December 2003

Self-Regulated Learning Strategies and Computer Software Training

Jane Gravill
The University of Western Ontario

Deborah Compeau
The University of Western Ontario, dcompeau@ivey.uwo.ca

SELF-REGULATED LEARNING STRATEGIES AND COMPUTER SOFTWARE TRAINING

Jane Gravill and Deborah Compeau
Ivey Business School
The University of Western Ontario
London, ON Canada
jgravill@ivey.uwo.ca **dcompeau@ivey.uwo.ca**

Abstract

User learning is central to the effective use of information technology within organizations, particularly given the changing nature of IT over the past decades. Research indicates that self-training is the most common means by which users learn. In addition, the use of Web-based training within organizations in these self-directed learning situations is increasing. The purpose of this research is to investigate the increasingly popular self-training phenomenon within organizations by examining the self-regulated learning strategies that individuals use in Web-based training situations, and how they influence learning outcomes. To do this, a two phase study was designed. Phase one of this study has been completed, and phase two has been initiated. Phase one took us into the field to explore interviewees' self-directed learning experiences by understanding the strategies they used and learning difficulties they encountered. It involved 27 interviews with knowledge-workers from a variety of organizations. Phase two (in progress) provides a field test of the research model. Organizations invest a great deal of resources toward training end users, and this research will assist organizations in gaining a return from this sizable investment in training end users, and in managing their most important resource—knowledge.

Keywords: User training, learning, end user computing, computer literacy

Research Objectives and Questions

Effective use of information technology within organizations requires ongoing user learning for employees to keep pace with the changing nature of IT and their roles. New learning requirements are increasingly becoming the responsibility of the employee, especially in the context of using IT. Research has long indicated that self-training is the most common means by which users learn (e.g., Nelson 1991). Self-directed learning is becoming even more common as firms adopt virtual or dispersed organizational structures, relying upon employees to self-manage their activities, including training (Saunders 2000). Furthermore, the use of Web-based training within organizations in these self-directed learning situations is also increasing. Gartner Group reports that 85 percent of companies surveyed used e-learning products, with product sales of $2.4 billion last year and a 40 to 50 percent annual expected growth (*Information Week*, March 2003). This trend within organizations emphasizes the importance of effective self-regulated learning. Self-regulated learning refers to the strategies which individuals undertake to control or manage their own learning experience, such as monitoring their progress while engaged in learning, determining where to spend extra effort within a training program to learn the material, or determining which material requires more practice before performing the new skills learned on the job.

Web-based, or online, training programs provide a good example of self-directed training situations, as users have control over their learning process and are required to manage their learning process themselves in these environments. Users functioning in these self-training environments are responsible for determining their own learning strategies, making decisions such as which are the best methods to learn the material offered in the training program to gain the skills they need, where to spend extra effort within the training program to learn the material, or what material requires more practice before performing the new skills learned

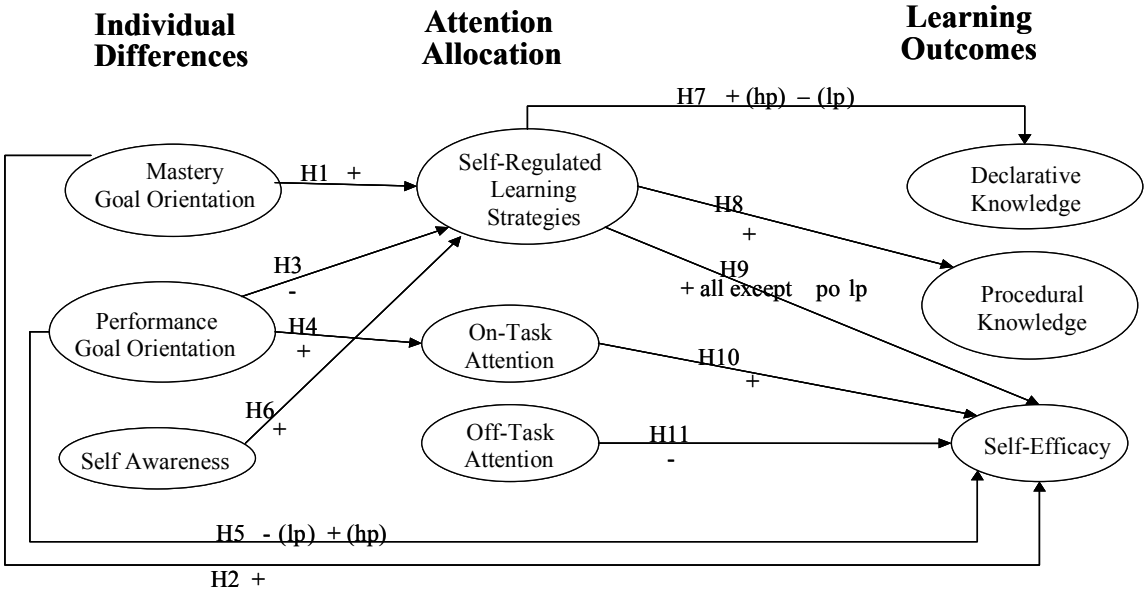
on the job. To manage self-regulated learning experiences effectively, individuals are required to make self-directed choices regarding the actions they will undertake, or the strategies they will invoke, to meet their goals (Bandura 1977).

The purpose of this research is to investigate how the use of self-regulated learning strategies influence learning outcomes in the increasingly popular self-training phenomenon within organizations, specifically in Web-based software training situations. This examination will assist in understanding the importance of self-regulated learning strategies in this context, what key individual differences influence the selection of effective self-regulated learning strategies in the online training environment, and will thus aid organizations in promoting the most effective on-line learning. This research objective is important as MIS training and learning studies have typically focused on classroom style training; therefore, a better understanding of the self-directed learning situation in the MIS context is required. Furthermore, studies from reference disciplines based on self-regulated learning have not typically focused on the MIS organizational context. This research study fills this gap and explores self-regulated learning strategies in the MIS organizational context.

To achieve the objectives of this research, a two phase study was designed. The first phase consisted of interviews conducted with knowledge workers in the field to better understand their self-directed learning experiences in this MIS organizational context, adapt study measures to the organizational MIS context, and provide preliminary evidence regarding the relationships in the proposed research model. The second phase is a field study where participants complete a hands-on Web-based training program, knowledge tests, and a questionnaire to further examine the expected relationships in the research model. The research model, revised based on phase one findings, is presented and discussed in the next section.

Research Model and Hypotheses

Figure 1 illustrates the model that guided this research. The model is founded upon Bandura's social cognitive theory of self-regulation (1977, 1991), the resource allocation model proposed by Kanfer and Ackerman (1989), and Kahneman's (1973) attention and effort theory. Through the social cognitive theory lens, learning is viewed as an enacted process where individuals are influenced by the environments and situations in which they exist, which are in turn influenced by their behavior. Bandura (1991) expands upon the original theory in the area of self-influence through analyzing the mechanisms of self-monitoring of one's own behavior, judgments of one's own behavior, and self-reaction. The resource allocation model (e.g., Kanfer and Ackerman 1989) focuses on self-regulated learning and posits that individuals evaluate the effort and performance implications of a given task or goal, and determine the level of resources they will direct toward various activities to achieve the learning objective.



N.B. hp = High Performers; lp = Low Performers; po = Performance Oriented; mo = Mastery Oriented

Figure 1. Research Model

The research model illustrates that individuals allocate their resources toward self-regulated learning and on-task and off-task activities, all of which have implications regarding their learning outcomes. The key focus of the model illustrates the positive relationship expected between individuals' use of self-regulated learning strategies and their learning outcomes, specifically declarative knowledge, procedural knowledge, and self-efficacy. Also considered in the model is the influence of key individual differences, goal orientation and self-awareness, on individuals' use of self-regulated learning strategies. While previous research supports a causal relationship between self-efficacy and the development of declarative and procedural knowledge, a direct path between self-efficacy and the other learning outcomes is not examined in this research model as these learning outcomes are measured concomitantly in this study, and are therefore best considered as co-varying dependent variables. The hypotheses derived from the research model are outlined below.

Hypotheses

Mastery goal orientation refers to individuals' desire to develop new skills, understand tasks, and successfully achieve self-referenced standards for mastery of the learning objective (e.g., Ford et al. 1998; Kanfer and Ackerman 1989). Mastery goal orientation is posited to have a positive influence on individuals' use of self-regulated learning strategies, as these individuals tend to enjoy the learning process and desire to learn as much as they can. Therefore, these individuals will be more likely to engage in self-regulatory learning strategies such as monitoring their learning process to ensure they are achieving their learning objectives. Thus,

H1: A mastery orientation will be positively related to individuals' use of self-regulated learning strategies.

Individuals with a mastery orientation are interested in the learning process, understand that their mistakes are part of the learning process, and perceive mistakes as opportunities to learn and improve (e.g., Martocchio 1994). Therefore, these individuals, even if difficulties are encountered, will perceive mistakes as useful learning experiences, and will demonstrate positive levels of self-efficacy. Thus,

H2: A mastery orientation will be positively related to self-efficacy.

In contrast to learning goal orientation, performance goal orientation focuses on individuals' desire to achieve superiority in performing or achieving the goal compared to others, to surpass normative-based standards, or to succeed with little effort (e.g., Ford et al. 1998; Kanfer and Ackerman 1989). Since performance oriented individuals are more focussed on learning outcomes than the learning process itself, these individuals will be less likely to engage in strategies to improve their learning process. Thus,

H3: A performance orientation will be negatively related to individuals' use of self-regulated learning strategies.

By extension, as a performance orientation guides individuals to focus on achieving higher performance with respect to the tasks at hand, these individuals will tend to devote their attention to on-task performance. Thus,

H4: A performance orientation will be positively related to on-task attention.

A link between performance goal orientation and self-efficacy is supported by the theory, but only in some situations. Specifically, we expect an individual's overall level of performance to moderate the impact of performance goal orientation on self-efficacy. Low-performing individuals will make more mistakes than high-performing individuals. Those with a performance orientation will attribute their mistakes differently than mastery oriented individuals. Performance-oriented individuals focus on their mistakes and will perceive their lack of ability as a lack of control, causing them to become more self-diagnostic than task-diagnostic, and thereby deflating their confidence or self-efficacy (e.g., Martocchio 1994). By contrast, this virtuous cycle will have a positive effect on self-efficacy for high performing individuals, as their confidence in their ability to perform will tend to increase. Thus,

H5: A performance orientation will be negatively related to self-efficacy for low-performing individuals, and will be positively related for high performing individuals.

Self-awareness is a key factor important to effective self-regulation (e.g., Zimmerman and Schunk 2001). Individuals must be aware of the strengths and weaknesses of their abilities to select appropriate self-regulated learning strategies. Thus,

H6: Self-awareness will be positively related to the use of self-regulated learning strategies.

Early in the learning process, the declarative knowledge phase, greater cognitive resources are required due to the demands of initial exposure to a new domain. Later in the learning process, the procedural knowledge phase, less cognitive resource demands are required as individuals begin to learn the various processes incorporated within the new domain. Due to resource constraints (e.g., Kanfer and Ackerman 1989), the use of self-regulated learning strategies during the early phase in the learning process is posited to negatively influence declarative knowledge learning outcomes for low performers. Low performers have fewer cognitive resources available, and therefore are not expected to benefit from allocating these scarce resources toward self-regulated learning during this initial learning phase. However, high performers do not have the same resource constraints as low performers, and are expected to benefit from the use of self-regulated learning strategies in this early phase of the learning process. Since the declarative phase has been shown to be the place where declarative knowledge is learned (e.g., Anderson 1992), this reasoning results in the hypothesized influence of self-regulation on declarative knowledge. We recognize that this may not be a perfect translation, since, for example, some declarative knowledge may be lost in later phases. However, we argue that for our first test of the model, the link is sufficiently well supported. Thus,

H7: Use of self-regulated learning strategies will be positively related to declarative knowledge learning outcomes for high performers, and will be negatively related to declarative knowledge learning outcomes for low performers.

At the later stage in the learning process, where procedural knowledge develops, users have less resource constraints overall (e.g., Kanfer and Ackerman 1989), as they are not focused on the initially demanding learning tasks such as the keystroke knowledge necessary to manipulate software. Therefore, the benefits of using self-regulated learning strategies toward improved procedural knowledge learning outcomes are posited to be experienced for all trainees.

H8: Use of self-regulated learning strategies will be positively related to procedural knowledge learning outcomes.

Self-regulation requires individuals to think about their abilities and how well they have understood material, and to monitor their progress and react accordingly (e.g., Bandura 1991). This process allows individuals to evaluate their own performance which can influence their confidence in their abilities (Bandura 1991). Mastery-oriented individuals perceive this self-evaluation as an opportunity to better understand their performance and abilities and, if substandard, will strive to improve. However, performance-oriented individuals will have positive affect only if they perceive they are performing superior to others, as this is their performance objective (e.g., Ford et al. 1998; Martocchio 1994). Thus,

H9: Use of self-regulated learning strategies will be positively related to self-efficacy for all participants, except low performing performance-oriented individuals where the relationship will be negative.

As practice is necessary to build self-efficacy (Bandura 1991; Ford et al. 1998), greater on-task attention will be positively related to self-efficacy. Generally, those who are inclined to practice their newly learned skills and focus on these tasks will generate increasing levels of self-efficacy. As indicated earlier, if the practice involves a greater proportion of errors, as it would for low performing performance-oriented individuals who will focus on their mistakes, this will cause greater on-task attention to be negatively related to self-efficacy. In this case, the quality of the time invested in practice is poor and will cause negative outcomes. Off-task attention reduces practice time, and hence will reduce self-efficacy. Thus,

H10: On-task attention will be positively related to self-efficacy, except for low performing performance-oriented individuals.

H11: Off-task attention will be negatively related to self-efficacy.

These hypotheses addressing the role of goal orientation, self-regulated learning strategies, self-efficacy, and learning outcomes are designed to gain a further understanding of the key relationships presented initially in the research questions. To test the research model and the hypotheses indicated above, a two-phase research study design was developed. The study design and methodology is indicated in the next section.

Methodology

Phase one, completed earlier this year, involved a series of 27 ***interviews*** conducted with knowledge-workers from a variety of organizations. Questions posed to these interviewees were designed to explore their computer software-related learning experiences in the organizational setting, specifically (1) their use of self-regulated learning strategies and the extent to which they participated in self-regulated learning in this context, (2) to adapt their existing self-regulated learning strategy measures and on/off-task attention measures to the organizational MIS context, (3) to determine additional constructs within the organizational context important to self-regulated learning, and (4) to provide preliminary evidence regarding the appropriateness of the research model.

Each of the interviews was tape-recorded and transcribed. The first author documented highlights of each interview and identified the common themes. Common themes were determined based on the frequency of related comments and their relevance toward the purpose of the study. Since the purpose of phase one was exploratory and the analysis preliminary, we did not deem it a serious limitation to have the analysis of transcripts conducted by a single individual.

Analysis of the transcription reports revealed many interesting insights regarding the self-regulated learning phenomenon experienced by knowledge workers learning computer software within organizations. First, it was clear that self-directed learning is by far the most common means by which employees within organizations learn computer software. Most interviewees indicated that 80 percent or more of their computer software learning was self-directed.

Second, the review of the interviews in phase one resulted in the identification of five additional self-regulated learning strategies used in the workplace. This is important, as adapting the self-regulated learning strategy measures to the organizational MIS context is key for optimization of the research model applied in the phase two field study. As explained at the onset of the paper, self-regulated learning strategies are the important processes that individuals use to monitor or control their own learning experiences to achieve their learning goals. Examples of these strategies are, "I tried to determine which things I didn't understand well," "I thought about how well my tactics for learning were working," and "I thought about what skills needed the most practice." The knowledge workers interviewed contributed additional strategies regarding self-directed learning on the job, including strategies such as monitoring one's time spent learning to ensure the use of their time was worthwhile, or gauging whether specific work tasks could be completed based on time invested toward learning. For example, interviewees explained, "I always assess whether my expenditure of time is worth it, am I getting my time's worth from this." Five additional off-task activities particular to the organizational context were also identified, including distractions such as telephone calls, voicemail, e-mail, and colleagues or managers interrupting the learning process with requests for tasks to be completed. The on-task measure was also adapted to the context of the study.

Third, four additional constructs were identified as being important to the self-directed learning process within organizations. Given the frequency of comments regarding these topics, it was evident that participants' judgments regarding the usefulness, ease of use, job relevance, and their intentions to use the software that they were learning influenced their effort devoted toward their learning experiences. These factors are key variables in the well-known technology acceptance model (e.g., Venkatesh and Davis 2000), which has been shown to be valuable in the MIS training and computer usage contexts. Phase one study results suggest that these factors are also important to include in learning models.

Finally, phase one findings provide tentative support for the key relationships in the research model between individual orientations, self-regulated learning, and learning outcomes. For example, those interested in the learning process, as opposed to performance outcomes, provided more detailed descriptions of their learning experiences, reportedly enjoyed their learning experiences, were successful learners, and claimed to conduct more self-monitoring or regulatory activities during their learning process. For example, one mastery-oriented interviewee explained, "I enjoy learning and usually try to learn as much as I can. I set learning goals and work to meet them, and this seems to work well for me." In contrast, a performance-oriented interviewee commented, "I spend time learning only when I need to perform a new task, and focus on getting the job done. I don't learn for the sake of learning." While this evidence is very preliminary, given the exploratory nature of the analysis, it does provide general support for the theoretical arguments we have advanced. More formal testing of those relationships will be made in the second phase of the study, to which we now turn.

In phase two, data are gathered in a field setting, as users proceed through a self-training program. This second phase of the study design is comprised of three steps. Subjects are asked to complete an online training session on their own, a study questionnaire, and two knowledge tests. A ***pilot study*** is currently being conducted to test procedures, validate adapted measures, and determine the appropriate sample size required for the main study. Results from this pilot study will provide an initial test of the model, and will be followed later this year by the main data collection, with a larger sample size.

Subjects: Subjects for this phase of the research are knowledge workers solicited from large organizations. Eligibility for participation in the study requires subjects to use computers in the course of their work and to have minimal previous experience with the empirical software domain used in this study. In exchange for participating in the study, each volunteer subject will receive free access to complete a variety of on-line training programs for a two-week period. The main study sample size is estimated to be 200 knowledge workers and the pilot study a sample size of 50. This sample size is consistent with studies of a similar nature (e.g., Kanfer and Ackerman 1989).

Measures: ***Mastery orientation*** is an eight-item measure (Button et al. 1996). ***Performance orientation*** is a 10-item measure (Button et al. 1996). ***Self-awareness*** is a 10-item measure (e.g., Hull et al. 2002). The ***self-regulated learning strategies*** construct is captured by two measures that will be compared in this study, Zimmerman and Martinez-Pons (1988) and Ford et al. (1998). Both measures are based upon the same theoretical framework, but have developed different self-regulated learning subprocesses. This study will determine which measure provides the most explanatory value regarding self-regulated learning in the organizational Web-based software training context. ***Declarative knowledge*** is an 11-item multiple-choice measure. ***Procedural knowledge*** is a 25-item hands-on test where participants are asked to conduct hands-on exercises using the software provided. ***Self-efficacy*** is a 10-item measure (Compeau and Higgins 1995). ***On-task and off-task attention*** measures (Kanfer and Ackerman 1989) are six-item and two-item measures, respectively, that will be adapted based on phase one interview findings.

Phase one has been completed. The *pilot study* in phase two is currently being conducted within a medium-sized organization. Based upon pilot study data analysis, we will make any modifications required to study procedures and measures, and will proceed with the main data collection. The pilot study data analysis will be complete by the conference. The research study findings from the pilot study and an update regarding the main study progress will be presented at the conference.

References

Anderson, J. "Acquisition of Cognitive Skill," *Psychological Review* (89:4), 1992, pp. 369-406.

Bandura, A. *Social Learning Theory*, Prentice-Hall, Inc., Englewood Cliffs, NJ, 1977.

Bandura, A. "Social Cognitive Theory of Self-Regulation," *Organizational Behavior and Human Decision Processes* (50), 1991, pp. 248-287.

Button, S., Mathieu, J., and Zajac, D. "Goal Orientation in Organizational Research: A Conceptual and Empirical Foundation," *Organizational Behavior and Human Decision Processes* (67:1), 1996, pp. 26-48.

Compeau, D., and Higgins, C. "Computer Self-Efficacy: Development of a Measure and Initial Test," *MIS Quarterly* (19:2), 1995, pp. 189-201.

Compeau, D., Higgins, C., and Huff, S. "Social Cognitive Theory and Individual Reactions to Computing Technology: A Longitudinal Study," *MIS Quarterly* (23:2), 1999, pp. 145-158.

Ford, J., Smith, E., Weissbein, D., Gully, S., and Salas, E. "Relationships of Goal Orientation, Metacognitive Activity, and Practice Strategies with Learning Outcomes and Transfer," *Journal of Applied Psychology* (83:2), 1998, pp. 218-233.

Hull, J., Slone, L., Meteyer, K., and Matthews, A. "The Nonconsciousness of Self-Consciousness," *Journal of Personality and Social Psychology* (83:2), 2002, pp. 406-424.

Information Week, "Educational Advantage," Gartner Group Data, March 2003, pp. 57-58.

Kahneman, D. *Attention and Effort*, Prentice-Hall Inc., Englewood Cliffs, NJ, 1973.

Kanfer, R., and Ackerman, P. "Motivation and Cognitive Abilities: An Integrative Approach to Skill Acquisition," *Journal of Applied Psychology Monograph* (74:5), 1989, pp. 657-690.

Martocchio, J. "Effects of Conceptions of Ability on Anxiety, Self-Efficacy, and Learning in Training," *Journal of Applied Psychology* (79:6), 1994, pp. 819-825.

Nelson, R. "Educational Needs as Perceived by IS and End-User Personnel: A Survey of Knowledge and Skill Requirements," *MIS Quarterly* (15:4), December, 1991, pp. 503-521.

Saunders, C. "Virtual Teams: Piecing Together the Puzzle," in *Framing the Domains of IT Management*, R. Zmud (ed..), Pinnaflex Educational Resources, Inc., Cincinnati, OH, 2000.

Venkatesh, V., and Davis, F. "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies," *Management Science* (42:2), 2000, pp. 186-204.

Zimmerman, B. J., and Martinez-Pons, M. "Construct Validation of a Strategy Model of Student Self-Regulated Learning," *Journal of Educational Psychology* (3), 1988, pp. 284-290.

Zimmerman, B., and Schunk, D. *Self-Regulated Learning and Academic Achievement: Theoretical Perspectives*, Lawrence Erlbaum Associates, Mahwah, NJ, 2001.