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Examining the interplay between middle school students' achievement goals and self-efficacy in a technology-enhanced learning environment

Peggy Pei-Hsuan Hsieh, The University of Texas at San Antonio,

YoonJung Cho, Washington State University

Min Liu, & Diane L. Schallert

The University of Texas at Austin

Abstract

Researchers have suggested that self-efficacy and goal orientation are context specific variables, however, few research have addressed these variables in technology-enhanced learning environments. This study examined changes in 549 middle school students' goal orientation, self-efficacy, and science knowledge after engaging in science learning in a technology-rich environment. Also explored was how these motivational constructs interact to predict science achievement. Results indicated that students' performance and self-efficacy increased significantly while the performance-approach and performance-avoidance goals significantly decreased. In addition, results also indicated that performance-avoidance goals moderated the relation between self-efficacy and science achievement, indicating that self-efficacy has positive influences on achievement when students are not performance-avoidance oriented.

Examining the interplay between middle school students' achievement goals and self-efficacy in a technology-enhanced learning environment

Over the past two decades, researchers have been increasingly interested in understanding students' motivation and finding ways to predict and improve academic performance. Researchers have suggested that motivation is related to students' initiation of the task, the amount of effort that they expend on the task, and their persistence in completing the task (Brophy, 1988; Maehr, 1984; Pintrich, Marx, & Boyle, 1993; Wigfield, 1994). Consequently, students' motivation has been proposed to affect their actions and academic achievement. This study attempts to extend our understanding of middle school students' motivation and achievement in a technology-rich science classroom by focusing on two social cognitive motivation theories, self-efficacy (i.e., students' beliefs about their capabilities to complete a task successfully) and goal orientation (i.e., students' reasons for doing a task).

Bandura (1997) maintained that people's actions and behaviors are guided by their beliefs about how successful they can be in performing a task, termed as *self-efficacy*. Not only do people need to have the skills and knowledge to execute a task successfully, they also have to have a certain level of expectation for success before they take on the assignment. Researchers have found that individuals who believe that they can successfully complete a task (or those who have high self-efficacy) tend to perform better as compared to those who lack such a belief (Jackson, 2002; Lane & Lane, 2001; Pajares, 1996; Pajares, 2003). They also suggest that individuals' self-efficacy beliefs may influence the types of goals they adopt for learning. Such reasons students learn or goals they have for learning are termed as *goal orientation* (Elliot & Harackiewicz, 1996). It is the goals that individuals set that influence their actions, reactions, and motivation for learning (Shim & Ryan, 2005). These goals and beliefs are not, however, formed in vacuum. Motivation researchers, particularly those taking the social cognitive perspective suggest that students' goals and beliefs are also shaped by their perceptions of the learning environment. Therefore, it is essential to examine how students' goals and beliefs are formed and maintained in different learning environments.

Goal Orientation

Students' goal orientation, the purposes that they have for completing an academic task, has received much attention due to its influential role on students' performances (Ames, 1992; Dweck, 1986). Detailed in the literature are three types of goal orientations. The first is a mastery goal, where students focus on mastery of a task and have the desire to acquire new skills. The second is a performance-approach goal, where learners' main concern is how competent they look in front of others, focusing on receiving favorable judgments of ability from others. The third is a performance-avoidance goal, where students attempt to avoid unfavorable judgments of capabilities and looking incompetent and may stay away from challenging tasks (Elliot & Harackiewicz, 1996).

Of the three types of goal orientations, the two that have received researchers' consensus in their findings on its relationship with students' actions and learning outcomes are the mastery and performance-avoidance goal orientations. Researchers have consistently found that students who adopt mastery goals tend to have higher self-efficacy, positive patterns of learning (such as paying more attention in class and processing information in a more meaningful fashion), and higher achievement (Middleton & Midgley, 1997; Midgley & Urdan, 1995; Pajares, Britner, & Valiante, 2000), while students who have performance-avoidance goals tend to have lower self-efficacy and have less challenge-seeking behaviors and intrinsic value for learning (Elliot, 1999; Hidi & Harackiewicz, 2000; Middleton & Midgley, 1997; Pajares et al., 2000; Skaalvik, 1997).

Research addressing performance-approach goals, however, has had more discrepancies reported. It is less clear about how performance-approach goals relate to patterns of learning and beliefs. While some researchers report performance-approach goals to be unpredictive of self-efficacy (Middleton & Midgley, 1997), others have found a positive relationship between this type of goal orientation and self-efficacy and self-concept (Bong, 2001; Pajares et al., 2000; Wolters, Yu, & Pintrich, 1996).

Self-efficacy

Students often develop goals for learning through the examination and their understanding about themselves, the task, and their expectations of success. To extend goal orientation theory and examine the extent to which goals are related to students' beliefs and expectations about their capabilities to perform successfully in school, self-efficacy was introduced in this study.

Bandura (1997) defined self-efficacy as people's judgment of their capabilities to complete a designated task successfully. Students with high self-efficacy often take on more challenging tasks, put in more effort, persist in the face of difficulty, and use strategies to make learning meaningful. When students believe in themselves, they may also be more likely to develop enabling goals that when executed will facilitate the accomplishing of the task, while students with sabotaging beliefs about their capabilities may avoid the learning task and opportunities to seek help. Thus, understanding students' beliefs about their capabilities can help educators understand better how goals are adopted and retained, where students' motivation comes from, and how to help students sustain the motivation that they gradually develop. Many researchers have suggested that students' self-efficacy is a good predictor of academic achievement and motivation (Graham & Weiner, 1996; Pajares, 2003; Pintrich & DeGroot, 1990;

Pintrich & Schunk, 1995). Much of this research has been conducted in areas such as math, writing, and sports (e.g., Bond, Biddle, & Ntoumanis, 2001; Pajares, 2003; Pajares & Miller, 1994, 1995) with college students. Research exploring students' self-efficacy in other domains and learning environments for younger age groups is scarce. As Bandura (1997) suggested, people's subjective self-appraisals are related to a specific area and they may view themselves as very competent in one area but not in another. As self-efficacy is both context and domain specific, the purpose of this study is to shed light on middle school students' self-efficacy for science learning (domain specific) in a technology-enhanced learning environment (context specific).

Researchers have examined the interplay between self-efficacy and performance goals in predicting learning and achievement, suggesting that self-efficacy plays a moderating role between performance goals and patterns of learning (Butler, 1993; Elliott & Dweck, 1988). They have found that students with performance goals are more vulnerable to maladaptive patterns of learning when they also have low self-efficacy than students who have high self-efficacy. They further suggested that students who adopt performance goals may have adaptive patterns of learning when accompanied by a high sense of self-efficacy for learning (Dweck, 1986; Dweck & Leggett, 1988). Therefore, Elliott and Dweck (1988) suggested that patterns of learning for students who adopt performance goals were highly dependent on the level of self-efficacy. Although such a moderating effect was suggested, several correlational studies have failed to find such a relationship (Harackiewicz et al., 1997; Kaplan & Midgley, 1997; Miller, Behrens, Greene, & Newman, 1993). As studies examining the interaction effect between performance goals and self-efficacy have focused primarily on performance-approach goals, ignoring performance-avoidance goals. Elliot (1999) and Hidi and Harackiewicz (2000) suggested that there is a need to test the interactions of self-efficacy with performance-avoidance goal separately to detect the buffer-effect that either beliefs or goals have on achievement. Given the mixed results and the lack of research examining the moderating role that performance-avoidance goals might play between students' self-efficacy and achievement, this study will attempt to provide a more lucid representation of students' achievement by examining how the negative effects of performance-avoidance goals and the positive effect of self-efficacy jointly affect achievement.

As such, this study examined the interaction effects between the three goal orientations (mastery, performance-approach, and performance-avoidance) and self-efficacy on middle school students' science achievement when engaged in a technology-enhanced learning environment. We were especially interested in the interaction effect between performance-avoidance goals and self-efficacy because they represent two opposite poles to students' motivation. Researchers have suggested that having strong performance-avoidance goals can result in maladaptive learning patterns and have a negative effect on achievement whereas having high self-efficacy beliefs can have positive indications for learning and achievement. However, research addressing how these two variables with differential effects on learning and achievement interact with each other has been scant. Thus, this study sought to examine how these two seemingly conflicting variables jointly affect achievement.

Technology-rich Learning Environments

Unlike traditional classroom instruction, the use of computer technology facilitates student interaction, exchange of ideas and responsibility-taking as classes are no longer conducted through direct instruction (Stahl, Koschmann, & Suthers, 2006). Researchers have suggested that technology creates a way to bring authentic problems into the classroom

(Bransford, Brown, & Cocking, 2000). As such, technology is viewed as an integral part of teaching and learning to improve both the effectiveness of instructional strategies and student motivation.

One of the major characteristics of a technology-enhanced environment that this study focuses on is its emphasis on and endorsement of self-directed problem-based learning without the use of textbooks. Such a technology-rich, problem-based learning environment uses a problem as a starting point of a lesson and students gather information to find a solution together. The purpose of this type of instructional strategy is to facilitate students' knowledge acquisition through exploration, self-direction and collaboration while building learner autonomy.

Accompanied with the increase in learner autonomy may be either positive or negative influences on students' learning, hypothesized to be dependent on the beliefs and goals that students bring in with them to the learning environment. Students' reaction to the autonomy can be enjoyment when they are confident in exploring the content without direct instructions given to them. While some students may prosper through working at their own pace, autonomy may be viewed as "a sudden loss of guidance" or "a threat" for students who have lower self-efficacy about working independently, especially on a topic that they are unfamiliar with. When students perceive tasks to be well beyond their capabilities, they will develop low self-efficacy and have little expectations of success that may lead to increased anxiety, less productivity, and decreased engagement (Winne, 1997). In reference to students' goals for learning, working in a self-directed, technology-enhanced learning environment may give students the opportunity to research more information than they need. Many times, they may be in situations where problem-solving and decision-making is required. Under these circumstances, mastery learners may be more engaged and may have higher achievement than learners who are more performance oriented. Lacking self-efficacy may also lead to students' adoption of performance-avoidance goals and doing bare minimum for the class, unwilling to explore the *unknown* and reluctant to take on challenges.

Although this environment can create challenges, there may also be positive impacts on students' motivation when students work collaboratively in this environment such that the emphasis is not on social comparison or competition, which may lead to a decrease in their adoption of performance goals. Researchers believe that technology can be a useful tool to support students learning through careful construction and planning of the lesson (Bransford et al., 2000).

Self-efficacy and goal orientation research have predominantly been conducted in traditional classrooms where students learn through direct instructions. To help us understand students' beliefs and goals in this environment seldom explored, this study has innovatively built on the existing literature by examining the interaction between these variables in a technology-rich collaborative learning environment.

Three research questions guided this study:

1. Are there any changes in sixth graders' goal orientations (mastery, performance-approach, and performance-avoidance goals), self-efficacy and science achievement after they are engaged in a technology-enhanced learning environment?
2. What are the relationships between students' goal orientations, their science self-efficacy beliefs, and science achievement as they are engaged in a technology-enhanced learning environment?

3. Is there an interaction between students' goal orientation and science self-efficacy beliefs, particularly between performance-avoidance goal and self-efficacy when predicting achievement in this technology-enhanced learning environment?

Method

Participants

A total of 549 sixth graders from two middle schools in a mid-sized southwestern city participated in this study. Of the 549 students, 49.5% (*n* =272) were female students and 50.4% (*n* =277) were males. All sixth graders were recruited from two schools in the same district sharing similar demographics. Participants included 73% Caucasian, 16% Hispanic, 6% African-American, and 5% other ethnic backgrounds. Five teachers taught these 27 science classes.

Measures

Goal Orientation. Students' goal orientation was measured by the Achievement Goal Orientation Inventory (Elliot & Church, 1997), which comprises three subscales of mastery, performance-approach, and performance-avoidance goals, 6 items for each goal orientation and a total of 18 items. Due to this particular learning context and age group, some of the original items were modified. Items containing words difficult for 6^{th} graders to understand were rephrased with easier equivalent. In addition, to specifically assess students' goal orientation toward science, the general term "class" was replaced with "science class". For example, the statement 'I hope to *have gained a broader and deeper knowledge* when I am done with this *class*' was rephrased into 'I hope to *have a good understanding of science* when I am done with this *science class*.' A 5-point Likert scale was used ranging from 1 (not at all true of me) to 5 (strongly true of me). Reliability coefficients for mastery, performance-approach, and performance-avoidance goals of the pre and post tests for this study are reported in Table 1.

Self-efficacy. Eight items that target self-efficacy for learning and performance in the Motivated Strategies for Learning Questionnaire (MSLQ, Pintrich, Smith, Garcia, and McKeachie, 1993) were used to assess students' *s*elf-efficacy. For each of the eight items, "science course" was used in place of "course" in the original statements. For example, "I am confident I can learn the basic concepts taught in this *science course*" was used in place of "I am confident I can learn the basic concepts taught in this *course*". In the post-survey, "science class" in each statement was rephrased into "science class using *Alien Rescue."* The Cronbach's alpha for the sample in this study was 0.93.

Science Achievement. To measure students' performance in their science class, a 25-item multiple-choice test was used to assess students' understanding of various scientific concepts introduced in *Alien Rescue* program. This test has been revised numerous times according to teachers' suggestions and pilot testing results using similar samples (Author, 2005). Since no direct teaching was involved in this study, a gain in the achievement score would indicate that the student has acquired a good understanding of the scientific concepts needed for problem-solving through his or her self-directed learning, classroom discussions, and/or peer interaction after being exposed to the Alien Rescue science learning program in the technology-rich environment.

Procedure

The study took place over a three-week period in the second semester of the school year. With parental consent, one week prior to the introduction of the study, students were given three questionnaires to fill out, one on their self-efficacy for science, one assessing their goal orientation, and another testing their science knowledge as a pre-measure. During the three weeks of their 45-minute science class, students studied the solar system unit using a computer program tailored to sixth graders. This program was aligned with the national science standards on scientific investigation and problem-solving. Instead of using direct instructional methods to teach this unit, a problem-based technology-rich learning environment was created where students were assigned to groups of two to three people and each student had a computer to work on to solve the central problem collaboratively. The five teachers involved in this study were experienced science teachers, but novice computer users. They went through a two-day training workshop on using the computer program. Four of the five teachers in this study had used the program in the previous year.

Two researchers observed students' interaction and their use of the program. On the last day of the program, students were asked to fill out the post-measures on their self-efficacy for science, their goal orientation, and their science knowledge.

Alien Rescue Program

The computer program used in this study, *Alien Rescue,* was designed to engage sixth-grade students in a problem-solving task to acquire knowledge about the solar system (Author, Williams, & Pedersen, 2002). Students were asked to solve an ill-defined problem using their knowledge about the planets in the solar system to make decisions. The program provided more information to students than was needed in solving the problems so that the students can actively engage in the task to find answers and determine appropriate use of resources that were made available.

Students had access to many built-in cognitive tools during their problem-solving activity. For example, four carefully constructed and well-organized knowledge databases enhanced through graphics, animations, and 3-D videos were available to alleviate cognitive load. When students came across a scientific concept that they were unfamiliar with, a concept database was provided to visually illustrate tutorials of the various science topics. Such tools helped reduce the memory burden for students and put the multimedia-enriched information at students' fingertips. An expert tool was available to support cognitive processes. Presented in video format, the expert was available at four critical points to model expert thinking processes in solving the central problem. To support cognitive activities that would be out of reach otherwise, the probe builder and launcher rooms allowed students to equip probes with various scientific instruments and launch them. Finally, in the control room, students studied the data coming back from probes to test their hypotheses and then write up their solution using a solution form provided by their teachers.

Results

Paired t- tests were run to see if there were any changes in students' goal orientations, self-efficacy, and science achievement from pre to post experience with the technology-enhanced environment. To control for Type I error, the alpha level for the follow-up ANOVA using Bonferroni adjustment was set at the .05 level divided by 5 (number of dependent variables for this study), or the .01 level. Results indicated that after being involved in the technology-enhanced learning environment, students' self-efficacy increased significantly (from a mean of 3.94 to 4.06; $p < .001$) while performance-approach (from a mean of 3.04 to 2.79; $p < .001$) and performance-avoidance goal orientation (from a mean of 2.9 to 2.76; $p < .001$) were found to have decreased significantly. This suggests that students gained more confidence in learning science in this environment and were being less worried or concerned about their performance compared to their peers (see Table 2). In addition, science knowledge (achievement) was also shown to have increased significantly after students were engaged in the technology-enhanced learning environment.

Correlation analysis was performed to examine how students' goal orientations, self-efficacy and science achievement were interrelated. As shown in Table 3, only the mastery and performance-approach goal orientations were positively correlated with self-efficacy ($r = .57$, $p < .001$ and $r = .23$, $p < .001$, at the pretest and $r = .63$, $p < .001$ and $r = .33$, $p < .001$ at the posttest respectively) while performance-avoidance goal orientation was not related to self-efficacy ($r = -.03$, $p > .05$ and $r = -.02$, $p > .05$). In addition, results of the correlation analyses indicated that students' science achievement correlated positively with students' self-efficacy ($r = .28$, $p < .001$ at both the pretest and posttest) and mastery goals ($r = .14$, $p < .001$ at the pretest and $r = .19$, $p < .001$ at the posttest), but correlated negatively with performance-avoidance goals ($r = -.25$, $p < .001$ at the pretest and $r = -.13$, $p < .001$ at the posttest). On the other hand, performance-approach goals indicated no relation with science achievement at both pretest and posttest ($r = -.01$, $p > .05$ and $r = .01$, $p > .05$, respectively).

Further analysis using multiple regression was conducted to identify significant predictors of science achievement and to examine the interaction effects of performance-avoidance goals and self-efficacy on achievement. Results indicated that the interaction between self-efficacy and performance-avoidance goal was significant in predicting science achievement ($\beta = -.59$, $p < .05$, see Table 4). To better interpret this finding, we graphed the significant interaction between self-efficacy and performance-avoidance goals (see Figure 1). Results revealed that the effect of self-efficacy on achievement differs as a function of the level of performance-avoidance goal orientation. Specifically, self-efficacy had a more noticeable positive effect on science achievement especially for students who reported having lower performance-avoidance orientation, indicating that those students low in performance-avoidance orientation who reported having higher self-efficacy reported significantly higher achievement than those who reported having lower self-efficacy. On the other hand, for students who reported having high endorsement of performance-avoidance goals, no significant differences were found between those who reported having high self-efficacy and those with low self-efficacy on science achievement. This is to say that the effect of self-efficacy on achievement is moderated by the adoption of performance-avoidance goals. Even though students reported having high self-efficacy for science, adopting performance-avoidance goals seem to have interfered with their science achievement.

Discussion

Researchers have consistently found that self-efficacy and goal orientations affect a number of variables relevant to students' achievement and motivation (Lane & Lane, 2001; Pajares & Miller, 1994; Pintrich & DeGroot, 1990). Although many researchers have argued that self-efficacy and goal orientation are context specific variables, few studies have been conducted where self-efficacy and goal orientations are measured in technology-enhanced learning environments. This study examined how students' goal orientation, self-efficacy, and science knowledge changed after learning science in a technology-rich, self-directed and collaborative learning environment and how these motivational construct predict science achievement.

As indicated by the results of the paired-t tests, students' science achievement scores and their self-efficacy levels for science increased significantly. This may be an indication of the positive effects that the technology-enhanced learning environment has on students' achievement and motivation. Even though the materials covered within this 3-week period were not taught through direct instruction, students were able to grasp concepts and gain understanding of the science materials, assessed through the science achievement posttest, as they worked collaboratively with their partners and incorporated problem-solving and self-directed learning skills in the learning process. Through self-directed learning in the technology-enhanced learning environment, students interacted and experimented with the material and constructed knowledge in a meaningful fashion.

An increase in students' self-efficacy was found after this type of learning environment was introduced to the sixth graders. This is a promising finding in that students developed self-efficacy for the science unit through collaboration with peers and autonomously learning science through their own exploration of the science topics.

The two goal orientations that significantly decreased after implementing the program were the performance-approach and performance-avoidance goals. The decrease in both performance-approach and performance-avoidance goals is an encouraging finding because researchers have typically found these types of goal orientations to be linked to maladaptive patterns of learning and correlated negatively to students' achievement (Middleton & Midgley, 1997; Midgley & Urdan, 1995; Pajares, et. al., 2000), as may also be suggested by the results of this study. This decrease indicated that students were not as focused on avoiding the possibility of demonstrating their lack of ability as they were before using the program. In addition, students were not as concerned about avoiding challenging tasks, which may be associated with this self-directed learning environment, because they gradually gained understanding that they could be assisted by technology tools, teachers, and had peer support.

An optimal self-directed, technology-enhanced environment is one in which students have the autonomy and are willing to explore, knowing that support, resource, and guidance are available when needed. These results would suggest that direct instruction is not the only means of teaching. In this case, the technological experience in a non-directive collaboration resulted in increased motivation and achievement.

Additionally, results of this study supported previous research findings indicating that self-efficacy correlated positively with students' performances. Researchers have suggested that students with high self-efficacy tend to learn and achieve more than students with low self-efficacy even when actual ability levels are the same (Bandura, 1986). This is partly because efficacious students tend to engage in cognitive processes that promote learning, such as paying attention, persisting longer at difficult tasks, and organizing and elaborating new information being presented to them (Bandura, 1986; Pintrich & Schunk, 2002; Tellefson, 2000). These are all tasks that are required for students to engage in under the technology-enhanced and self-directed learning environment investigated in this study.

Our results indicated a strong positive relationship between students' self-efficacy and mastery and performance-approach goals. Inconsistent with findings of previous studies, no significant relationship was found between self-efficacy and performance-avoidance goal orientation (Pajares et al., 2000). Further analysis was performed to better understand students with seemingly conflicting beliefs and goals, and it was found that the interaction between self-efficacy and performance-avoidance goals was significant in predicting achievement. Though self-efficacy has been considered to be one of the most powerful predictors of achievement, our results indicated that self-efficacy exerts a stronger positive influence on achievement in absence of performance-avoidance goal orientation. The interaction effect between performance-avoidance goals and self-efficacy indicated that the joint effects of self-efficacy and goal orientation may offer key information in explaining student achievement better than the separate independent effects of each individual variable.

Implications

The findings of this study provide practical implications and suggestions about how teachers can promote student learning, performance, and motivation. Knowing how self-efficacy influences students' behaviors and achievement, finding ways to increase self-efficacy is crucial. Teachers can increase students' self-efficacy by conveying to students that they are competent to learn the material and by providing them with helpful learning strategies that can lead to success. As with the case of the technology-enhanced collaborative learning environment, teachers can reaffirm that students can receive support from the teacher, their peers, and the computer program. While creating learning environments, teachers should design tasks at which the students can succeed if they work diligently. Self-efficacy can also be strengthened when students experience success or see others become successful.

Teaching practices or instructional environments focusing on enhancing self-efficacy should not be the sole approach, especially for students who are performance-avoidance oriented, as suggested from the results of this study. Even though students may have high self-efficacy, their achievement can be sabotaged when they also hold strong performance-avoidance goals, emphasizing on how others might view them, instead of how much they can learn. Therefore, our efforts to help students avoid the adoption of performance-avoidance goals need to be made along with an effort to enhance students' self-efficacy to help boost the level of performance because self-efficacy functions best when students stay away from the adoption of performance-avoidance goals.

To prevent students from adopting performance-avoidance goals, teachers should help students see that making mistakes is part of the learning process and avoid the use of competition. Students develop performance-avoidance goals easily when they are being compared to against their peers, especially to someone whom they view as being more competent. Teachers should also emphasize how the class material is applicable to the real world so that students develop mastery goals for learning, i.e., learning to develop skills and acquire knowledge. As with this particular science unit, for instance, students developed an understanding of temperature and pressure and are able to apply their knowledge in the real world. Providing opportunities for students to practice autonomy also increases motivation to learn. In the case of this study, although teachers did not give up decision making about the curriculum, students were able to freely work at their own pace and collaborate with their peers to explore the science unit successfully.

The results of this study should be interpreted in light of several limitations. The fact that the study was correlational in nature, it does not provide the examination of causality between the variables. Interpretation about the relationships among variables needs to be made with caution. As there was no control group to compare our results against, changes in students' achievement, beliefs, and goals may be attributed to other factors that were not controlled for. Another limitation is the generalizability of these findings to students at other schools and age groups. Like other self-reported questionnaire data, our results suffer from the same limitations in that it is difficult to determine how students may have interpreted the items on the questionnaires.

Nevertheless, this study has provided valuable insights to our understanding of students' goal orientation and self-efficacy in a technology-rich, self-directed learning environment. Our preliminary findings suggest that future research is needed to examine the interaction between students' self-efficacy and performance-avoidance goals with students of other age groups to see if the results hold true.

References

Author (2005). The effect of a hypermedia learning environment on middle school students' motivation, attitude, and science knowledge. *Computers in the Schools, 22*, 159-171.

Author, Williams, D., & Pedersen, S. (2002). Alien Rescue: A problem-based hypermedia learning environment for middle school science. *Journal of Educational Technology Systems, 30*, 255-270.

Ames, C. (1992). Achievement goals and classroom motivational climate. In J. Meece & D. Schunk (Eds.), *Students' perceptions in the classroom* (pp. 327-348). Hillsdale, NJ: Erlbaum.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: Freeman.

Bond, K. A., Biddle, S. J., & Ntoumanis, N. (2001). Self-efficacy and causal attribution in female golfers. *International Journal of Sport Psychology, 31,* 243-256.

Bong, M. (2001). Between and within-domain relations of academic motivation among middle and high school students: Self-efficacy, task value, and achievement goals. *Journal of Educational Psychology, 93*, 23-34.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How People Learn: Brain, Mind, Experience, and School: Expanded Edition.* Washington, DC: National Academy Press.

Brophy, J. E. (1988). Research linking teacher behavior to student achievement: Potential implications for instruction of Chapter 1 students. *Educational Psychologist, 23*, 235-286.

Butler, R. (1993). Effects of task- and ego-achievement goals on information-seeking during task engagement. *Journal of Personality and Social Psychology, 62*, 934-943.

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

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95,* 256-273.

Elliot, A. J. (1999). Approach and avoidance motivation and achievement goals. *Educational Psychologist, 34,* 169-189.

Elliot, A. J., & Church, M. (1997). A hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology*, *72*, 218-232.

Elliot, A. J., & Harackiewicz, J. M. (1996). Approach and avoidance achievement goals and intrinsic motivation: a mediational analysis. *Journal of Personality and Social Psychology*, *70*, 461-475.

Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology, 54*, 5-12.

Graham, S., & Weiner, B. (1996). Theories and principles of motivation. In D. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 63-84). New York: Macmillan.

Harackiewicz, J. M., Barro, K. E., Carter, S. M., Lehto, A. T., & Elliot, A. (1997). Predictors and consequences of achievement goals in the college classroom: Maintaining interest and making the grade. *Journal of Personality and Social Psychology, 73*, 1284-1295.

Hidi, S., & Harackiewicz, J. M. (2000). Motivating the academically unmotivated: A critical issue for the 21st century. *Review of Educational Research, 70*, 151-179.

Jackson, J. W. (2002). Enhancing self-efficacy and learning performance. *The Journal of Experimental Education, 70*, 243-255.

Kaplan, A., & Midgley, C. (1997). The effects of achievement goals: Does level of perceived academic competence make a difference? *Contemporary Educational Psychology, 22,* 415-435.

Lane, J., & Lane, A. (2001). Self-efficacy and academic performance. *Social Behavior and Personality, 29*, 687-694.

Maehr, M. L. (1984). Meaning and motivation: Toward a theory of personal investment. In R. Ames & C. Ames (Eds.), *Research on motivation in education: Vol. 1. Student motivation.* San Diego, CA: Academic Press.

Middleton, M. J., & Midgley, C. (1997). Avoiding the demonstration of lack of ability: An underexplored aspect of goal theory. *Journal of Educational Psychology*, *89*, 710-718.

Midgley, C., & Urdan, T. (1995). Predictors of middle school students' use of self-handicapping strategies. *Journal of Early Adolescence*, *15*, 389-411.

Miller, R. B., Behrens, J. T., Greene, B. A., & Newman, D. (1993). Goals and perceived ability: Impact on student valuing, self-regulation, and persistence. *Contemporary Educational Psychology, 18,* 2-14.

Pajares, F. (1996). *Assessing self-efficacy beliefs and academic outcomes: The case for specificity and correspondence.* Paper presented at the Annual Meeting of the American Educational Research Association, New York.

Pajares, F. (2003). Self-efficacy beliefs, motivation, and achievement in writing: A review of the literature. *Reading and Writing Quarterly, 19,* 139-158.

Pajares, F., Britner, S., & Valiante, G. (2000). Relation between achievement goals and self-beliefs of middle school students in writing and science. *Contemporary Educational Psychology, 25*, 406-422.

Pajares, F., & Miller, M. (1994). Role of self-efficacy and self-concept beliefs in mathematical problem solving: a path analysis. *Journal of Educational Psychology, 86*, 193-203.

Pajares, F., & Miller, M. (1995). Mathematics self-efficacy and mathematics outcomes: The need for specificity of assessment. *Journal of Counseling Psychology, 42*, 190-198.

Pintrich, P., & DeGroot, E. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*, 33-40.

Pintrich, P. R., Marx, R. W., & Boyle, R. A. (1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research, 63,* 167-199.

Pintrich, P. R., & Schunk, D. H. (1995). *Motivation in education: Theory, research, and applications.* Englewood Cliffs, NJ: Prentice Hall.

Pintrich, P. R., & Schunk, D. H. (2002). *Motivation in education: Theory, research, and applications* (2nd ed.). Upper Saddle River, NJ: Merrill/Prentice Hall.

Pintrich, P. R., Smith, D. A., Garcia, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the motivated strategies for learning questionnaire (MSLQ). *Educational and Psychological Measurement, 53*, 801-813.

Shim, S., & Ryan, A. (2005). Changes in self-efficacy, challenge avoidance, and intrinsic value in response to grades: The role of achievement goals. *The Journal of Experimental Education, 73,* 333-349.

Skaalvik, E. M. (1997). Self-enhancing and self-defeating ego orientation: Relations with task and avoidance orientation, achievement, self-perceptions, and anxiety. *Journal of Educational Psychology, 89,* 71-81.

Stahl, G., Koschmann, T., & Suthers, D. D. (2006). Computer-supported collaborative learning. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 409-425). Cambridge, England: Cambridge University Press.

Tellefson, N. (2000). Classroom applications of cognitive theories of motivation. *Educational Psychology Review, 12*, 63-84.

Wigfield, A. (1994). Expectancy-value theory of achievement motivation: A developmental perspective. *Educational Psychology Review, 6,* 49-78.

Winne, P. H. (1997). Experimenting to bootstrap self-regulated learning. *Journal of Educational Psychology, 89*, 397-410.

Wolters, C. A., Yu, S. L., & Pintrich, P. R. (1996). The relation between goal orientation and students' motivational beliefs and self-regulated learning. *Learning and Individual Differences, 8,* 211-238.

Table 1

Reliability Coefficients for Goal Orientations and Self-efficacy

	Pretest α	Posttest α
Mastery goal	.90	.92
Performance-approach goal	.90	.92
Performance-avoidance goal	.73	.82
Self-efficacy	.93	.93

Table 2

Means and Standard Deviations for Goal Orientation, Self-efficacy, and Science Achievement from Pretest to Posttest

	Mastery goal (*n* = 486)		Performance-approach goal (*n* = 491)		Performance-avoidance goal (*n* = 483)		Self-efficacy (*n* = 482)		Science Achievement (*n* = 510)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Pretest	3.92	.81	3.04	1.00	2.90	.80	3.94	.74	46.89	15.94
Posttest	3.93	.84	2.79 [a]	1.03	2.76 [a]	.90	4.06[a]	.72	70.13 [a]	18.42

Note. Self-Efficacy and Achievement Goal Orientation Scales range from 1 to 5; Science Achievement Test ranges between 1 to 100. [a] Superscript denotes that posttest scores are significantly different from pretest scores ($p < .001$).

Table 3

Correlations between Self-efficacy, Goal Orientation, and the Science Achievement

Variables (*pretest* scores)	1	2	3	4	5
1. Science Achievement	__				
2. Self-efficacy	.28***	__			
3. Mastery goal	.14***	.57***	__		
4. Performance-approach goal	-.01	.23***	.29***	__	
5. Performance-avoidance goal	-.25***	-.03	.06	.35***	__
Variables (*posttest* scores)	**1**	**2**	**3**	**4**	**5**
1. Science Achievement	__				
2. Self-efficacy	.28***	__			
3. Mastery goal	.19***	.63***	__		
4. Performance-approach goal	.01	.33***	.40***	__	
5. Performance-avoidance goal	-.13***	-.02	.17***	.40***	__

** $p < .01$ *** $p < .001$

Table 4

Regression Analysis for Predicting Science Achievement

Variables (posttest scores)	*B*	*SE B*	*β*	*t*
Self-efficacy	15.43	4.30	.64 **	3.59
Mastery goal	-1.63	4.79	-.08	-.34
Performance-approach goal	4.80	4.79	.28	1.00
Performance-avoidance goal	5.49	5.21	.28	1.05
Self-efficacy x Mastery goal	.27	1.17	.08	.23
Self-efficacy x Performance-approach goal	-1.10	1.12	-.32	-.97
Self-efficacy x Performance-avoidance goal	-2.44	1.20	-.59*	-2.04

Note. N = 472. Interactive effect terms between self-efficacy and goal orientations are indicated by Self-efficacy x Mastery goal, Self-efficacy x Performance-approach goal, and Self-efficacy x Performance-avoidance goal, respectively.

* $p < .05$ ** $p < .01$

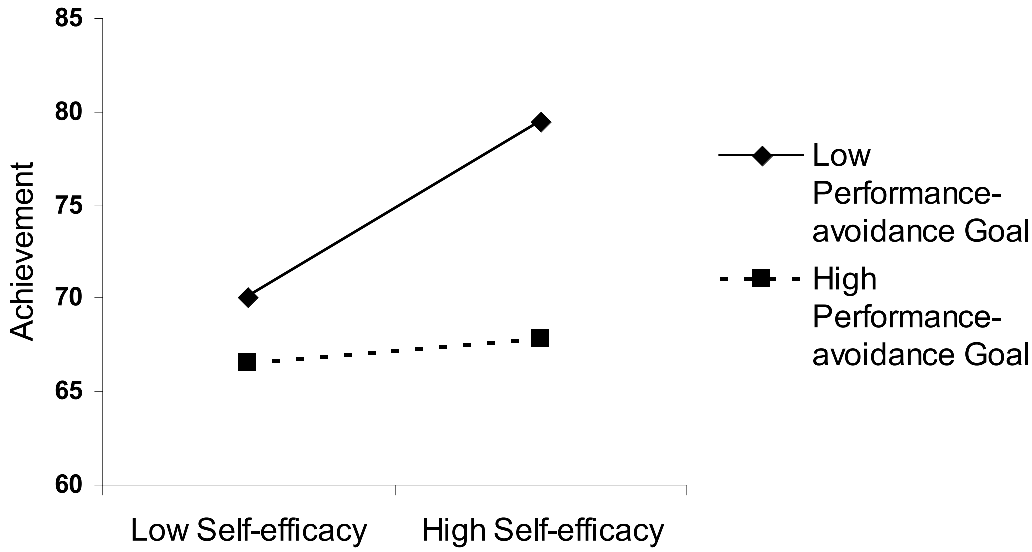

Figure 1. Interaction effect between self-efficacy and performance-avoidance goal on science achievement.