with novice users. These users often can not form goals about the content any more specific than the superficial goal of learning “about” the content and fall prey to the structure imposed by the author, negating benefits from a networked environment. A glaring consistency in the amount of control afforded to users in a networked environment is that if users are allowed to make decisions about the amount of instruction, practice, or examples, they often make incorrect assumptions about their knowledge and often terminate lessons or the complete system before receiving enough instruction.

In order to combat the negative effects of too much learner control, Shin, Schallert, and Savenye (1994) studied the implementation of an advisement strategy in a hypermedia system. Users were still allowed a great deal of control in terms of sequence, scope, level of mastery, and mode of display of the instruction; however, advice was offered for making some of these decisions. Previous findings regarding advisement in the instructional process show that students obtained higher achievement scores, took longer to complete the instruction, and reported liking the advisement in the user control condition, which suggested that user control becomes more effective for instruction when advisement is provided.

The study utilized second grade students familiar with computer-based instruction and hypermedia systems and incorporated two types of user control and four advisement structures. The hypermedia unit was structured with either limited or free access and the four advisement structures included advice to finish the current topic, advice on navigational functions, advice on the results of practice, and advice on the menu screen in the free-access condition. Findings confirm the effectiveness of advisement and provide implications for hypermedia sequence structuring. Without advisement, almost all students in the free-access condition appeared to get confused, whereas when their counterparts with advisement tried to leave a section uncompleted or follow a nonsupported link, they followed the prompted advice to continue the section 70% of the time. Students in the free-access, no-advisement condition also left over five topics incomplete, while mean scores for incomplete topics for the remaining three groups were less than one. In terms of achievement, students with high prior knowledge functioned well in both the free-access and limited-access sequence, while students with little prior knowledge scored much lower with free-access. The advisement condition did not significantly affect achievement outcomes; however, it did help students with low prior knowledge complete the lesson quicker. Students with low prior knowledge and no advisement often did not even complete the lesson. Students in the limited-access structure liked the program regardless of the presence of advisement, while the only free-access group that liked the instruction was in the advisement condition. The free-access with advisement group was the most liked treatment, whereas the free-access with no advisement group was the least liked treatment (Shin, Schallert & Savenye, 1994). Implications from this study indicate that a structured hypermedia environment can provide enjoyable, successful instruction; however, when placed in unstructured network environments, which may be most characteristic of utilizing the Internet, some type of advisement will allow users to complete instructional units and can increase enjoyment.

Media characteristics. Burton, Moore, and Holmes (1995) discuss the influence of multiple-channel communication, or cue summation. Cue summation predicts that learning is increased as the number of available cues or stimuli is increased. By increasing the number of available cues, the likelihood an individual will learn to make correct discriminations implied in the learning material is expected to increase over time. However, this theory is highly contingent

upon the relevance of cues in the learning environment. While redundant information presented simultaneously may be more effective for obtaining learning outcomes, unrelated or contradictory messages presented via multiple channels will compete with each other and result in interference. They caution that the common inclusion of the latest technology-driven innovative novelties, referred to as “bells and whistles,” may result in a pattern of interference as described above. While these media characteristics may be helpful to some, regulation of these novel technologies is a serious consideration for the development of effective hypermedia learning environments. Burton, Moore, and Holmes (1995) summarize the findings of a metanalysis of combined presentation research by Levie and Lentz, who suggest the following developmental strategies from the perspective of multiple-channel presentations: (a) using text-redundant illustrations will facilitate learning the textual material, (b) illustrations will help learners understand and remember readings, (c) learners often need prompting to pay attention to critical information found in illustrations, (d) learners’ enjoyment and affective reactions may be evoked from illustrations, (e) poor readers may benefit from illustrations, and (f) learner-generated imaginal pictures are generally less useful than supplied illustrations.

Learner characteristics. Related to the media characteristic of multiple-channel presentation is the learner-centered problem of cognitive overload (Bieber et al., 1997; Gleim & Harvey, 1992; Heller, 1990; Jonassen, 1988; Marchionini, 1988). Heller (1990) states that hypermedia systems can often be so rich with information that the user becomes overwhelmed. A common effort on the part of users to combat this feeling of overload is to compensate by browsing through the system rather than by the deliberate review of the system in the order determined by the programmer. Gleim and Harvey note that “exposure to large bodies of unfamiliar information may not be suitable for all tasks or all individuals and may result in confusion or indecisiveness on the part of the learner” (p. 2). The cognitive resources expended by the user in attempting to understand the hypermedia environment may actually interfere with the intended learning task (Gleim & Harvey, 1992).

Related to the problem of cognitive overload is that of maintaining user motivation or commitment to the hypermedia system (Heller, 1990). A user may become distracted due to the supposed benefit of a high level of learner control. This freedom in regard to navigating the structure of the system can be confusing because it increases the decision-making load of the user. Cognitive resources needed to comprehend the content may have to be diverted simply to deal with the navigation of the system (Marchionini, 1988). Marchionini further offers media and instructional strategies that can address this problem of cognitive overload. Structure can be applied to the hypermedia system in the form of guided tours, and the incorporation of layers of paths or webs. He also suggests that instructors and designers can mitigate distraction by examining strategies for studying, filtering information, evaluating relationships, and processes for self-directed learning. All of these processes are explicitly linked to the concept of self-regulation, and these findings imply that capitalizing on known self-regulating strategies can decrease cognitive overload in hypermedia environments.

Despite the advancements of digital audio and video, much hyperlinked material is text-based. Poor readers are especially susceptible to problems in such an environment. Not only do poor readers suffer from problems inherent in text-based instruction, but they often have the inability to accurately monitor success or failure, do not develop clear-cut goals, and often terminate instruction prematurely. Hypermedia specifically may be the most difficult learning

environment for poor readers because the connections and relations between links in the text are central to understanding (Balajthy, 1990). Students with low prior knowledge also tend to succumb to some of the same problems in hypermedia as poor readers, with the addition of too little practice, emphasizing only topics with which they have familiarity, making poor sequencing decisions under user control environments, and the general lack of good learning strategies (Gay, 1986; Shin, Schallert, & Savenye, 1994). The direct teaching of how to use control options may be effective for improving learning with these users (Balajthy, 1990; Gay, 1986). Balajthy (1990) suggests strategies for organizing the structure of hypermedia systems can be incorporated to help poor readers, such as some sort of graphic overlay or the incorporation of comprehension monitoring by the system itself. Comprehension monitoring is an awareness on the part of a reader of success or failure of understanding. Younger and poor readers have poor self-monitoring ability, do not comprehend that their understanding is not complete, and do not capitalize on the known successful strategies of rereading, looking ahead, or referring to a dictionary or other source. Hypermedia offers the ability to impose comprehension monitoring upon the user. Organizers that are known to improve comprehension monitoring and actively engage readers include the incorporation of structured overview diagrams, adjunct questions, headings, and the inclusion of introductions and summaries. In addition, known effective cognitive learning strategies that may be applied in a hypermedia environment include surveying text material before reading, developing questions about important material, and reading to find the answer to those questions (Balajthy, 1990).

Transfer of knowledge. From the standpoint of instruction, perhaps the greatest problem with hypermedia is the problem learners face in integrating the information acquired in a hypertext into their own knowledge structures (Gleim & Harvey, 1992; Jonassen, 1988; Jonassen & Reeves, 1996). The new information must be related to the user's current knowledge base. Users must develop their own knowledge structures and use them to accommodate the acquisition of the new material; however, the less structured the hypermedia system is, the less likely users are to integrate its contained knowledge (Jonassen, 1988). Gleim and Harvey (1992) state that trying to connect information in multiple ways may create uncertainty in the users, who may then become hesitant to follow linked information because they become unsure of what is expected of them. Grabinger (1996) related a similar concern. There is a need to consider interactive media designs that function as scaffolds rather than always providing an option for full support.

McKnight and Dillon (1996) related that a major weakness of the pedagogical application of hypermedia has been the inadequate theoretical explanation of the nature of learning that hypertext systems might support. In addition, they list problems that exist in research of hypermedia and its effects. These problems include difficulties in controlled experimentation, difficulties in finding valid and applicable tasks, difficulties in describing the research process, and difficulties in defining and measuring the outcomes of learning as directly attributed to hypermedia. Hannafin (1992) stated that the key dimension in hypermedia is not simply the ability to link media, but the ability to manage how linkages occur. He suggested that new design notions must evolve if we are to optimize the capability of emerging technologies for learning.

Navigation. Patterns of navigation can be established by both the author and the user of the hypermedia system. These navigational patterns would appear to be explicitly determined by the linking structure of the system itself. Navigational patterns, however, appear to be driven by

self-regulating activities more than structures imposed by the use of technology. Schroeder and Grabowski (1995) studied the navigational patterns of users in a hypermedia system with three structural conditions. The three treatment groups consisted of (a) linking to information through the use of hotwords presenting links to a related screen, (b) the presence of a hierarchical graphic presentation of links, and (c) the same graphic presentation with the inclusion of a description of the relationships between the linked icons. Key to the study is the presentation of instructional objectives to the participants prior to beginning the hypermedia instruction. In summarizing path analyses of the subjects, no significance can be attributed to any one type of linking architecture. The subjects relied heavily on a passive approach to navigating through the information, which suggests that the subjects followed the objective relationship implied by the program's design in an effort to achieve the objectives of the lesson. None of the architecture types significantly influenced navigation (Shcroeder & Grabowski, 1995).

Gay, Trumbull, and Mazur (1991) tested a hypermedia system which allowed subjects to navigate via three navigation patterns: (a) browsing, (b) utilizing an index, or (c) consulting an on-line guide. Student navigation patterns as well as learning and self-regulation processes were measured. The Learning and Study Skills Assessment Inventory (LASSI) was utilized to measure levels of anxiety, motivation, concentration, use of study aids, and information processing. The subscale measuring the use of study aids focuses on a subject's ability to understand diagrams, use summaries, and understand the importance of section headings as cues, as well as a subject's ability to generate one's own study aids. The subjects worked on the hypermedia system twice. The first session was designed to orient users to the system, take baseline navigation measurements, and reduce the effect of novelty upon the later findings. The second session began with the presentation of focus questions which were designed to form achievement goals for the users. Results show that the index mode was not an effective method for locating information, because the focus questions did not request results in ways directly related to the index. In fact, time spent in the index mode was negatively correlated to the number of relevant items found. The guide mode, however, was significantly correlated with lower anxiety perception by the users, and qualitative analysis showed that some subjects learned and followed new associations to material observed through the use of the guide. While the browse mode was the preferred mode of navigation, the subjects reduced their use of the browse mode from 84% to 57% of the time in subsequent sessions, suggesting the impact of goal-centered activity based on the presentation of the focus questions. The time spent in the browse mode was significantly correlated to the number of relevant items found. The authors suggest that the combination of the freedom offered by the browse mode and the interactive regulation provided by the guide mode should promote the further development of flexible tools for navigation and directed learning in hypermedia (Gay, Trumbull, & Mazur, 1991).

These design issues are not limited to stand-alone instructional applications. Navigation is truly complicated as users foray into the largest hypermedia system, the World Wide Web, which offers the great benefit of vast amounts of information and the seemingly overwhelming complication of complete free-access over this limitless arena. Jakob Nielsen (1997, 1998), who publishes the "column" Alertbox on the web for Sun computers, discusses this problem frequently. As a usability expert, he offers suggestions for designers as well as manufacturers of Internet-based software. Two issues that coincide with much of the literature reviewed here in educational settings include the lack of support for user navigation and the incorporation of well-defined links. Much like educational researchers who focus on hypermedia specifically designed

for instruction, he calls for better tools for Internet users which incorporate such aspects as the ability to bookmark nodes according to relevancy to the user, provide visual navigation histories and the inclusion of link titles which briefly describe the nature of the link before it is selected. Similar to earlier suggestions (Stanton & Baber, 1994; Tudhope & Taylor, 1997), Nielsen (1997, 1998) suggests that browser navigation be developed to show the relationships between pages, eliminating the current limitation of the browser to view the individual “page” as the fundamental unit of navigation. Greater integration between searching and browsing is also recommended, echoing in sentiment the suggestions of his counterparts in educational technology (Gay, Trumbull, & Mazur, 1991; Heller, 1990; Locatis, Letourneau, & Banvard, 1989).

A description of a variety of navigational aids is given for discussing applications developed and in the process of development for hypermedia that could be applied to Internet applications (Bieber et al., 1997). Link markers and corresponding nodes can be coordinated semantically. Connections between links and nodes can be made through the need to see explanation, further details, contrasting arguments, as well as annotations and glossary-type functions. A graphical issue-based information system (gIBIS) is modeled on the premise that key issues culled from the design process can have positions that assert or resolve the issue, as well as arguments supporting or refuting positions. The three node types for this system correspond to issues, positions, and arguments, and navigation is made based on decision types linking these node types. Link types can be presented through the use of pop-up windows or menus available when the mouse cursor moves over the link, frames providing information for link types. The authors suggest that multiple labels can be attached to links by both authors and users of a hypermedia system who may include keywords, label types, and timestamping (Bieber et al., 1997).

Another key asset of hypermedia designed to promote goal-directed user navigation and promote better understanding of content is the provision of annotations (Bieber et al., 1997). Annotations are described as a basic aspect of hypermedia systems and describe current annotation systems which allow three levels of annotation: personal, workgroup, and public annotations. Trails and advances in backtracking are features of navigation that are being developed for further functionality. A trail is simply a chain of links through a hypermedia system which may be recorded by users wishing to remember paths they have taken, as well as by authors or interested third parties who can recommend trails for instructional or information purposes. The suggestion is made that future developments of trails will include semantic linking types, keywords and other attributers, access permissions, views and user information to organize and tailor the system dynamically based on the needs of individual users. Chronological backtracking returns the user through a previous path in reverse order and is readily apparent in most hypermedia environments. Task-based backtracking, on the other hand, restricts backtracking to nodes that are within the current task. Advanced functionality is added to the backtracking feature by including functions or conditions that allow the user to specify nodes based on a parameter of query expression (Bieber et al., 1997).

Smith and Parks (1997) relate findings of usability studies of hypermedia. They suggest that if a navigation aid is to be provided for hypermedia, the navigation aid should be dependent upon the types of tasks to be supported by the system. When dividing navigation behaviors into the two categories of searching or exploration, searching was best suited in hierarchical systems

which provided index-type navigation aids, while graphical aids in a network-based system were most appropriate for exploratory tasks. Unfortunately, these tasks are not mutually exclusive, and task categories are combined within and across users. Predicting which type of task will be performed by individual users is not always possible. The World Wide Web, which is the particular focus of Smith and Parks (1997), represents a network-based system that is too large for the effective use of the preferred navigation method of exploration. In order to provide viable information through user searches, nodes of information in hypermedia systems are being transformed, as discussed earlier. Languages like Java allow a node of information to become a program, far surpassing the concept of a “page” of information. The authors advocate that the user of a network-based hypermedia system, even one as seemingly infinite as the Internet, should be allowed to create task-related searching and navigation external to but utilizing the network facilities. This approach imposes no preordained structure upon hypermedia authors, does not alter information in the system, but allows users to create their own “hypermedia network” upon existing systems for accomplishing their own goals. The construction of user-based hypermedia networks upon an existing system is described as related to the authors’ work on the GENIE Service (UK Global Environmental Network for Information Exchange), a system designed to make data more readily available to researchers throughout the United Kingdom and to advertise the system beyond its borders. The system uses distributed information management software (TIMES) developed by two of the authors in conjunction with several interfacing subsystems. The user interface can be provided through a web browser and the search; virtual hierarchy and virtual network pages which go to the browser are generated dynamically by a CGI (common gateway interface) web server.

Summary of Hypermedia

Hypermedia learning environments offer flexibility to users to make decisions and implement actions to evaluate their own progress and offer the potential for new strategies of learning, studying, and creating (Marchionini, 1988). These systems should capitalize on the inherent possibilities of the technology, which include linking material semantically as well as providing learner aids such as the capability to annotate text by creating notes, explanations, and analogies, bibliographies, or glossaries (Jonassen, 1988). The concept of flexibility extends to the concept of learner control and sequencing of information, considerations which are dependent upon the implied learning task. Complex outcomes may be obtained better through greater learner control of the presentation, while simpler outcomes may be most efficiently addressed under strict program control (Williams, 1996). However, consistent in the literature concerning learner control is the finding that if users are allowed to make decisions about the amount of instruction, practice, or examples, they often make incorrect assumptions about their knowledge and often terminate lessons or the complete system before receiving enough instruction (Shin, Schallert & Savenye, 1994). Most hypermedia fail to provide suggestions about where the user should begin, and this initial failing may greatly affect understanding of both the content and the structure of the system (Jonassen & Reeves, 1996). Unrestrained navigation may not be the key to successful instruction. Instead, hypermedia structures which provide navigation cues related to instructional objectives may combine the flexibility inherent in hypermedia with the ability to obtain information desired in learning tasks.

The use of query languages can provide the benefits of marking and storing relevant source nodes while increasing greater flexibility for the user. As an extension of this hypermedia

characteristic, the concept of the basic hypermedia node may have to be reconsidered to reflect advances in computer languages that provide structure based on semantic relationships, such as inheritance and membership (Stanton & Barber, 1994). These hypermedia characteristics would allow an individual to structure the hypermedia environment to meet the prescribed goals of the user, promoting and sustaining both motivation and increased perception of self-efficacy. Advisement strategies can be programmed (Shin, Schallert, & Savenye, 1994) which impose user-specific guidance and can increase achievement and enjoyment.

Aligned with the tenets of self-regulation, externally imposed mediation upon learning tasks may supersede structural cues provided by the interface or inherent to a hypermedia system. Imposing goals and objectives upon learning tasks may contribute more to user achievement, reduced disorientation, and navigation patterns than imposed structure (Beasley & Waugh, 1995; Gay, Trumbull, & Mazur, 1991; Jonassen, 1992; Schroeder & Grabowski, 1995). Users differ in their ability to impose structure upon hypermedia, but allowing the manipulation of the structure by the user can make content more relevant and meaningful to the user (Jonassen, 1992). Hypermedia may further address components of self-regulation through the utilization of guided tours, paths, filtering information, and evaluating semantic relationships between nodes (Marchionini, 1988). Comprehension monitoring may also be imposed on a hypermedia system by incorporating structured overview diagrams, adjunct questions, headings, and the inclusion of introductions and summaries (Balajthy, 1990).

CHAPTER THREE: METHOD

The study was conceived as developmental research in which components would be added to an existing hypermedia learning environment based on user input. These components would then be evaluated. During the course of the study, it became apparent that the previously existing components of the web site provided important insight into the participants' self-regulation strategy use and it was best to consider all of the components, not just those newly developed.

Due to the length of the study and the multiple data sources, a variety of data gathering and analysis procedures were incorporated. The primary method of analysis utilized in the study was domain analysis as described by Spradley (1980). A full explanation of this procedure and its application to this study is included later in this chapter. In addition, a self-regulation strategy-use index was administered in a pre-, post-, delayed posttest design to measure the effects of participation in the hypermedia environment upon perceived level of self-regulation. Responses to this index were analyzed utilizing paired samples t-tests. An exit questionnaire was administered in a post-, delayed posttest design. Responses from this questionnaire were analyzed through the procedure of domain analysis as well as frequency counts and mean comparisons through the use of paired samples t-tests.

The chapter begins with a description of the participants. Following is a description of the actual electronic materials used in the course including descriptions of web site components extant at the beginning of the study as well as materials developed and utilized throughout the remainder of the study. A description of the data sources utilized throughout the study follows and includes the three primary data sources which were presented on-line and involved collection of responses through a database as well as secondary data sources. Following the description of the data sources is an explanation of the domain analysis procedure with references to data collected in the current study.

The chapter closes with a chronological presentation of the procedures followed through the course of the study. This chronology includes further description of how previously mentioned components and data sources were implemented during the study.

Participants

Participants consisted of the instructor and the students enrolled in a course entitled "Childhood and Adolescence" (FCD 1004) which is offered through the department of Human Development within the College of Human Resources and Education at Virginia Tech. The course is intended to provide an introduction to human development, concentrating on the first two decades of life. It is primarily a first-year course and serves as a major core requirement for both Family and Child Development majors and Health and Physical Education majors. The course also serves as a Social Science university core requirement and is therefore open as an elective to all undergraduate students on campus. Of the students enrolled in the course ($N = 260$), 85 (32.7%) were meeting a major requirement and 140 (53.9%) were first-year students.

Due to the variety of data sources and multiple administrations of two of these, a stratified, random sample ($N=35$) was selected for some analyses. Stratification was based upon

whether the course was a major requirement or elective, and upon the participant's year in school. The year in school stratification was classified as either first-year or not first-year. It is important to note that although participant response to data collection was often high, participation was voluntary and not all students completed all administrations of the data collection. The stratified, random sample was selected from 117 participants who completed all data collection administrations. Bias may exist when considering that these 117 participants may have been more motivated to complete the on-line data collection procedures or more adaptive to the learning environment; however, students neither gained nor lost advantage in the course in the form of recognition or grades by providing data for the purpose of the study. The stratification of this smaller sample to reflect the entire population is an attempt to decrease this bias and provide a workable sample to complete domain analyses.

Virginia Tech is a large state university in Southwest Virginia which has encouraged the development and implementation of numerous on-line and distance-based courses. The course in question previously incorporated web-based instructional elements as ancillary instruction over the course of four semesters with one additional summer session utilizing the web page as the primary source of instruction. Regularly scheduled class meetings occur twice a week and focus on a variety of presentation methods to illustrate materials presented both through the web page and supplemental materials. Students were not required to attend all class meetings due to the information available on the web site; however, all students attended class four times during the semester to take 60-question multiple-choice tests. The study took place during the Fall semester of 1998.

The objectives of the researcher were presented during the introductory weeks of the class both on-line and during class meetings. Self-regulation is a topic discussed in the course and students participated in some of the activities of this study as part of the requirements for the course; however, participants were given the option to have their responses in data collected during these activities to not be included in any analyses relating to this study. Participants had the opportunity to decline from participation in any activities that were implemented strictly for the purpose of the study. Due to the tracking of participant responses throughout the semester, information gathered in this study is confidential but not anonymous.

Materials

Course web site. A template for a suite of course web pages was previously developed and revised for the course instructor over a period of three years. The web pages are intended to augment the class meetings by presenting topics of study, study guides, and content information, as well as multiple-choice quizzes for drill and practice as well as for grading purposes. The main page, of which a portion is given in Figure 3, is entitled the "Game Plan" and is organized as a weekly grid with consistently located activities in each corresponding week's row. The word "Game" is an acronym for phases of self-regulation strategies promoted by the instructor. Corresponding terms for this acronym are Goals, Activities, Monitor, Evaluate.

	Chapter	G Goals	A Activities	M Monitor	E Evaluation
Week 1	Chapter 1: Nature of Child Development	Topic Outline Print and Preview: Study Guide 1	Read: Chapter 1 Attend Class: Aug. 24 & 25 View: Lecture On-Line	Practice: Quiz 1	Quiz 1 for credit by: Aug. 28
Week 2	Chapter 2: Nature of Child Development	Topic Outline Print and Preview: Study Guide 2	Read: Chapter 2 Attend Class: Aug. 31 & Sept. 2 View: Lecture On-Line Lab 1 Self-Regulation Questionnaire	Practice: Quiz 2	Quiz 2 for credit by: Sept. 4
Week 3	Chapter 3: Biological Beginnings	Topic Outline Print and Preview: Study Guide 3 -	Read: Chapter 3 Attend Class: Sept. 7 & 9 View: Lecture On-Line Do: Lab 2: Temperament by Sept. 10	Practice: Quiz 3	Quiz 3 for credit by: Sept. 11

Figure 3. The GAME Plan

The course instructor was responsible for the addition and revision of course material, management of the pages, and all correspondence of an academic nature from students generated from the web pages throughout the duration of the course. The instructor made all revisions to the course content through an Hypertext Markup Language (HTML) editor. Students were responsible for accessing information from the web page outside of the weekly scheduled course meetings. The web pages were accessible through standard web browsers on personal computers with internet access, and students viewed these pages either in their dorm rooms, homes, or in computer labs on campus. All dorm rooms and labs on campus are outfitted with Ethernet access. While the general course pages may be available for perusal by guests, the self-regulation components and all data and collection procedures were protected by participant-selected passwords verified through the use of an on-line database of students registered for the course.

Components of the original web page included the following: (a) a Topic Outline which listed learning goals for the week; (b) a Study Guide which presented detailed questions, comments, and terms which the students were responsible for investigating throughout the week; (c) the Lecture On-line which was a slide presentation of content which could either be viewed or printed in a graphic or text-based form; and (d) a Practice Quiz and (e) graded "Real" Quiz which presented 10 randomly-selected, multiple-choice questions from a test bank. The test bank was developed and presented utilizing a FileMaker 3.0 database. Students could take the Practice

Quiz as often as they wished and received confirmatory feedback upon answering each question. In addition, surveys and questionnaires were offered as Labs which often included follow-up information in the form of explanation of scores and hyperlinked elaboration.

On-line databases. FileMaker Pro 4.0 was used to collect data from participants as well as to administer some functionality related to the web site. Some of these database functions included providing access to password-protected components of the web site as well as storing student data such as grades and responses from on-line labs. The FileMaker Pro 4.0 databases were housed on a Macintosh server using Lasso 3.0 server software, due to Lasso's integration of the FileMaker Pro commands.

FileMaker Pro 4.0 provides relational capabilities between separate database files, the ability to interface files through the World-Wide Web, as well as the possibility for automated electronic mail notification to users (Langer, 1998; Schwartz, 1998). Using a combination of HTML tags and Claris Dynamic Markup Language (CDML) tags, FileMaker Pro 4.0 files can be accessed through a standard browser. These database files can be manipulated through the browser from remote computers. File manipulation by remote users can include the creation, revision, and deletion of records with a variety of security privileges ranging from read-only access of records to complete free-access dependent upon password combinations.

Two plug-ins were used in conjunction with the FileMaker Pro 4.0 databases to enhance the functionality of the databases. The scheduling plug-in "Schedule-it" allowed the scheduling of FileMaker events on a recurring basis. These tasks once scheduled, such as sorting or running of scripts, would occur at regulated intervals automatically. In addition, the "Mondo Mail for FileMaker" plug-in expedited the sending of electronic mail. This plug-in allowed for the creation and manipulation of many of the components of a standard email message, such as the sender, receiver, and message. These electronic mail components could be altered remotely through the use of HTML pages linked to the FileMaker Pro databases.

The extant course web page was housed on a separate Macintosh server utilizing FM-link server software. The site was not housed on a single server. Both the instructor and existing components of the web site depended upon functionality and access available on the original server. The site utilized a FileMaker 3.0 database for the weekly quizzing of students and did not contain software that allowed the incorporation of FileMaker 4.0. The quiz database, which was a major component of the extant web site, contained a question bank for each week of the course and interfaced with the web page through the use of FM-Link software. Students were able to access questions from the database each week as many times as they wished in the form of a randomly-generated, 10-question, multiple-choice practice quiz which provided confirmational feedback to each question answered. In addition, each student could access the database only once a week for a graded quiz. Grades from these quizzes were stored in a separate text file and available only to the course instructor and server administrator.

Class listserv and electronic mail. Class listservs are regularly created for courses registered within the university curriculum by the university at the option of the instructor. The current instructor incorporated the use of a listserv for the class. The listserv postings to the entire class were restricted to the instructor, her teaching assistant, and the researcher, who worked as a technical assistant for the semester. These postings commonly consisted of

announcements regarding class procedures and schedules as well as supplemental content information, some of which was student-initiated. In the latter case, a student might email comments, a web site URL, or an attachment to the professor and she could then post selected materials to the class via the listserv once garnering the student's permission. Students could not post to the listserv directly. Private correspondence between instructor and student was handled through electronic mail. The instructor scheduled time each weekday for email correspondence as a type of "virtual office hour" as well as providing for the opportunity for face-to-face meetings, if arranged.

Data Sources and Collection Procedures

Data from participants came from six sources throughout the semester and are fully elaborated upon below. Three of these sources are primary data sources and include the "Motivated Strategies for Learning Questionnaire" (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991), comments generated by questions on the class listserv, and an exit questionnaire at the conclusion of the semester. Secondary data sources included frequency counts of usage of the additional components developed and employed throughout the first half of the semester in response to participant recommendations. A final data source included input from the course instructor made throughout the semester.

MSLQ. Participants completed the "Motivated Strategies for Learning Questionnaire" (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991), an index of self-regulation strategy use, during the second, ninth, and final week of the semester. Based upon the general cognitive view of motivation and learning strategies, the MSLQ is designed to assess college students' motivational orientations and their use of different learning strategies for a college course. Sample statements from the index include, "If I can, I want to get better grades in this class than most of the other students," and, "When I take tests I think of the consequences of failing." These statements are rated on a seven-point scale whether the statement is "very true" of the participant or "not at all true" of the participant.

The MSLQ contains 15 subscales which make up two major sections concerning motivation and learning strategies selection, respectively. The motivation section consists of 31 items that assess student goal and value beliefs for a course, beliefs about their skill to succeed in a course, and test anxiety. The learning strategies section contains 31 items regarding student use of cognitive and metacognitive learning strategies. The second section also includes 19 items concerning student management of different resources. The subscales are designed to be modular and adaptable to individual courses; however, all 15 subscales were utilized for this study (Pintrich, Smith, Garcia, & McKeachie, 1991).

The MSLQ was incorporated into the course content during the second week of class and participants completed the index as the "lab" on the topic of self-regulation as part of that week's course activities. Participation was high during this first administration ($N = 246$). The remaining two administrations were voluntary, and although participants received encouragement from the instructor responses were not as high as the first administration. ($N = 116$ and $N = 143$, respectively). This resulted in a smaller final population from which to draw the stratified, random sample, which was discussed previously.

Listserv questions. A series of three questions was posted to the course web page during the third, fifth, and seventh week of the semester. The listserv was utilized by the researcher to notify students of the presence of the questions on the course web site and to request input. Participants were provided the opportunity to present short answers to each of the questions which allowed for highly specific answers. The questions often addressed the same concepts but were varied over the three presentations. A sample question from week two is, “How did you prepare for the exam OFF-line?” while one of the final set of questions is, “What is the most difficult learning activity you associate with using this web site?” The full series of listserv questions is presented in Appendix B.

Response rates for the listserv questions varied, with the second set of questions ($N = 42$) resulting in the lowest response rate as compared to the first set of questions ($N = 117$) and the final set of questions ($N = 71$). Responses were anonymous, however, and no effort was made to determine which participants did or did not respond to these questions.

The questions were analyzed utilizing the procedure of domain analysis (Spradley, 1980) to determine the effectiveness of the existing regulation components imposed by the web site and the need for additional components to meet participant goals. Through the analysis of email responses and these listserv questions, terms given by the participants and the relationships implied between these terms were utilized to describe new components intended for the web site. These components were intended to fill needs expressed by the participants. Components developed included the capacity to monitor grades (grades on-line), establish date-based goal reminders (goal checklist), and elaborative feedback in testing situations.

Exit questionnaire. An exit questionnaire allowed participants to self-report their use of learning strategies, web site components, as well as affective data about the web site and its components. Participants answered questions regarding the type of learning strategies they used during the semester as well as the frequency and effectiveness of components of the web site. The exit questionnaire was presented twice during the semester, once during the ninth week and once during the final week of the semester.

Responses from the exit questionnaire included Likert-type scale items as well as opportunities for short responses. The exit questionnaire was administered on-line and all responses were stored in a FileMaker Pro 4.0 file. Both administrations of the exit questionnaire resulted in a similar percentage of responses, with the first administration response rate ($N = 138$) slightly higher than that of the second administration response rate ($N = 117$). Appendix C contains the full exit questionnaire.

Data Analysis

Self-regulation strategies. It is important to note that six self-regulation learning strategies culled from the review of self-regulation literature served as a focus in the adaptation of the course web pages for the purpose of this study. All six of these strategies are noted as strategies most often utilized by students with high levels of perceived self-regulation (Risemberg & Zimmerman, 1992; Zimmerman & Martinez-Pons, 1986, 1990). They include (a) keeping records and monitoring, (b) reviewing notes, (c) organizing and transforming, (d) seeking information from nonsocial sources, and (e) seeking teacher assistance. The sixth strategy is

goal-setting behavior, which finds further support in the literature describing the self-regulation process (Ames & Archer, 1986; Bouffard, Boisvert, Vezeau, & Larouche, 1995; Butler, 1997; Dweck, 1986; Ertmer & Schunk, 1997; Meece, 1994; Miller, Behrens, Greene, & Newman, 1993; Zimmerman & Kitsantas, 1997). These six strategies serve as a basis for comparison between the body of self-regulation and findings from the current study.

Domain Analysis. The procedure of domain analysis was utilized throughout the course of the study to ascertain the need for new web site components as well as to evaluate the existing and new web site components. Domain analysis, as described by Spradley (1980), is a search for patterns within a culture. In this case, the culture was the interaction by the participants within and relating to the use of the course web site. Like patterns comprised cultural domains, or a group of different objects which were treated equivalently. In this study, data collected from the MSLQ, class listserv, and exit questionnaire was analyzed for patterns of knowledge, behavior, and the creation of artifacts within the culture.

Cultural domains are made up of three basic elements: (a) a cover term, (b) included terms, and (c) semantic relationships. The cover term is simply the name of the cultural domain while the included terms are names for smaller categories inside the larger cultural domain. Semantic relationships are the links between two or more categories. Spradley (1980) describes nine types of common semantic relationships, with spirit inclusion and means-end being the most common. These descriptions are presented in Table 4.

Table 4.

Semantic Relationship Types (Spradley, 1980)

Relationship	Description
Spirit inclusion	X is a kind of Y
Means-end	X is a way to do Y
Spatial	X is a place in Y
Cause-effect	X is a result of Y
Rationale	X is a reason for doing Y
Location-for-action	X is a place for doing Y
Function	X is used for Y
Sequence	X is a step or stage in Y
Attribute	X is an attribute or characteristic of Y

Cultural domains may be described using folk terms, analytic terms, or a mixture of the two. Folk terms are derived from the way participants within a cultural domain speak. When descriptions of terms or semantic relationships are made utilizing folk terms, these descriptions comprise the folk domain. An analytic domain is comprised of terms not within the language of the culture's participants. The terms used in this case are analytic terms. When only a few folk terms exist, but analysis indicates that additional patterns of knowledge, behavior, or artifacts exist which need labels, these items comprise a mixed domain. The type of term used is not as crucial for determining cultural domains as is the identification of terms and semantic relationships.

Spradley (1980) further details seven steps for completing a domain analysis. Information from data sources is reviewed looking for the names of things. These things may include objects, places, people, and procedures. These different things may be grouped in kind due to a semantic relationship (see Table 4). The researcher prepares a worksheet to describe a semantic relationship within a domain, including the terms related to the chosen relationship. Multiple semantic relationships may be identified and the procedure is repeated for each observed semantic relationship. The total of worksheets can be compiled as a list of all identified domains, including the cover terms, included terms, and semantic relationships for each. In this study, instead of a worksheet, responses to individual questions were placed in a database and terms and relationships were determined through repeated analyses. The use of a database allowed for quick organization and searching capabilities and allowed for a timely review of large amounts of data.

An example of a single analysis of one of the listserv questions is shown in Figure 4. In this example, a domain analysis relating to types of learning strategies utilized by participants was undertaken. The first question from the first administration of the listserv questions is in the green box followed by a participant's response. This response is followed by a list of the original six self-regulation strategies which serve as the focus of the study with check boxes to indicate which strategies may be described by the participant's response. Following the original six strategies, the analysis indicated that additional learning strategies were incorporated by the participants beyond the original six focus strategies, and the remaining strategies identified by Zimmerman and Martinez-Pons (1986) were included in the domain analysis procedure along with variations of some of these strategies specific to the hypermedia environment (i.e., review text/media and review web site). Fields at the bottom of Figure 4 allow for additional descriptors and keywords to be entered as well as the ability to link responses to specific web site components.

Eval 1A

Layout #1

Records: 117

Unsorted

21

What type of self-regulation strategy (strategies) have you utilized when utilizing the course web site?

SR_Strategy I now use Netscape to work in this web site. I always read emails relating to this class. I attempt to visit the web site at least three times per week. This would be to print the study guide, view the lecture, do practice quizzes and questionnaires/labs, and to take the quiz.

strategy ☒ setting goals ☐ reviewing notes ☐ seeking information
☐ keeping records ☐ organizing and transforming ☐ teacher assistance

3. **Goal-setting and Planning:** Setting of educational goals or subgoals and planning for sequencing, timing, and completing activities related to those goals by the student.
5. **Keeping records and Monitoring:** Student-initiated efforts to record events or results.
13. **Reviewing records:** Student-initiated efforts to reread notes.
2. **Organizing and Transforming:** Student-initiated overt or covert rearrangement of instructional materials to improve learning.
4. **Seeking information:** Student-initiated efforts to secure further task information from nonsocial sources when undertaking an assignment.
10. **Seeking social assistance:** Student-initiated efforts to solicit help from teachers.

otherstrategy ☒ self-evaluation ☐ rehearsing; memorizing ☐ reviewing tests
☐ environmental ☐ assistance from peers ☒ reviewing text/media
☐ self-consequences ☐ assistance from other adults ☐ review website

1. **Self-evaluation:** Student-initiated evaluations of the quality or progress of their work.
6. **Environmental:** Student-initiated efforts to select or arrange the physical structuring setting to make learning easier.
7. **Self-consequences:** Student arrangement or imagination of rewards or punishment for success or failure.
8. **Rehearsing and Memorizing:** Student-initiated efforts to memorize material by overt or covert practice.
9-11. **Seeking social assistance:** Student-initiated efforts to solicit help from peers (9), and adults (11).
12-14. **Reviewing records:** Student-initiated efforts to reread tests (12), or textbooks (14) to prepare for class or further testing.

strategy not listed check email (teacher assistance)
keywords computer skill; pace
example possible
guided activity ☐ topic outline ☒ study guide ☒ lecture ☒ practice quiz ☒ lab

100 Browse

Figure 4. Domain analysis worksheet

The domain analyses procedure was also used after the conclusion of data collection to determine if relationships exist between reported levels of self-regulation and usage patterns of components developed for this study. The analyses were intended to determine the existence of any relationships between which components participants thought they needed and their actual use of the components. Due to the large amount of data available throughout the semester, this final domain analysis was limited to the stratified, random sample of 35 participants.

Trustworthiness of the data. Researchers addressing the assessment of an ethnography often cannot rely on methods designed for strict empirical research. The concepts of validity and reliability may not be as clearly demarcated in the qualitative realm as in its quantitative counterpart, and the statistical tools available in a quantitative assessment may not be appropriate elsewhere. This does not suggest, however, that generalizations and claims proposed in an ethnographic report cannot be scrutinized and evaluated. Hammersley (1990) suggests that the

validity of ethnographic claims can be assessed on three accounts: plausibility, credibility, and validity. If the claims are likely to be true given the existing body of knowledge, the claims may be said to be plausible. Credibility refers to whether the claims made are accurate given the nature of the phenomenon explored, the circumstances of the research, and the characteristics of the researcher. Claims that are very plausible or highly credible should be accepted as valid without further evidence. If neither occurs, it is the obligation of the researcher to provide evidence to support claims utilizing data collected throughout the study. In the current study, evidence is provided by the presentation of quantitative analyses of selected data such as the MSLQ subscales, frequency counts self-reported by users and corroborated through review of components, as well as affective data obtained throughout the semester through the use of on-line questionnaires and electronic mail correspondence. Claims that are plausible and credible, or claims that are indeed supported by further evidence, may be considered valid.

Miles and Huberman (1984) further warn about concerns that must be heeded in qualitative research. Multiple sources of bias within the analytic process can weaken or even invalidate possible findings. They identify three of these primary biases. Holistic fallacy implies that events are more patterned or congruent than they really are. An elite bias occurs when data from accessible, articulate, or elite participants is more prevalent or weighted more heavily than that from less articulate participants or those of a lower perceived status. Also, the researcher may succumb to cooptation, or becoming too entrenched in the perceptions and explanations of the participants and not remaining distant enough to make valid observations and judgments. Fortunately, Miles and Huberman (1984) also suggest strategies the ethnographic researcher may employ to avoid these biases in qualitative analysis. Several of these research strategies are listed below along with their methods of employment within the current study.

The researcher must check the “representativeness” of the informants, events, and processes. This can be accomplished by including a large number of cases for study, looking for cases which are negative or extreme, or by sorting the cases systematically and evaluating case types not fully represented. Within the present study, the number of potential cases and the duration of the observation are sufficient for providing data from representative members of the population. The most complex analyses included assessment of the hypermedia components incorporated within the web site that were cross-referenced to questions from the exit questionnaire. The use of a stratified, random sample was a procedure utilized to check for the representativeness of the data collected.

Assessment of an ethnographic report must consider the possibility of researcher effects. The researcher may have effects upon the site while the site may also influence the researcher. Miles and Huberman (1984) suggest the researcher stay on the site as long as possible and use unobtrusive measures whenever possible. Similar to representativeness, the site may influence the researcher in the form of elite bias if data is not collected from varied members of the population. Site effects can be reduced by including extreme cases, those with negative attitudes or different points of views, and triangulating with several data collection methods. An outside reader is also helpful to identify biases which may be present inadvertently.

In the current study, the period of observation was the complete semester in which the course web site functioned, and all participants were possible data sources. As was mentioned in the description of the participants, it is important to note that some bias may exist in the analyses

of responses from the stratified, random sample. This sample was drawn from 117 participants who completed all three administrations of the MSLQ as well as both administrations of the exit questionnaire. Stratification was utilized to reduce the possibilities of bias and better represent the full population since not all members of the population completed all data sources.

Triangulation is directly addressed through the use of many and varied data collection methods, including the MSLQ, open-ended responses from the class listserv, frequency and affective data from the exit questionnaire, as well as analysis of usage patterns of the implemented hypermedia components. Outside readers were also available throughout the data collection and analyses stages.

Procedure

This section contains examples of components of the web site which may have been previously mentioned as well as the three newly added components which were a result from this developmental study. However, the components are listed in the order in which they were presented to the participants with further elaboration. To help clarify components and their chronology within the course of the study, Table 5 presents a week-by-week account of actions related to the study which occurred throughout the semester.

Table 5.

Chronology of Study

Week	Data Source or Component Added	Analysis Procedure	<u>N</u>
2	MSLQ (1)	Paired samples t-test	246
3	Listserv questions (1)	Domain analysis	117
4	Grades on-line added		
5	Listserv questions (2)	Domain analysis	42
6	Goal checklist added		
7	Listserv questions (3)	Domain analysis	72
8	Elaborative feedback	Domain analysis	
9	MSLQ (2)	Paired samples t-test	116
9	Exit questionnaire (1)	Domain analysis, frequency count, paired samples t-test	138
16	MSLQ (3)	Paired samples t-test	143
16	Exit questionnaire (2)	Domain analysis, frequency count, paired samples t-test	117

MSLQ. Participants completed the “Motivated Strategies for Learning Questionnaire” during the second, ninth, and final week of the semester. This 81-question index provided scores for 15 subscales relating to self-regulation strategy use by participants in this specific course. Statements such as, “It is my own fault if I don't learn the material in this course” were rated by participants on a seven-point scale as being either “very true” or “not at all true” of the participant. Analyses of these subscales were run on the stratified, random sample.

Upon completion of the index, participants were immediately notified of their scores in each subscale. An example of this score reporting is given in Figure 5. Participants who view this screen are given their score in each of the 15 subscales and a brief interpretation of each subscale.



Figure 5. MSLQ results

Subscale scores that represented areas of weakness in self-regulation were paired via hyperlinks to additional information regarding further explanation of the subscale and a description of strategies that students may employ to encourage greater success in these areas. In Figure 5, these hyperlinks can be seen as the blue, underlined text in the far right column. Hyperlinks were score-sensitive and only appeared when scores on the given subscale indicated a need for further strategy knowledge and practice.

An example of one of these further elaborations is given in Figure 6. This figure illustrates strategies relating to the Interest subscale of the MSLQ. Participants could access their own previous scores, the hyperlinked self-regulation strategy suggestions, as well as resources for further information directly from the web site Main Menu at any time after the completion of the first index. The index was presented on-line within the framework of the class with responses stored in a FileMaker Pro 4.0 database. An example of further elaboration and discussion of the MSLQ scores hyperlinked to the MSLQ results is given in Figure 6, while the complete MSLQ is provided in Appendix A.



Figure 6. MSLQ further elaboration

Grades on-line. During the first two weeks of the course, participants immediately began making requests from the instructor for a method of viewing their grades on-line. Previously, the instructor had posted grades to the class via the class listserv and using the last four digits of each student number. The volume of requests for on-line viewing of grades during the first two weeks of the semester promoted the development of the first added component to the web site, grades on-line.

Using a FileMaker Pro 4.0 database, student grades from quizzes and exams were downloaded once a week and imported into a gradebook database. These grades were then available for review to individual students after confirmation of their identity through the use of their chosen course password. Students were shown all of their recorded grades as well as averages and a final grade which was calculated with each new addition. An example of the student record in the grades on-line component is given in Figure 7.



Grade entry for: John Ross

Number	Quiz Grades Quizzes are worth 10% your final grade.	Lab Grades Labs are worth 10% your final grade.	Exam Grades Exams are worth 80% your final grade.
1	5	10	100
2	9	10	0
3	0	10	97
4	7	0	0
5	8	10	
6	6	10	
7	0	10	
9	0		
10	0		
11	0		
12	10		
14	10		
15	0		
16	0		
17	0		
Averages:	3.66666666666667	8.57142857142857	49.25
Your grade at this point =			51.6380952380952

Figure 7. Grades on-line

The grades on-line component was also available to the instructor as a master gradebook through a series of web pages. The instructor could not only view but could also edit grades through a standard web browser. The instructor could view an individual student record, grades for all students on an individual graded activity, as well as all grades for all students.

Goal checklist. The results of the domain analysis of the first series of listserv questions (N = 117) indicated that some participants missed deadlines associated with the course. Most of these deadlines related to graded activities, such as quizzes. One participant even commented, “. . .you could add a box that allows us to write down our goals if we want to. . .so that way we can see if we are sticking with it or not.”

In response to this and other comments relating to deadlines and goals, the goal checklist was developed utilizing a FileMaker Pro 4.0 database which was accessed through a series of web pages linked to the main menu of the course web site. Goals could be added through the interface shown in Figure 8.

Add Goals to Checklist

You will be returned to this page to Add more goals. To **VIEW** or **EDIT** your added goals, please use the buttons at the bottom of the page.

Priority	Order	Goal	Chapter	Date Due	Completed
A	1		1	9/5/98 (ie. 9/5/98)	NO

To assure proper assignment, please enter your PID again:

An e-mail reminder will be sent on the Due Date you have selected above.

Figure 8. Adding goals to the goal checklist

Records in this database were created and edited by participants. Each had the capability to create new records each week consisting of self-selected instructional goals for the week and projected completion date. Participants were also able to edit their own records at any time. Goals that were not completed prior to the participants' chosen deadline date triggered electronic mail notification reminders to individual participants. The Schedule-It plug-in triggered a script once every morning which searched the goal checklist database to find reminders which were to be mailed that day. The MondoMail plug-in then compiled and mailed these reminders to individual participants through the use of a standard electronic mail program. These reminders were intended to address the problem of missed deadlines. An example of a student-created reminder appears in Figure 9.

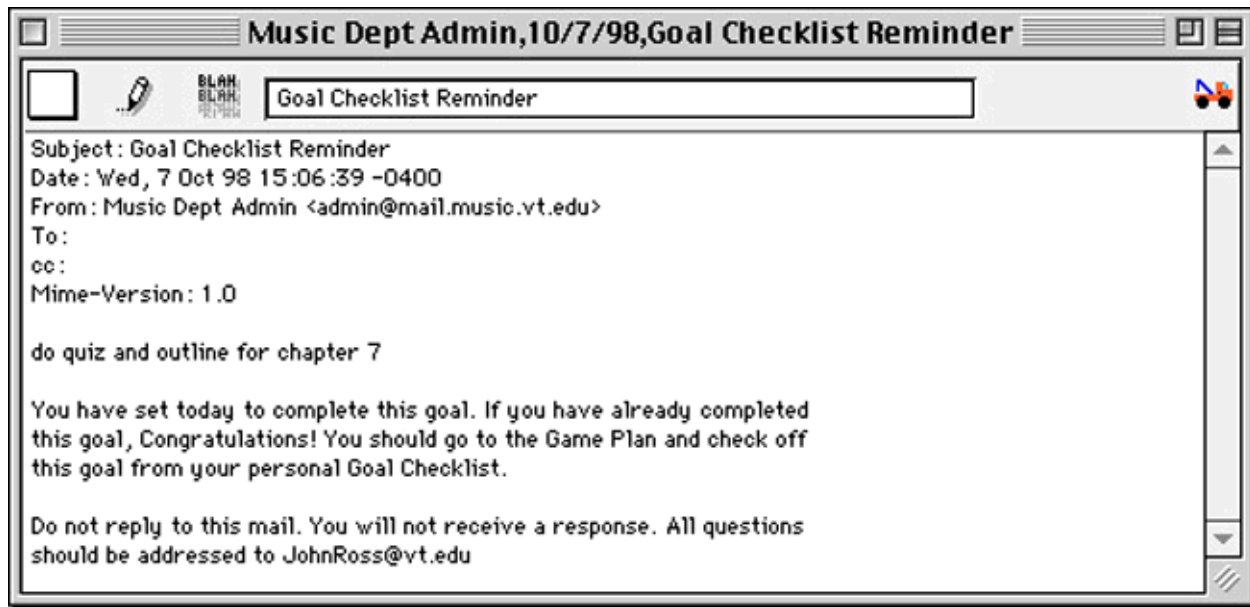


Figure 9. Goal checklist reminder

Elaborative feedback on quizzes. The results of the domain analysis of the second set of listserv questions ($N = 42$) continued the discussion of participant dissatisfaction with the current quizzing system occasionally mentioned in the first set of listserv questions. During practice quizzes, participants received confirmatory feedback after answering each question. Following the completion of the graded quiz, the only feedback participants received was outcome feedback giving the number of questions answered correctly. No indication was given of which questions were answered correctly nor what were the correct responses to missed questions. Responses such as the following were common, “one problem I have is if I get a question wrong I don’t know which one and how to fix it. So if I get it wrong on the quiz I may get it wrong on the test.”

The extant quiz database was developed in FileMaker 3.0 and relied on FM-Link server software to serve the pages to the participants. An attempt was made to shift to an on-line testing environment called “Whiz Quiz” in order to provide participants with the elaborative feedback they desired, called cognitive validity feedback by Butler and Winne (1995). Whiz Quiz was developed at Virginia Tech for use by faculty. While the multiple-choice feel of the tests remained the same, upon completing the Whiz Quiz version of the graded test, participants received feedback indicating not only the number of correct responses but their responses to each question, which questions were answered correctly and incorrectly, and the correct response--if not given by the participant.

The Whiz Quiz format was utilized for the administration of two graded quizzes; however, the reporting of the grades to the instructor proved to be unreliable. Unfortunately, the Whiz Quiz format was dropped and a suitable replacement was not found within the remainder of the course.

Exit questionnaire. The exit questionnaire was administered twice during the semester. It was presented first during the ninth week of the semester following the final addition of the three hypermedia components requested by the participants and once in the final week of the semester.

The Exit questionnaire was presented on-line and responses were stored in a FileMaker Pro 4.0 database.

CHAPTER FOUR: RESULTS

The findings in this chapter are presented in relation to the research questions. Each of the four subquestions are restated individually followed by pertinent findings and supporting discussion relating to that question. Addressing the four subquestions in this manner provides support for answering the more global questions from which they were derived. Often, the findings from separate subquestions can be combined to offer support for points of discussion; therefore, the individual subquestions are not summarized in this chapter. A summary addressing the more global research questions but utilizing the results presented here is provided in the final chapter.

When reporting findings from statistical tests, an alpha level of $p \leq .05$ was used, although two-tailed tests should be read with an alpha level of $p \leq .025$. Unless indicated, no significant difference was found in responses between the two administrations of the exit questionnaire. In reporting statistics from the exit questionnaire, figures given are taken from the second administration of the questionnaire.

Question I.1.1

What influence does perceived level of self-regulation have upon self-regulation strategies employed in an instructional hypermedia environment?

A series of paired samples t-tests indicated a significant difference in three of the 15 subscales in the MSLQ (see Table 6). Mean scores for the stratified, random sample ($N = 35$) for the subscale measuring self-efficacy for learning and performance were significantly greater for the third and final administration of the MSLQ over both the first and second administrations. Mean scores for test anxiety measurements showed a significant decrease between each subsequent administration of the index. Scores for the test anxiety subscale are read in opposition to the other scales; a low score indicates a lower perception of test anxiety. In addition, mean scores for the subscale measuring metacognitive self-regulation increased significantly between the first and third administration of the index.

Table 6.

Motivated Strategies for Learning Questionnaire

Subscale	First		Second		Third		p		
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	1:2	1:3	2:3
Intrinsic Goal Orientation	5.252	.992	5.192	1.055	5.300	1.056	.694	.743	.544
Extrinsic Goal Orientation	5.550	1.081	5.543	.952	5.321	1.119	.961	.112	.157
Task Value	6.375	.716	6.348	.700	6.405	.615	.783	.776	.534
Control of Learning	5.602	.732	5.847	.695	5.841	.872	.068	.069	.971
Beliefs									
Self-efficacy for Learning	5.863	.847	5.290	.881	6.248	.727	.526	*.001	*.001
and Performance									
Test Anxiety	4.029	1.397	3.531	1.525	3.164	1.483	*.025	*.000	*.015
Rehearsal	5.186	.997	5.403	.966	5.500	1.126	.228	.081	.503
Elaboration	4.981	1.095	5.009	1.116	5.019	1.015	.856	.812	.927
Organization	4.450	1.385	5.009	1.116	5.019	1.015	.856	.812	.927
Critical Thinking	4.211	1.532	4.314	1.679	4.406	1.633	.494	.250	.550
Metacognitive Self-	4.453	.929	4.592	.944	4.809	1.037	.101	*.006	.035
Regulation									
Time and Study	5.124	.975	5.113	1.038	5.254	.968	.933	.301	.240
Environment									
Effort Regulation	5.329	1.155	5.136	.882	5.181	1.162	.196	.314	.777
Peer Learning	3.543	1.172	3.657	1.290	3.643	1.784	.538	.724	.948
Help Seeking	4.143	1.291	4.000	1.103	4.179	1.067	.457	.848	.242

Note. df for all test = 34; N = 35

* indicates significance

When asked to indicate which one learning strategy from the six self-regulation learning strategies addressed in this study was used, members of the stratified, random sample ($N = 35$) self-reported that reviewing notes was the most common learning strategy. Domain analysis of the responses to the listserv questions concerning this same topic differ, however. From the analyses, six different strategies were rated higher than reviewing notes, with two of these indicating strategies not included in the original six strategies which serve as the focus of the study. Keeping records and self-evaluation were the two most often cited learning strategies in this analysis. Strategies most often mentioned from the listserv question responses are presented in Table 7.

Table 7.

Domain Analysis: Frequency of Learning Strategies

Strategy	Frequency of term usage in 117 Records	Percent
*Keeping records	37	32.6%
Self-evaluation	35	29.9%
*Setting goals	32	27.4%
Pacing	27	23.1%
Reviewing web site (layout)	20	17.1%
Reviewing text/media	22	18.8%
*Organizing and Transforming	12	10.3%
*Reviewing notes	8	6.8%
Checking email	5	4.3%
*Seeking information	3	2.5%
Reviewing tests	2	1.7%
*Seeking teacher assistance	1	<1%

Note. *Indicates original six strategies

Consideration should be given to the sequencing of the evaluations. The listserv questions were presented at the beginning of the semester prior to the inclusion of new components, while the self-reporting on the exit questionnaires occurred at the midterm and

conclusion of the semester. At the time of the listserv questions, it may be assumed that some students may have still been developing their strategies for utilizing the web site and may have not yet established their final strategy use patterns. The later temporal element of the self-reporting on the exit questionnaire may have led students to actually believe that reviewing notes was their most often utilized strategy.

In addition, utilizing the logic of domain analysis, the strategy of reviewing notes may be considered only one aspect of a larger strategy simply designated as “reviewing.” Students not only reviewed notes they either printed from the web site or compiled on their own but reviewed the actual layout of the web site for structural clues as well as reviewing the web site and textbook for content. Two of the 35 participants even indicated they reviewed old tests. When considering all of the responses under the category of reviewing, this strategy becomes the most often utilized strategy as determined by domain analysis of the listserv questions with 44.4% of the respondents indicating they perform some type of review activity.

Responses, such as the following, indicate that not all record keeping consisted of completely student-generated materials. Instead of just taking notes, students found printing components of the web site useful.

Being able to print out info. such as study guides and practice quizzes is a great help. I am able to budget my time better since I don't have to run all over campus to complete activities for this class. I am able to complete the assignments from the comfort of my own room.

Much like the previous participant quotation, responses to the listserv questions often indicated several strategies utilized in combination. Similar to this response, one new strategy that was not often mentioned in the literature dealt with the domain of pacing. Terms related to pacing often grouped into different types of pacing, such as being able to “go at my own pace” and the ability to “get ahead” in the assigned work. Going at one’s own pace does not imply going either quickly or slowly through the material but simply completing material when convenient. Learning strategies are often combined. Pacing is often combined with goal-setting and monitoring behaviors, illustrated best by one student who, after describing a typical week’s pace, noted, “I take the practice quiz to see how I am doing. If I do well then I go ahead and take the real quiz.” The following student response supports the use of goal setting strategy in combination with pacing and is typical of responses regarding this additional strategy.

I go about the same schedule and pace each week. I print out the study guide and fill it in on Sundays, do any labs on Mondays, complete practice quizzes on Tuesdays, and take real quizzes on Wednesdays. I find that if I stick to this schedule I keep myself ahead of my work. I enjoy working online at my own pace.

The sample group indicated a significant decrease in their perception of test anxiety throughout the semester as measured by subsequent administrations of the MSLQ. The chance to practice testing situations on the web site in a similar form as the true testing situations may have helped to decrease the participants’ level of test anxiety. Many students note utilizing the practice quiz component “over and over.” The use of the practice quizzes resulted in the single most

common activity for the self-evaluative learning strategy. The popularity of the practice quizzes is further supported in the domain analysis in two administrations of the listserv questions. In the first series of questions, participants indicated they used some form of a self-evaluative strategy, most often indicating the use of the practice quizzes. One participant reported,

I often complete assignments, such as quizzes, easier since they are on the web at all times of the day/night. I feel I can complete them at my own pace. Being able to print out info. such as study guides and practice quizzes is a great help.

Similar examples are found in the analysis of responses to the question, “What did you do to prepare for this exam ON-line?” This question, from the second administration of listserv questions, indicated that participants utilized self-evaluative strategy far greater than any other strategy, also confirming the use of the practice quizzes as the one component most often used in this self-evaluative behavior. Even though participants self-reported on the exit questionnaire that they utilize the strategy of reviewing notes most often, this conflicts with the analysis of this second set of listserv questions. Over 83% of those responding to the on-line exam preparation question indicated they utilized self-evaluation through the use of the practice quizzes more than any other learning strategy. One student even noted, “I did every quiz until I got them all right.” Although not all participant responses indicated this stringent level of mastery, the practice quizzes were the most often utilized component to prepare for exams on-line (see Table 8).

Table 8.

Component Use for Exam Preparation On-line

Component	Frequency of mentions in 42 records	Percent
Practice quiz	35	83.3%
Lecture on-line	15	35.7%
Study guide	12	28.6%
Email to professor	12	28.6%
Grades on-line	0	-
Topic outline	0	-
Goal checklist	0	-
Elaborative feedback	Not in implementation	-

Consistently throughout the presentation of listserv questions, very few responses indicated specific desired changes for the web site. Many of the student responses were overwhelmingly positive, and soliciting suggestions for specific additional components yielded very little guidance. It was only through the analysis of reported behaviors that additional components were developed. When asked how the web site could have better prepared students for the in-class exams, one student enthusiastically replied,

I don't think that there could have been a better way to prepare for the exam. When I first came to this class, I wasn't sure how I would do with a majority of the course being online. But, I think that you have done such a good job with the web site and I find it very easy to follow and it shows in my grades. THANKS!!

Question I.1.2

What self-regulation strategies do students manifest off-line to accomplish learning tasks related to an instructional hypermedia environment?

Responses from participants throughout the period of study indicated that a majority of the time and activities associated with the class occurred on-line, not off-line. In the first set of listserv questions, 32.6% of the participants ($N = 117$) indicated that they utilized the strategy of keeping records. While not explicit in determining the type of records kept, subsequent questioning divulged that they not only kept their own notes, but printed out components of the web site—even components that were not originally intended to be printed. One participant mentioned, “I have printed out all the notes and quizzes.”

The study guides were presented both in HTML format, which contained some site-specific graphics such as the navigation header and no page formatting, as well in a Portable Document Format (PDF) which provided students pages better formatted for printing with no graphics. The study guides were intended to be printed and then filled in by the student while viewing the lecture on-line or when reading the textbook. The exit questionnaire indicated that many students did indeed print out the study guide once a week ($N = 35$, $M = 1.9143$, $SD = .8179$) with 94.3% of the stratified, random sample indicating they print out the study guide at least once a week.

To ascertain this, participants were asked, “How often do you print out the study guides from the web page?” Possible responses for this and several other component frequencies include: never (0), less than once a week (1), once a week (2), several times a week (3), once a day (4), and several times a day (5). While presented on this scale ranging from zero to five, this mean score ($M = 1.9143$) appears low. However, a score of two indicates that the participant printed out the study guide “once a week.” Since the information on the study guide for each chapter did not change, there was no need to print out the study guide more than once. The mean score ($M = 1.9143$) from the exit questionnaire indicates that most students in the stratified, random sample did print out the study guide. One participant noted

The study guides have really helped me to learn the information. It makes reading the book easier, and it makes comprehending the information easier. You can pick out what you will need to know, and then you can still learn the other information, but you know that you don't need to focus on it.

It is important to note that the study guides also represent instructor-imposed goal-setting behavior. Both the study guides and the topic outlines are designed to inform students of content-related goals for the week. The structure of these components imposes goals upon the student based on content. While no temporal element is necessarily implied by these components, students may be passively guided by the instructor to then structure more specific goals based upon their own needs and work habits.

Some students indicated they printed out components from the web site that were not necessarily originally intended for print. In addition to the study guides, 45.7% of the stratified, random sample indicated they also printed out the lectures on-line ($N = 35$, $M = .8286$, $SD = .8179$) at least once a week and 34.3% of this sample indicated they print out the practice quizzes ($N = 35$, $M = .6667$, $SD = 1.0206$) at least once a week. Utilizing the same scale on the exit questionnaire, a score of zero indicated that the participant did not print out the component in question, and a score of one indicated that the participant printed out the component "less than once a week." A fractional score between zero and one indicated that some students did print out a component and some did not.

In preparing for an in-class exam, two strategies were indicated almost exclusively regarding off-line preparation. In response to the second set of listserv questions, participants ($N = 42$) indicated that the strategy of reviewing the textbook (85.7%) was utilized most often, while reviewing notes (40.5%) was the only other strategy mentioned to any significant degree. These findings are consistent with the previously mentioned finding that students indicated they perform "reviewing" strategies, as a whole, most often. There may have been very little use of strictly off-line learning strategies. With the availability of the textbook, printed notes and quizzes, and the wealth of information available on-line, participants indicated much more on-line preparation for the in-class exams than the contrary. The two types of preparation, on- and off-line, undoubtedly influenced each other, as hinted by one participant, "I skimmed the chapters concentrating on similar information that was discussed on line."

Question I.2.1

What components do students desire to accomplish learning tasks?

Of the three components added to the web site during the semester, grades on-line was indicated as a "highly effective" component ($N = 35$; $M = 4.6286$; $SD = .6456$) while elaborative feedback was indicated as a "moderately effective" component ($N = 35$; $M = 3.7429$; $SD = 1.3578$). Participants indicated the goal checklist ($N = 35$; $M = 1.8529$; $SD = 1.5789$) had "no effect" on completing their learning objectives. Mean scores for the helpfulness of the grades on-line component outpaced those of both the previously existing components of the study guides and lectures on-line (see Table 9).

Table 9.

Helpfulness of Web Site Components

Component	Midterm		Final	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Practice quiz	4.7143	.6217	4.8857	.3228
Grades on-line	4.3429	.9375	4.6386	.6456
Lecture on-line	4.6286	.6897	4.5143	.6122
Study guide	4.6571	.5913	4.4857	.6585
Email professor	3.8714	.8907	4.0571	1.0831
Elaborative feedback	3.9143	1.1725	3.7429	1.3578
Topic outline	2.5429	1.3360	2.5714	1.4810
Goal checklist	2.000	1.1547	1.8529	1.5789

Note. 0 = negative effect, 1 = no effect, 2 = little effect, 3 = moderate effect, 4 = highly effective, 5 = most effective

This offers support for the premise that not only did students desire a component to assist with their keeping records and monitoring strategies, but they utilized the component as well, making this type of component a strong component for consideration in similar learning environments. Student usage of the grades on-line component was high, with the responses from the second administration of the exit questionnaire ($N = 35$, $M = 2.8857$, $SD = 1.0784$, $p = .009$) significantly higher than the first administration of the exit questionnaire ($N = 35$, $M = 2.4286$, $SD = 1.8840$). These scores indicated that students checked their grades on-line several times a week, even though grades were updated at most only once a week. Students returned to view their grades throughout the week, even though they received no indication that the grades had changed or had been updated. Suggestions for improving the grades on-line component most commonly referred to automatic updating of the grades so that students could immediately see their current grade upon completing a quiz.

Technical problems both on the student- and teacher-end resulted in the removal of the Whiz Quiz system. The system was implemented in an attempt to provide elaborative feedback to participants after completing a graded testing activity. The Whiz Quiz layout, however, provided a great deal more information than the original testing layout and included possible links to describe the quiz as well as additional information regarding specific questions. One distracting problem occurred when participants attempted to return to the Game Plan once

completing a quiz. Due to problems in the Whiz Quiz system, participants were presented with an error message when they left the Whiz Quiz system even though their grades may have been appropriately recorded. The superfluous error message was confusing and for some outweighed the advantage of elaborative feedback.

I thought the whole new process of the new quiz was too complicated and confusing. Too much extra information (ex. About the quiz, retake quiz). I liked the old quizzes much better. A simpler method.

Although the Whiz Quiz system had to be removed from use with the real quizzes, it was still presented as an additional option for the practice quizzes. This not only allowed those students who preferred the Whiz Quiz format to continue receiving the elaborative feedback they desired, but also reduced the user load upon the very busy server hosting the original practice quizzes. In addition, due to student requests, practice exams were developed in the Whiz Quiz system prior to the third in-class exam. The practice exam consisted of a 60-question, multiple-choice test and was drawn from test banks from multiple chapters similar to the in-class exam. This was possible in Whiz Quiz due to the ease in programming. Therefore, while the elaborative feedback was no longer available on the real quizzes, many students were still exposed to the feedback in practice quizzes and practice exams, which perhaps supports the rating of the elaborative feedback as being “moderately effective.” An easier and more consistent means for providing this elaborative feedback is still desired, however.

Simplicity, or the lack thereof, may have been the downfall of the goal checklist. While the results of the domain analysis of the first set of listserv questions indicated that some participants had difficulty keeping track of goals and deadlines, the goal checklist may have been too difficult to manipulate. One student remarked, “I just can’t figure it out exactly.” Participants wanted simplicity and when they could not find it resorted to more traditional methods of goal setting.

In the analysis of the first listserv questions, setting goals was the third most frequently discerned learning strategy (see Table 4); however, the goal checklist did not contribute significantly to the goal setting strategies of the participants. When asked why they did not use the goal checklist, participants responded that it was too difficult to understand, too complicated, or that they used more traditional methods of setting goals, such as using assignment books or calendars. Several participants indicated that the Game Plan format itself, based on weekly goals, was sufficient for keeping their own goals. One participant remarked, “The setup provides me with all the reminders I need.” Another student emphasizes that the simple table-like format for the web site helped with setting and achieving goals.

I really like the way that the web page is designed. It is easy to understand what needs to be done this week and that makes it easier for me to plan my schedule for studying. At the beginning of the week, I plan out when I am going to study and the using the lectures and study guides is extremely helpful.

While participants indicated they wanted a component to help set goals, for many that component existed in the choice of layout and consistency of design. Further goal-setting

behavior is apparent from many of the participant responses. As one participant stated regarding the goal checklist,

I have not used this tool. I tried it once but couldn't figure it out and have not gone back to try again. I feel I keep a fine record of my own when I need to have stuff done.

The lack of use of the goal checklist was the result of poor design upon the part of the researcher. Participants indicated they simply wanted a method to remind themselves of assignments due. The goal checklist, as seen in Figure 8, was designed to provide an intensive cataloging of goals which could then be updated on-line. Although provided with instructions intended to help participants establish and promote more advanced goal-setting behavior, the goal checklist provided too many options. Even if participants viewed the goal checklist at least once, many just chose not to use it. Through the goal checklist, students could prioritize and order goals and link goals to the chapters being studied. These many options were too complex.

In addition, the goal checklist was available only through a screen entitled "Study Tools" which was java-enabled. Navigating to the study tools menu required that the participant's browser initialize the java component, and the participant must wait as much as 30 seconds for this procedure to complete. While 30 seconds may not seem long and the java component only had to be initialized once per session, it may have severely hindered the pace of participants working on the web site. The goals checklist itself did not require java and could have been presented without the delay required by this extraneous technical demand. The original intent of utilizing the java-enabled study tools menu, however, stemmed from the designer's conception that several study tool components may have been added to the web site during the semester and this floating window would have provided consistent access to all of these tools. The need for several tools did not emerge, however, and this technical component may have contributed to the lack of response in utilizing the goal checklist.

It should not be forgotten, however, that the domain analysis of the listserv questions did indicate that some students had difficulty keeping track of goals and deadlines. A simpler component may meet this need. Perhaps a component that simply allowed the students to enter a short text-based goal and the date they wished to receive their goal reminder would suffice. A few students did consistently utilize the goal checklist throughout the remainder of the semester, even sending themselves goals that were not related to the course, such as "study for math test." A simpler component is worthy of further investigation and development. On the exit questionnaire, one student remarked concerning the goal checklist

I chose not to use the Goals list component because I find that I, personally, do better when I check goals on my own personal calendar. But, I have seen the checklist and think it would be effective for many people.

Question I.2.2

What components do students utilize to accomplish learning tasks?

In comparing components of the web site, participants indicated the practice quizzes ($N = 35$; $M = 4.8857$, $SD = .3228$) were the most helpful component of the web site with the goal checklist ($N = 35$; $M = 1.8529$; $SD = 1.5789$) being the least helpful component. Of the three added components, grades on-line ($N = 35$; $M = 4.8857$, $SD = .3228$) was rated highest and was rated more useful than the study guides and lectures on-line. Response categories ranged in a scale between zero and five and, after recoding, included having a negative effect (0), no effect (1), little effect (2), moderate effect (3), highly effective (4) and being most effective (5).

These findings are consistent with responses to a pair of questions in which participants were asked to single out the “most beneficial” and “least beneficial” component of the web site. Participants indicated that the practice quizzes were the “most beneficial” (51.4%) component of the web site. The study guides and lectures on-line both ranked second (24.3%). When asked which component was the “least helpful,” the goal checklist was the most often cited component (24.3%); however, ranked higher than the goal checklist were responses related to the cover term “nothing.” The reference to this term indicates that none of the components appeared distracting or unhelpful to 41.4% of the participants in the stratified, random sample. On the first exit questionnaire one student remarked, “It has got all sorts of things for different kinds of people and learners, I think it is excellent and would not change it as of now.”

Participants indicated a significant increase in their perception of self-efficacy for learning and performance in each subsequent administration of the MSLQ. This subscale is described as measuring one’s perception of potential success in the course and one’s level of self-confidence for understanding the course content (Pintrich et al., 1991). A significant increase between the first and second administration of the index may have just indicated a shift in ease of the participants as they move from the unknown to a known class procedure. However, mean scores for this measurement increased significantly between the second and third administration as well, indicating that self-confidence and the belief of potential success as a whole continued to increase throughout the semester.

Components of the web site may have helped to contribute to these increased self-efficacy indicators. Of the eight major components of the web site, only two components, the goal checklist and the topic outlines, were rated as having “little effect” on the exit questionnaire. The elaborative feedback component of the Whiz Quiz system was still rated as “moderately effective” even though the component had been discarded from use with the real quizzes after two weeks. All of the remaining components were rated as being “highly effective” (see Table 9). Strategies demonstrated by participants that correspond with the highest rated components include self-evaluation (practice quiz), keeping records and monitoring (grades on-line, lecture on-line, and study guide), organizing and transforming (lecture on-line and study guide), and seeking assistance from the teacher (electronic mail to professor).

CHAPTER FIVE: SUMMARY

In reviewing results from the four subquestions, patterns emerge which can be used to answer the overriding question, “What hypermedia components, based on self-regulation learning strategies, should be included in an instructional hypermedia environment?” These patterns are consistent with much of the findings of previous research in self-regulation and may serve as suggestions for methods for dealing with the problems inherent to hypermedia.

Students partake in a variety of self-regulation strategies in an on-line web-based learning environment, regardless of whether they are cognizant of these strategies or not. Designers and educators who intend to incorporate web-based technologies for the purpose of instruction can capitalize on key self-regulation strategies which may increase the use of learning strategies by their prospective clients. In the current study, participants demonstrated an increased perception of their self-efficacy for learning and performance as well as their perception of their metacognitive self-regulation. This finding is consistent with earlier research which demonstrated that the incorporation of self-regulation activities may not only be measured in changes in achievement and skill development, but in the change in the level of self-regulation itself (Zimmerman, 1989; Zimmerman & Martinez-Pons, 1986). It is important to remember that self-efficacy is situationally dependent and that one’s behaviors will actually modify one’s efficacy beliefs (Bandura, 1997; Schunk, 1989). In this study, components of the web site, whether previously existing or incorporated throughout the course of the study, have been shown to modify participants’ self-efficacy beliefs.

Zimmerman (1995) has shown that one’s perceived level of self-efficacy is dependent upon the validity of prior learning and testing experiences. The ability to self-evaluate and rehearse testing situations in a consistent fashion with real testing situations on the current web site perhaps best illustrates the validity of the learning and testing experiences provided participants in the current study. The decreased level of test anxiety exhibited by the participants further supports the validity of the learning and testing experiences. This increased perception of self-efficacy among the study’s participants may have also led to an increased use of learning strategies, a result originally suggested by Pintrich and De Groot (1990).

Meece (1994) points out that the learning environment can orient students towards the adoption of goal types. The primary learning environment in the current study should be considered the on-line activities. While class lectures still occurred, their low attendance indicates that many students obtained much of their primary instruction from the web site. Previous studies have shown that not only can the environment influence the regulatory processes within the self, but people can influence their own environments as a result of their self-regulatory behavior (Bandura, 1986; Schunk, 1989). Components of the on-line environment under consideration have demonstrated positive influences upon the regulatory processes of the participants with increased levels of self-efficacy and metacognitive self-regulation. Examples of participant influence upon the environment exist as well. In the current study, not only could students actually contribute to the development of needed components, but the sequencing, pacing, and selection of on-line activities by participants are indicative of self-influences upon the learning environment which may be easily replicated in similar on-line learning environments which are not besieged by the throes of study.

While participants in this study indicated they felt that they most often engaged in the strategy of reviewing notes, further analysis of descriptive comments indicate that the participants engaged in several other learning strategies to a much greater degree, including keeping records, self-evaluation, and setting goals. Incorporating components that promote the most common learning strategies can be adapted to similar instructional web sites. This study began by focusing on six strategies garnered from the literature of self-regulation strategies off-line: setting goals and planning, keeping records and monitoring, reviewing notes, organizing and transforming, seeking information from nonsocial sources, and seeking assistance from the teacher. While several of these strategies were apparent in the current study of a web-based instructional environment, other learning strategies come to the fore as being as prevalent or more so, each of which can be paired to corresponding components within the environment itself.

The four most commonly utilized learning strategies by participants in the current study included keeping records, self-evaluation, setting goals, and pacing. While keeping records was most often mentioned, McCombs (1986) promotes that the most important process in the self-system in terms of function is that of self-evaluation. The participants in the current study exhibited a great deal of overt self-evaluative behavior—best demonstrated by use of the practice quizzes—but the lines drawn between learning strategies are not distinct nor are the strategies mutually exclusive when related to activities. Keeping records may at times also be considered self-evaluative. It has already been mentioned that setting goals and pacing show a great deal of correspondence.

Lessons learned from the current study regarding the inclusion of hypermedia components indicate that these components should support the ability for students to keep records, either electronically or through hard-copy documentation, and provide the ability for self-evaluative activities. The very nature of hypermedia environments allows for a great flexibility in pacing, but consideration should be given to combining this flexibility with goal-setting behavior either through design-imposed goals similar to the study guide component or allowing self-imposed goals by the student.

When considering all aspects of review, such as reviewing notes, textbooks, media, and tests, a supercategory relating to reviewing would have been the most common learning strategy. Current findings in the literature support the effects of reviewing strategies. The constant monitoring of feedback provided by the learning environment, feedback which is obtained through the reviewing process, helps to determine the effectiveness of current strategies and can result in the completion, elimination, or alteration of goals or selection and intensity of further learning strategies (Butler & Winne, 1995; Ertmer & Schunk, 1997; Zimmerman, 1989a, 1989b, 1990). While it may seem obvious, hypermedia environments that would promote the reviewing strategy should include flexibility in the sequencing of material. In the current study, there was complete flexibility in sequencing to the point that participants could choose not to complete any activities at all if they so desired. While this is the nature of many web-based presentations, stand-alone hypermedia might consider incorporating the ability to review material, even if sequencing of instructional material is fixed for an initial presentation. This does not solve the problem of amount of learner control (Hannafin, 1992; Shin, Schallert, & Savenye, 1994; Williams, 1996), but does suggest that in similar web-based learning environments that the ability to review is not only desired but actually utilized by students. Further, designers are

encouraged to incorporate greater learner control in hypermedia if only to allow for this learning strategy. One participant commented, “I also like the fact that you can go over the lectures and all the information more than once just in case you missed information.” When asked what improvements could be made to the site, an additional participant commented,

I don’t have any suggestions for improving the web site. It is very simple to understand and is a good way for me to understand the material, because if I don’t understand something, I can always go back to the slides and read it over again.

Learning strategies focused more upon the self and the materials that were readily available—the components of the web page. Isolation may have increased the need for self-evaluation which, in this case, was provided primarily by the practice quizzes and to a lesser degree by the grades on-line. In addition, the reviewing of the media associated with the web site became much more evident. While the participants indicated that they felt they reviewed their own notes most often while working in this environment, their responses indicated that they more often reviewed the actual layout of the web site. Perhaps due to the transient nature of the material in a hyperlinked environment, participants reviewed the web site for cosmetic changes in the layout. These changes, which may be as minute as a text color change indicating a newly available hyperlink, may indicate new or revised deadlines, assignments, and schedules. This behavior was related to the actual layout of the site and did not include a review of content. However, the review of content, either of the electronic media or the associated textbook, was also an often-cited strategy in addition to reviewing the layout. The simplicity of design of the web site was actually a boon to participants who showed the propensity for utilizing the strategies relating to reviewing the media.

Noticeably absent are the strategies of seeking information from nonsocial sources and seeking teacher assistance. Perhaps due to the nature of the web-based environment, participants completed many activities in isolation. Socialization could occur during class discussions or perhaps working on-line in a computer lab or with a friend; however, many participants indicated they completed their on-line activities at their own pace at their own leisure. This isolation decreased the opportunity for seeking information elsewhere or asking for assistance from the teacher; however, the participants indicated that sending electronic mail to the professor was a “highly effective” component of the web site. Still, this contact may be less prevalent in a web-based environment simply because the teacher is not physically present. There is no immediate response, despite the best intentions of any instructor.

It should be mentioned that the web-based mode of instruction is different from stand-alone hypermedia applications. The web site that is the focus of this study is further unique in that although the primary presentation of instructional material occurred on-line, class sessions did still occur. This unique instructional attribute which may not be present in all distance-based instructional settings, a live teacher, was also available for further comment on-line through electronic mail. Both the instructor and students who attended class noted changes in the style of presentation and intention of class meetings. The instructor noted that her class meetings changed from the presentation of fact-based verbal information, which was formerly sketchily and hastily copied by students with the intention of memorization and regurgitation in testing situations, to more intimate and detailed discussions of the application of this information drawn from her own experiences and those of her students. She liked to call this process the

“illumination” of the content. Participants who attended class indicated that obtaining material on-line at their own pace afforded more productive class meetings. One participant called the on-line instruction the “tedious part of the class” which allowed time for lectures, videos, and for guests to share during class time. One student enthusiastically remarked, “It is really cool having a class like this, with notes and lecture on-line, and a real teacher to back it all up.” This sentiment is echoed by this participant:

I haven’t had trouble completing my goals or activities while using the web site. I feel that it is more convenient to have a study guide and web work, than writing down everything said in lecture and not absorbing the material. I feel that I am getting more out of class because I have an outline in front of me and know what is being presented.

This is a major implication for instructors who incorporate web-based elements into their overall teaching. In this study, the basic nature of teaching changed. By providing the “tedious part” of the material on-line—fact-based information, verbal knowledge, as well as drill and practice—allowed the instructor to change her approach to her face-to-face presentations. A shift in teaching style may have also led to a shift in learning by the students. No longer are students merely presented basic verbal knowledge. They are offered the opportunity to utilize and develop higher-order critical thinking skills, perhaps synthesizing the verbal knowledge they have received prior to attending class. Future study should explore whether a shift towards higher-order thinking skills is, in fact, occurring. Also considered for future study should be the possibility of providing activities on-line which promote these thinking skills while incorporating the important lessons learned in this study regarding the simplicity of design, ease of use, and ability to utilize review and self-evaluative strategies.

While all of the added components to the web site did not meet with complete success, it should be noted that these components were derived directly from student desires. Although the web site provided components which allowed for a variety of learning strategies, students still made requests for improvements. At the onset of the semester, participants almost immediately began requesting a method for viewing their grades on-line. The resulting component, which supported the keeping records and monitoring learning strategy, was considered “highly effective” and rated more useful than any other component of the web site, including the study guides, lectures on-line, and the ability to send electronic mail to the instructor. Suggestions for improvement of the grades on-line component almost unanimously focused on automatic recording and updating of the grades. While the interpretation of this strategy may be different in future hypermedia learning environments, these findings strongly suggest that some type of component which allows for monitoring of progress should be included, whether this progress is measured through graded activities or not.

This ability to monitor progress is closely tied to motivation. Schunk (1989) reported that the belief that one is making acceptable progress can enhance self-efficacy and sustain motivation. The increased self-efficacy scores of the participants may be directly linked to this concept of motivation which was provided by a component that allowed the monitoring of progress. Meece’s (1994) findings further support the need to allow monitoring of progress when relating this to the perception of ability. Individuals who develop and maintain positive perceptions of their abilities report higher performance expectations, greater control over their

learning, and greater interest in learning due to intrinsic motivators. The following testimony could not be much more positive (capitalization is that of the participant):

I LOVE THIS SITE, THE LECTURES ON LINE, AND THE PRACTICE QUIZES HELP ME SOO MUCH. IT IS HELPED ME THE MOST BY FAR IN LEARNING COMPARED TO OTHER MULTIMEDIA APPROACHES.

Although the Whiz Quiz format did not prove to be a successful method for providing the real quizzes, the elaborative feedback that it offered still met with satisfaction by the participants. The component, which continued to be used for practice quizzes and the newly established practice exams, was still rated as “moderately effective.” This rating may stem from the fact that the participants requested some form of elaborative feedback in their testing situations. This desire echoes findings of previous research in which external feedback is considered to be more effective in a learning situation than internal feedback (Butler & Winne, 1995). Outcome feedback, which in this study was represented by the feedback presented in the original quizzes, is considered least effective in a learning situation. Cognitive feedback which links cues and achievement is demonstrated by the elaborative feedback of the Whiz Quiz system and can promote self-regulation of the learning task (Butler & Winne, 1995). The current study suggests that even the most basic confirmatory feedback is useful, but that components which provide more elaborative cognitive feedback are desired. This component may actually be easier to design in a stand-alone application, but further development may yield reliable on-line structures which provide the desired feedback.

The increased perception of metacognitive self-regulation indicates that students were able to monitor their own goals and adjust their learning strategies and goals dependent upon the outcome of their actions. The setting and monitoring of goals is a common learning strategy, and evidence for this strategy existed in a variety of ways from the participants. From monitoring their pace, the use of off-line assignment books and calendars, to depending upon the layout of the web site itself, students demonstrated goal-setting behavior. Still, the goal checklist was developed due to the request for additional help monitoring assignment deadlines. While the goal checklist itself was not effective in its current state, the desire by some of the population to set and monitor goals still exists. Designers who wish to incorporate goal-setting components in future hypermedia learning environments can capitalize on findings from the current study. The study guides provided an outline of the material to be covered each week and helped to impose content-based goals upon participants. The apparently simple yet consistent layout of the web site also contributed to goal-setting behavior among the participants. It is the hope of this researcher that by taking a cue from the insistence of the participants that simplicity in design was both appreciated and effective, a modified form of the goal checklist is worth further study to reach that part of the population desiring extra help monitoring their goals.

Ease of use was a common theme from the participants. Said one participant, “I think that this web site is the best one that I visit out of all of my classes. It’s easy to follow and very informative.” Although the layout of the web site does appear to be simple, it must be remembered that the site utilized during the study was the result of several years of development. This development led to the decreased use of graphics and other media and relied upon consistency to provide cues and to help establish successful learning strategies for the participants. Consistency is exhibited both in layout and in the sequencing of instructional events

implied by the layout. Simplicity and consistency helped to combat several problems often associated with hypermedia, such as disorientation and navigation.

Stanton and Baber (1994) emphasize that disorientation in hypermedia is most often the result of poor design. They suggest the possible use of guided tours, progressive information, bookmarks, and query languages. The current web site can be considered to have utilized progressive information, but the complications in terms of programming as well as user training of a guided tour or use of query languages was not necessary. In addition, of all the students polled over five separate data-gathering events, only once did a student mention the desire for a search engine. In terms of scope, a great deal of information was presented to the participants throughout the course of the semester, but no mention is made of feeling lost or overwhelmed.

Review of previous findings regarding the problems of scope are supported in the current study. This study emphasizes previous findings in the literature that self-regulating tasks may be more significant in reducing disorientation than programming constraints and “helper” items such as system maps (Beasley & Waugh, 1995). The consistent and simple presentation of information superceded the need for any of these more complex components. Stanton and Baber’s (1994) suggestion that disorientation in hypermedia is the result of poor design is not only supported in the current study, but supplants the common plea for the use of helper items such as site maps, guided tours, bookmarks and query languages. Simple, consistent design can effectively support learners and promote successful learning strategies without the addition of complex, superfluous, programming artifacts. Added components in the current web site, such as the ability to view grades on-line, were successful because they were easy to use and supported self-regulatory behavior. As one student confirmed, “I find this site to be pretty easy to use. It’s not hard to find anything that I am searching for.”

When asked to compare the current web site with other web sites and multimedia products, one participant stated,

I think that this website is the most useful out of all the websites I have for my other classes. It includes everything I need and would want to know. For example, it has practice quizzes for me to evaluate what I need to study more and my grades so I can keep up with my progress in this class.

No participant in the stratified, random sample ($N = 35$) indicated that the current web site contributed less to their success in the course than any other web site with which they work. However, of the 26 participants in the stratified sample that indicated they utilize a web page in another course, all 26 participants indicated that this web site contributed more to their success in the course than any other course web site with which they currently worked. One participant confirmed

Personally, this is one of the better ones I have had to work with. It is very organized, and simple, which makes learning easier and less stressful. You can put anything on it, but since we learn from the computer, make sure everything is clear cut, without questionable interference.

As outlined in these findings, instructional designers and educators can construct web-based instruction which capitalizes on the incorporation of the learning strategies which promote self-directed behavior. The expected fundamental components of instruction which promote participants to set learning goals, keep records, and organize and transform content to be meaningful and relevant remain valuable in an on-line learning environment. However, more emphasis should be placed upon supporting self-directed activities, and components in the web site should reflect this. In the current study, participants were able to practice skills and monitor their success once these skills had been applied to graded activities. In addition, simplicity of design and function prompted further review of material. Complex functionality and technical demands were not successful. As one participant pleaded, "Keep the web site simple please."

References

- Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation process. Journal of Educational Psychology, 80(3), 260-267.
- Balajthy, E. (1990). Hypertext, hypermedia, and metacognition: Research and instructional implications for disabled readers. Reading, Writing, and Learning Disabilities, 6, 132-202.
- Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.
- Bandura, A. (1997). Self-efficacy. The exercise of control. New York: W. H. Freeman.
- Bandura, A., & Cervone, D. (1986). Differential engagement of self-reactive influences in cognitive motivation. Organizational Behavior and Human Decision Processes, 38, 92-113.
- Bandura, A., & Schunk, D. H. (1981) Cultivating competence, self-efficacy, and intrinsic interest through proximal self motivation. Journal of Personality and Social Psychology, 41, 586-617.
- Barone, C. A. (1996) Full speed ahead--With caution. Educom Review, 31(3), 28-29.
- Beasley, R. E., & Waugh, M. L. (1995). Cognitive mapping architectures and hypermedia disorientation: An empirical study. Journal of Educational Multimedia and Hypermedia, 4(2/3), 239-255.
- Bieber, M., Vitali, F., Ashman, H., Balasubramanian, V., & Oinas-Kukkonen, H. (1997). Fourth generation hypermedia: Some missing links for the World Wide Web. International Journal of Human-Computer Studies, 47, 31-65.
- Bielaczyc, K., Pirolli, P. L., & Brown, A. L. (1995). Training in self-explanation and self-regulation strategies: Investigating the effects of knowledge acquisition activities on problem solving. Cognition and Instruction, 13(2), 221-252.
- Borkowski, J. G., Carr, M., & Pressley, M. (1987). "Spontaneous" strategy use: Perspectives from metacognitive theory. Intelligence, 11, 61-75.
- Bouffard, T., Boisvert, J., Vezeau, C., & Larouche, C. (1995). The impact of goal orientation on self-regulation and performance among college students. British Journal of Educational Psychology, 65, 317-329.
- Bransford, J., Sherwood, R., Vye, N., & Rieser, J. (1986). Teaching thinking and problem solving. American Psychologist, 41(10), 1078-1089.
- Burton, J. K., Moore, M. D., & Holmes, G. A. (1995). Hypermedia concepts and research: An overview. Computers in Human Behavior, 11(3-4), 345-369.

Butler, D. L. (1997). The Roles of Goal Setting and Self-monitoring in Students' Self-regulated Engagement in Tasks. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. Review of Educational Research, 65(3), 245-281.

Campion, M. A., & Lord, R. G. (1982). A control systems conceptualization of the goal-setting and changing process. Organizational Behavior and Human Performance, 30, 265-287.

Clark, R. E. (1983). Reconsidering research on learning from media. Review of Educational Research, 53(4), 445-459.

Conklin, J. (1987). Hypertext: An introduction and survey. Computer, 20(9), 17-41.

Corno, L. (1986). The metacognitive control components of self-regulated learning. Contemporary Educational Psychology, 11, 333-346.

Dharmadasa, K. H., & Gorrell, J. (1996). Elements of self-regulation in students' scripts related to particular learning situations. Paper presented at the annual meeting of the Mid-South Educational Research Association, Tuscaloosa, AL.

Dirkes, M. A. (1988). Self-directed thinking in the curriculum. Roeper Review, 11(2), 92-94.

Dweck, C. S. (1986). Motivational processes affecting learning. American Psychologist, 41(10), 1040-1048.

Ertmer, P. A., & Schunk, D. H. (1997). Influence of goals and self-evaluation. Paper presented at the annual meeting of the American Education Research Association, Chicago, IL.

Garcia, T. (1995). The role of motivational strategies in self-regulated learning. In P. R. Pintrich (Ed.), Understanding Self-regulated Learning. (pp. 29-42). San Francisco, CA: Jossey-Bass.

Garcia, T., & Pintrich, P. R. (1994). Regulating motivation and cognition in the classroom. In D. H. Schunk and B. J. Zimmerman (Eds.), Self-regulation of Learning and Performance. (pp.127-154). Hillsdale, New Jersey: Erlbaum.

Garcia, T., & Pintrich, P. R. (1995). Assessing Students' Motivation and Learning Strategies: The Motivated Strategies for Learning Questionnaire. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Gay, G. (1986). Interaction of learner control and prior understanding in computer-assisted video instruction. Journal of Educational Psychology, 78(3), 225-227.

Gay, G., Trumbull, D., & Mazur, J. (1991). Designing and testing navigational strategies and guidance tools for a hypermedia program. Journal of Educational Computing Research, 7(2), 189-202.

Gleim, C. W., & Harvey, F. A. (1992). Viewing hypermedia through the prism of evaluation. In Proceedings of Selected Research and Development Presentations at the Convention of the Association for Educational Communications and Technology and Sponsored by the Research and Theory Division.

Grabe, M., Petros, T., & Sawler, B. (1989). An evaluation of computer assisted study in controlled and free access settings. Journal of Computer-based Instruction, 16(3), 110-116.

Grabinger, R. S. (1996). Rich environments for active learning. In D. Jonassen (Ed.), Handbook of Research for Educational Communications and Technology (pp. 665-692). New York: Simon & Schuster MacMillan.

Hannafin, M.J. (1992). Emerging technologies, ISD, and learning environments: Critical perspectives. Educational Technology Research and Design, 40(1), 49-63.

Heinich, R., Molenda, M., & Russell, J.D. (1996). Instructional media and technologies for learning (5th ed.). New Jersey: Prentice Hall, Inc.

Heller, R. S. (1990). The role of hypermedia in education: A look at the research issues. Journal of Research on Computing in Education, 22, 431-441.

Jonassen, D. H. (1988). Designing structured hypertext and structuring access to hypertext. Educational Technology, 28(11), 13-16.

Jonassen, D. H. (1992). Hypertext as instructional design. Educational Technology Research and Design, 40(1), 83-92.

Jonassen, D. H. (1993). Effects of semantically structured hypertext knowledge bases on users' knowledge structures. In C. McKnight, A. Dillon, & J. Richardson (Eds.), Hypertext: A Psychological Perspective. (pp. 153-169). New York: Ellis Horwood.

Jonassen, D. H., & Reeves, T.C. (1996). Learning with technology: Using computers as cognitive tools. In D. Jonassen (Ed.), Handbook of Research for Educational Communications and Technology (pp. 693-719). New York: Simon & Schuster MacMillan.

Kinzie, M. B., & Berdel, R. L. (1990). Design and use of hypermedia systems. Educational Technology Research and Development, 38(3), 61-68.

Langer, M. (1998). Database Publishing with FileMaker Pro on the Web. Berkeley, CA: Peachpit Press.

Locatis, C., Charuhas, J., & Banvard, R. (1990). Hypervideo. Educational Technology Review and Development, 38(2), 41-49.

- Locatis, C., Letourneau, G., & Banvard, R. (1989). Hypermedia and instruction. Educational Technology Research and Development, 37(4), 65-77.
- Marchionini, G. (1988). Hypermedia and learning: Freedom and chaos. Educational Technology, 28(11), 8-12.
- Massy, W. F., & Zemsky, R. (1996) Information technology and academic productivity. Educom Review, 31(1), 12-14.
- McCombs, B. L. (1986). The role of the self-system in self-regulated learning. Contemporary Educational Psychology, 11, 314-332.
- McKnight, C., & Dillon, A. (1996). User-centered design of hypertext/hypermedia for education. In D. Jonassen (Ed.), Handbook of Research for Educational Communications and Technology (pp. 622-633). New York: Simon & Schuster MacMillan.
- Meece, J. L. (1994). The role of motivation in self-regulated learning. In D. H. Schunk and B. J. Zimmerman (Eds.), Self-regulation of Learning and Performance. (pp. 25-44). Hillsdale, New Jersey: Erlbaum.
- Miller, R. B., Behrens, J. T., Greene, B. A., & Newman, D. (1993). Goals and perceived ability: Impact on student valuing, self-regulation, and persistence. Contemporary Educational Psychology, 18, 2-14.
- Nielsen, J. (1997, Nov 1.) The tyranny of the page: Continued lack of decent navigation support in version 4 browsers. Alertbox [On-line]. Available: <http://www.useit.com/alertbox/9711a.html>
- Nielsen, J. (1998, Jan 11.) Using link titles to help users predict where they are going. Alertbox [On-line]. Available: <http://www.useit.com/alertbox/980111.html>
- Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. Journal of Educational Psychology, 82(1), 33-40.
- Pintrich, P. R., Smith, D., Garcia, T., & McKeachie, W. J. (1991). A Manual for the Use of the Motivated Strategies for Learning Questionnaire. National Center for Research to Improve Postsecondary Teaching and Learning, Ann Arbor, MI.
- Risemberg, R., & Zimmerman, B. J. (1992). Self-regulated learning in gifted students. Roeper Review, 15(2), 98-101.
- Schroeder, E. E., & Grabowski, B. L. (1995). Patterns of exploration and learning with hypermedia. Journal of Educational Computing Research, 13(4), 313-335.
- Schunk, D. H. (1989). Social cognitive theory and self-regulated learning. In B. J. Zimmerman & D. H. Schunk (Eds.), Self-regulated Learning and Academic Achievement: Theory, Research, and Practice. (pp. 83-110). New York: Springer-Verlag.

Schunk, D. H. (1994). Self-regulation of Self-efficacy and Attributions in Academic Settings. In D. H. Schunk & B. J. Zimmerman (Eds.), Self-regulation of Learning and Performance. (pp. 75-99). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Schunk, D. H. (1996). Attributions and the Development of Self-regulatory competence. Paper presented at the annual meeting of the American Educational Research Association, New York.

Schwartz, S. A. (1998). FileMaker Pro 4 Bible. Foster City, CA: IDG Books Worldwide, Inc.

Shin, C. E., Schallert, D. L., & Savenye, W. C. (1994). Effects of learner control, advisement, and prior knowledge on young students' learning in a hypertext environment. Educational Technology Research and Development, 42(1), 1042-1069.

Smith, P. A., Newman, I. A., & Parks, L. M. (1997). Virtual hierarchies and virtual networks: Some lessons from hypermedia usability research applied to the World Wide Web. International Journal of Human-Computer Studies, 47, 67-95.

Stanton, N. A., & Baber, C. (1994). The myth of navigating in hypertext: How a "Bandwagon" has lost its course! Journal of Educational Multimedia and Hypermedia, 3(3/4), 234-249.

Stuckey, J. E. (1996). Negotiating the slippery slope of technological progress. Educom Review, 31(3), 28-29.

Tripp, S. D., & Roby, W. (1990). Orientation and disorientation in a hypertext lexicon. Journal of Computer-based Instruction, 17(4), 120-124.

Tudhope, D. & Taylor, C. (1997). Navigation via similarity: Automatic linking based on semantic closeness. Information Processing and Management, 33(2), 233-242.

Welsh, T. M., Murphy, K. P., Duffy, T. M., & Goodrum, D. A. (1993). Accessing elaborations on core information in a hypermedia environment. Educational Technology Research and Development, 41(2), 19-34.

Williams, M. D. (1996). Learner-control and instructional technologies. In D. Jonassen (Ed.), Handbook of Research for Educational Communications and Technology (pp. 957-983). New York: Simon & Schuster MacMillan.

Yang, Y. (1993). The effects of self-regulatory skills and type of instructional control on learning from computer-based instruction. International Journal of Instructional Media, 20(3), 225-241.

Young, J. D. (1996). The effect of self-regulated learning strategies on performance in learner controlled computer-based instruction. Educational Technology Research and Development, 44(2), 17-27.

Zimmerman, B. J. (1989a). Models of self-regulated learning and academic achievement. In B. J. Zimmerman & D. H. Schunk (Eds.), Self-regulated Learning and Academic Achievement: Theory, Research, and Practice. (pp. 1-26). New York: Springer-Verlag.

Zimmerman, B. J. (1989b). A social cognitive view of self-regulated academic learning. Journal of Educational Psychology, 3, 329-339.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. Educational Psychologist, 25(1), 3-17.

Zimmerman, B. J. (1995). Self-regulation involves more than metacognition: A social cognitive perspective. Educational Psychologist, 30(4), 217-221.

Zimmerman, B. J., & Kitsantas, A. (1997). Developmental phases in self-regulation: Shifting from process goals to outcome goals. Journal of Educational Psychology, 89(1), 29-36.

Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. American Educational Research Journal, 23(4), 614-628.

Zimmerman, B. J., & Martinez-Pons, M. (1990). Student differences in self-regulated learning: Relating grade, sex, and giftedness to self-efficacy and strategy use. Journal of Educational Psychology, 82(1), 51-59.

Appendix A: Motivated Strategies for Learning Questionnaire

Motivated Strategies for Learning Questionnaire (MSLQ)

The following questionnaire asks you about your study habits, your learning skills, and your motivation for work in this course. There are **NO RIGHT OR WRONG ANSWERS** to this questionnaire. **THIS IS NOT A TEST.** Please respond as accurately as possible reflecting your own attitudes and behaviors in this course. Your answers to this questionnaire will be analyzed and you will receive an individual report at its conclusion. The individual report will help you identify motivation and learning skills that you may want to improve during the semester. Additionally, Dr. Rogers will receive feedback on your class as a whole, which will allow her to tailor the course to class needs.

Thank you for participating in this questionnaire.

The following questions ask about your motivation for and attitudes about this class. Remember, **there are no right or wrong answers.** Please answer as accurately as possible. Use the scale below to answer the questions. If you think the statement is very true of you, click the radio button to the left of 7; if a statement is not at all true of you, click the radio button to the left of 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

All survey questions MUST be answered for this form to process.

There are 81 items plus some demographic information in this questionnaire.

1	2	3	4	5	6	7
not at all true of me						very true of me
1. In a class like this, I prefer course material that really challenges me so I can learn new things. <input checked="" type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7						
2. If I study in appropriate ways, then I will be able to learn the material in this course. <input type="radio"/> 1 <input checked="" type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7						
3. When I take a test I think about how poorly I am doing compared with other students. <input type="radio"/> 1 <input type="radio"/> 2 <input checked="" type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7						
4. I think I will be able to use what I learn in this course in other courses. <input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input checked="" type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7						
5. I believe I will receive an excellent grade in this class. <input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input checked="" type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7						
6. I'm certain I can understand the most difficult material presented in the readings for the course. <input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input checked="" type="radio"/> 6 <input type="radio"/> 7						

Figure 10. On-line presentation of the MSLQ

Informed Consent for Participants of Investigative Projects

I. The purpose of this project

You are invited to participate in a study about self-regulation self-regulation, which relates to "how you know what you know." With this questionnaire, you will begin by assessing your own levels of self-regulation and be exposed to some strategies that you can use to improve your own self-regulating habits. Successful students are shown to use self-regulation strategies. While self-regulation is a course topic studied this semester, data gathered from this class is also intended for analyses regarding the student use of self-regulation strategies in hypermedia. (Hypermedia includes web pages.) Any questions you have regarding this project may be addressed directly to the principal investigator, John Ross. You will be given the opportunity to decline to have your responses included in this research at the bottom of this introduction.

II. Procedure

Following is a questionnaire regarding self-regulation that will take approximately 15 to 20 minutes to complete. There are 81 items and some demographic information requested. Upon

completion of the questionnaire, you will be given an index ("score") that relates to several dimensions of self-regulation. In addition, a description of each dimension is given as well as strategies you can use to address areas that you may feel are a problem. There are no right or wrong answers. The strategies are presented as an opportunity for you to direct your own learning in areas of your own choosing. No further action is required.

Throughout the semester, you will be given the opportunity to comment on how you use self-regulation strategies in relation to this course and its accompanying web site. Some of these comments will be solicited from the web site or class listserv.

III. Benefits of this project

This project will provide you important insight into the strategies you use to learn. In addition, it will present alternate strategies that you may consider to improve your own processes of knowledge acquisition. Knowing what strategies you currently utilize is an important first step in this process.

In addition, your participation in this project will provide instructional designers concerned with developing hypermedia with important insight into the issues encountered by students actually using technology in the instructional process. Thus, the information that you provide will enable instructional designers to improve the electronic media that students like you are encountering from secondary and post-secondary educational programs.

IV. Extent of anonymity and confidentiality

Student responses to this questionnaire and electronic mail will be kept strictly confidential. The information that you provide will have names removed and an identification number will be used during analysis and in any reported results. At no time will your responses be released to anyone other than the individuals working on the project without your written consent. There is no compensation for participating in this project.

V. Freedom to withdraw

You have the freedom to prevent your responses from being recorded for the purpose of study. In addition, you may withdraw from this research project at any time without penalty. Should you decide to withdraw, you will not lose course points or be penalized in any way.

VI. Subject permission

I have read and understand the informed consent and conditions of this project. My questions concerning the project have been answered. I hereby acknowledge the above and give my voluntary consent for participation in this project. I may withdraw from this project at any time without penalty. I agree to adhere to the rules of this project. I may contact the following persons should I have any questions regarding this research project or its conduct.

Investigator: John D. Ross
Committee Chairman: Dr. Mike Moore
Chair, IRB Research Division

Phone: 961-0918
Phone: 231-5587
Phone: 231-6077

The following information regarding informed consent is required by Virginia Tech.

Student Name:
Social Security Number:
PID:

One of the following buttons must be selected to continue. Once completed, scroll down to take the questionnaire.

- I have read the above and agree to have my responses considered for the purpose of educational research.
- I prefer that my responses not be used for the purpose of study.

Motivated Strategies for Learning Questionnaire (MSLQ)

The following questionnaire asks you about your study habits, your learning skills, and your motivation for work in this course. There **are NO RIGHT OR WRONG ANSWERS** to this questionnaire. **THIS IS NOT A TEST**. Please respond as accurately as possible reflecting your own attitudes and behaviors in this course. Your answers to this questionnaire will be analyzed and you will receive an individual report at its conclusion. The individual report will help you identify motivation and learning skills that you may want to improve during the semester. Additionally, Dr. Rogers will receive feedback on your class as a whole, which will allow her to tailor the course to class needs.

Thank you for participating in this questionnaire.

The following questions ask about your motivation for and attitudes about this class. Remember, there are no right or wrong answers. Please answer as accurately as possible. Use the scale below to answer the questions. If you think the statement is very true of you, click the radio button to the left of 7; if a statement is not at all true of you, click the radio button to the left of 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

All survey questions **MUST** be answered for this form to process.
There are 81 items plus some demographic information in this questionnaire.

not at all true of me 1 2 3 4 5 6 7 very true of me

1. In a class like this, I prefer course material that really challenges me so I can learn new things.
2. If I study in appropriate ways, then I will be able to learn the material in this course.
3. When I take a test I think about how poorly I am doing compared with other students.
4. I think I will be able to use what I learn in this course in other courses.
5. I believe I will receive an excellent grade in this class.
6. I'm certain I can understand the most difficult material presented in the readings for the course.
7. Getting a good grade in this class is the most satisfying thing for me right now.
8. When I take a test I think about items on other parts of the test I can't answer.
9. It is my own fault if I don't learn the material in this course.
10. It is important for me to learn the course material in this class.
11. The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.
12. I'm confident I can learn the basic concepts taught in this course.
13. If I can, I want to get better grades in this class than most of the other students.
14. When I take tests I think of the consequences of failing.
15. I'm confident I can understand the most complex material presented by the instructor in this course.
16. In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.
17. I am very interested in the content area of this course.
18. If I try hard enough, then I will understand the course material.
19. I have an uneasy, upset feeling when I take an exam.
20. I'm confident I can do an excellent job on the assignments and tests in this course.
21. I expect to do well in this class.
22. The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.
23. I think the course material in this class is useful for me to learn
24. When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.
25. If I don't understand the course material, it is because I didn't try hard enough.
26. I like the subject matter of this course.
27. Understanding the subject matter of this course is very important to me.
28. I feel my heart beating fast when I take an exam.
29. I'm certain I can master the skills being taught in this class.
30. I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.
31. Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.

The following questions ask about your study skills and learning strategies for this class. Again, there are no right or wrong answers. Answer the questions about how you study in this class as accurately as possible. Use the same scale to answer the remaining questions.

32. When I study readings for a course, I outline the material to help me organize my thoughts.
33. During class time I often miss important points because I'm thinking of other things.
34. When studying for a class, I often try to explain the material to a classmate or friend.
35. I usually study in a place where I can concentrate on my course work.
36. When reading for a class, I make up questions to help focus my reading.
37. I often feel so lazy or bored when I study for class that I quit before I finish what I planned to do.
38. I often find myself questioning things I hear or read in class to decide if I find them convincing.
39. When I study for class, I practice saying the material to myself over and over.
40. Even if I have trouble learning the material in class, I try to do the work on my own, without help from anyone.
41. When I become confused about something I'm reading for class, I go back and try to figure it out.
42. When I study for class, I go through the readings and my class notes and try to find the most important ideas.
43. I make good use of my study time for class.
44. If course readings are difficult to understand, I change the way I read the material.
45. I try to work with other students from class to complete the course assignments.
46. When studying for class, I read my class notes and the course readings over and over again.
47. When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.
48. I work hard to do well in class even if I don't like what we are doing.
49. I make simple charts, diagrams, or tables to help me organize course material.
50. When studying for class, I often set aside time to discuss course material with a group of students from the class.
51. I treat the course material as a starting point and try to develop my own ideas about it.
52. I find it hard to stick to a study schedule.
53. When I study for class, I pull together information from different sources, such as lectures, readings, and discussions.
54. Before I study new course material thoroughly, I often skim it to see how it is organized.
55. I ask myself questions to make sure I understand the material I have been studying in class.
56. I try to change the way I study in order to fit the course requirements and the instructor's teaching style.
57. I often find that I have been reading for class but don't know what it was all about.
58. I ask the instructor to clarify concepts I don't understand well.
59. I memorize key words to remind me of important concepts in this class.
60. When course work is difficult, I either give up or only study the easy parts.
61. I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying.
62. I try to relate ideas in this subject to those in other courses whenever possible.

63. When I study for a course, I go over my class notes and make an outline of important concepts.
64. When reading for class, I try to relate the material to what I already know.
65. I have a regular place set aside for studying.
66. I try to play around with ideas of my own related to what I am learning in this course.
67. When I study, I write brief summaries of the main ideas from the readings and my class notes.
68. When I can't understand the material, I ask another student in class for help.
69. I try to understand the material in class by making connections between the readings and the concepts from the lectures.
70. I make sure that I keep up with the weekly readings and assignments for this course.
71. Whenever I read or hear an assertion or conclusion in class, I think about possible alternatives.
72. I make lists of important items for class and memorize the lists.
73. I attend class regularly.
74. Even when course materials are dull and uninteresting, I manage to keep working until I finish.
75. I try to identify students in class whom I can ask for help if necessary.
76. When studying, I try to determine which concepts I don't understand well.
77. I often find that I don't spend very much time on coursework because of other activities.
78. When I study for class, I set goals for myself in order to direct my activities in each study period.
79. If I get confused taking notes in class, I make sure I sort it out afterwards.
80. I rarely find time to review my notes or readings before an exam.
81. I try to apply ideas from course readings in other class activities such as lecture and discussion.

All survey questions MUST be answered for this form to process.
Thank you for participating in this questionnaire.

Appendix B: Listserv Questions

Week Three

- 8 What type of self-regulation strategy (strategies) have you utilized when utilizing the course web site?
- 9 What type of goals or activities have you had trouble completing when using this web site?
- 10 How would you suggest improving the web site to help you incorporate your own self-regulation strategies and meet your goals?

Week Five

- 8 How did you prepare for the exam **ON-line**?
- 9 How did you prepare for the exam **OFF-line**?
- 10 How could the web site have better prepared you for the exam?

Week Seven

1. Compare your use of this site to other web sites, CD-Roms, or other multimedia products that you might use. What activities or functions might be incorporated into THIS web site that you find useful from other multimedia?
2. What is the most difficult learning activity you associate with using this web site?
3. If you were in charge of this web-site, what one thing would you have ADDED or CHANGED to improve your ability to complete your learning goals?

Appendix C: Exit Questionnaire

This questionnaire focuses on your usage patterns of computers in general and the Game Plan site specifically. Information regarding the effectiveness of the Game Plan web site and its components are also requested. The questions are presented in multiple-choice format as much as possible with a few short answer questions. This format should allow you to complete the questionnaire quickly. Please respond by choosing the most likely response.

Your identity will remain confidential. Your social-security number is necessary for cross-reference; however, all responses will be anonymously assigned index numbers for the purpose of research. No reference to your identity will be utilized in any discussion or publication of these findings.

Please fill in your social-security number:

I. Self-regulation strategies.

Of the six learning strategies listed below, which ONE do you most often use in conjunction with the Game Plan?

1. Setting goals.
2. Keeping records.
3. Reviewing notes.
4. Organizing and transforming information. (Making the material relevant to you. Putting it into "your own words" or a form you better understand.)
5. Seeking information from nonsocial sources. (Nonsocial sources are not human. These sources may include books, journals, or on-line references.)
6. Seeking teacher assistance.

Please describe ONE way in which you personally might accomplish each of these learning strategies when using the Game Plan.

7. Setting goals.
8. Keeping records.
9. Reviewing notes.
10. Organizing and transforming information.
11. Seeking information from nonsocial sources.
12. Seeking teacher assistance.

II. Frequency of Use Ratings.

Please use the following scale to approximate how often you utilize the Game Plan and its components.

- 0 = Never
- 1 = Less than once a week
- 2 = Once a week
- 3 = Several times a week
- 4 = Once a day
- 5 = Several times a day

How often do you. . .

- 13. Go to the Game Plan web site?
- 14. Read the Topic Outlines?
- 15. Read the Study Guide?
- 16. Print the Study Guide from the web page?
- 17. Print the Study Guide from the .pdf file?
- 18. View the Lecture On-Line?
- 19. Print any part of the Lecture On-Line?
- 20. Take a Practice Quiz?
- 21. Print a Practice Quiz?
- 22. View the Syllabus?
- 23. Email the Instructor with a question or comment about COURSE CONTENT?
- 24. Email the Instructor with a TECHNICAL question or comment?
- 25. Email a TA with a question or comment about COURSE CONTENT?
- 26. Email a TA with a TECHNICAL question or comment?
- 27. View your grades on-line?
- 28. Use the Goal Checklist?

III. Usefulness of components.

Overall, how HELPFUL or APPLICABLE were the following components from the Game Plan web site in relation to successfully completing this course? Please use the following scale to approximate usefulness.

-1= **Negative Effect.** This component actually made it difficult to complete class objectives. I would rather have not used this component.

0 = **No Effect.** I do not believe this component either helped or hindered in completing my learning objectives.

1= **Little Effect.** This component probably had some minimal effect in helping me to complete my learning objectives.

2= **Moderate Effect.** This product was one factor that helped me to complete my learning objectives.

3 = **Highly Effective.** This product was a significant factor in helping me to complete my learning objectives.

4 = **Most Effective.** This one product was the most significant factor in helping me to complete my learning objectives.

How helpful were the . . .

- 29. Topic Outlines?
- 30. Study Guides?
- 31. Lectures On-line?
- 32. Practice Quizzes?
- 33. Email from the professor?
- 34. Grades on-line?
- 35. Goal Checklist?
- 36. Feedback from Quizzes (in Whiz Quiz format)?

IV. Web site Additions

Due to input from students, three components were added to the web site: Grades on-line, the Goal Checklist, and Quizzes with feedback (Whiz Quiz format). The following questions refer to these three added components.

The Grades on-line component was designed in response to student requests to review and monitor their grades at any time--taking advantage of being in a hypermedia environment. Reviewing grades can be considered a function of the keeping records and monitoring, or seeking information from nonsocial sources learning strategies.

- 37. Does the Grades On-line component fulfill your needs to monitor your achievement?
YES NO (If NO, please include your reasons why in the field for question 33.)
- 38. If you have used this component and could edit it to better serve your needs, what would you change?
- 39. If you do not use this function, why?

The Goal Checklist component was designed in response to student requests to better keep track of assignments and due dates. This is a function of the goal setting and keeping records learning strategies.

- 40. Does the Goal Checklist component fulfill your needs for setting goals? YES NO
(If NO, please include your reasons why in the field for question 36.)
- 41. If you have used this component and edit it to better serve your needs, what would you change?
- 42. If you do not use this component, why?

The Feedback from Quizzes in the Whiz Quiz format was developed due to numerous requests by students to see which questions were answered correctly and incorrectly on graded quizzes. Although this system proved unreliable for the purpose of grading, the system was still available for practice quizzes. This is a function of the keeping records and monitoring learning strategy.

43. Does the Feedback in the Whiz Quiz format fulfill your keeping records and monitoring needs? YES NO (If NO, please include your reasons why in the field for question 39.)
44. If you have used this component and could edit it to better serve your needs, what would you change?
45. If you do not use this function, why?

V. Course Web Pages

46. Do you have any other courses that utilize a course web page? YES NO
47. If YES, how many classes did you have this semester that utilized a course web page?
48. If YES, did the Game Plan contribute MORE or LESS than other course web pages in helping you to successfully accomplish your learning goals within a particular class?
Less No Significant Difference More
49. What ONE factor contributed most to this success?
50. In your opinion, what is the most beneficial aspect of the Game Plan web site?
51. In your opinion, what is the most distracting or least helpful aspect of the Game Plan web site?

VI. Technical Help

Please use the following scale to answer questions about technical support. Please choose your MOST COMMON response.

- 1 = Experimentation, I usually try to figure it out myself
 2 = Printed manual
 3 = On-line help
 4 = Friend or colleague
 5 = Faculty or staff
 6 = University-sponsored help-lines, such as "4-HELP"
 7 = I often do not find sufficient help
 8 = Other

52. If you have a software problem, how/where do you find help?
 53. If you have a hardware problem, how/where do you find help?
 54. How do you most often first learn to utilize new software?
 55. How do you most often first learn to utilize new hardware?

VII. Computer and User Statistics

56. If you use your own personal computer at home or dorm, please describe your computer as specifically as possible:

1. Macintosh, Model:
2. Windows-based PC, Model:
3. Other, Model:

57. When did you purchase your computer?

1. within the last 6 months
2. 6 to 12 months ago
3. 1 to 2 years ago
4. more than 2 years ago

58. Where do you most commonly access the Game Plan?

1. Dorm Room
2. On-campus Lab
3. Off-campus housing
4. Other

59. If you access the Game Plan off-campus, what type of connection/modem do you utilize?
(please answer below)

1. 14.4 Modem
2. 28.8 Modem
3. 56 Modem
4. Ethernet

60. Please describe your level of familiarity/ease with working on a computer:

1. **Extreme novice.** This is all brand new to me. I'm not always too sure what I'm doing and often get frustrated. I usually try to avoid working on the computer if I can help it.
2. **Novice User.** I'm pretty new to this, but I've managed to work out my own methods for getting my work done with a computer.
3. **Occasional User.** I use the computer when I have to, but I don't go to the computer as my first choice. I can usually complete assignments that require skills such as word processing or using the Internet.
4. **Familiar User.** I feel fairly confident using the computer as a tool. I use the computer consistently for word processing and/or other specialized software (i.e., graphics, math, or audio/video software). I often use the Internet, both for school and leisure.
5. **Expert User.** I use a computer virtually every day for both school and leisure tasks. I often use specialized software which requires skills greater than simple word-processing. I am highly confident with accessing multiple sources on the Internet for information.

Thank you very much for helping with this research.

JOHN DOUGLAS ROSS

on-line portfolio: <http://www.music.vt.edu/students/jdross/>

311-A Reynolds Street
Blacksburg, VA 24060

540-961-0918
JohnRoss@vt.edu

OBJECTIVE

Instructional designer for multimedia such as electronic books, CD-ROMs, web sites, interactive kiosks, and related educational products with career development path towards project manager and executive producer. Opportunities for travel welcomed.

PROFESSIONAL EXPERIENCE

Virginia Tech, Blacksburg, Virginia

1996 to Present

- **Instructor.** (Spring 1999) "History and Analysis of Musical Styles." Sophomore-level required course designed to provide music majors with critical analysis skills based on the tradition of Western Art Music.
- **Teaching Assistant.** (Fall 1996 - Fall 1998)
- **Instructional Designer.** (Fall 1998) Designed and maintained on-line databases for presentation of course content and record keeping for FCD 1004 "Childhood and Adolescent Development."
- Designed instructional multimedia for use in two classes in the Music Department utilizing common authoring software (Authorware and HyperCard).
- **Graduate Assistant.** Assistant to David McKee and the "Marching Virginians," the 300+ member university marching.
- **Presenter.** (Spring 1999) Presented paper on preliminary findings of dissertation research regarding self-regulation strategies utilized in a web-based learning environment.
 - EERA Conference. (February 24, 1999, Hilton Head, SC)
 - IT 99. (March 21-24, 1999, Virginia Tech)
- **Teaching Assistant.** (Summers: 1997 & 1998) Faculty Development Institute.

Longwood College, Farmville, Virginia

Fall 1997

Instructor. MUSC 349: "Marching Band Methods." Developed curriculum and designed all associated web pages, graphics, and animations for distance-based course developed to provide necessary skills for undergraduate music education majors for all aspects of designing and implementing the modern high school marching band program.

York High School, Yorktown, Virginia

1989 to 1996

Director of Bands. Organized and taught all aspects of Marching, Concert, and Jazz Bands in a program I grew from 45 to 120 students over 7 years.

- **Winner:** Organized, designed, and taught superior performing ensembles that consistently earned state and national honors including DownBeat Magazine's "Most Outstanding Classical Instrumental Ensemble" in 1990 as well as Grand Champion at both the Shenandoah Apple Blossom Festival and Toronto Fiesta-val. Nominated, "Teacher of the Year," 1996.
- **Producer:** Annually raised and managed \$30,000 budget for parent booster group. Hired clinicians, purchased equipment, and organized travel for 120-member band and support group to all performances, including Orlando, Toronto, and New York City. Designed, oversaw bidding for, and purchased \$35,000 worth of new band uniforms.
- **Leader:** Elected District Chairman (1991-1993) and District Auditions Chairman (1990-1996) of Virginia Band and Orchestra Directors Association (statewide professional organization). Planned and managed Association events for 42 schools with more than 50 total directors and over 3,000 students.
- **Writer:** Published article, "Establishing Goals in the Music Program" in *Fanfare* magazine, a national publication. Authored and held seminars on time management and goal setting. Designed and produced 150-page District Policy Manual yearly using PageMaker software.

Newport News Summer Institute for the Arts, Newport News, Virginia Summers 1994-1995

Teacher. Intensive summer program for advanced music students that received advanced placement credits toward high school graduation.

Redesigned, rewrote, and taught new Music History curriculum, which is now standard course material.

Rehearsed and conducted Symphonic Orchestra.

Freelance Musician 1986-Present

- **Musical Director.** Virginia Tech Theater Department production of "Godspell." Nominated for two Roanoke-area theater awards: "Best Ensemble" and "Best Musical."
- **Featured Performer.** Southeastern Composer's Conference, Radford, Virginia (April, 1997)
- **Performer.** Virginia Wind Symphony, Tidewater Winds Symphonic Band, Faculty/Graduate Saxophone Quartet, Virginia Tech (1996-1998)

WHRO Public Radio, Norfolk, Virginia Summer 1993

Teacher. Presented seminar class for "Using PageMaker" software application.

Clute Intermediate School Brazosport I.S.D., Clute, Texas 1986-1989

Director of Bands. Taught Symphonic, Concert and Beginning Band classes. Organized and taught Jazz Ensemble in a program I grew from 70 to over 200 students in two years.

EDUCATION

Virginia Tech, Blacksburg, Virginia 1996-Present

Ph.D., Curriculum and Instruction, Instructional Technology. College of Human Resources and Education.

Dissertation: "Regulating Hypermedia: Self-regulation learning strategies in a hypermedia environment."

Teaching Assistant to Dr. James Sochinski, Music Department. Teaching Assistant to David McKee and the "Marching Virginians"

University of Texas at Austin, Austin, Texas 1985-1986

Master of Music in Music Education. Thesis on "Evaluating Aural Music Skills Courseware" developed criteria for evaluating professional music instruction software packages. Music Scholarship entire period.

University of South Carolina, Columbia, South Carolina 1981-1985

Bachelor of Music Education, Magna Cum Laude. Selected Outstanding Senior for academic and extracurricular excellence. Named to Dean's List every semester. Academic Scholarship and Music Scholarship every semester. Member, Mortar Board Pi Sigma Alpha national honor society, Phi Mu Alpha Sinfonia professional men's music fraternity, and Pi Kappa Lambda national honorary music fraternity.

REFERENCES

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Teaching and Learning, College of Human Resources and Education, Virginia Tech

Dr. Barry L. Beers, Principal 804-898-0354
York High School, 9300 George Washington Highway, Yorktown, Virginia

