Self-Regulatory Processes During Computer Skill Acquisition : Goal and Self-Evaluative Influences

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Article:

In the studies reported in this article we examined the influence of learning goals and self-evaluation on college students' achievement outcomes during computer skill learning. Our conceptual focus was social cognitive theory, which postulates a critical role for self-regulation (Bandura, 1991a, 1991b; Zimmerman, 1998). Self-regulation refers to self-generated thoughts, feelings, and actions that are planned and cyclically adapted to attain personal goals (Zimmerman, 1989).

Social cognitive theory emphasizes the interaction of personal, behavioral, and environmental factors (Bandura, 1986; Zimmerman, 1994). Self-regulation is a cyclical process because these factors typically change during learning and must be monitored. Such monitoring leads to changes in an individual's strategies, cognitions, affects, and behaviors.

This cyclical nature is captured in Zimmerman's (1998) three-phase self-regulation model. The forethought phase precedes actual performance and refers to processes that set the stage for action. The performance (volitional) control phase involves processes that occur during learning and affect attention and action. During the self-reflection phase, which occurs after performance, individuals respond to their efforts.

Social cognitive theory postulates that perceived self-efficacy, or personal beliefs about one's capabilities to learn or perform actions at designated levels (Bandura, 1986, 1997), is a key variable that affects all phases of self-regulation (Zimmerman, 1990, 1998). Compared with less efficacious students, those with higher self-efficacy are more likely to select challenging tasks, expend effort and persist when difficulties are encountered, and demonstrate higher achievement (Bandura, 1993, 1997; Pajares, 1996; Schunk, 1991). Individuals acquire information to appraise efficacy from their performances, vicarious (observational) experiences, forms of persuasion, and physiological responses (e.g., sweating, heart rate).

The hypothesized process whereby self-efficacy affects phases of self-regulation is as follows (Schunk, 1996). Students enter learning situations with varying degrees of self-efficacy for learning (forethought). As they engage in the task (performance control), they use self-regulatory strategies on the basis of their knowledge of them, their beliefs that the strategies are effective, and their efficacy for using them skillfully (Zimmerman, 1989, 1998). During periods of self-reflection, students evaluate their learning progress. Perceived progress sustains self-efficacy and motivation, which enhance learning. Perceptions of little progress will not necessarily diminish efficacy if learners believe they know how to perform better, such as by working harder, seeking help, or switching to a more effective strategy (Schunk, 1996).

The present research addressed all three phases. As part of the forethought phase we provided students with goals to pursue during subsequent learning. To assess performance control, we determined students' perceived competence and self-reported use of self-regulatory strategies. During periods of self-reflection, students evaluated their learning progress. We discuss goals and self-evaluation in turn.

Goals

Goals affect motivation, achievement, and self-regulation (Bandura, 1988, 1991a, 1991b; Locke & Latham, 1990; Schunk, 1991; Schutz, 1991) and provide standards against which students can assess learning progress. When students adopt a goal, they may experience a sense of self-efficacy for attaining it and be motivated to perform appropriate self-regulatory activities (Schunk, 1996). Self-efficacy is substantiated as students perceive their goal progress. Goals, however, are less important than their properties. Goals that incorporate specific performance standards and are close at hand and moderately difficult raise motivation and achievement better than goals that are general, distant, or viewed as overly easy or difficult (Locke & Latham, 1990; Schunk, 1990, 1991).

Research has focused on such product goals as rate or quantity of work or tasks to be completed (e.g., “Complete 100 addition problems in 5 minutes”). In contrast, process goals involve techniques and strategies students use to learn or acquire knowledge or skills (e.g., “Learn how to compute square roots”; Schunk & Swartz, 1993a). Researchers have used various labels to distinguish these goals. Although meanings differ somewhat, process goals are analogous to learning, task, and mastery goals, whereas product goals are similar to outcome, performance, and ego–ability goals (Ames, 1992; Dweck & Leggett, 1988; Jagacinski, 1992; Meece, 1991; Pintrich & Schrauben, 1992; Urdan & Maehr, 1995).

Process goals may help focus students' attention on learning and promote the use of self-regulatory strategies and activities that help students improve their skills (Ames, 1992; Kanfer & Kanfer, 1991; Purdie, Hattie, & Douglas, 1996; Zimmerman & Kitsantas, 1996, 1997). Students' perceptions of their goal progress during learning substantiate their self-efficacy and promote motivation and achievement (Schunk, 1996). In contrast, product goals focus students' attention on completing tasks. Such goals may not highlight the importance of self-regulatory processes underlying skill acquisition or raise self-efficacy for learning (Schunk & Swartz, 1993a, 1993b). As students work on the task they may not compare their present and past performances to assess progress, which will not substantiate self-efficacy or enhance motivation and achievement.

A growing body of correlational research shows that process goals relate positively to perceptions of competence, self-regulation, and achievement (Meece, Blumenfeld, & Hoyle, 1988; Middleton & Midgley, 1997; Nolen, 1988, 1996; Pintrich & Garcia, 1991). Experimental studies have yielded benefits of process goals with children (Elliott & Dweck, 1988; Schunk, 1996; Schunk & Rice, 1989, 1991; Schunk & Swartz, 1993a, 1993b).

In the present research we explored the effects of process and product goals on college students' achievement outcomes during computer skill learning. We felt this focus was significant for several reasons. First, there is a lack of experimental research on process-goal effects among postsecondary students during academic learning. Second, most of our participants were female undergraduates. Women often hold lower perceptions of competence for acquiring mathematical and scientific skills than do men (Meece & Courtney, 1992; Meece & Jones, 1996). Finally, we thought that these college students would be knowledgeable of self-regulatory strategies (Pintrich, 1990), which would allow us to assess goal effects on their perceptions and use of strategies.

We hypothesized that providing students with process goals would focus their efforts on the skills to be acquired, allow for assessment of learning progress, and enhance implementation of successful learning strategies. In contrast, we felt that providing product goals would not highlight the importance of learning to the same degree, nor provide as valid a standard for gauging progress or cue the necessity of using effective self-regulation strategies. We predicted that process goals would lead to higher self-efficacy, achievement, perceived competence for self-regulation, and self-reported use of self-regulatory strategies.

Self-Evaluation

A second purpose of this research was to determine how providing students with opportunities to self-evaluate the progress of their learning would affect achievement outcomes. Personal evaluation is an integral component of the self-reflection phase of self-regulation (Zimmerman, 1998). Positive evaluations substantiate self-efficacy for learning and motivate learners to work diligently because they believe they are capable of making further progress (Schunk, 1991). Low self-evaluations do not necessarily diminish self-efficacy or motivation if students believe they are capable of learning and can do so by using effective self-regulatory strategies (Zimmerman & Martinez-Pons, 1992).

Despite these theoretical benefits, little research has explored how self-evaluation affects achievement outcomes. Research with children during mathematical (Schunk & Hanson, 1985; Schunk, Hanson, & Cox, 1987) and writing-skill instruction (Schunk & Swartz, 1993a) found that self-efficacy for learning or improving skills assessed before children received instruction predicted subsequent motivation and achievement. Masters and Santrock (1976) showed that children who verbalized self-judgments while performing a difficult handle-turning task (e.g., “I'm really good at this”) persisted longer than children who verbalized neutral or critical statements.

Research has obtained some benefits of self-evaluation among adults (Bandura & Cervone, 1983, 1986; Cervone, Jiwani, & Wood, 1991). With children, Schunk (1996) found differential effects of self-evaluation as a function of its frequency. Frequent opportunities for self-evaluation of capabilities or progress raised achievement outcomes regardless of whether students received learning or performance goals. Conversely, infrequent opportunities for self-evaluation raised self-efficacy and achievement only among students receiving learning goals. From these results we infer that frequent self-evaluations of learning capabilities or progress can substantiate one's self-efficacy for learning and sustain motivation and self-regulation regardless of one's goal. When self-evaluation of capabilities or progress occurs less often, it may complement process goals better than product goals with corresponding benefits for achievement outcomes.

In the present research, college students worked under conditions involving process or product goals. In the first study, half the students received a single opportunity for self-evaluating learning progress; in the second study, some students were given multiple self-evaluation opportunities. We hypothesized that infrequent self-evaluation would complement process goals and enhance self-efficacy, achievement, and self-regulation competence and frequency. Conversely, we expected multiple self-evaluations to negate the benefits of process goals and raise achievement outcomes for both process- and product-goal condition students.

Experiment 1

Method

Participants

The final sample included 44 students (40 women, 4 men) enrolled in an introductory course on computers in education. Ages ranged from 18 to 39 years ($M = 21$ years). The majority of students ($n = 28$) were pursuing a degree in elementary education. The remaining students represented related program areas such as secondary education, special education, and early childhood education. The sample's ethnic composition was predominantly (90%) White American. The initial sample comprised 61 students, but we dropped 13 students from the study because they missed some of the sessions, and randomly excluded the data of 4 others to equalize cell sizes. Most students reported average or little experience with computers before the study. Prior experiences were primarily limited to word-processing applications.

Course and Instruction

The course “Introduction to Computers in Education” is a 3-hr lecture–laboratory course designed to introduce undergraduates to educational computer skill applications including word processing, spreadsheets, telecommunications, and Hypercard. Students attended a large lecture session twice a week (1 hr each) and an instructional laboratory once a week (2 hrs). There were approximately 10 to 12 students in each of six laboratory sessions. Laboratory projects were explained and outlined in the lecture session and completed in the laboratory sections under the direction of teaching assistants.

Students were required to complete six laboratory projects, accounting for 50% of their course grade. A manual delineated specific grading criteria for each project based on competencies students were expected to gain through completion of each project. Students were allowed to resubmit projects after receiving formative feedback from the teaching assistant.

The Hypercard unit was the fourth project of the semester and extended over 3 weeks. Compared with the other projects, the Hypercard unit was considered the most complex; it had the highest point value and was allotted the most time. Objectives for this project were substantially similar to the items on the self-efficacy and achievement tests administered in this study (Appendix).

Students were pretested before the start of the Hypercard unit. The study was conducted over the following three laboratory sessions (3 weeks). Posttesting occurred during a separate session following the last laboratory session. The goal instructions were given at the start of each of the three sessions. The self-evaluation instrument was administered at the end of the second session.

Pretest

The pretest was administered by one of two testers who were not course instructors or laboratory assistants. The pretest consisted of measures of self-regulation (perceived competence and frequency), self-efficacy, and achievement.

Self-regulation

The self-regulation test contained 16 items that tapped the four self-regulation dimensions identified by Zimmerman (1994). Four items were included for each dimension. The four dimensions (and sample items) were: motives (“find ways to motivate myself to finish a lab project even when it holds little interest for me”), methods (“locate and use appropriate manuals when I need to accomplish an unfamiliar computer task”), performance outcomes (“set specific goals for myself in this course”), social–environmental resources (“find peers who will give critical feedback on early versions on my projects”). A complete list of items is shown in the Appendix.

Students made competence and frequency judgments for the same 16 items. For the competence measure, students judged how well they thought they could perform each activity on a 7-point scale ranging from 1 (not well) to 7 (very well). Students were advised to answer honestly and accurately on the basis of their beliefs about their current levels of self-regulatory performance and not in terms of how they thought they could or should answer. Students made their judgments privately. For the frequency measure, students judged how often they actually performed each self-regulatory activity on a 7-point scale ranging from 1 (never) to 7 (all the time).

We assessed the reliability of the self-regulation test during a pilot study with 12 students who were comparable to the present sample but who did not participate in the study. Students completed the instrument twice, 2 weeks apart. Test–retest competence coefficients were as follows: motives ($r = .92$), methods ($r = .83$), outcomes ($r = .67$), resources ($r = .93$), full scale ($r = .92$). Percentages of agreement for individual items (Cohen's kappa) ranged from .20 to .89 ($M = .54$). Test–retest frequency coefficients were as follows: motives = .80, methods = .63, outcomes = .78, resources = .49, full scale = .81. Cohen's kappa values for individual items ranged from .11 to .84 ($M = .45$). Given that some of the subscale coefficients were not high, subsequent data analyses involved only the full-scale competence and frequency measures. For participants in the present study, Cronbach's alpha was .80 for the competence measure and .75 for the frequency measure.

Self-efficacy

The self-efficacy test assessed students' perceived capabilities for performing 12 Hypercard tasks at an exemplary (accurate and neat) level of performance (Appendix). In a laboratory session before the pretest, students were shown model Hypercard projects by the course instructor. For the efficacy assessment, students privately judged their confidence for performing each task on a 7-point scale ranging from 1 (not confident) to 7 (very confident). Students were advised to answer honestly on the basis of how they felt at the time and not on the basis of how they wished they felt or how they might feel at the end of the course. Test–retest reliability of this measure assessed during the pilot test was .94. Cohen's kappa values for individual items ranged from .17 to .90 (M = .62). Cronbach's alpha for present participants was .96.

Achievement

The achievement test comprised 15 tasks that closely matched those on the efficacy test (Appendix). The objective of the achievement test was to create a five-card Hypercard stack. Students were advised to complete as many of the tasks as they wished, although they could omit tasks and quit working at any time. At the time the pretest was given, students had not received instruction on Hypercard. Most students did not attempt to perform the tasks, and no student correctly performed any of the items. Consequently, pretest achievement scores were not used in the data analyses.

Procedure

Six laboratory sections were used. Four sections were randomly assigned to one of four experimental conditions: process goal with self-evaluation (PC-SE); process goal without self-evaluation (PC-NoSE); product goal with self-evaluation (PD-SE); product goal without self-evaluation (PD-NoSE). Students in each of the other two sections were assigned randomly to one of two conditions (i.e., to PC-SE and PC-NoSE in Section 5 and to PD-SE and PD-NoSE in Section 6). We followed this random assignment procedure to eliminate an unwanted potential source of error; had students in the same laboratory section been assigned to different goal conditions, they might have wondered why they were receiving different goal instructions. Before the study, laboratory instructors confirmed that there were no achievement differences between sections in computer skills. We found no statistically significant differences between laboratory sections on any pretest measure.

Experimental conditions: Goals

Experimental procedures were administered by one of two researchers who were not course instructors or laboratory assistants. At the start of each of the three laboratory sessions the researcher distributed to students assigned to the PC-SE and PC-NoSe conditions a list of the course Hypercard objectives and verbalized the following:

While you are working on computer assignments it helps to keep in mind what you are trying to do. At the beginning of the course you received a list of expected outcomes from your Hypercard project. These are shown on this page and can be thought of as goals that you are trying to accomplish. For example, some of these goals are to learn to use different fonts, format and size fields, use at least two relevant pictures, make your design clear and appropriate for the chosen audience, and plan and organize your stack. So while you are receiving Hypercard instruction and working on assignments you should keep in mind the goals listed on this page.

To students assigned to the PD-SE and PD-NoSE conditions, the researcher gave the following instructions at the beginning of each of the three laboratory sessions:

While you are working on computer assignments it helps to keep in mind what you are trying to do. At the beginning of the course you were advised to try to complete your assignments. So while you are receiving Hypercard instruction and working on assignments you should keep in mind the goal of trying to complete your assignments.

The differences between the process- and product-goal conditions seem subtle because they involve distributing the course unit objectives to process-goal students but not to product-goal students (although the latter had received them in the course materials) and some changes in the verbal instructions. To ensure that conditions were distinguished and that goals were clear in students' minds, the researcher gave the instructions at the start of each laboratory session, after which he or she asked students if the goal sounded reasonable and attainable. No student expressed dissatisfaction with the goal in any session.

Experimental conditions: Self-evaluation

Students assigned to the PC-SE and PD-SE conditions judged their progress in acquiring Hypercard skills at the end of the second laboratory session. The materials and procedure were identical to those of the pretest self-efficacy assessment except that students judged the amount of progress they had made in learning to perform the tasks. Students privately judged each of the 12 tasks on a 7-point scale ranging from 1 (none) to 7 (quite a lot). Cronbach's alpha was .93.

Students assigned to the PC-NoSE and PD-NoSE conditions did not complete the learning progress self-evaluation instrument; however, at the end of the second laboratory session the researcher gave them a single-item attitude questionnaire that asked how much they enjoyed Hypercard instruction and working on assignments. Students rated their enjoyment on a 7-point scale ranging from 1 (not at all) to 7 (a great deal). This assessment controlled for potential effects of making judgments. Within Sections 5 and 6, it also ensured that all students completed an instrument at the end of the second session. Attitude scores of the PC-NoSE and PD-NoSE conditions did not differ significantly. These attitude scores are not otherwise relevant to this study, thus we do not discuss them further.

Posttest

We gave the posttest during the week following the last laboratory session. It was identical to the pretest except that a different assignment was used on the achievement test to control for potential effects of students' selective memory of the pretest assignment. The pre- and posttest achievement tests were of comparable difficulty. Cronbach's alpha coefficients for the posttest measures were as follows: self-efficacy = .93, self-regulation competence = .87, self-regulation frequency = .85, achievement = .79. All tests were scored by an individual who was unaware of students' experimental assignments.

Results and Discussion

Means and standard deviations are presented by condition in Table 1. Preliminary analyses of variance (ANOVAs) yielded no significant between-condition differences on pretest measures. There also were no significant differences on any measure due to gender, ethnic background, or laboratory section.

Table 1
Means and Standard Deviations, Experiment 1

		Condition								
		PC-SE		PC-NoSE		PD-SE		PD NoSE		
Measure	Phase	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	Results
Self-efficacy	Pretest	4.3	1.5	3.5	1.2	3.9	1.6	3.9	1.2	*n.s.*
	Posttest	6.5	0.4	5.8	0.6	4.2	0.5	4.1	0.5	PC > PD SE > NoSE
Achievement	Pretest	0	0	0	0	0	0	0	0.0	*n.s.*
	Posttest	12.4	1.1	12.1	2.2	12.1	1.7	11.9	1.7	*n.s.*
Self-regulation										
Competence	Pretest	5.3	1.0	5.1	0.8	5.2	0.7	4.6	0.8	*n.s.*
	Posttest	5.6	0.6	5.7	0.7	5.3	0.8	4.7	0.9	PC > PD
Frequency	Pretest	5.3	0.7	5.3	0.7	4.9	0.7	4.6	0.8	*n.s.*
	Posttest	5.6	0.5	5.6	0.9	5.1	0.7	4.5	0.9	PC > PD
Self-evaluation	Instruction	6.0	0.4			4.3	0.9			PC-SE > PD-SE

Note. $N = 44$; $n = 11$ per condition. PC = process goal; PD = product goal; SE = self-evaluation; NoSE = no self-evaluation. Self-efficacy, self-regulation, and self-evaluation measures ranged from 1 (*low*) to 7 (*high*); the achievement measure ranged from 0 (*low*) to 15 (*high*).

Means and Standard Deviations, Experiment 1

Self-Efficacy and Achievement

We applied an analysis of covariance (ANCOVA) to posttest self-efficacy by using pretest self-efficacy as the covariate. The use of covariance necessitated demonstration of homogeneity of slopes across conditions. Tests of slope differences for this and other measures to which covariance was applied in Experiments 1 and 2 found the assumption of slope homogeneity to be tenable (ps > .05).

The posttest self-efficacy ANCOVA yielded significant effects due to goal, $F(1, 39) = 186.97$, $p < .001$, and self-evaluation, $F(1, 39) = 5.45$, $p < .05$; the interaction was not significant. Providing a process goal and an opportunity for self-evaluation of learning progress enhanced students' perceptions of self-efficacy.

We analyzed posttest achievement with an ANOVA. We did not use pretest achievement as a covariate because no student correctly performed any pretest achievement task. This result was nonsignificant; conditions did not differ in posttest achievement.

Self-Regulation

We computed self-regulation competence and frequency average scores across all items. ANCOVAs applied to posttest competence and frequency scores using the corresponding pretest scores as covariates yielded significant goal effects for each measure: competence, $F(1, 39) = 5.83$, $p < .05$; frequency, $F(1, 39) = 5.05$, $p < .05$. Thus, the hypothesized benefits of process goals on self-regulation were obtained.

Self-Evaluation

We analyzed self-evaluation scores of the PC-SE and PD-SE conditions with a t test, which yielded significant results, $t(20) = 5.98$, $p < .001$. PC-SE students judged their progress to be greater than did PD-SE students.

Correlational Analyses

We computed product–moment correlations among the posttest measures of self-regulation competence and frequency, self-efficacy, and achievement to explore relations among theoretically relevant variables. We then calculated correlations separately within each condition; these did not differ significantly. Correlations were averaged across conditions, and averages are reported in Table 2.

Table 2
Intercorrelations of Posttest and Instructional Measures, Experiment 1

Measure	1	2	3	4	5
1. Self-efficacy	—	.74**	.61*	.46	.66*
2. Achievement		—	.19	.18	.25
3. Self-regulation–Competence			—	.87**	.06
4. Self-regulation–Frequency				—	.28
5. Self-evaluation					—

Note. Correlations are averaged across the four treatment conditions (two conditions for correlations involving self-evaluation), $n = 11$ per condition.
$^*p < .05$. $^{**}p < .01$.

Intercorrelations of Posttest and Instructional Measures, Experiment 1

Self-efficacy correlated significantly and positively with achievement and self-regulation competence. The two self-regulation measures were significantly correlated. Among students assigned to self-evaluation conditions, self-evaluation score related positively to self-efficacy.

Experiment 2

Method

Experiment 1 demonstrated that providing students with process goals enhanced their self-efficacy for successfully performing computer-based tasks and their perceived competence with and frequency of use of self-regulatory strategies better than did providing product goals. We also found that providing an opportunity for self-evaluation promoted self-efficacy better than did no self-evaluation opportunity. Among students who self-evaluated progress, judgments were higher for those who had received process goals. There were, however, no differential effects of process goals or self-evaluation on achievement.

We designed Experiment 2 to investigate in greater depth the hypothesis that process goals and self-evaluation affect achievement outcomes through the common mechanism of conveying information about learning progress. The self-evaluation component in Experiment 1 was minimal because it occurred only once. For students who received process goals, one self-evaluation may have been sufficient to convey progress because it was linked to their goals that reflected unit objectives. Product-goal students, on the other hand, may have derived less clear information about progress because the self-evaluation opportunity did not directly ask about their goals. Product-goal students may not have used the self-evaluation opportunity as fully to assess their progress toward unit objectives.

In Experiment 2, students evaluated their learning progress at the end of each of the three laboratory sessions rather than once. We felt the more frequent self-evaluations would increase the likelihood of product-goal students deriving progress information. We also dropped the PD-NoSE condition because Experiment 1 showed that outcomes are not enhanced as well in the absence of process goals and self-evaluation and because two studies by Schunk (1996) with children obtained these same negative results. We realized that the PD-NoSE condition provided a control group to compare with other conditions to determine benefits of goals and self-evaluation. Our primary purpose in conducting Experiment 2, however, was to ascertain whether frequent self-evaluations would compensate for the effects of process goals. We therefore predicted that the PC-SE, PC-NoSE, and PD-SE conditions would demonstrate comparable outcomes.

Participants

Experiment 2 was conducted during the semester following that in which Experiment 1 took place. Participants (N = 33, 29 women, 4 men) were undergraduate students enrolled in the course “Introduction to Computers in Education.” Participants' characteristics were similar to those of Experiment 1 participants. The initial sample consisted of 45 students; 11 students were dropped because of missed laboratory sessions and 1 was dropped to equalize cell sizes.

Table 3
Means and Standard Deviations, Experiment 2

		Condition						
		PC-SE		PC-NoSE		PD-SE		
Measure	Phase	*M*	*SD*	*M*	*SD*	*M*	*SD*	Results
Self-efficacy	Pretest	2.9	1.6	2.4	1.5	3.3	1.7	*n.s.*
	Posttest	6.1	0.5	5.9	0.6	6.2	0.8	*n.s.*
Achievement	Pretest	0	0	0	0	0	0	*n.s.*
	Posttest	12.5	2.3	12.1	1.0	12.5	1.4	*n.s.*
Self-regulation								
Competence	Pretest	5.5	0.8	5.3	0.8	5.0	1.3	*n.s.*
	Posttest	5.9	0.7	5.5	0.7	5.6	0.9	*n.s.*
Frequency	Pretest	5.4	0.7	5.1	0.5	4.8	1.2	*n.s.*
	Posttest	5.6	0.7	5.3	0.5	5.4	1.2	*n.s.*
Self-evaluation	Instruction	4.8	0.6			5.0	0.6	*n.s.*

Note. $N = 33$; $n = 11$ per condition. PC = process goal; PD = product goal; SE = self-evaluation; NoSE = no self-evaluation. Self-efficacy, self-regulation, and self-evaluation measures ranged from 1 (*low*) to 7 (*high*); the achievement measure ranged from 0 (*low*) to 15 (*high*).

Tests, Materials, and Procedure

Except where indicated, pretest, laboratory session, and posttest materials and procedure were the same as those used in Experiment 1. There were six laboratory sections; 6 to 9 students per section volunteered to participate in the study. Students were pretested on the following (Cronbach's alpha coefficients are presented in parentheses): self-regulation competence (.87), self-regulation frequency (.81), self-efficacy (.92), and achievement (could not be computed). Two laboratory sections were randomly assigned to each of three conditions: process goal with self-evaluation (PC-SE), process goal without self-evaluation (PC-NoSE), product goal with self-evaluation (PD-SE).

At the start of each of three sessions, students received process- or product-goal instructions (identical to those of Experiment 1) depending on their experimental assignment. Students assigned to the PC-SE and PD-SE conditions evaluated their progress in skill acquisition at the end of each session by using the same instrument and procedure that students had used in Experiment 1 ($\alpha = .96$). PC-NoSE students were given the attitude instrument. We posttested all students during the week following the last session on the following items

(Cronbach's alpha coefficients are presented in parentheses): self-regulation competence (.86), self-regulation frequency (.84), self-efficacy (.95), and achievement (.80).

Results and Discussion

Means and standard deviations are shown in Table 3. ANOVAs yielded no significant between-conditions differences on pretest measures, nor were there significant differences on any measure that were due to gender, ethnic background, or laboratory section. Students had no prior knowledge of Hypercard; no student could perform any pretest achievement task.

Means and Standard Deviations, Experiment 2

Self-Efficacy and Achievement

We applied an ANCOVA to posttest self-efficacy by using pretest self-efficacy as the covariate; the three conditions constituted the treatment variable. This analysis was nonsignificant. We analyzed posttest achievement with an ANOVA; this result also was nonsignificant. The three treatment conditions did not differ in posttest self-efficacy or achievement.

Self-Regulation

We analyzed posttest competence and frequency scores with ANCOVAs by using the corresponding pretest scores as covariates; the three conditions constituted the treatment factor. These results were nonsignificant; conditions did not differ in self-reported competence and frequency of self-regulation.

Self-Evaluation

We compared self-evaluation scores of the PC-SE and PD-SE conditions for each of the three sessions, as well as average scores across the three sessions. The results of t tests were nonsignificant.

Correlational Analyses

We computed product–moment correlations among posttest self-regulation (competence, frequency), self-efficacy, and achievement (Table 4). Self-efficacy correlated significantly and positively with achievement and self-regulation competence; self-regulation competence and frequency were highly correlated; self-evaluation bore a positive relation to self-efficacy and self-regulation competence.

Table 4
Intercorrelations of Posttest and Instructional Measures, Experiment 2

Measure	1	2	3	4	5
1. Self-efficacy	—	.80**	.66*	.54	.64*
2. Achievement		—	.10	.16	.50
3. Self-regulation–Competence			—	.92**	.61*
4. Self-regulation–Frequency				—	.45
5. Self-evaluation					—

Note. Correlations are averaged across the three treatment conditions (two conditions for correlations involving self-evaluation), $n = 11$ per condition.
$^{*}p < .05$. $^{**}p < .01$.

Intercorrelations of Posttest and Instructional Measures, Experiment 2

General Discussion

The results of these studies show that providing college students with process goals is an effective way to enhance achievement outcomes and that under certain conditions opportunities for self-evaluation are beneficial. Our first experiment showed that students who received process goals judged self-efficacy and self-regulation competence and frequency higher than did students who received product goals. Process goals also led to higher self-evaluations of progress than did product goals. Providing students with an opportunity for self-evaluation enhanced their self-efficacy.

An explanation for these findings based on social cognitive theory is as follows. Providing students with a goal to learn to perform computer applications can increase their self-efficacy for learning, help focus their attention on the learning process, and motivate them to use effective self-regulatory activities (Ames, 1992; Kanfer & Kanfer, 1991; Purdie et al., 1996; Zimmerman, 1998; Zimmerman & Martinez-Pons, 1990). Self-efficacy is substantiated and motivation and self-regulation are sustained as students perceive their progress in skill acquisition (Bandura, 1997; Schunk, 1996). Especially in the initial stages of learning, process goals can help focus students' efforts on the task and provide the motivation to engage in self-regulation (Schunk, 1996; Zimmerman & Kitsantas, 1996, 1997).

White, Kjelgaard, and Harkins (1995) suggested that research that explores the conditions under which self-evaluation motivates performance is needed. The present research helps to clarify the role of self-evaluation during cognitive skill learning. In the first experiment, students engaged in self-evaluation once. Given that this assessment was closely tied to the process goal because it called for self-evaluation of progress, it complemented that goal better than the product goal. With infrequent opportunity for self-evaluation, the assessment may have conveyed a clearer sense of progress to process-goal students than to product-goal students. Students who received a process goal self-evaluated learning progress higher than did students who received a product goal, which supports the notion that even one opportunity for self-evaluation can highlight perceptions of progress when the self-evaluation is closely linked to a process goal.

In contrast, the self-evaluations in the second study were more powerful because they occurred weekly. Under these conditions, the type of goal may make little difference. Our results are consistent with those of Schunk (1996), who found that frequent self-evaluation produced comparable results in the presence of learning or performance goals but learning goals exerted stronger effects with infrequent self-evaluation.

The present results must be qualified because students were acquiring skills and making positive self-evaluations. Self-evaluation could exert negative effects on motivation and self-regulation if students encountered difficulties and concluded they were incapable of learning (Schunk, 1996). Merely having an evaluative criterion against which to compare performance is insufficient (White et al., 1995). Further, benefits of self-evaluation should occur when the focus is on progress relative to one's initial performance. Negative effects on motivation and learning can occur when self-evaluations involve social comparisons with others (Ames, 1992; Dweck & Leggett, 1988; Meece, 1991) and when self-evaluations yield a large negative discrepancy between present performance and one's goal (Bandura, 1986). Thus, we advise readers to be cautious in generalizing our results to contexts other than those involving self-evaluations of learning progress.

Although students in our studies made explicit self-evaluations, the procedure need not be overt. The critical element is the occurrence of self-evaluation, not its means. Asking students to overtly evaluate their progress ensures that self-evaluation occurs. This may be useful in the classroom, especially for learners who otherwise might not engage in self-evaluation. We would expect comparable effects if students engaged in covert self-evaluation. Bandura (1997) discussed evidence showing that the process of making overt judgments does not cause behavior change. Behavior change is linked to the perception of progress, not from the procedure used to assess it.

We must further qualify these results because our sample comprised primarily female college students who were education majors. We found no differences in any measure between our male and female participants, but given the small number of male students in our samples, we recommend replicating the studies with a diverse sample. We believe, however, that our participants were typical of the larger college student population who generally have a good repertoire of self-regulation strategies (Ertmer, Newby, & MacDougall, 1996; Lindner & Harris, 1992; Pintrich, 1990; Pressley, Levin, & Ghatala, 1984; Weinstein & Stone, 1993; Zimmerman & Paulsen, 1995). Process goals and self-evaluation will have little effect on self-regulation if students are unaware of strategies, cannot use them effectively, or question whether self-regulation improves learning (Borkowski, Johnston, & Reid, 1987; Schunk, 1991).

We found no benefits of process goals and opportunities for self-evaluation on computer-skill achievement. This research cannot determine the reasons for these nonsignificant results, which are inconsistent with those obtained by Schunk (1996) with children. One possibility is that the process goal may have seemed too easy to students. Easy goals can raise self-efficacy but not affect performance if all students can accomplish the task (Bandura, 1988; Locke & Latham, 1990). Our process goals were tied to course objectives that students were expected to master if they wanted a good grade. Under these mastery conditions, it is not surprising that posttest self-efficacy and achievement scores were generally high and variability was restricted.

A second possibility is that students implicitly held learning-goal orientations and engaged in self-evaluation of progress on their own. Our goal instructions were designed to promote students adopting a particular goal for the setting. In contrast, goal orientations are characterized as general and stable personal dispositions that manifest themselves in diverse situations (Ames, 1992; Meece, 1991). If most students implicitly held a learning-goal orientation and covertly self-evaluated progress, then our process-goal and self-evaluation conditions served to make those processes more salient. Such saliency can raise self-efficacy by highlighting progress, but not necessarily promote achievement if all students were motivated to succeed and employed effective strategies. Future research might explore students' goal orientations and determine whether students adopt situational goals that diverge from their dispositions (Nicholls, 1983).

The present results support the idea that self-efficacy is not merely a reflection of prior performances (Bandura, 1986, 1997). Students in all conditions received equal time on computer instruction and practice, yet self-efficacy differences emerged in Experiment 1. This research also shows that capability self-perceptions help to predict achievement and self-regulation. In both studies, self-efficacy bore a strong, positive relation to achievement and perceived self-regulation competence. Personal expectations for success are viewed as important influences on achievement by different theoretical approaches (Bandura, 1986, 1997; Covington, 1992; Pajares, 1996; Weiner, 1985).

The results of these projects have implications for teaching computer skills or other content where computers are used. Making explicit the link between class objectives and process goals can enhance students' self-efficacy, motivation, and self-regulated learning. Opportunities for self-evaluation are easy to incorporate into teaching, and frequent self-evaluations are beneficial. Computers offer a desirable means for this because the goals and self-evaluation assessments can be included in the software. Although these studies do not show that process goals and self-evaluation are necessary for achievement, they can facilitate achievement outcomes when integrated with sound instruction.

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APPENDIX

APPENDIX A: Test Items Administered in This Study

Motives

Start a new computer project (after initial instruction) with no difficulty.
Work on lab projects even when there are other interesting things to do.
Find a way to concentrate on lab projects even when there are many distractions around me.
Find ways to motivate myself to finish a lab project even it holds little interest for me.

Methods

Make a plan to complete my lab assignments.
Remember information presented in the textbook and in lab.
Organize my lab work.
Locate and use appropriate manuals when I need to accomplish an unfamiliar computer task.

Performance Outcomes

Set specific goals for myself in this course.
Refer to the goals I set early in the course to gauge the progress I am making.
Modify my approach to this class if I find that the one I am using isn't working.
Keep an accurate record of the course points I have earned so far.

Social–Environmental Resources

Find peers whom I can ask for help if I'm unsure of what to do.
Arrange a place to work without distractions.
Find peers who will give critical feedback on early versions of my projects.
Manage my time efficiently when I have a deadline on a project.
Add and format buttons (icons, styles, script)
Add and format “special effects” buttons (fade, dissolve)
Add and format fields (style, size)
Use graphic tools to create card designs
Use Hypercard clip art
Script buttons and link correctly
Create an exit button that quits Hypercard
Create a background design that is used by multiple cards
Use more than one background design
Use different fonts
Print a hard copy of your stack
Create a grade “A” project that combines the above tasks

A. Create a five-card Hypercard stack that includes:
Use of the background feature to create more than one background (e.g., use one design as the background for three cards and another design as the background for the other two cards)
First card (title screen): Instructional approaches (also include your four-digit ID code)
Second card (instructional information): Instructional approach #1* (include the name and description of one type of instructional approach)
Third card (example): Include an example of the instructional approach you described on Card 2.
Fourth card (instructional information): Instructional approach #2* (include the name and description of another type of instructional approach)
Fifth card (example): Include an example of the instructional approach you described on Card 4

Be sure that you include the following features:
(a) 2–3 different button icons
(b) 2–3 different field styles and sizes
(c) 2–3 different fonts
(d) A picture from the Hypercard idea stack
(e) The use of at least one special “button effect” (e.g., fade, dissolve)
(f) An exit button that works

B. Link the cards
C. Save as “Hypercard Perf” and print out your stack

Appendix Footnotes
* *Choose from any of the following instructional approaches: presentation, demonstration, discussion, cooperative learning, discovery, problem solving, instructional games, simulation, drill and practice, tutorial.
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