Predicting seventh grade students' engagement in science by their achievement goals

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Abstract

The aim of this study was to examine how well seventh grade students' engagement in science can be predicted by their achievement goals. For the specified purpose, a correlational research design was utilized. Data were obtained from 153 seventh grade students through administration of Achievement Goal Questionnaire and Engagement Questionnaire. Results from a series of multiple regression analysis revealed that mastery approach goals were significantly and positively related to all aspects of engagement in science. In addition, mastery avoidance goals were found

to be positively associated with cognitive engagement. Based on the results, some specific suggestions were made to create learning environments conducive to adoption of mastery approach goals in science classes.

Keywords: achievement goals, engagement, science

Introduction

In recent decades, educational and psychological researchers focused on student motivation and its effect on academic performance. Accordingly, motivation is a central focus of educational research in teaching and learning (Pintrich, 2003). Motivation refers to the process whereby goal-directed activity is started and sustained (Schunk, Pintrich, & Meece, 2008). Student engagement is one of the key factors of motivation (Ferrel, 2012). Based on some researchers' definitions, student engagement is described as students' "psychological investment in and effort directed toward learning, understanding or mastering the knowledge, skills, or crafts that academic work is intended to promote" (Newmann, Wehlage, & Lamborn, 1992, p. 12); students' "involvement with school" (Finn, 1989), and their "interest" and "emotional involvement" with school, including their "motivation to learn" (Steinberg, 1996). In general, student engagement refers to the extent to which a student involves actively in a learning activity (Connell & Wellborn, 1991). Because of its significant value in predicting the students' academic progress and achievement, student engagement has been investigated in many studies (Bong, 2009; Fredricks, Blumenfeld, & Paris, 2004; Greene, Miller, Crowson, Duke, & Akey, 2004). Although engagement is a multi-dimensional construct, which comprises psychological and behavioral dimensions (Fredricks, Blumenfeld, & Paris, 2004), according to general consensus, student engagement has three aspects, namely behavioral, emotional, and cognitive aspects. In a more recent research, in addition to these three-component models, Reeve & Tseng (2011) have proposed engagement taxonomy with four aspects: behavioral, emotional, cognitive, and agentic engagement.

Behavioral engagement can be defined in three ways. The first one requires developing positive action, such as obeying the rules in classroom and avoiding skipping school (Finn & Rock, 1997). Second concerns involvement in academic and learning tasks through efforts and attentions (Birch & Ladd, 1997). The last definition involves active participation in activities (Finn, 1993). *Emotional*

engagement refers to students' affective reactions in the classroom such as existence of enthusiasm and interest or non-existence of anger, boredom and anxiety (Connell & Wellborn, 1991; Reeve & Tseng, 2011). It contains not only positive reactions but also negative reactions to schools, teachers, classmates, and it affects students' willingness to complete tasks (Fredricks et al., 2004). *Cognitive engagement* involves students' thinking skills that help them proceed with mental processes necessary for learning (Corno & Mandinach, 1983; Fredricks et al., 2004). Cognitively engaged students use strategic and sophisticated learning strategies such outlining and summarizing (Fredricks et al., 2004). *Agentic engagement* is defined as "students' intentional, proactive, and constructive contribution into the flow of instruction they receive" (Reeve, 2012, p. 161). It is a process through which students purposely attempt to create, enrich and personalize both what they learn and the conditions under which they learn (Reeve & Tseng, 2011).

Achievement Goals

Achievement goals have drawn the attention of educators to better understand the reasons of students' achievement behaviors, i.e. why they personally engage in an academic task. While early research in this area identified two types of achievement goals namely, mastery goals and performance goals (Ames, 1992), more recent research proposed a four-factor model of achievement goals with the inclusion of approach/avoidance distinction to mastery-performance goals dichotomy (Elliot & McGregor, 2001). Accordingly, four achievement goals have emerged in the literature: mastery approach goals, performance approach goals, mastery avoidance goals, and performance avoidance goals. Mastery approach goals emphasize learning, deep understanding, and self-improvement while performance approach goals emphasize demonstrating ability and outperforming others. Concerning avoidance goals, while mastery avoidance goals focus on avoiding not understanding and not learning, performance avoidance goals focus on avoiding being inferior and getting the worst grades (Anderman & Patrick, 2012). Related research has demonstrated that students with approach goals strive to improve the existing situation to realize their goals. They tend to try different strategies and focus on positive opportunities. Thus, they are less likely to experience negative feelings such as worry and anxiety than students adopting avoidance goals (Elliot, 2006).

Achievement Goals and Cognitive Engagement

Considerable research has revealed that the kinds of achievement goals that students hold are linked to the types of cognitive and metacognitive strategies they utilize while engaging in an academic task (Anderman & Patrick, 2012). For example,

related studies showed a positive association between approach goals and use of various cognitive and metacognitive strategies resulting in deeper processing of information. Students with approach goals are found to demonstrate higher levels of metacognitive awareness and self-monitoring of cognition (Elliot & McGregor, 2001). For example, the study conducted by Wolters, Yu, and Pintrich (1996) revealed that students studying for the reasons of learning and understanding and showing their abilities to others tend to use various cognitive and self-regulatory strategies. In addition, Bong's study (2009) indicated a positive relation between mastery approach goals and adaptive strategy use. Although the same study showed a positive association between mastery avoidance goals and adaptive strategy use, this association was weaker. Supporting this finding, Elliot and McGregor (2001) reported that mastery avoidance goals were not related to strategy use. On the other hand, related research generally showed that performance avoidance goals are linked to maladaptive strategy use (Elliot & McGregor, 2001).

Achievement Goals and Emotional Engagement

A number of studies revealed the association between achievement goals and various indicators of emotional engagement such as affect (Daniels et al., 2009; Elliot, 2006) and motivation (Murayama & Elliot, 2009). Indeed, Elliot (2006) reported that students with approach goals are likely to experience positive feelings while students with avoidance goals are likely to experience negative feelings such as worry and anxiety. Supporting this idea, working with college students, Daniels et al. (2009) found a positive link between both mastery- and performance approach goals and the feelings of hopefulness. Additionally, the study revealed a negative relationship between mastery approach goals and the feelings of helplessness. Similarly, Skaalvik (1997) conducted a study to examine the relationship between achievement goals and affect. According to the results, mastery approach goals and performance approach goals were related positively to self-esteem and negatively to math anxiety. On the other hand, performance avoidance goals were found to be negatively associated with self-esteem and positively with both verbal and math anxiety.

Achievement Goals and Behavioral Engagement

There are various studies revealing positive associations between mastery approach goals and academic behaviors such as expending effort and persistence (Miller et al., 1996); seeking help when needed (Ryan & Pintrich, 1997); and discussing schoolwork with other students (Patrick, Ryan, & Kaplan, 2007). Related studies showed that students with mastery goals are likely to prefer challenging tasks, persist in the face of difficulties, and demonstrate greater effort and less avoidance

behaviors (Elliot & Church, 1997; Kaplan, Middleton, Urdan, & Midgley, 2002). On the other hand, adaptation of performance goals was not found to be linked to either persistence or effort (Miller et al., 1996). Performance goals were found to be associated with avoiding seeking help when needed (Ryan & Pintrich, 1997) and demonstrating disruptive behaviors during lessons (Ryan & Patrick, 2001).

Achievement Goals and Agentic Engagement

Since studies on the agentic engagement are relatively new and incomplete, there is not much research concerning the relationship between agentic engagement and goal orientations. However, Reeve and Lee (2014) stated that if teachers create a mastery-oriented classroom climate, their students will pay more attention to exerting effort; focussing on emotions of pleasure from hard work; using deeper cognitive strategies; and seeing other people as sources of knowledge, help and support. In other words, these students will concentrate on all aspects of engagement (i.e., behavioral, emotional, cognitive, and agentic). The reason why agentic engagement occurs in such classrooms is that students can easily reflect their opinions or feelings during an activity as an active participant (Ainley, 2012). Since Reeve (2012) defined agentic engagement as students' active contribution to teaching and learning practices, rather than static or compliant engagement, the present study predicts that there is a link between mastery goals and agentic engagement. More specifically, students who adopt mastery goals focus on learning as much as possible, overcoming a challenge, and enhancing their competence level. Accordingly, they are expected to share their opinions about how to improve the classroom practices or express their preferences; they may enthusiastically ask questions to improve their learning to their teachers. Additionally, agentic engagement requires students to have the capability to deal with new and challenging situations (Peach & Matthews, 2011) and it is thought that students' mastery goal orientations can provide these requirements.

In sum, the relevant literature suggests that students' adoption of mastery goals is positively associated with all aspects of engagement (i.e., behavioral, emotional, and cognitive engagement). Additionally, students' adoption of mastery goals is expected to be associated with their agentic engagement. However, the literature concerning the relations between performance goals, avoidance goals and student engagement presents mixed results.

Significance of the Study

Despite the presence of a considerable body of research on student engagement in

relation to achievement goals, most of these studies center on the mastery and performance goal dichotomy without considering a distinction between avoidance and approach goals. Therefore, in the current study achievement goals was investigated with regards to approach and avoidance goals. Thus, it is expected that this study may have potential to enlighten the inconsistent findings concerning the relationship between performance goals and different aspects of student engagement. Moreover, most of the engagement studies in the literature focused on behavioral, emotional, and cognitive components of engagement, but Reeve and Tseng (2011) searched out that this three component model presents incomplete understanding, so they added agentic engagement as a fourth aspect. Inclusion of agentic engagement as a fourth aspect in engagement studies can provide a full understanding of student engagement (Reeve & Tseng, 2011). Considering the importance of this new construct and insufficient research on it, the present study included agentic engagement as well as emotional, behavioral and cognitive engagement to conceptualize student engagement. Thus, it is expected that the gap in the engagement research may be filled by this study. Additionally, this study specifically focused on science domain because, in today's world, one of the major goals of science education involves developing students as scientifically literate individuals who deeply comprehends and reflects on scientific knowledge, ideas, and explanations, actively participates in science activities and tasks, produces scientific evidences, and demonstrates positive affect toward science. According to National Academy of Sciences' Committee on Science Engineering, and Public Policy (2001) to support the workforce in science, technology, engineering and mathematics such habits of minds should be nurtured in K-8 education. Thus, there is a need for science educators to investigate the factors which are related to all aspects of student engagement in science which involves students' use of various strategies, their persistence, effort, positive affect, and intentional, constructive contribution to instruction. Because, achievement goals emerge as an important factor in all aspects of student engagement, current study aims to examine student engagement in science in relation to their achievement goals. Current findings can provide important implications for teachers, science educators, and curriculum developers, to create classroom environments promoting adoption of achievement goals conducive to student engagement in science.

Method

Sample

The data for the present study were obtained from 153 seventh grade students (n = 85 girls, n = 68 boys) in the second semester of academic year attending urban public schools in Turkey. The students ranged in age from 12 to 15 years with a mean age of 13.22 (SD= .54).Majority of them were from middle socioeconomic class families. The mean of the students' science report card grade was 3.78 out 5 with a standard deviation of 1.05.

Research design

In the present study, a correlational research design was conducted using The Achievement Goal Questionnaire and Engagement Questionnaire. Accordingly, the data were obtained via administering these self-report instruments to the sample of seventh grade students to identify relationships between achievement goals and engagement.

Instruments

The Achievement Goal Questionnaire (AGQ)

The AGQ is a 15-item, five-point Likert scale developed by Elliot and McGregor (2001) to assess students' achievement goals. It consists of four sub-scales namely: mastery approach goals (e.g. "I want to learn as much as possible from science classes", n =3 items, α = .87), mastery avoidance goals (e.g. "I worry that I may not learn all that I possibly could in science classes", n =3 items, α = .73), performance approach goals (e.g. "It is important for me to do well compared to others in science classes", n =3 items, α = .68) and performance avoidance goals (e.g. "My fear of performing poorly in science classes is often what motivates me", n =6 items, α = .82). In the current study, as a validity evidence for 4-factor structure of the AGQ, confirmatory factor analysis was conducted. Results provided an acceptable model fit (CFI = .93, RMSEA = .11, SRMR = .08). In terms of reliability, cronbach's alpha coefficients for each sub-scale were sufficiently high to conduct further analyses.

Engagement Questionnaire (EQ)

The EQ was used to assess student engagement in science classes (Reeve &Tseng, 2011). It is a seven-point-likert type self-report instrument with 22 items in four sub-scales namely, behavioral engagement (e.g. "I listen carefully in science classes", n =5 items, α = .92), emotional engagement (e.g. "When I am in science class, I feel curious about what we are learning", n =4 items, α = .84), cognitive engagement (e.g. "When I study for science, I try to connect what I am learning with my own

experiences", n =8 items, α = .86) and agentic engagement (e.g. "I offer suggestions about how to make the science class better", n =5 items, α = .82). In the current study, confirmatory factor analysis results conducted to validate 4-factor structure of the instrument indicated a good model fit (CFI = .98, RMSEA = .05, SRMR = .05). In addition, cronbach's alpha coefficients for each sub-scale suggested high internal consistency.

Data analysis

As part of descriptive statistics mean and standard deviations for achievement goals and engagement variables were reported. As an inferential procedure multiple regression analyses were conducted to examine the seventh grade students' engagement in science in relation to their achievement goals.

Results

Descriptive Statistics

Descriptive statistics concerning students' achievement goals (mastery approach, performance approach, mastery avoidance, and performance avoidance goals) and engagement (agentic, behavioral, cognitive, and emotional) were summarized in Table 1 and Table 2, respectively.

Table 1. Mean and Standard Deviation Values for Students' Achievement Goals

	M	SD
Mastery Approach Goals	4.34	.77
Performance Approach Goals	4.16	.80
Mastery Avoidance Goals	3.53	.98
Performance Avoidance Goals	3.65	.91

Concerning achievement goals, the highest mean score was obtained for the mastery approach goals sub-scale followed by performance approach goals sub-scale (see Table 1). These results suggested that students tend to study for demonstrating their abilities to others and getting the best grades as well as learning and understanding in science classes. The next highest mean score was on the performance avoidance goals. Although, the mean score was lowest on mastery avoidance goals it was still above the mid-point of five-point scale. Overall, results with respect to students'

approach and avoidance goals tendencies revealed that seventh grade students possess higher levels of approach goals than avoidance goals in science classes.

Table 2. Mean and Standard Deviation Values for Students' Engagement

	M	SD
Agentic Engagement	2.93	.63
Behavioral Engagement	3.36	.59
Cognitive Engagement	3.08	.54
Emotional Engagement	3.20	.67

Examination of the mean scores for student engagement revealed that, on a four-point scale, the highest mean score was obtained for behavioral engagement (see Table 2). This finding implied that students tend to show behaviors such as persistence, effort, concentration, and attention in their science classes at high levels The next highest mean scores, still well-above the mid-point, were obtained on the emotional engagement and cognitive engagement subscales suggesting that students tend to demonstrate positive affective reactions such as interest and enjoyment and use learning strategies to remember, organize, and understand the material to accomplish tasks in the science classes at high levels as well. The lowest mean score was obtained for agentic engagement. Even though the mean score was lowest on this sub-scale, it indicated a moderate level of agentic engagement.

Inferential Statistics

In order to examine how well seventh grade students' achievement goals predict each aspect of their engagement in science, four separate multiple linear regression analyses were conducted.

According to first regression analysis, the linear combination of four predictors; mastery approach, performance approach, mastery avoidance, and performance avoidance goals accounted for 38 % of variance in seventh grade students' cognitive engagement ($R2$=.38, F (4, 137) = 20.79, p< .05). More specifically, results showed that mastery approach goals and mastery avoidance goals made a statistically significant contribution to the prediction of students' cognitive engagement (p <.05), while other two goals failed to achieve significance (p >.05). Among these variables, mastery approach goals made the largest contribution (β= .56, $sr2$= .25), followed by mastery avoidance goals (β= .19, $sr2$= .03) to the prediction of cognitive engagement in science (see Table 3). Indeed, mastery approach goals uniquely explained 25 % of

variance in cognitive engagement. In addition, inspection of beta values revealed that cognitive engagement was positively related to both mastery approach goals and mastery avoidance goals. These results implied that students having higher levels of mastery approach goals and mastery avoidance goals demonstrate higher levels of cognitive engagement in science.

Table 3. Contribution of Students' Achievement Goals to Cognitive Engagement

Predictor variables	β	p	sr2
Mastery Approach Goals	.56	.00	.25
Mastery Avoidance Goals	.19	.02	.03
Performance Approach Goals	-.02	.82	.00
Performance Avoidance Goals	.01	.88	.00

The second regression analysis results indicated that the linear combination of predictor variables (mastery approach, performance approach, mastery avoidance, and performance avoidance goals) accounted for 41 % of variance in seventh grade students' emotional engagement ($R2$=.41, F (4, 137) = 24.22, p < .05). More specifically, as shown in Table 4, results showed that mastery approach goals made a statistically significant contribution to the prediction of students' emotional engagement (p <.05), while other predictors did not (p >.05). Additionally, examination of the standardized beta values and squared semi-partial correlations revealed that mastery approach goals were positively related to emotional engagement and made the strongest contribution (β= .62, $sr2$= .31) to explain the variability in emotional engagement. More specifically, mastery approach goals accounted for 31 % of variance in the dependent variable uniquely. These results showed that students with higher levels of mastery approach goals demonstrate higher levels of emotional engagement in science.

Table 4. Contribution of Students' Achievement Goals to Emotional Engagement

Predictor variables	β	p	sr2
Mastery Approach Goals	62	.00	.31
Mastery Avoidance Goals	.07	.37	.00
Performance Approach Goals	.04	.66	.00
Performance Avoidance Goals	-.03	.76	.00

The third regression analysis conducted for behavioral engagement showed similar results with the emotional engagement. That is, the linear combination of predictor variables accounted for 43 % of variance in seventh grade students' behavioral engagement ($R2$=.43, F (4, 137) = 25.49, p< .05) and mastery approach goals made a statistically significant contribution to the prediction of students' behavioral engagement (p <.05), while other predictors did not (p >.05). A closer inspection of beta coefficients and squared semi-partial correlation showed that mastery approach goals were positively linked to behavioral engagement and made the strongest contribution (β= .61,$sr2$= .29) to the prediction of this variable (see Table 5). Actually, mastery approach goals uniquely explained 29 % of variance in behavioral engagement. These results implied that students with higher levels of mastery approach goals tend to demonstrate higher levels of behavioral engagement in science classes.

Table 5. Contribution of Students' Achievement Goals to Behavioral Engagement

Predictor variables	β	p	sr2
Mastery Approach Goals	.61	.00	.29
Mastery Avoidance Goals	-.10	.20	.01
Performance Approach Goals	.02	.74	.00
Performance Avoidance Goals	.11	.25	.01

The fourth regression analysis showed that the linear combination of predictor variables accounted for 23 % of variance in seventh grade students' agentic engagement ($R2$=.23, F (4, 137) = 10.28, p < .05). Similar to the previous results, as shown in Table 6, mastery approach goals were found to make a statistically significant and the strongest contribution (β= .43; $sr2$= .14) to the prediction of students' agentic engagement (p <.05), while other predictors did not (p >.05). Mastery approach goals explained 14 percent of variance in agentic engagement uniquely. These results suggested that students with higher levels of mastery approach goals are likely to show higher levels of agentic engagement in science classes.

Table 6. Contribution of students' achievement goals to agentic engagement

.Predictor variables	β	p	sr2
Mastery Approach Goals	.43	.00	.14
Mastery Avoidance Goals	.09	.33	.00

Performance Approach Goals	.07	.49	.00
Performance Avoidance Goals	-.00	.98	.00

Discussion

This study examined the relationship between seventh grade students' achievement goals and their engagement in science. Results showed that seventh grade students' mastery approach and avoidance goals significantly predicted their cognitive engagement in science. This finding indicated that students who study for the reasons of learning and mastering the course material (adopting *mastery approach goals*) and avoiding from misunderstanding or not mastering the task (adopting mastery avoidance goals) tend to use various cognitive and learning strategies to remember, organize, and understand the science topics at higher levels. There are many studies in the literature supporting these findings: Considerable research has shown that students who adopt task or mastery goals use greater learning strategies and self-regulation strategies than students who adopt performance goals (e.g., Miller et al., 1996; Nolen, 1988). For example, Greene, Miller, Crowson, Duke, and Akey (2004) reported that mastery goals were directly and positively linked to meaningful strategy use, while performance-approach goals were not. Similarly, Kahraman and Sungur (2011) found that students' mastery approach goals significantly predicted their metacognitive strategy use in science classes, while avoidance goals and performance approach goals did not. Thus, consistent with relevant literature, current findings suggest that science teacher provide students with learning environments which encourage adoption of mastery goals, especially mastery approach goals. Actually, present study showed that mastery approach goals make stronger unique contribution to the explanation of cognitive engagement in science classes than mastery avoidance goals.

Current findings also revealed that seventh grade students who focus on learning, understanding, and self-improvement (mastery approach goals) are more likely to show positive affective reactions such as interest, and enjoyment in the science classes (emotional engagement). This finding concerning the relation between mastery approach goals and emotional engagement was as expected and confirms the results of previous research. For instance, Gonida et al. (2009) found that behavioral engagement and emotional engagement were predicted by student's mastery goal orientation. These findings, overall, are consistent with Elliot's (2006) proposition

that students adopting mastery approach goals tend to experience positive feelings such as enjoyment.

This study also demonstrated that seventh grade students' mastery approach goals significantly predicted their behavioral engagement in science, while other three goals failed to predict behavioral engagement. This finding implied that students who focus on self-improvement and mastering the task at hand are likely to show behaviors such as persistence, effort, and concentration in science classes. Actually, it is reasonable to find a positive association between mastery approach goals and behavioral engagement because students adopting mastery goals study for the reasons of learning and mastering the course material. According to ample research (Kaplan et al., 2002; Miller et al., 1996; Wolters, 2004), they are likely to persist in the face of difficulties and put greater effort forth using variety of strategies in order to achieve these adaptive goals.

Finally, results concerning agentic engagement showed that students whose purpose is to improve their competence and learning (mastery approach goals) are likely to enrich the learning environment and make constructive contribution to instruction in science classes (agentic engagement). Initially, this study proposed that if students study for the reasons of self-improvement, learning and understanding in science classes, they may try to enrich the learning environment and make constructive contribution to instruction through enthusiastically asking questions to improve their learning to their teachers and reflecting their opinions or feelings during an activity as an active participant in science classes. On the other hand, if students study for the reasons of looking smart, demonstrating their abilities to other, and obtaining a good grade, they may be less likely to share their opinions about how to improve the classroom practices or express their preferences to improve their learning. Therefore, although there is not much research concerning the relationship between agentic engagement and goal orientations in the literature, the findings concerning the relationship between achievement goals and agentic engagement was as expected.

Overall, the findings of this study indicated significant relationship between mastery approach goals and student engagement in terms of behavioral, cognitive, emotional, and agentic in science. When considered the importance of student engagement in adaptive outcomes, such as improvement in motivation, academic achievement, and ultimately in scientific literacy, it is suggested that science teachers help students adopt mastery approach goals. To be able to support mastery goals Ames (1992) recommended some strategies. Firstly, instructional tasks involving interest, medium

challenge, and active participation should be provided. More specifically, tasks which are challenging, interesting, meaningful, and relevant to students; offer variety and diversity; controlled by students are likely to enhance curiosity for learning and promote mastery orientation and active engagement (Nicholls, 1989). Secondly, evaluation practices concentrated on personal improvement, progress, and mastery should be emphasized. Finally, autonomy in the learning environment should be provided. Students should feel independent and responsible for their own learning. There is some evidence that teachers can learn how to become more autonomy supportive through participating in a training program (Reeve, 2006; 2012). Therefore, it can be recommended that Ministry of Education organize in-service trainings in order to help science teachers to improve their autonomy supportive style of teaching. Similarly, teacher education programs should emphasize the importance of creating autonomy supportive classrooms and provide specific suggestions to enhance students' autonomy in science classes: For example, it can be suggested that problem-based learning, which requires students to deal with ill-structured problems from daily lives to understand underlying basic scientific concepts, is implemented in science classes. Actually, problem-based learning provides students with authentic learning environments in which they use different strategies to propose solutions to given problems accessing different resources. Thus, during this process students feel autonomous in their learning: They decide on which strategy to use, from whom to seek help, which resources to access to improve their knowledge on the related science topic. Ill-structured problems from daily lives increase their curiosity and help them realize the connection between what they learn in the classroom to their real life experiences. Additionally, because students work in small groups, while dealing with ill-structured problems, they cooperate with, not compete against each other while gaining knowledge because it's the groups' responsibility to propose a solution and provide a scientific explanation for a given problem. All these characteristics of problem-based learning can help students adopt mastery goals in their science learning. In addition, integration of hands-on, inquiry based activities can be conducive to adoption of mastery goals.

Recommendations

According to current findings, students holding mastery goals use a variety of strategies resulting in a deeper processing of scientific information, pay attention to science class, feel curious and interested while studying science, and ask questions, offer suggestions to make science class better. All these characteristics can result in improvement in students' scientific literacy because scientifically literature individuals have a deep understanding of scientific knowledge, demonstrate positive

attitudes toward science, they enjoy involving in scientific tasks, and overall, science becomes an important part of their lives. Thus, current study has potential to provide valuable implications to improve science education and scientific literacy. Future studies can examine effectiveness of suggested instructional strategies on supporting mastery goals, student engagement, and ultimately, scientific literacy. Future studies can also use qualitative methodologies to illuminate the current findings and provide in-depth explanations for the observed relations. Longitudinal studies are also suggested to reveal cause and effect relations.

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