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EMPIRICAL STUDY

Enhancing self-regulation of practice: the influence of graphing and self-evaluative standards

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Abstract The purpose of this study was to examine the role of graphing of self-recorded outcomes and self-evaluative standards on the acquisition of a motoric skill with 70 college students. It was postulated that students who were provided with *graduated* self-evaluative standards would surpass those who were provided with *absolute* standards or no standards (control) in both motoric skill and in motivational beliefs (i.e., self-efficacy, attributions, and self-satisfaction). Regarding graphing of self-recorded outcomes, it was hypothesized that students who graphed their results visually would show higher dart skill and stronger motivational beliefs than participants who did not graph their results. Support was found for these hypotheses. The implications of findings of this study were discussed for instructors in terms of how the effects of self-directed practice can be enhanced.

Keywords Self-regulation · Practice · Graphing · Self-evaluative standards

It is an article of faith among many athletes and coaches that the quantity and quality of one's practice is closely linked to competitive success (Burfoot, 1997), and there is a growing body of evidence of the importance of self-disciplined learning and practice to the development of expert levels of competence (Ericsson, 1997). Because practicing and self-studying involve solitary as well as coached activities, a number of researchers have investigated the role of various self-regulatory processes (Kirchenbaum, 1984; Kitsantas & Zimmerman, 1998; Locke & Latham, 1990; Winne & Perry, 2000). Self-regulation has been defined as cyclical efforts to optimize cognitive, motivational, and behavioral processes leading to one's goal attainment (Schunk & Zimmerman, 1998).

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Social cognitive researchers have postulated that learners self-regulate in three sequential phases: forethought, performance, and self-reflection (Zimmerman, 2000). Forethought phase processes precede and prepare one to engage in a task. This phase includes two major categories of self-regulatory processes: task analysis and sources of self-motivation, such as self-efficacy beliefs (see Fig. 1). Performance phase processes influence one's attention, volition, and execution of the task. These phase processes are grouped into two major categories: self-control methods and self-observation. Self-control refers to various strategies that learners use and self-observation refers to metacognitive monitoring or keeping records of one's performance. Self-reflection phase processes occur after one's performance but reflect back upon its personal meaning. These phase processes involve two major categories: self-judgments and self-reactions regarding those judgments, such as self-satisfaction. One type of self-judgment involves a causal attribution (i.e., an attribution judgment) for one's successes and failures, such as to one's ability or effort.

Another type of self-judgment that has received only limited study to date is self-evaluation (i.e., a self-evaluative judgment). This involves comparing self-monitored outcomes with a goal or standard (Winne & Hadwin, 1998), which is defined as an expected or preferred quality or level of performance (English & English, 1958). Like goals, standards can be set personally or by others during forethought. A problem in self-

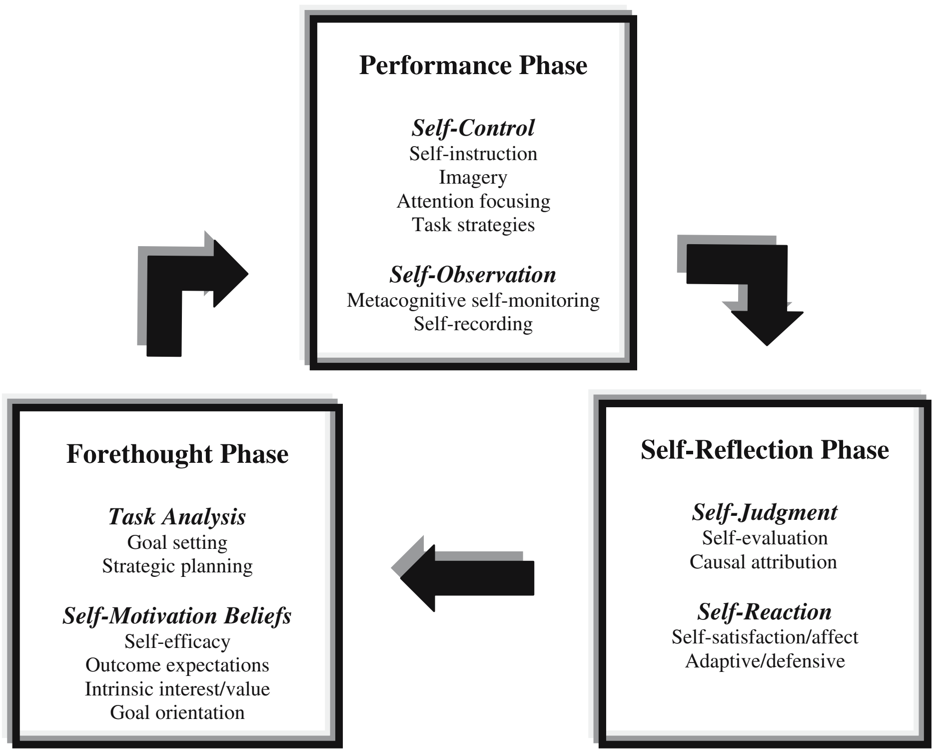

Fig. 1 Phases and subprocesses of self-regulation. From "Motivating self-regulated problem solvers" by B. J Zimmerman, & M. Campillo (2003), in *The psychology of problem solving* (Figure 8.1, p. 239). J. E. Davidson & R. J. Sternberg (Eds.). New York: Cambridge University Press. Copyright by Cambridge University Press. Adapted with permission

evaluation can arise when a person adopts an absolute standard and classifies his/her outcomes crudely as either successes or failures. For example, the legendary American golfer Walter Hagen discovered that high absolute self-evaluative standards became a mental block for him, and so he decided to alter his self-evaluative standard to improve his self-reactions to errors (Nicklaus, 1992). Hagen assumed that he would make three or four errors during each round of golf, and this enabled him to shrug off frustration quickly when he made an error and avoid rumination that could lead to further mistakes. Absolute standards encourage users to interpret their outcomes in stark and simplistic terms, and if the task in question is difficult, most outcomes may be perceived as negative (Kitsantas & Zimmerman, 2002; Zimmerman & Kitsantas, 1999). By contrast, experts appear to prefer challenging standards that involve subtle gradations in performance (Ericsson, 2001).

This distinction between absolute and graduated standards differs from that between easy versus difficult goals, which have generally shown that difficult goals lead to higher levels of performance (Locke & Latham, 1990). Graduated standards are ultimately just as difficult as absolute standards, but they emphasize the importance of approximations of the ultimate standard. Fine-grained standards can have two key benefits: They can enable learners to be more sensitive to small changes in skill and make more appropriate adaptations in learning strategies (Grudowski, 2003). Furthermore, when learners sense an improvement in skill, they will experience a greater sense of causal control, self-satisfaction, and self-efficacy beliefs—three key sources of motivation. Attribution of errors to controllable variables, such as one's strategy, can sustain further efforts to learn (Zimmerman & Kitsantas, 1999).

Learners' self-evaluations also depend on processes from prior self-regulatory phases, especially self-observation processes. Research studies of the accuracy or calibration of self-observations indicate that students' spontaneous metacognitive monitoring is often inaccurate (Chen, 2003; Stone, 2000; Winne & Jamieson-Noel, 2002). However, self-recording can significantly improve the quality of self-observation (Zimmerman & Kitsantas, 1996). We suggest that the effects of self-recording can be enhanced further if the information is presented in a way that facilitates advantageous forms of self-evaluation, such as visual graphs of one's performance over time can enhance use of a personal comparison standard (Bandura, 1984).

The purpose of the present study is to compare students' efforts to practice and learn on their own using what is expected to be a superior form of self-observation (i.e., a graph of self-recorded outcomes) and a superior form of self-evaluation (i.e., a graduated standard). In addition, the combined effectiveness of these two closely associated self-regulatory processes will also be studied. It is hypothesized that when self-records are presented in the form of a graph, they will be more easily evaluated. Graphs have been used extensively in self-regulation research that has employed time series designs (Watson & Tharp, 1997). A graph can portray the dynamics and direction of change in a simple straight-forward manner. Surprisingly, the effectiveness of graphing has received little attention in research on self-regulated learning to date.

The impact of these two forms of self-observation (graphics versus no graphics) and self-evaluative standards (absolute versus graduated) was studied using the following measures of performance and self-regulation: motoric skill, self-efficacy judgments, attributions of causality, self-evaluative standards, and self-satisfaction reactions. As we noted earlier, these measures are linked theoretically together in three cyclical phases of self-regulation (Zimmerman, 2000): forethought, performance, and self-reflection. Thus, this study examines the effectiveness of teaching designed to optimize the quality of a novice learner's self-observation and self-evaluation during a self-directed practice episode. It is hypothesized that a graph and a graduated self-evaluative standard will additively increase students' acquisition of motoric skill, self-efficacy perceptions, self-evaluations, self-satisfaction reactions, and attributions to strategy use and practice.

Methods

Participants

The present study consisted of 70 undergraduate participants from an American state university. The students were recruited from the psychology subject pool. The sample was diverse in terms of ethnic origin: 31% White; 29% African American; 25% Hispanic; 15% Asian; and 15% other. There were 35 women and 35 men. The participants' mean age was 21.4 years. These students had no previous experience with dart-throwing. They received one credit towards their 3 credit requirement for participation in research, which was part of their introductory psychology course.

Task material

The target was a wooden framed dartboard. The dartboard was made of 8 regular concentric circles with a bull's-eye having a radius of 1/2 inch, each succeeding circle increasing in radius by one inch. The target was positioned with its uppermost edge 5.8 feet high, and all darts were thrown from a distance of 8.5 feet from the target. Six steelhead plastic darts were given to the participants to perform the task during practice and the posttest.

Measures

Dart-throwing skill To determine the posttest skill level of each participant, his or her average score for six throws was calculated. Regardless of experimental group assignment, all participants' posttest dart-throwing results were scored using the 1 to 7 point system and thus could range between 0 and 42 points. Each zone or circle was assigned a numerical value, beginning with a center value or bull's eye of 7 and successively diminishing in assigned values by one until the outermost circle has a value of zero. This measure has demonstrated high levels of inter-item reliability according to Cronbach's test (0.91) in prior research (Kitsantas, Zimmerman, & Cleary, 2000).

Self-efficacy scale A measure of self-efficacy was developed for use in this study following procedures outlined by Bandura and Schunk (1981). The self-efficacy measure involved ratings of the participants' capability to throw darts. The participants were asked how sure they were that they could score a bull's eye with each dart. Written descriptions were provided beside the following points of scale: 10 (not sure), 40 (somewhat sure), 70 (pretty sure), 90 (very sure). In prior research involving use of this scale during learning (Zimmerman & Kitsantas, 1996), the inter-item reliability was 0.89 according to Cronbach's alpha test.

Self-satisfaction scale Satisfaction with one's dart-throwing proficiency was assessed using a one-item scale that ranged from 0 to 100 in 10 unit intervals. Written labels were offered for the following points: 10 (not satisfied) 40 (somewhat satisfied), 70 (pretty satisfied) and 90 (very satisfied). Each participant's score indicated how satisfied that he or she was about overall performance. This contextually-specific scale has revealed statistically reliable differences in self-satisfaction between high and low self-regulated learners in prior research (Zimmerman & Kitsantas, 1997, 1999).

Self-evaluation scale Students' perceptions of success in acquiring dart skill were assessed using a one-item scale that ranged from 0 to 100 points in 10 unit intervals. They were asked how sure they were about improving their level of dart skill. The subjects responded using a self-evaluation scale that ranged from 0 to 100 points in 10 unit intervals Written descriptions were provided beside the following points of scale: 10 (not sure), 40 (somewhat sure), 70 (pretty sure), 90 (very sure). Each participant's score indicated how much they felt they were improving in their level of dart skill. This contextually-specific scale revealed statistically reliable differences in self-evaluation between standards and graphing learning groups in the present research (see Results).

Attribution scale Finally, the participants in all of the treatment groups, including a control group, were asked to answer the following questions when they missed the bull's-eye during the posttest of dart-skill: "Why do you think you missed the bull's eye on the last attempt?" and "what can you do to improve your performance." Students' answers to this orally presented, open-ended question were recorded verbatim and were grouped later into one of 6 categories according to the believed cause of insufficiency: type of strategy, amount of effort, level of ability, amount of practice, "I don't know" or "other." The strategy category included statements referring to needed improvements in any aspect of the method of learning. Two trained individuals coded the data separately, and disagreements were resolved through discussion. Intercoder agreement on these classifications was 98 percent.

Design and procedure

The participants were drawn from a university psychology subject pool and were contacted online. The website allowed the students to sign up for a specific time and date. One additional student signed up to participate but dropped out beforehand, and thus the attrition rate for the sample was less than two percent. When the students arrived for their appointment, they received a description of the study and were given the informed consent form to fill out. Then the students were randomly assigned to one of the five groups. The experimental conditions were based on the two types of self-evaluative standards (absolute or graduated) and two types of self-recording (with or without graphing of the results). There were thus five groups: (a) a no-treatment control, (b) absolute standards without graphing, (c) absolute standards with graphing, (d) graduated standards without graphing, and (e) graduated standards with graphing. There were 14 students in each of the five experimental groups. In prior research on self-recording and self-evaluative standards (Zimmerman & Bandura, 1994; Zimmerman & Kitsantas, 1996), large effect sizes were obtained. For the present size of sample, the statistical power of the planned F-tests ($p<0.05$) for detecting a large size effect is 79% (Cohen, 1988).

The experimenter tested the students individually. Students in all experimental groups were given identical instructions about throwing the darts (see McClintock, 1977; McLeod, 1977), including that the purpose of the task was to hit the center of the target. The participants were then given three intervals of four minutes to practice throwing the darts. This training was completed in a single session. Participants in the *absolute standard without graphing* group were told that the bull's eye was worth seven points but the concentric circles around it were worth zero points. After the practice phase was completed, these students were posttested. They were reminded that the purpose of the task was to hit the center of the target. The self-efficacy measure was given first, followed by the test for dart-throwing skill. The attribution measure was given during the dart-skill posttest, followed by the self-evaluation and self-satisfaction scales. The latter two measures were given after dart-skill was assessed to ensure that the students' self-reactions would refer to performance under standardized conditions (namely to the results of six dart throws). Prior research revealed that self-recording decreases the number of dart-throws during practice and would lead to group differences during practice (Zimmerman & Kitsantas, 1997).

For participants in the *absolute standard with graphing group*, they too were also told that the bull's eye was worth seven points and the concentric circles around it were worth zero points. After each four-minute interval of practice, participants in this group filled in their scores on a graph that hung beside them on the wall. After the practice phase was completed, the students were posttested identically to the subjects of the absolute standard group without engaging in graphing.

Participants in the *graduated standard group without graphing group* were told that the scoring system ranged from zero to seven. Each zone or circle was assigned a numerical value, beginning with a center value or bull's eye of 7 and successively diminishing in assigned values by one until the outermost circle has a value of zero. Participants in the treatment conditions were given three intervals of four minutes to practice throwing the darts. After the practice phase was completed, the students were posttested identically to the subjects of the absolute standard group.

Students in the *graduated standard with graphing group* were told about the scoring system that ranged from zero to seven points. Students in this group also recorded the points (1–7) they received for each dart thrown on a graph that hung on the wall beside them. After each four-minute interval of practice, participants in this group filled in their scores on the graph. When the practice phase was completed, the students were posttested identically to subjects in the absolute standard with graphing group.

It should be noted that there was no suggestion that the participants should improve their score over time for either the absolute or the graduated standard, but it is likely that progressive changes in skill would be more evident from graphed results.

Participants in the *control group* were given identical instructions about throwing the darts as participants in the treatment groups. They were told that the purpose of the task was to hit the center of the target, and they did not engage in any graphing. They were posttested in identical fashion to students in the treatment groups.

In terms the fidelity of the treatments, the experimenter directly observed the students' completion of the graphs, and all students who were assigned to graphing conditions completed the graphs as directed, and none of the participants in the no graphing group spontaneously created graphs. Regarding students in the two standards condition, the experimenter could observe their use of the standards in the graphing conditions. All students recorded points that were consistent with their assigned standard (i.e., using either the graduated or absolute standard).

Table 1 Dependent measure means and standard deviations for control and each experimental group

Experimental groups					
Dependent measure	No graphing			Graphing	
	Control group	Absolute feedback	Graduated feedback	Absolute feedback	Graduated feedback
Dart-skill	*M* 22.21	*M* 24.21	*M* 27.00	*M* 26.21	*M* 29.86
	SD 3.58	*SD* 2.86	*SD* 2.04	*SD* 3.33	*SD* 2.21
Self-satisfaction	*M* 67.14	*M* 60.00	*M* 81.43	*M* 71.43	*M* 83.57
	SD 17.73	*SD* 20.75	*SD* 9.49	*SD* 17.48	*SD* 9.29
Self-evaluation	*M* 52.14	*M* 60.00	*M* 80.71	*M* 75.00	*M* 82.86
	SD 19.29	*SD* 17.97	*SD* 13.28	*SD* 16.53	*SD* 10.69
Self-efficacy	*M* 57.86	*M* 55.71	*M* 74.36	*M* 72.86	*M* 83.57
	SD 20.31	*SD* 20.64	*SD* 12.17	*SD* 16.84	*SD* 8.47

Results

The frequency of ethnic group members in each experimental group was compared using chi-square procedures, and no differences of statistical significance emerged. Clearly randomization procedures had been effective in balancing the ethnic composition of each experimental group. Because of the frequency of any particular ethnic membership within an experimental group was low, no further statistical analyses could be conducted.

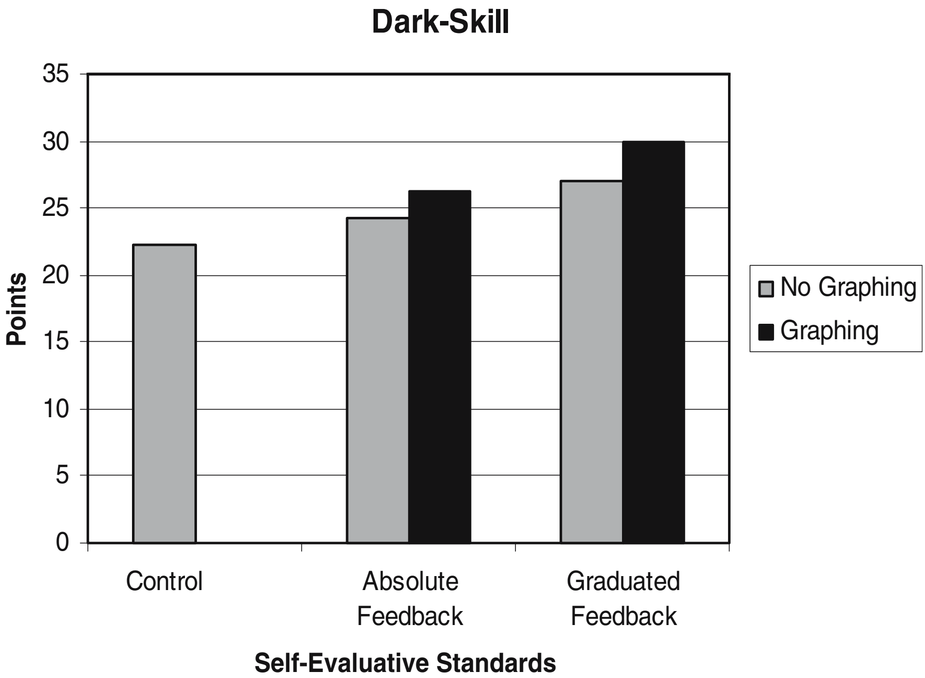

Fig. 2 Mean differences in dart-skill based on students' graphing and self-evaluative standard

However, these analyses did reveal that experimental group differences would not be influenced by the students' ethnicity.

The data were analyzed using a 2 (self-evaluative criteria)×2 (graphing or no graphing) analysis of variance (ANOVA). Table 1 depicts the descriptive statistics for each experimental condition and the control group. Independent *t*-tests were conducted to determine whether there were any differences between the control and each experimental group. Zero-order correlations among the dependent measures were also performed.

Experimental group analyses

For the posttest measure of *dart skill*, there was a significant main effect for self-evaluative criteria, $F\,(1, 52)=20.42$, $p<0.001$, with students who used the graduated standard showing higher levels of dart skill than those using an absolute standard. There was also a main effect for graphing, $F\,(1, 52)=11.65$, $p<0.001$, with students who graphed their performance showing higher levels of skill than those did not graph their performance. No significant interaction between self-evaluative standard and graphing treatments was found (see Fig. 2).

Similar results were found for the measure of *self-efficacy*. Specifically, there was a significant main effect for self-evaluative standards, $F\,(1, 52)=12.99$, $p<0.01$, with students who used the graduated standard showing higher levels of self-efficacy than those who adopted an absolute standard. There was also a main effect for graphing, $F\,(1, 52)=10.44$, $p<0.01$, with students who graphed showing higher levels of self-efficacy than those who did not graph their results. Once again, no significant interaction between self-evaluative standards and graphing was found.

For the measure of *self-evaluation* judgments of improvement, there was a significant main effect for type of self-evaluative standards, $F\,(1, 52)=12.89$, $p<0.001$, with students who used the graduated standard perceiving higher levels of improvement than those who adopted an absolute standard. There was also a main effect for graphing, $F\,(1, 52)=4.64$, $p<0.05$, with students who graphed perceiving higher levels of improvement than those who did not graph. There was no significant interaction between self-evaluative standards and graphing.

In terms of *self-satisfaction* reactions to their performance, there was a significant main effect for self-evaluative standard, $F\,(1, 52)=17.29$, $p<0.001$, with students who used the graduated standard showing higher levels of self-satisfaction than those who adopted an absolute standard However, there was no significant main effect for graphing or interaction between self-evaluative standards and graphing.

Control group analyses

Independent *t*-tests ($p<0.05$) were conducted between the control group and each treatment group for all the measures. With regard to dart-throwing skill, the control group was significantly below the following treatment groups: the absolute standard with graphing group, $t\,(26)=3.06$, $p<0.01$; the graduated standard with no graphing group , $t\,(26)=4.35$, $p<0.001$; and the graduated standard with graphing group, $t\,(26)=6.80$, $p<0.001$. The control group did not differ significantly from the absolute standard no graphing group, $t\,(26)=-1.63$, $p>0.11$. With regard to self-satisfaction reactions, the control group was significantly below the two graduated standard groups (with no graphing and with graphing), $t\,(26)=2.66$, $p<0.01$, and $t\,(26)=-3.07$, $p<0.01$ respectively, but did not

Table 2 Attributions for each goal self-monitoring group (combined for self-evaluative standards)

Groups	Attributions				
	Strategy	Effort	Ability	Practice	Other
Control	1	1	8	2	2
No graphing	5	1	11	7	4
Graphing	15	3	3	6	1

significantly differ from the two absolute standard groups (with no graphing and with graphing), t (26)=0.98, p>0.34; t (26)=−0.64, p>0.53, respectively. With regard to self-evaluation reactions, the control group was significantly below the following treatment groups: the absolute standard with graphing group, t (26)=−3.37, p<0.01; the graduated standard with no graphing group, t (26)=−4.57, p<0.001; and the graduated standard with graphing group, t (26)=−5.21, p<0.001. The control group did not differ significantly from the absolute standard no graphing group, t (26)=−1.12, p>0.28. Regarding posttest self-efficacy, the control group was significantly below the following experimental groups: the absolute standard with graphing group, t (26)=−2.13, p<0.05; the graduated standard with no graphing group, t (26)=−2.61, p<0.01; and the graduated standard with graphing group, t (26)=−4.37, p<0.001), The control group did not differ significantly from the absolute standard no graphing group, t (26)=0.28, p>0.78.

Attribution analyses

In terms of posttest *attributions*, the students' answers were classified into six categories of performance insufficiency: type of strategy, amount of effort, level of ability, amount of practice, "I don't know" or "other." These attribution categories were compared based on the type of self-evaluative standards the students adopted (e.g., absolute, graduated, or none i.e., control) in a 6×3 chi-square analysis, but no significant differences emerged. When the same chi-square model was applied to the three graphing groups (i.e., graphing, no graphing, control), significant differences emerged, χ^2 (4),=12.45, p<0.01 (see Table 2). Students who graphed their results were more likely to attribute their performance insufficiency to strategy deficiency whereas students who did not graph their results were more likely to attribute their performance insufficiency to ability.

To determine the predictability of the four main causal attributions to the other self-regulatory processes, we conducted point biserial correlations using the presence or absence of each attribution and the metric value of the other measures. These results are presented in

Table 3 Biserial correlations among dependent measures

Variable	Strategy	Ability	Effort	Practice
1. Dart skill	0.19*	−0.20*	−0.01	0.12
2. Self evaluation	0.24*	−0.30*	0.14	−0.10
3. Self-efficacy	0.18*	−0.11	−0.01	−0.04
4. Self-satisfaction	0.18*	−0.23*	0.12	−0.10

Table 4 Zero-order correlations among dependent measures

Variable	1	2	3	4
1. Dart-skill	–			
2. Self-evaluation	0.94**	–		
3. Self-efficacy	0.30*	0.27*	–	
4. Self-satisfaction	0.33**	0.29*	0.15	–

*$p<0.05$, **$p<0.01$

Table 3. We classified each student's strategy in the nominal categories of strategy, ability, and effort. The students' attributions of their performance deficiencies to strategy insufficiency were significantly related to more positive self-evaluations of learning progress, higher levels of self-satisfaction, greater self-efficacy about subsequent dart throwing, and higher levels of dart throwing skill. In contrast, the students' attributions of their dart-throwing deficiencies to inadequate ability were negatively related to self-evaluation, self-satisfaction, and dart-skill. Clearly attributions to strategies were linked to more favorable self-regulatory processes not only during self-reflection but also more favorable self-efficacy beliefs regarding subsequent levels of learning.

Correlation analyses

Zero-order correlations among the dependent measures are presented in Table 4. All self-regulatory process measures correlated significantly with dart-throwing skill, and the correlation between dart-throwing skill and self-evaluations of performance improvement was especially high. Self-efficacy beliefs correlated significantly with subsequent dart-throwing skill and evaluations of success.

Discussion

The present research is an initial effort to study the role of self-evaluative standards and graphing on learners' performance and motivational beliefs when learning an athletic task. It was hypothesized that setting high absolute standards can limit a learner's sensitivity to small improvements in functioning. In support of this hypothesis, students who set absolute standards reported significantly less awareness of learning progress than students who set graduated standards (to the same high level). In addition to this effect of self-evaluative standards on students' self-evaluation, there was a corresponding significant improvement in dart-skill as well. The correlation between the self-evaluation and dart-throwing outcomes measures was extraordinarily high ($r=0.94$). Furthermore, students who evaluated their dart-throwing outcomes according to graduated standards significantly increased their learning compared to students in the no standards no graphing control group. This indicates that these control students did not spontaneously set graduated standards, but if they did adopt them, there were significant benefits. Not only were students' learning processes impacted by their self-evaluative standards but so were their motivational beliefs. For example, students who set graduated standards significantly increased their feelings of self-satisfaction with their performance and their self-efficacy beliefs about performing compared to students who set absolute standards. Research evidence of motivational as well as learning benefits of graduated standards confirms anecdotal observations of the benefits derived from these standards by professional athletes (Nicklaus, 1992) and sport psychologists (e.g., Loehr, 1991) These findings extend our prior research (Zimmerman & Kitsantas 1996, 1997) by revealing how self-evaluative standards influence learning within a cycle of self-regulation.

It was also hypothesized that graphing can enhance a learner's sensitivity to improvements in functioning. In support of this hypothesis, students who graphed their learning results reported significantly greater awareness of learning progress than students who did not graph their results. In addition to this effect of graphing on students' self-evaluation, there was a corresponding significant improvement in actual learning. In terms of its impact on motivation, graphing significantly increased students' self-satisfaction with their performance and their self-efficacy beliefs about performing compared to no graphing. Regarding students' attributions, graphing led to significantly more controllable attributions for their less effective responses. The graphing groups reported significantly more attributions to strategy use than no graphing or control groups. The latter two groups attributed their poor performance more frequently to a lack of ability, which has been shown to detract from motivation (Kitsantas & Zimmerman, 1998; Zimmerman & Kitsantas, 1997). With regard to students' self-satisfaction, their graphing increased these reactions. Clearly students who perceived improvements in their learning reacted with greater self-satisfaction. In summary, these findings extend prior research based on numerical forms of self-recording (Kitsantas & Zimmerman, 1998; Zimmerman & Kitsantas, 1997) to include visual depictions of outcomes. In addition, empirical evidence of the benefits of graphing confirms anecdotal reports of its importance (Grudowski, 2003; Watson & Tharp, 1997).

Conclusions

The results provide support for a cyclical model of self-regulation. Enhancing performance phase recording via graphing led not only to improved dart-throwing performance but also to improved self-reflection phase self-evaluations and attributions. Furthermore, the use of graduated self-evaluation standards not only increased students' judgments of performance improvements but also their self-satisfaction reactions with that performance. Attributions to strategy use were predictive of within self-reflection phase self-satisfaction reactions and across phase self-efficacy beliefs during forethought. Clearly an intervention designed to enhance learners' self-observation and self-evaluation processes produced cyclical changes in phase-related self-regulatory processes.

These findings have implications for students who want to exercise greater control over their learning. They can significantly improve the quality of their outcomes by depicting them in graphic form and by comparing them to a graduated standard. Students in the control group did not spontaneously use either of these processes. These findings also have significant implications for designing instruction. Often students set unrealistic standards for themselves, and instructors need to identify these students and help them readjust their standards to be sensitive to small improvements in skill. Teaching students to monitor these outcomes with visual graphs can enhance not only successful adaptations in performance but also positive self-reflections on their efforts to learn.

References

Bandura, A. (1984). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A., & Schunk, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology, 41*, 586–598.

Burfoot, A. (1997). *Runner's world complete book of running*. Emmaus, PA: Rodale.

Chen, P. P. (2003). Exploring the accuracy and predictability of the self-efficacy beliefs of seventh-grade mathematics students. *Learning and Individual Differences, 14*, 79–92.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.) Hillsdale, NJ: Erlbaum.

English, H. B., & English, A. C. (1958). *A comprehensive dictionary of psychological and psychoanalytic terms*. New York: David McCay Inc.

Ericsson, K. A. (1997). Deliberate practice and the acquisition of expert performance: An overview. In H. Jorgensen, & A. C. Lehmann (Eds.), *Does practice make perfect?* (pp. 9–51). Stockholm: NIH Publikasjoner.

Ericsson, K. A. (2001). Attaining excellence through deliberate practice: Insights from the study of expert performance. In M. Ferrari (Ed.), *The pursuit of excellence through education* (pp. 21–55). Mahwah, NJ: Erlbaum.

Grudowski, M. (2003). The girl next door is hungry. *Men's Journal, 12*(7), 72–73 (August).

Kirchenbaum, D. S. (1984). Self-regulation and sports psychology: Nurturing an emerging symbiosis. *Journal of Sport Psychology, 6*, 159–183.

Kitsantas, A., & Zimmerman, B. J. (1998). Self-regulation of motoric learning: A strategic cycle view. *Journal of Applied Sport Psychology, 10*, 220–239.

Kitsantas, A., & Zimmerman, B. J. (2002). Comparing self-regulatory processes among novice, non-expert, and expert volleyball players: A microanalytic study. *Journal of Applied Sport Psychology, 13*, 365–379.

Kitsantas, A., Zimmerman, B. J., & Cleary, T. (2000). The role of observation and emulation in the development of athletic self-regulation. *Journal of Educational Psychology, 92*, 811–817.

Locke, E. A., & Latham, G. P. (1990). The application of goal setting to sports. *Journal of Sport Psychology, 7*, 205–222.

Loehr, J. E. (1991). *The mental game: Winning at pressure tennis*. New York: Plume.

McClintock, J. (1977). *The book of darts* (1st ed.). New York: Random House.

McLeod, R. T. (1977). *Darts unlimited*. New York: Grosset & Dunlap.

Nicklaus, J. (1992). *Jack Nicklaus' lesson tee*. New York: Simon & Schuster.

Schunk, D. H., & Zimmerman, B. J. (Eds.) (1998). *Self-regulated learning: From teaching to self-reflective practice*. New York: Guilford.

Stone, N. J. (2000). Exploring the relationship between calibration and self-regulated learning. *Educational Psychology Review, 12*, 437–475.

Watson, D. L., & Tharp, R. G. (1997). *Self-directed behavior: Self modification for personal adjustment* (7th ed.). Pacific Grove, CA: Brooks/Cole.

Winne, P. H., & Hadwin, A. F. (1998). Studying as self-regulated learning. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 279–306). Hillsdale, NJ: Erlbaum.

Winne, P. H., & Jamieson-Noel, D. L. (2002). Exploring students' calibration of self-reports about study tactics and achievement. *Contemporary Educational Psychology, 27*, 551–572.

Winne, P. H., & Perry, N. E. (2000). Measuring self-regulated learning. In M. Boekaerts, P. Pintrinch, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 531–566). New York: Academic.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. Pintrinch, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). New York: Academic.

Zimmerman, B. J., & Bandura, A. (1994). Impact of self-regulatory influences on writing course attainment. *American Educational Research Journal, 31*, 845–862.

Zimmerman, B. J., & Kitsantas, A. (1996). Self-regulated learning of a motoric skill: The role of goal setting and self-monitoring. *Journal of Applied Sport Psychology, 8*, 69–84.

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

Zimmerman, B. J., & Kitsantas, A. (1999). Acquiring writing revision skill: Shifting from process to outcome self-regulatory goals. *Journal of Educational Psychology, 91*, 1–10.