Education and Science

Vol 48 (2023) No 215 55-94

Original Article

Lensing Paths Going to Achievement: The Relationship among Students' Beliefs, Goal Orientation, Cognitive and Behavioral Process, and Achievement *

Filiz Bezci [1], Semra Sungur [2]

Abstract

This study presents a proposed and tested model for achievement motivation. The model aims to broaden and tailors Dweck and her colleagues' framework. A path analysis was conducted to test the designed model to investigate the associations among students' beliefs, goal orientations, cognitive-behavioral processes, and achievement. The study posits that students' beliefs play a fundamental role in learning and were included in the model as implicit theories of intelligence, epistemological and motivational beliefs. Indeed, knowledge acquisition is a purposeful endeavor, and to understand why students engage in learning activities, learners' achievement goals have been incorporated into the model. Numerous cognitive and behavioral processes are involved in the learning process. To represent these processes, the model includes the use of cognitive and metacognitive learning strategies, as well as the procrastination of students. A total of 4510 seventh-grade middle school students attended the current study. The path analysis results revealed that the model explained 5% to 29% of the variance in the dimensions of achievement goals, 58% to 74% of the variance in the dimensions of learning strategies use, 38% of the variance in procrastination, and 20% of the variance in achievement. Also, the study concludes by proposing several suggestions to maximize the benefits of the results.

Keywords

Beliefs of students
Goal orientation
Learning strategies
Procrastination
Achievement

Article Info

Received: 10.17.2021
Accepted: 05.03.2023
Published Online: 07.26.2023

DOI: 10.15390/EB.2023.11320

* This article is derived from Filiz Bezci's Master's thesis / PhD dissertation entitled " The interplay among elementary students' implicit theories of ability, epistemological beliefs, motivational beliefs,achievement goals,learning strategies, procrastination and science achievement", conducted under the supervision of Semra Sungur.

[1] Çankırı Karatekin University, Faculty of Letters, Department of Educational Sciences, Turkey, filizbezci@gmail.com
[2] Middle East Technical University, Faculty of Education, Department of Mathematics and Science Education, Turkey, ssungur@metu.edu.tr

Introduction

Achievements or failures do not happen suddenly; they result from complex processes. A holistic examination is needed to understand those processes' lay of the land. Accordingly, the current study proposed a path model to lens the associations among students' beliefs, goal orientations, cognitive and behavioral processes, and achievement. Beliefs affect individuals' thinking, feeling, and behavior, so their importance in learning cannot be negligible. As a result, learners' beliefs about ability, knowledge, knowing, capability judgment, and task quality were taken into the hand. Also, learners' engagements in learning activities are orientated with different purposes, and achievement goals were added to understand students' goal orientations in the model. Other basic processes run during learning are cognitive and behavioral processes. Learning strategies and procrastination were examined in the model to represent those processes. The model was proposed for the science domain, considering the domain-specific nature of the mentioned variables and achievement. The constructs examined in the model are elaborated in the subsequent sections.

Theoretical Background of the Proposed Model

In the social-cognitive achievement motivation model developed by Dweck and her colleagues, individual beliefs and values play a significant role in shaping their psychological worlds and impacting their thoughts, emotions, and actions. These beliefs, known as implicit theories, differ from person to person (Bandura & Dweck, 1985; Dweck, Chiu & Hong, 1995). While Dweck's model can be applied to various domains, including intelligence, personality, and morality, the current study focused on implicit theories related to intelligence. Dweck and Legget (1988) identified two self-theories based on how individuals perceive the nature of intelligence: the fixed entity theory and the malleable incremental theory. In the entity theory, intelligence is considered as fixed and unchangeable, while in the incremental theory, intelligence is perceived as malleable and capable of change. Dweck and her colleagues conducted multiple studies analyzing the behavior patterns of learners based on their beliefs regarding the nature of intelligence. (e.g., Bandura & Dweck, 1985; Diener & Dweck, 1978, 1980; Dweck et al., 1995; Dweck & Legget, 1988; Elliott & Dweck, 1988; Leggett & Dweck, 1986). The researchers built the model around learners' goals and their goal-oriented behaviors. In the pioneering study, Dweck and Elliott (1983) introduced two types of goals: performance and learning, associated with subjective values. Performance goals focus on gaining approval and avoiding incompetence, while learning goals aim to improve competence. Learners with performance goals believe ability is fixed, while those with learning goals believe it can be increased. Having different goals leads to different response patterns: mastery-oriented or helpless. Those with performance goals tend towards the helpless pattern while learning goals result in mastery-oriented patterns (Elliott & Dweck, 1988; Leggett & Dweck, 1986). Helplessness is avoidance of challenge and worsened performance, while mastery-oriented patterns involve seeking challenges and persistence under failure (Dweck & Leggett, 1988). Additionally, learners' behavior pattern related to their goal orientation is influenced by their perceived present ability (Dweck & Leggett, 1988; Elliott & Dweck, 1988). Depending on their perceived ability level, students with a performance goal orientation may exhibit either adaptive or maladaptive behavior patterns. Those who perceive their ability as high seek challenges, persist in the task, and use more effective strategies, while those who perceive their ability as low avoid challenges, show low persistence, and use ineffective strategies. However, for individuals with a learning goal orientation, their perceived ability level does not impact their behavior pattern. They consistently strive for challenges to improve their learning and display great persistence. How learners perceive their abilities significantly impacts their academic goals, task selections, strategies, persistence, and performance in academic tasks (Dweck, 2002; Dweck et al., 1995; Dweck & Legget, 1988; Hong, Chiu, Dweck, Lin, & Wan, 1999).

In summary, the achievement motivation model Dweck and her colleagues developed is a valuable tool for comprehending the influence of motivation on students' participation and accomplishments in academic settings. This model can guide the development of practical approaches that enhance educational environments. While there are examples of the adaptation of this model, it is notable that it covers the learning process less than the original model (e.g., Karlen, Suter, Hirt, & Merki, 2019). Consequently, the ultimate aim of this study is to expand and customize the model by incorporating additional considerations; this goal is to provide a more comprehensive and tailored framework for comprehending and promoting students' motivation and achievement. Accordingly, a new model is proposed based on Dweck and her colleagues 'model in the current study (see Figure 1). The reconstructed model tested the proposed associations among students' beliefs, goal orientations, cognitive-behavioral processes, and achievement with path analysis. In the model, students' beliefs represent implicit theories of ability (i.e., the detailed explanation is provided under the subheading of Implicit theories of ability to express why ability term is used instead of intelligence), epistemological beliefs, and motivational beliefs. In the original model, the significance of individuals' beliefs is emphasized, precisely the value of students' beliefs regarding the potential for their abilities to improve through their efforts and practice. (Dweck, 2006a). Also, epistemological beliefs and implicit beliefs of ability are interconnected and critical in understanding how individuals approach learning and academic achievement (Blackwell, Trzesniewski, & Dweck, 2007; Schommer, 1990; Schraw, Bendixen, & Dunkle, 2002). So epistemological beliefs concept was embedded into Dweck and colleagues' achievement motivation model to gain a more comprehensive understanding in educational settings. In addition, the renewed model includes motivational beliefs of students representing self-efficacy of students and their task-value. These motivational beliefs were placed in the model as representing perceived present ability and subjective value about the task (i.e., challenging or not) from the original model. Besides, students' goal orientation was placed in the reconstructed model as achievement goals as in the original model. Since many experimental studies indicated that rather than directly affecting their performance (Linnenbrink-Garcia, Tyson, & Patall, 2008), individuals' goals drive their performance through a cognitive, emotional, and behavioral process (Elliott & Dweck, 1988; Maehr & Zusho, 2009), the association between achievement goals and achievement was set as indirectly upon the cognitive and behavioral process of learners in the proposed model. This cognitive and behavioral process is mentioned as adaptive and maladaptive behavior patterns in Dweck and her colleagues' original model (Dweck & Leggett, 1988; Elliott & Dweck, 1988). Accordingly, learners' adaptive and maladaptive behavior patterns are characterized by considering effective or ineffective strategy use and persist or not on a task (Dweck, 1986). Therefore, learning strategies (i.e., cognitive and metacognitive strategies) use and procrastination were identified as the cognitive and behavioral processes in the renewed model. Moreover, finally, academic achievement is placed as academic performance in the proposed model in the current study.

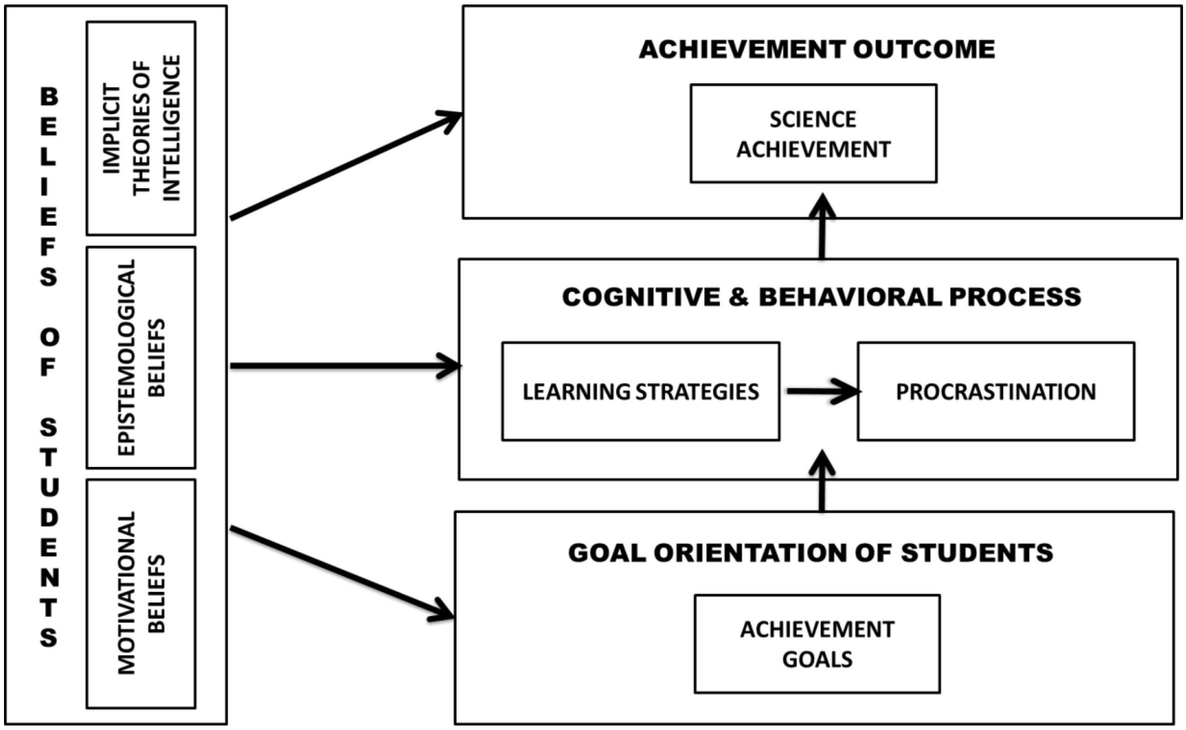

Figure 1. The proposed basic model

Beliefs of students

Individuals develop beliefs that play a pivotal role in their lives; they will impact how individuals coordinate their life and construe the meaning behind their experiences with their beliefs (Dweck, 1999). These beliefs subsequently construct individuals' psychological world by influencing their behavior, emotions, and thoughts. In academic settings, students' beliefs treat as a filter, assisting them in interpreting the action and the components therein (Thomas & Rohwer, 1987). The present study examined learners' beliefs regarding implicit theories of ability, epistemology, and motivation.

Implicit theories of ability. In the 1980s, Dweck and her colleagues researched achievement motivation and developed a social-cognitive model. The basic assumption of the model is that beliefs and values lie behind the difference of individuals (Hong et al., 1999). Within the model, there is a prevalent reference to implicit theories; these theories encapsulate an individual's beliefs and values in various domains, including intelligence, personality, and morality (Dweck, 1999; Dweck et al., 1995). People's implicit theories impact their perceptions and can strongly influence how they make judgments and react. Implicit theories of intelligence specifically pertain to an individual's beliefs about their own intellectual capabilities. Two self-theories have been specified: an *entity theory of intelligence*; and an *incremental theory of intelligence* according to individuals' beliefs about the nature of intelligence. According to the former, intelligence is regarded as fixed and non-malleable. In the latter's case, intelligence is deliberated as malleable and changeable. Those self-theories are essential in their motivational, cognitive, and behavioral learning processes. Coherent to their self-theories, learners put different achievement goals, use diverse learning strategies, and show persistence and performance (Dweck, 2002; Dweck & Legget, 1988; Hong et al., 1999). Even though ability and intelligence are not interchangeable terms, they both refer to a similar concept, as suggested by implicit theories of both. These theories have been utilized in various studies related to intelligence and ability (Cury, Elliot, Da Fonseca, & Moller, 2006; Dweck, 2002; Ommundsen, 2003; van Aalderen-Smeets & van der Molen, 2018). Also, while assessing learners' implicit theories of ability, focusing on a specific academic domain, such as science or math, is essential since learners' beliefs about implicit theories of intelligence have domain-specific nature (Chen & Pajares, 2010). Accordingly, this study aims to analyze participants' implicit beliefs about their science skills. Specifically, the study focuses on the incremental theory of science ability, as assessing both implicit theories of ability can make one polar more appealing to participants (Dweck et al., 1995).

Epistemological beliefs. The nature of human knowledge and its acquisition process have been topics of philosophical discussion since ancient Greek times (Buehl & Alexander, 2001). Those discussions were branched out into epistemology as a field of philosophy. Epistemological beliefs take psychologists' attention after realizing that they unconsciously influence individuals' interpretation of their surroundings (Hofer, 2001). Psychology and educational science researchers delve into individual beliefs regarding knowledge and its impact on their perception of the world (Chen & Pajares, 2010). Pioneering studies focused on decoding students' beliefs in unidimensional models but needed to be more decisive in understanding the elaborated structure of personal epistemology and its relation to learning. Because of this, researchers proposed multidimensional models (e.g., Hofer & Pintrich, 1997; Schommer, 1994). The models distinguish each dimension from the others and progress from simple to complex beliefs. This implies that a learner may have advanced beliefs in one area while holding primitive beliefs in another (Schommer, 1994). Schommer (1990) developed a multidimensional model comprising five dimensions related to epistemological beliefs about knowledge and learning: structure, certainty, source, control, and speed. However, Hofer and Pintrich (1997) criticized the model's control and speed dimensions for not focusing on the nature of knowledge or knowing. In response, researchers proposed a new multidimensional model consisting of two general areas: the nature of knowledge and the process of knowing. The first area includes certainty of knowledge (fixed or fluid) and simplicity of knowledge (discrete, solid facts or relative, contingent, and contextual). The second area contains the source of knowing (external sources and authority or self-ability to build up knowledge) and justification for knowing (evidence of authority and expertise or self-evaluation). Epistemological beliefs are differentiated according to fields (Jehng, Johnson, & Anderson, 1993; Paulsen & Wells, 1998) and disciplines (Hofer, 2000), indicating domain-specificity. Therefore, domain-specificity in students' epistemological beliefs should be considered in research (Hofer, 2006; Muis, Bendixen, & Haerle, 2006). This study focuses on the science domain in line with this recommendation. Epistemological beliefs are revealed as a further important role in affecting achievement-related processes and outcomes (Ryan, 1984) since they are pivotal in that student's learning (Hofer & Pintrich, 1997). These beliefs are formed in the early child development stages (Wellman, 1992) and continue to develop throughout children's development (Chandler, Hallett, & Sokol, 2002). Accordingly, students own more sophisticated epistemological beliefs in higher grades than lower ones (Schommer-Aikins, Mau, Brookhart, & Hutter, 2000; Kurt, 2009). On the other hand, research about learners' epistemological beliefs mainly studied college and high school students' beliefs. Consequently, it is necessary to investigate students' epistemological beliefs at early grade levels. The study aimed to investigate elementary school students' epistemological beliefs in science. To accomplish this, Conley, Pintrich, Vekiri, and Harrison (2004) four-dimensional model was used, as it matched the sample and domain of the study. The four dimensions of the model include the source of knowledge (whether it comes from authority or individual observation), the certainty of knowledge (whether there are one or multiple correct answers to scientific questions), the development of knowledge (whether scientific knowledge is absolute or evolving), and the justification for knowing (whether scientific phenomena are justified through simple investigations or reasoning, thinking, and experimentation). Along with these beliefs, motivational beliefs also play a crucial role in students' achievement motivation.

Motivational beliefs

Students' motivational beliefs are pivotal in their academic performance and learning, along with their other beliefs. Based on existing literature studies, these beliefs can be viewed from different perspectives, but the most significant ones are self-efficacy and task-value beliefs (Liou, 2017).

Self-efficacy beliefs. Albert Bandura's social cognitive theory (1986, 1997) proposes that individuals possess a self-system that governs their behaviors, emotions, and thought processes. This system is crucial in shaping one's perception and interaction with the world. The theory highlights the active role of individuals in their development, referred to as human agency. Humans have unique abilities to learn from others, plan alternative strategies, symbolize, regulate ourselves, and self-reflect. Self-reflection involves evaluating oneself, which enables us to improve our behaviors, emotions, and thoughts (Pajares, 1995; Schunk & Pajares, 2009). Self-efficacy beliefs of students related to their judgment about their capabilities of completing a particular task; self-efficacy can affect students' choice, effort, persistence, interest, and achievement of activities (Bandura, 1986, 1997). Also, identifying students' self-efficacy levels provides accurate predictions about their performance. Indeed, students with high self-efficacy beliefs are prone to self-regulate more in academic settings (Schunk & Pajares, 2009). Taking into account the significance of self-efficacy beliefs in students' learning process, it has been incorporated into the proposed model.

Task-value beliefs. Early laboratory-based research on expectancy-value theory indicated that the frame of achievement motivation has two main components: expectancies of success and incentive values (Atkinson, 1957). Incentive values were defined as the attractiveness of a task to succeed, but those values were not brought into the achievement motivation equation in that early research. Afterward, expectancy and value components are broadly examined in a more profitable way considering psychological, social, and cultural determinants focusing on real-world situations, and the model indicates that expectancy and value components are connected to learners' performance, persistence, and choice (Eccles, 2005; Eccles et al., 1983; Eccles & Wigfield, 1995; Wigfield, 1994a; Wigfield, Tonks, & Klauda, 2009). Specifically, the value component was conceptualized by considering the task's qualities and its effect on individuals' desire to do the task, termed task-value. According to the model, students' task-values involve their belief regarding the tasks' importance, attractiveness, and usefulness qualities. If individuals believe the task has importance, enjoyability, utility, and affordability, they are most likely to engage with it and finish it. Furthermore, task-value is related to learners' achievement performance, persistence, and choices within an academic setting. The studies on the expectancy-value domain also mentioned that students' task-value could be specified for a domain if students are in fifth grade or beyond (Eccles et al., 1983; Eccles & Wigfield, 1995). As part of the proposed model in the current study, the task-values of seventh-grade students in the science domain were considered.

Goal Orientation

In the current study, the goal orientations of learners were examined as achievement goals. Achievement goals lift the curtain on the purpose of individuals while engaging the learning activities (Elliot, 1999; Kaplan & Maehr, 2007). Different achievement goals foster and orient learners to different behavior patterns (Maehr & Nicholls, 1980; Midgley, Kaplan, & Middleton, 2001). Achievement goal was first conceptualized in achievement motivation studies, and they were commonly examined in dichotomous frameworks (Ames & Archer, 1988; Bandura & Dweck, 1985; Elliott & Dweck, 1988; Leggett, 1985; Leggett & Dweck, 1986; Nicholls, 1989). Although various terms are used to label these frames, the commonly used ones are learning and performance goals. Mastery goals and task goals are considered synonyms with learning goals, and ability goals, ego-involved goals, and normative goals are used as synonyms for performance goals (Dweck, 1999). If students focus on tasks, they set learning goals but performance goals to concentrate on self-related issues. Based on research conducted by Elliot and his colleagues, it has been found that performance goals can take on different orientations in achievement settings (Elliot & Church, 1997; Elliot & Harackiewicz, 1996). These orientations may involve striving toward success or avoiding failure. So, they established two homological performance objectives with distinct causes and effects, referred to as *performance-approach* and *performance-avoidance*, and introduced the trichotomous achievement goals model. Later studies implementing the new valence on the mastery goals reached conceptual and empirical validity, and the achievement goal framework became a 2x2 structure (Elliot, 1999; Elliot & McGregor, 2001; Pintrich, 2000). The current study is guided by a framework consisting of four distinct categories: mastery-approach goal, performance-approach goal, mastery-avoidance goal, and performance-avoidance goal. *The mastery-approach goal* pertains to acquiring knowledge and understanding; learners set this goal type to focus on self-improvement. Similarly, *the mastery-avoidance goal* is related to avoiding the failure to learn or understand tasks; learners focus on avoiding mistakes or incorrectness. On the other hand, *the performance-approach goal* focuses on being the best and surpassing others; learners who set this type of goal consider normative standards the benchmark for comparison. *The performance-avoidance goal* aims to avoid inferiority compared to others; learners set this goal to focus on normative standards and avoid being the worst among their peers. The role of achievement goals in students' motivation cannot be understated, as they are closely linked to cognitive, affective, and behavioral domains (Elliott & Dweck, 1988; Maehr & Zusho, 2009). Furthermore, it has been noted that achievement goals may vary depending on the grade level and the domain (Pintrich, Smith, Garcia, & McKeachie, 1991). As such, the present study sought to investigate the achievement goals of seventh-grade elementary school students in the domain of science.

In the pioneering studies, the associations between implicit theories of ability and achievement goals were touched, and the oncoming experimental studies put forth the causal connection between them and clarified that different implicit beliefs lead students to adjust different achievement goals (Cury et al., 2006; Elliott & Dweck, 1988). In Dweck's social-cognitive model, the mentioned achievement goals are performance - learners' avoidance from miscalling and slipping up as well as their desire to make the right decisions- and learning goals – learners' desire to learn and understand-; accordingly, entity theory of intelligence is positively linked to performance goals and incremental theory of intelligence is positively associated with learning goals (Bandura & Dweck, 1985; Dweck & Legget, 1988). However, the following studies do not give consistent results with the model (Cury et al., 2006; Elliot & McGregor, 2001; Stipek & Gralinski, 1996; Robins & Pals, 2002; Ommundsen, 2001a). As Stipek and Gralinski's (1996) displayed, the relationship between the student's belief and their achievement goal can be changed depending on the course, like math vs. social studies, which may be a reason for inconsistent results. So, the domain is essential while investigating the association between the variables, and every investigation of the relationships from different domain contribute to this research field. Correspondingly, it was already decided to focus on science courses in the current study.

The achievement goals of individuals may be influenced by their beliefs (Stodolsky, Salk, & Glaessner, 1991), including their epistemological beliefs (Hofer & Pintrich, 1997). While the literature has produced diverse outcomes based on the classification of variables and study contexts, sophisticated epistemological beliefs have been identified as predictive of learning goals, while naïve beliefs have been linked to performance goals (Chen & Pajares, 2010; Hofer & Pintrich, 1997; Kızılgüneş, Tekkaya, & Sungur, 2009; Muis & Franco, 2009; Pamuk, 2014; Paulsen & Feldman, 1999). Considering the 2x2 achievement goal framework, the basic expectation is that while sophisticated beliefs are positively related to mastery-approach goals, naïve beliefs are positively linked with avoidance and performance goals (Muis & Franco, 2009).

The concept of goals plays an essential role in the self-evaluative judgment of individuals' capabilities, as various studies assert (Bandura, 1986; Bandura & Schunk, 1981; Zimmerman, 2000; Zimmerman & Bandura, 1994). Notably, achievement goals and self-efficacy are interdependent concepts. Early achievement motivational studies showed that learners with a performance goal orientation would exhibit adaptive or maladaptive behavior patterns based on their perceived present ability (Dweck & Leggett, 1988; Elliott & Dweck, 1988). Later, perceived competence, commonly known as self-efficacy, was found to be an explicit predictor of achievement goals instead of a mediator (Cury et al., 2006). Previous studies have revealed that self-efficacy has negative links with performance-avoidance goals (Cury et al., 2006; Elliot & Church, 1997; Liem, Lau, & Nie, 2008) and positive associations with mastery and approach goals (Cury et al., 2006; Elliot & Church, 1997; Kahraman & Sungur, 2013; Kıran, 2010; Wolters, Shirley, & Pintrich, 1996). Additionally, goals affect learners' subjective values (Dweck & Elliott, 1983; Eccles et al., 1983), with general goals impacting specific goals (Wigfield, 1994b). According to related literature, task-value positively relates to mastery and approach goals (Kahraman & Sungur, 2013; Liem et al., 2008; Senler & Sungur-Vural, 2014; Wolters et al., 1996). However, there is no consistency in the relationship between performance-avoidance goals and task-value (Kahraman & Sungur, 2013; Senler & Sungur-Vural, 2014).

Cognitive and behavioral processes

A well-common fact about learning is that it does not happen suddenly; it takes time. Different processes run during learning; cognitive and behavioral processes are the most basic two. During learning, the obtained information is intentionally manipulated by individuals in the cognitive process, and learners use various types of strategies (Brandt, 1988; Gagné, 1985; Pintrich et al., 1991; Weinstein & Mayer, 1986). The present study mainly concentrated on learning strategies regarding the cognitive process. Also, individuals act, respond, and self-regulate while engaging in learning tasks differently. Although positive terminal behaviors are commonly expected in formal education, it is not always possible, and students may experience failure. One of the most mentioned behavioral and self-regulation failures is procrastination in existing literature (Abdi Zarrin & Gracia, 2020; Howell & Buro, 2009; Senécal, Koestner, & Vallerand, 1995; Steel, 2007; Tuckman, 1991). Therefore, regarding behavioral processes, the present study focused on procrastination to understand its nature and role in students' achievement.

Learning strategies. Learning strategies are the learners' intellectual activities during their learning activities (Brandt, 1988). Preliminary studies classified learning strategies differently as *effective* and *ineffective* (Diener & Dweck, 1978, 1980; Dweck & Leggett, 1988; Elliott & Dweck, 1988); *deep* and *surface* (Biggs, 1987; Meece, Blumenfeld, & Hoyle, 1988; Miller, Greene, Montalvo, Ravindran, & Nichols, 1996), *cognitive* and *metacognitive strategies* (Pintrich et al., 1991; Weinstein & Mayer, 1986). Students' learning strategies can differ across domains due to course requirements (Pintrich, 2004). Accordingly, the current study focused on seventh-grade students' cognitive and metacognitive learning strategies use in the science course. Learners' cognitive learning strategies are focused on effectively managing their involvement, learning, memory, and thinking abilities (Gagné, 1985). These strategies are crucial for successful learning and involve techniques such as *rehearsal*, *elaboration*, *organization*, and *critical thinking* (Pintrich et al., 1991). In addition to these strategies, learners also employ metacognitive learning strategies to regulate their knowledge of cognitive processes, products, and other aspects of the learning process (Flavell, 1979). These strategies include *planning*, *monitoring*, and *regulation* (Pintrich et al., 1991). It is important to note that metacognitive learning strategies are closely linked to cognitive learning strategies, and as such, learners' metacognitive learning strategies depend on their cognitive process (Flavell, 1979; Saçkes, 2010).

Students use varying strategies and behave differently according to their beliefs regarding the malleability of ability (Diener & Dweck, 1978, 1980; Dweck & Leggett, 1988; Elliott & Dweck, 1988). Learning strategies use are directly and indirectly mediated by achievement goals related to students' beliefs about ability (Stipek & Gralinski, 1996). While students' incremental theories of ability are a positive predictor of cognitive and metacognitive strategies, the entity theories negatively anticipate them (Abdullah, 2008; Ommundsen, 2003). The beliefs held by students regarding the nature of knowledge and knowing play a crucial role in their information-processing strategies (Ryan, 1984). In particular, the levels of development of these beliefs can significantly impact the mental activities involved in learning. Students with more sophisticated beliefs tend to rely more heavily on learning strategies than those with more naïve beliefs (Kardash & Howell, 2000). Previous studies have shown this holds true for cognitive and metacognitive learning strategies. In other words, if students possess sophisticated epistemological beliefs, they tend to use more cognitive and metacognitive learning strategies, and vice versa (Alpaslan, Yalvac, Loving, & Willson, 2015; Braten & Strømsø, 2005; Pamuk, 2014; Paulsen & Feldman, 2007).

Learners' motivational beliefs also play an essential role in their learning strategy use. In earlier studies, it was asserted that if learners have high perceived ability, they pursue compelling tasks and use more efficient strategies, but if they have low perceived present ability, they seek unchallenging tasks, and nearly 60% of strategies they use are ineffective (Dweck & Leggett, 1988; Elliott & Dweck, 1988). Also, the studies grounded on Bandura's (1986) triadic reciprocal determinism model remarked that students' strategy uses are directly connected with their self-efficacy (Braten & Olaussen, 1998; Zimmerman & Martinez-Pons, 1990). Numerous studies have shown that a student's cognitive and metacognitive learning strategies heavily influence their ability to complete a task (Pintrich & De Groot, 1990; Taş & Çakır, 2014; Kıran, 2010). Furthermore, a student's perception of the quality of a task can impact their task choice and performance (Wigfield & Eccles, 2000) and their utilization of learning strategies (Yumuşak, Sungur, & Çakıroğlu, 2007). In particular, those who recognize the value of a task tend to utilize both cognitive (Pintrich & De Groot, 1990; Taş & Çakır, 2014) and metacognitive (Pintrich & De Groot, 1990; Sungur, 2007) learning strategies more effectively.

Learning goals were another identifier of learning strategies use (Ames & Archer, 1988; Dweck & Leggett, 1988; Elliot, McGregor, & Gable, 1999; Elliot & McGregor, 2001; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000). Accordingly, students having mastery goals are prone to hold up more adjustable learning patterns and utilize in-depth strategies. However, students setting performance goals demonstrate more maladaptive learning patterns and use more surface learning strategies. More recent ones examined achievement goals in the 2x2 framework, giving more profound information about the association between students' goals and the utilization of learning strategies. Those results indicated that students with one of those achievement goals use cognitive learning strategies. In other words, links between each of those achievement goal dimensions and cognitive strategy use are positive (e.g., Alpaslan et al., 2015; Dupeyrat & Mariné, 2005; Kadıoglu & Uzuntiryaki-Kondakci, 2014; Kingir, Tas, Gok, & Sungur-Vural, 2013; Muis & Franco, 2009; Rastegar, Jahromi, Haghighi, & Akbari, 2010; Taş & Çakır, 2014; Wolters, 2004). In keeping with cognitive learning strategies, students' all mastery and approach goals positively related to metacognitive learning strategy utilization (Alpaslan et al., 2015; Kahraman & Sungur, 2011; Kingir et al., 2013; Kıran, 2010; Muis & Franco, 2009; Rastegar et al., 2010; Wolters, 2004). However, performance-avoidance goals show a negative connection with metacognitive learning strategy utilization distinctly (e.g., Muis & Franco, 2009).

Theoretically, metacognition regulation is the source of metacognitive learning strategies (Pintrich et al., 1991). Furthermore, skills to regulate metacognition are conceptualized as *higher-order cognition about cognition* (Flavell, 1979; Nelson, 1999). Accordingly, metacognitive learning strategies, just as metacognitive skills, draw on the cognitive process. The supervisory role of metacognition to start up and control the cognitive process is clarified in theoretical conceptualization (Veenman, 2012). Studies have shown that students who employ cognitive learning strategies are more likely to use metacognitive learning strategies (Heikkilä & Lonka, 2006; Kasımi, 2012; Phakiti, 2006; Saçkes, 2010).

Procrastination. Overall, procrastination is accepted as students' intentional postponement; similarly, academic procrastination is considered a student's deliberate delay of academic tasks (Steel, 2007). In the present study, procrastination is regarded as academic procrastination. Preparing for examinations; studying and repeating daily subjects; doing homework such as research, writing essays and reports, practicing, modeling, and so forth are considered academic tasks. Procrastination can be defined in several different ways because it has been studied according to various perspectives, including as a trait (Schouwenburg & Lay, 1995; van Eerde, 2004), state (Senécal, Lavoie, & Koestner, 1997; Steel, 2007), self-protection method (Burka & Yuen, 1983), reinforced/punished behavior (Bijou, Morris, & Parsons, 1976; McCown & Johnson, 1991; Solomon & Rothblum, 1984), childhood experience/parenting style (Davis, 1999; Ferrari & Emmons, 1995; Ferrari & Olivette, 1994; Missildine, 1963; Rothblum, Solomon, & Murakami, 1986; Spock, 1971), aversiveness of the task (Senécal et al., 1995; Ferrari & Tice, 2000) and suspicion regarding one's ability (Ellis & Knaus, 1977; Ferrari, 1991c, 1992; Ferrari, Johnson, & McCown, 1995). Almost all definitions include *delay* as a keyword, even detected in early school years (Fuke, Kamber, Alunni, & Mahy, 2023). Various studies have examined procrastination as a failure of students' self-regulatory mechanisms and have characterized it as a maladaptive behavioral outcome (Howell & Buro, 2009; Steel, 2007; Senécal et al., 1995; Tuckman, 1991). Deficiency in the cognitive, motivational, and behavioral movement to reach the set goals of learners signed the failure in self-regulated learning (Baumeister, Heatherton, & Tice, 1993; Doerr & Baumeister, 2010; Pintrich, 2000). Also, procrastination is conceptualized using the self-regulation framework in the current study.

Learners with incremental theory show functional persistence when faced with obstacles, whereas learners with entity theory display avoidance and low persistence in the same situation (Bandura & Dweck, 1985; Leggett & Dweck, 1986). Parallel to their beliefs about ability, learners' ways of coping with tasks become different (Howell & Buro, 2009; Rhodewalt, 1994; Ommundsen, 2001a; Ommundsen, Haugen, & Lund, 2005). Therefore, students' intentional postponement of academic tasks might be associated with their beliefs about ability. If they believe in ability stability, they tend to delay academic tasks, but if they believe in the ability's malleability, they do not (Howell & Buro, 2009). Schommer (1990) signified that the effect of epistemological beliefs on learners' struggle against academic difficulties should be considered. In addition, epistemological beliefs affect students' motivation and self-regulation (Braten & Strømsø, 2005). Therefore, students' naïve epistemological beliefs can be connected with their academic problems. Remarkably, despite the need for additional studies to clarify the connection, learners' less sophisticated epistemological beliefs have a role in their academic procrastination (Boffeli, 2007).

The motivational beliefs of learners also give clues about their procrastination level. For instance, if learners efficaciously engage in academic tasks, they prefer more challenging tasks, begin more immediately, endure more, are resilient more, and perform better for sure, accordingly to their motivation and ability level (Bandura, 1986, 1997). Also, students with high self-efficacy for learning participate in tasks vigorously, but if they feel less efficacious, they avoid them (Schunk & Zimmerman, 2006). Their avoidance may emerge as procrastination (Haycock, McCarthy, & Skay, 1998). In other words, students' self-efficacy belief is negatively related to their academic tasks' procrastination (Haycock et al., 1998; Klassen, Krawchuk, & Rajani, 2008; Tuckman, 1991; Uzun Özer, 2010; Wolters, 2003, 2004). Task-value is the other motivation belief in the scope of the current study, and as mentioned before, it is about students' engagement with the task in terms of selection, continuity, and fulfillment (Eccles et al., 1983; Eccles & Wigfield, 1995; Wigfield & Eccles, 2000). Accordingly, if a learner's task-value is low, learners may abstain from the task, which may lie behind their procrastination (Ackerman & Gross, 2005). Tasks appear to procrastinators difficult, dull, and unpleasant (Pychyl, Lee, Thibodeau, & Blunt, 2000). So, if the given tasks do not attract the learners' interest, they are more likely to procrastinate those tasks (Corkin, 2012; Hensley, 2013; Solomon & Rothblum, 1984; Taura, Abdullah, Roslan, & Omar, 2015).

Procrastinators hold out on their cognitive ability level to preserve their self-esteem since they judge their self-worth based on their task performance to complete (Burka & Yuen, 1983; Ferrari, 1991a, 1991b). They believe that exposing their ability level to people around them will harm their self-esteem and public image. Since their cognitive capacity is only known by themselves, they believe that they do not fully use it. A study conducted by Ferrari (1991c) indicated that procrastinators prefer tasks that provide social visibility than need cognitive effort. Also, they choose tasks that help to increase their self-confidence, such as easy and non-diagnostic, when they have a chance to select (Ferrari, 1991c; Scher & Ferrari, 2000). Research has shown that students who focus on learning and understanding tend to procrastinate less (Howell & Buro, 2009; Howell & Watson, 2007; Kandemir, 2010; Scher & Osterman, 2002). However, if they avoid misunderstanding or feel inferior, they can still fall into the trap of procrastination (Howell & Buro, 2009; Howell & Watson, 2007; McGregor & Elliot, 2002; Scher & Osterman, 2002; Wolters, 2003). Similarly, those striving for superiority may struggle with procrastination (Ganesan, Mamat, Mellor, Rizzuto, & Kolar, 2014; Wolters, 2003).

Procrastinators have low learned resourcefulness (Milgram, Dangour, & Ravi, 1992). They also poorly use cognitive strategies effectively (Howell & Watson, 2007; Klingsieck, Fries, Horz, & Hofer, 2012; Wolters, 2003). Besides, procrastinators have weak skills in doing and applying planning since planning necessitates systematic and disciplined work (Lay, 1992; Lay & Schouwenburg, 1993). So, as their cognitive learning strategy utilization, their metacognitive learning strategies use is also weak (Howell & Watson, 2007; Klingsieck et al., 2012; Motie, Heidari, & Sadeghi, 2012; Wolters, 2003).

Achievement

The literature supposedly indicates that learners' beliefs, learning strategies, and procrastination levels impact academic performance. As the abovementioned variables are domain-specific and for this reason, the present study focuses on one domain—science—and explores how those mentioned variables are connected with students' science achievement (see Figure 2).

The primary purpose of education is considered to live well conceptualized in ancient Greek; this concept entails students' good judgment capability involving learning and understanding features and aspects of the world (Curren, 2014). Harmoniously, science education is grounded on subjects about the environment's living, physical, material, and technological components. Besides, the global and local aim of science education is to educate individuals as scientifically literate having competence in science subjects (American Association for the Advancement of Science, 1990, 1993; Ministry of National Education of Turkey [MoNE], 2005, 2013, 2018; National Research Council, 1996, 2012). Therefore, students' science achievements have critical importance in figuring out to what degree the purpose of education and the specific goal of science education has been reached or not.

Learners' belief about the nature of ability is one of the essential components of their achievement motivation (Dweck, 2002, 2006a; Hong et al., 1999). Orientation of students in compliance with their ability beliefs, such as entity and incremental theory, even though their former achievements and skills are the same, students exhibit different outputs (Hong et al., 1999). Empirical evidence indicates that students' achievement is differentiated according to ability beliefs (Blackwell et al., 2007; Good, Aronson, & Inzlich, 2003). Accordingly, students' achievement is negatively related to the entity theory and positively associated with the incremental theory (Chen & Pajares, 2010; Cury et al., 2006).

Another type of belief that students have is epistemological beliefs; these beliefs significantly influence students' cognition, motivation, and learning (Hofer & Pintrich, 1997; Perry, 1981). Especially individuals' beliefs about knowledge and knowing have a significant role in shaping their standards of the learning process, which mediate their performance (Ryan, 1984). Accordingly, sophisticated epistemological beliefs are positively associated with academic achievement (Conley et al., 2004; Hofer, 2000; Yeşilyurt, 2013), but their direct and indirect associations are needed in examination (Schommer, 1993).

Individuals' judgment about their capabilities is another determinant of their performance (Bandura, 1977, 1982, 1986). It is the answer to the "Can I do this task in this situation" question with their inner voice (Linnenbrink & Pintrich, 2003, p. 120). Individuals' perceived self-efficacy might vary across domains (Bandura, 1997). This critical point is essential since it may result in variations in the link between self-efficacy and achievement in different domains. Specifically for the science domain, learners' self-efficacy is positively connected with their performance (Chen & Pajares, 2010; Sungur & Güngören, 2009). Learners' subjective task-value, as motivational beliefs, is also a direct predictor of their achievement-related choices (Eccles, 2005; Eccles et al., 1983; Eccles & Wigfield, 1995; Meece, Wigfield, & Eccles, 1990; Wigfield, 1994a; Wigfield & Eccles, 2000). Accordingly, learners who believe the task's qualities about their importance, attractiveness, and usefulness show higher performance on the task. While investigating the task-value, it should be considered that it is not only subjective but also task-specific (Pintrich et al., 1991). Therefore, explicitly considering the science domain task-value is positively associated with the student's achievement (Senler & Sungur-Vural, 2014; Yumuşak et al., 2007).

Learning activities necessitate mental processes, and learners use various strategies to get the information (Brandt, 1988). Sometimes using these preferred strategies leads learners to success but sometimes not. Therefore, high and low-achiever students' learning strategies are differentiated in frequencies and consistencies (Zimmerman & Martinez-Pons, 1986, 1988). Specifically, students' cognitive and metacognitive learning strategies are positively associated with their academic achievements (Fooladvand, Yarmohammadianb, & Zirakbashc, 2017; Muis & Franco, 2009). An important distinguishing feature of achievement is the study habits of learners (Lum, 1960). However, not all habits lead learners to success; on the contrary, some sabotage them, such as procrastination (Scher & Osterman, 2002). Students' procrastination is about not accomplishing tasks on time, which messages their academic achievement (van Eerde, 2003). The previous studies about procrastination mainly focus on older students, so there is a need for further studies to understand younger students' procrastination levels and their results. The literature indicates that the association between procrastination and achievement is negative for older students (Klassen et al., 2008; Klingsieck et al., 2012; Steel, 2007). There is also a need to examine this relationship in younger age groups.

Aim of the study

Dweck and her colleagues' achievement motivation model highlights the importance of mindset in shaping individuals' motivation and achievement in various domains, including science learning (Dweck, 2006a). Science learning provides insights into how students' beliefs about their ability to learn impact their motivation to engage in science learning activities. Students' motivation to learn science is strongly influenced by their desire to succeed or avoid failure (Elliot & Dweck, 2005). Students with high levels of achievement motivation are more likely to engage in activities that will help them succeed in science, such as studying, asking questions, and seeking feedback. Conversely, students who lack achievement motivation may avoid these activities and be more likely to give up on science learning when faced with challenges (Murphy & Alexander, 2000). Research has shown that interventions affect students' motivation, engagement, and academic achievement (Dweck, 2006b. Therefore, educators who have a comprehensive knowledge of the achievement motivation model can create science learning environments that can motivate students effectively while minimizing any factors that could hinder their motivation; these factors could include assignments that are either overly complicated or uninteresting (Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013; Wigfield & Eccles, 2000). The significance of the achievement motivation model in science education lies in its ability to offer a structure to comprehend how motivation impacts students' involvement and accomplishments within the subject. This research aims to extend and personalize Dweck and her colleagues' achievement motivation model, particularly in science education. In this respect, the aim and research questions of the study are presented below.

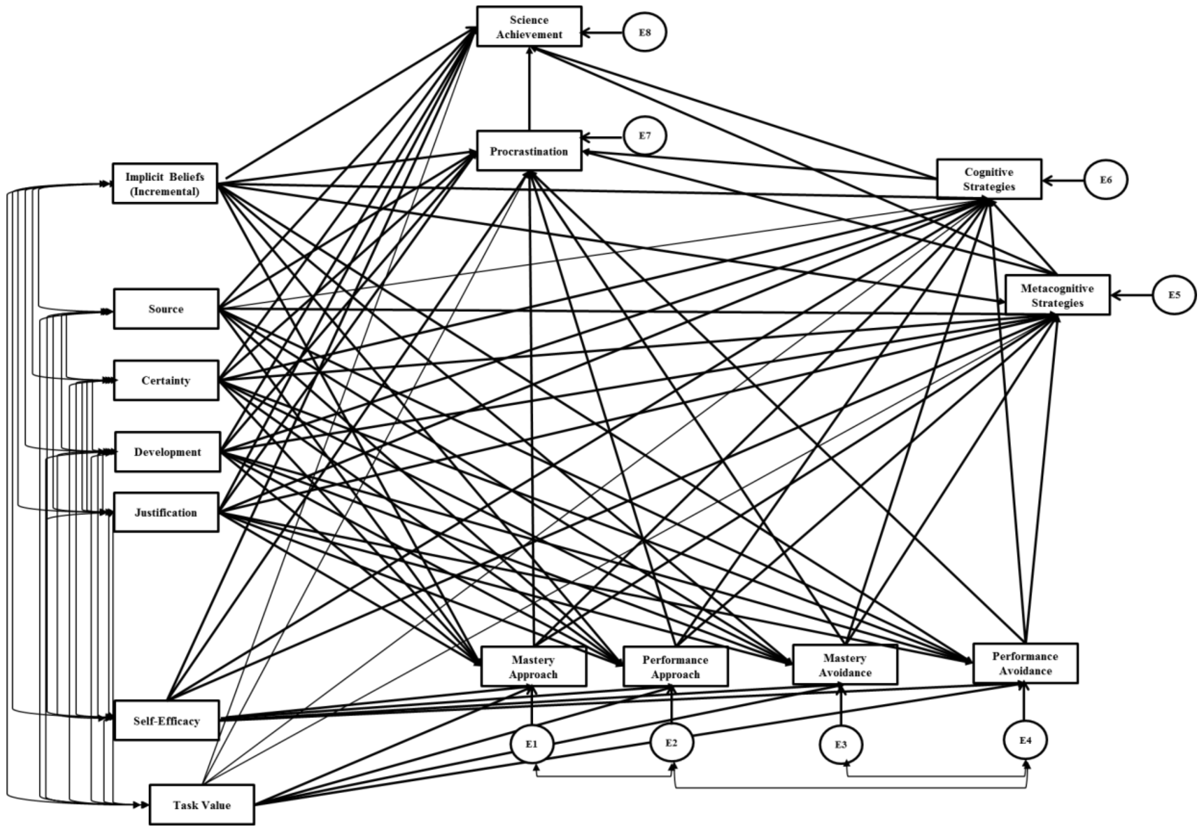

Figure 2. The proposed model

Aim. The current study aims to extend and personalize Dweck and her colleagues' achievement motivation model, particularly in science education. To reach the aim, a comprehensive model is proposed to enhance the substantial knowledge by exploring the connections between the incremental theory of scientific ability, epistemological beliefs, motivational beliefs, achievement goals, learning strategies, procrastination, and science achievement (see Figure 2).

Research questions. The main research question of the study is;

What are the relationships among the incremental theory of scientific ability, epistemological beliefs, motivational beliefs, achievement goals, learning strategies, procrastination, and science achievement, as depicted in the proposed path model?

Sub-research question on achievement goals

- What are the direct effects of the incremental theory of science ability, epistemological beliefs, and motivational beliefs on achievement goals?

Sub-research questions on learning strategies

- What are the direct and indirect effects of the incremental theory of science ability, epistemological beliefs, motivational beliefs and achievement goals on learning strategies?
- What is the relationship between cognitive and metacognitive strategy use?

Sub-research question on procrastination

- What are the direct and indirect effects of the incremental theory of science ability, epistemological beliefs, motivational beliefs, achievement goals, and learning strategies on procrastination?

Sub-research question on science achievement

- What are the direct and indirect effects of the incremental theory of science ability, epistemological beliefs, motivational beliefs, learning strategies, and procrastination on science achievement?

Significance of the study

According to the definition of the MoNE (2005, 2013, 2018), the central vision of the national elementary science-education curriculum is educating every student as a scientifically literate individual. Scientifically literate individuals recognize the significance of science, even if only for its practical applications in everyday situations, so they grasp basic scientific concepts deeply and have basic science processing skills. Science curriculums are prepared to qualify students for science concepts and skills to realize this primary aim. As for that, science achievement shows to what extent this aim is reached. However, specific international examinations—such as the TIMSS and PISA—indicate that, on examination, Turkish students commonly rank below average among students from participating countries concerning science achievement (Martin, Mullis, Foy, & Stanco, 2016; OECD, 2019). Therefore, the MoNE considered these results as feedback and emended the science curriculum as a pivotal system input to reach desired outcomes. Firstly, the curriculum was revised using the constructivist approach for 6-8 grades (MoNE, 2005). Secondly, science courses were obligatory starting from 3rd grade (MoNE, 2013). Also, the science curriculum has recently been purified from redundant content (MoNE, 2018). From the perspective of the present study, focusing only on the curriculums is not enough. Because one of the critical inputs of the system is students, and to achieve the desired level of improvement, it is necessary to consider the different variables that affect students' achievement in a complex way. In this direction, the current study aims to identify crucial factors influencing students' achievement and test their effect via the proposed model. Besides, the study has the potential to visualize a complex model for students' achievement. Accordingly, the present study will likely have substantial implications for elementary education, especially for the science domain. Furthermore, though the present study variables have been the subject of extensive research in Western countries for many years, the number of research from non-Western countries regarding such variables and their effects remains limited. This study was conducted in Turkey; and Turkey bridges Europe and Asia and has a different socio-cultural background from other nations. Furthermore, Turkey has a centralized, exam-oriented, competitive educational system; consequently, the study adds to the existing literature by examining the interrelationships among the abovementioned variables in a different context.

Method

The present study explored relationships among the variables by proposing and testing a path model. Accordingly, before starting the data collection procedure, necessary ethical board permissions were obtained.

Sample

The study sample comprises 4510 seventh-grade students from 46 different elementary schools, with the sample specified through the integration of convenience and cluster random sampling techniques. Initially, convenience sampling was employed to identify three districts that would be suitable for the study based on considerations such as travel, time, and cost constraints. Subsequently, schools were randomly selected as clusters from the three districts. During the selection process, the total number of schools in each district was obtained from the Education Directorates of the respective districts. The first district had 42 public elementary schools, the second one had 74 public elementary schools, and the third one had 89 public elementary schools. Each school was assigned a number, and a table of random numbers was utilized to identify the schools that would be included in the study. As a result, approximately 20% of the schools in each district were randomly selected, including 11 elementary schools from the first, 15 from the second, and 20 from the third district. Consequently, the sample consisted of 2246 (49.8%) girls and 2255 (50.0%) boys, with a mean age of 13.12 (*SD*=.38). Also, the average science grade of the participants in the previous semester was 3.72 (*SD*=1.09).

Data collection

Before data collection, all stakeholders involved in the study, including students, teachers, and administrators, were provided with a comprehensive explanation of the study's purpose. Also, participants were assured that the study would not have any physical or psychological impact. Additionally, they were informed that the study results would not affect their school grades and that the names of students would not be collected. Participation of the study was voluntary based, and students could withdraw from the study if they felt uncomfortable. Students were instructed on the proper procedure for completing self-reporting tools and were informed that there is no definitive right or wrong answer. The data collection process for each class lasted approximately 40 minutes.

Data analysis

The study utilized SPSS 22 for Windows to conduct descriptive statistical analysis, assumption check, and reliability analysis. Additionally, the study employed two types of Structural Equation Modeling (SEM) - confirmatory factor analysis (CFA) and path analysis - using LISREL 8.80 for Windows (Jöreskog & Sörbom, 2006). SEM is a statistical technique that tests relationships between independent and dependent variables (Tabachnick & Fidell, 2007) and simplifies complex models (Tarka, 2018). Given the comprehensive and complex nature of the proposed model, the study prioritized using path analysis to simplify and explain it. The analysis of SEM involves five fundamental steps: model specification, identification, estimation, testing, and modification (Schumacker & Lomax, 2004). During the model specification phase, it is essential to construct a model based on relevant literature (Kline, 2011; Tabachnick & Fidell, 2007). This can be achieved by creating a model diagram or describing a series of equations (Kline, 2011). In this study, the proposed model is a renewed version of Dweck and her colleagues' achievement motivation model, as seen in Figures 1 and 2.

Model identification involves three requirements: the degrees of freedom of the model should be at least zero ($dfm \geq 0$), a metric scale should be assigned for every latent variable, and the model should be recursive (Schumacker & Lomax, 2004; Kline, 2011; Tabachnick & Fidell, 2007). In this study, the degrees of freedom were seven, all error terms of observed variables were standardized using the LISREL 8.80 program, and the proposed model had a bow-free pattern, which qualifies it as a recursive model.

Several methods exist to estimate population parameters, including unweighted or ordinary least squares, generalized least squares, and maximum likelihood (Schumacker & Lomax, 2004). The LISREL 8.80 program defaults to the maximum likelihood method (Kline, 2011), which requires large sample sizes, continuous scales, and multivariate normality (Brown, 2006). A robust maximum likelihood method is recommended if the variables are non-normal and continuous (e.g., Bentler, 1995, as cited in Brown, 2006). Since the variables in this study did not meet the requirements for multivariate normality, a robust maximum likelihood method was utilized for model estimation.

During model testing, the data are assessed for how well they fit the theoretically proposed model (Jöreskog & Sörbom, 1993; Schumacker & Lomax, 2004). In this study, path analysis indicated a good fit for the theoretically constructed model (RMSEA = .09, SRMR = .02, NFI =.99, CFI =.99, GFI =.99), which indicates a statistically significant and practically meaningful model.

The proper execution of the SEM requires the fulfillment of certain assumptions. Tabachnick and Fidell (2007) outline these include examining sample size and missing data; normality and linearity; outliers; absence of multicollinearity and singularity; and residuals. A large sample size is essential for SEM analysis. The sample size required is calculated based on the N:q rule (where N represents the number of cases and q is the number of parameters in the model) and should not be less than 10:1 (Jackson, 2003, as cited in Kline, 2011). In the present study, the 10:1 ratio was used to assess the sample size for the CFA and the path analysis, with no indications of any violations.

Schumacker and Lomax (2004) recommend various methods, including deleting subjects, data replacement, and robust statistical procedures to handle missing data. Tabachnick and Fidell (2007) assert that missing data percentages equal to or less than 5% from a large sample in a random pattern create fewer problems, and handling methods yield similar results. In the present study, students who did not answer all scales or tests were excluded from the analysis entirely. The missing percentages of the remaining data were less than 5%. Missing data regarding students' background characteristics remained unchanged. Missing data for the achievement test were replaced by zero, assuming that if students did not attempt to solve a question, this indicated that they did not know the answer. The missing values of scales and questionnaires used in the study were replaced with the mode values of the items. The mode values of each item for each classroom were calculated, and the replacement procedure was done separately for each classroom as the classroom context may influence assessed variables.

The process of SEM analysis is predicated upon the assumption of multivariate normality. This assumption entails that there exists a normal univariate distribution of all individual variables, a normal bivariate distribution of any pair of variables, and linear and homoscedastic bivariate scatterplots (Kline, 2011). Any instance of multivariate non-normality can be detected from the univariate distribution of variables, and univariate normality can be gauged by utilizing skewness and kurtosis values in a single variable (Kline, 2011). An absolute skewness value more significant than three and an absolute kurtosis value greater than ten are considered extreme (Kline, 2011). The present study analyzed multivariate skewness and kurtosis values for each path analysis and the CFA. It is essential to mention that while univariate non-normality was not detected, multivariate non-normality was in the study. Therefore, a robust maximum likelihood method was used for analyses to ensure accurate model estimation. Linearity is another essential consideration in the application of SEM techniques. It refers to a straight-line relationship between two variables, and the SEM techniques need to examine the linear relationships between variables (Schumacker & Lomax, 2004; Tabachnick & Fidell, 2007). As Tabachnick and Fidell (2007) noted testing linearity between all variables is not feasible; therefore, it could be examined through the selected variables in scatter plots. Based on the suggestion, bivariate scatter plots of variables were examined for path analysis in the current study, and no violations were detected. When performing CFA analysis, using variables with five or more response categories is recommended as the sample size is typically large and has a normal distribution (Bentler & Chou, 1987; Cohen, Cohen, West & Aiken,, 2003). In line with this, the current study utilized variables with five or more response categories for conducting DFA analysis. The present study analyzed univariate and multivariate outliers to detect extreme values and odd combinations of two or more variables' scores (Stevens, 2009; Tabachnick & Fidell, 2007). Potential outliers are identified by z-scores that exceed an absolute value of 4 (Stevens, 2009). Z-scores were utilized to identify univariate outliers, while Mahalonobis' distances were employed to detect multivariate outliers. The critical chi-square value at an alpha level of .001 was determined using the number of independent variables as the degree of freedom (Tabachnick & Fidell, 2007). As a result of the conducted examination, no violations were found.

In order to identify the presence of multicollinearity and singularity in the data, it is common practice to conduct bivariate correlations between variables. If these correlations are equal to or exceed .90, it can indicate such issues (Tabachnick & Fidell, 2007). The current study examined the presence of multicollinearity and singularity through the warning messages generated by LISREL 8.80. This program is known for its compassion towards these issues and does not analyze if they are detected between variables. Furthermore, the correlation between CFA variables and path analysis variables was checked to ensure the absence of multicollinearity and singularity. Residual covariances in the SEM should be symmetrical, with a small frequency distribution around zero (Tabachnick & Fidell, 2007). For this reason, the current study assessed the standardized residuals' statistics provided by LISREL, including modification indices for both CFA and path analysis, and no issues were identified.

Instruments

The Implicit Theories of Science Ability Scale (ITSAS). This scale was adapted from the Implicit Theories of Intelligence Scale for Children-Self Form (Dweck, 1999) by Chen and Pajares (2010) to measure students' beliefs about their science abilities. The scale uses a six-point Likert scale ranging from 1 (strongly agree) to 6 (strongly disagree). Translation and adaptation of the ITSAS into Turkish were made in the present study. Considering Dweck's (1999) suggestion and relevant existing studies, only a three-item subscale assessing *entity theory science ability* (e.g., "You have a certain amount of science ability, and you really can't do much to change it") was pilot tested during ITSAS's adaptation into Turkish. This instrument was pilot tested with 109 (62 girls and 47 boys) seventh-grade students' participation, and the results of the analysis ensured the unidimensional factor structure's validity (RMSEA=.00, SRMR=.00, NFI=1.00, CFI=1.00, GFI=1.00) and reliability (Cronbach's alpha=.75). Likewise, the CFA was also a perfect fit regarding the current study, with a reliability coefficient of .71. Before the path analysis, the scores of ITSAS were reverse coded so that higher scores indicate more high ability beliefs which represent *incremental theories of science ability* of students.

Epistemological Beliefs Questionnaire (EBQ). The EBQ (Conley et al., 2004) is a five-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*) to assess elementary students' epistemological beliefs in science. It includes 26 items and four subscales: *source of knowing* (*n*=5 items; e.g., "Everybody has to believe what scientists say"), *certainty of knowledg*e (*n*=6 items; e.g., "All questions in science have one right answer"), *development of knowledge* (*n*=6 items; e.g., "Some ideas in science today are different than what scientists used to think") and *justification for knowing* (*n*=9 items; e.g., "In science, there can be more than one way for scientists to test their ideas"). Özkan (2008) translated and adapted the EBI into Turkish. In the present study, the instrument's factor structure was tested using confirmatory factor analysis (CFA) to support a four-factor structure (RMSEA=.04, SRMR=.05, NFI =.95, CFI=.96, GFI=.95). Besides, the alpha coefficient was .74 for the source of knowing, .71 for the certainty of knowledge, .57 for the development of knowledge, and .75 for the justification for knowing dimensions.

The Achievement Goal Questionnaire (AGQ). The AGQ (Elliot & McGregor, 2001) was developed to measure students' achievement goals with a five-point Likert scale ranging from 1 (*never*) to 5 (*always*). It comprises 15 items in four subscales, namely; *mastery-approach goal* (*n*=3 items; e.g., "I desire to completely master the material that presented in this class"), *mastery-avoidance goal* (*n*=3 items; e.g., "I worry that I may not learn all that I possibly could in this class"), *performance-approach goal* (*n*=3 items; e.g., "It is important for me to do better than other students"), and *performance-avoidance goal* (*n*=6 items; e.g., "My goal for this class is to avoid performing poorly"). The AGQ was translated and adapted into Turkish for elementary students by Senler and Sungur (2007). The CFA results of the current study confirmed the four-factor structure of the AGQ (RMSEA=.06, SRMR=.05, NFI=.94, CFI=.95, GFI=.95). Moreover, the alpha coefficients were .65 for the mastery-approach goal, 73 for the mastery-avoidance goal, .64 for the performance-approach goal, and .73 for the performance-avoidance goal.

The Motivated Strategies for Learning Questionnaire (MSLQ). The MSLQ (Pintrich et al., 1991) is an 81-item self-report instrument with a seven-point Likert scale ranging from 1 (*not at all true of me*) to 7 (*very true of me*). Although the questionnaire was initially developed for college students, the MSLQ has been used successfully in many studies when applied to elementary and high school students (Higgins, 2000). Mainly the questionnaire has two major sections; one of them is the *motivation section,* and the other one is the *learning strategies section*. Sungur (2004) translated and adapted the whole questionnaire into Turkish. In the current study, students' motivational beliefs were assessed using *self-efficacy for learning and performance* (*n*=8 items; e.g., "I believe I will receive an excellent grade in this class") and *task-value* (*n*=6 items; e.g., "I think I will be able to use what I learn in this course in other courses") subscales were taken from the motivation section. Additionally, subscales from the learning strategies section, including *rehearsal* (*n*=4 items; e.g., "When I study for this class, I practice saying the material to myself over and over"), *elaboration* (*n*=6 items; e.g., "When reading for this class, I try to relate the material to what I already know"), *organization* (*n*=4 items; e.g., "When I study the readings for this course, I outline the material to help me organize my thoughts") and *critical thinking* subscales (*n*=5 items; e.g., "I often find myself questioning things I hear or read in this course to decide if I find them convincing") were consolidated to assess students' *cognitive learning strategy use* in science. Furthermore, *metacognitive self-regulation* subscale items were used to assess the extent to which students use various *metacognitive learning strategy use* such as planning, monitoring, and evaluating (*n*=12 items; e.g., "If the course materials are difficult to understand, I change the way I read the material"). Two separate CFAs were conducted to validate the factor structure for motivational beliefs (i.e., self-efficacy and task-value) and learning strategies use (i.e., cognitive and metacognitive strategies). The result supported two-factor structure for both motivational beliefs (RMSEA=.05, SRMR=.03, NFI=.99, CFI=.99, GFI=.95) and learning strategies use (RMSEA=.05, SRMR=.04, NFI=.98, CFI=.98, GFI=.92). Also, the present study yielded the following alpha coefficients: .88 for self-efficacy,.82 for task-value, .91 for cognitive learning strategies, and .80 for metacognitive learning strategies.

The Tuckman Procrastination Scale (TPS). The TPS (Tuckman, 1991) is a four-point Likert scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). The TPS was designed to evaluate students' inclination to delay tasks, manage schedules, and inefficiency of self-regulation. A 16-item version of the scale was used in the current study; it was translated and adapted into Turkish by Uzun Özer, Saçkes, and Tuckman (2009). The current study adapted items to assess elementary students' procrastination, specifically in science courses (e.g., "I needlessly delay finishing jobs in science classes, even when they're important"). The CFA results indicated the validity of the one-factor structure (RMSEA=.08, SRMR=.06, NFI =.95, CFI=.95, GFI=. 91). Also, the reliability coefficient was found to be .87 above the sufficiency level.

The Science Achievement Test (SAT). The SAT (Yerdelen, 2013) was developed to assess seventh-grade elementary students' science achievement. The test comprises 14 multiple-choice items covering the content of a seventh-grade elementary science course for the first semester. Of these, seven questions concern the Body Systems unit, four concern the Force and Motion unit, and four concern the test's Electricity unit. Items were classified according to Bloom's taxonomy as knowledge, comprehension, and application-level questions. The reliability coefficient of the SAT used in the current study was computed using the Kuder Richardson 20 (KR) formula, which was found to be .75.

Results

Descriptive statistics

Table 1 presents the model's variables, including their respective mean, standard deviation, minimum, and maximum values.

Table 1. Descriptive statistics

	M	SD	Min.	Max.
Incremental Theory of Science Ability	3.55	1.36	1.00	6.00
Epistemological Beliefs				
Source of Knowing*	2.64	.85	1.00	5.00
Certainty of Knowledge*	3.07	.80	1.00	5.00
Development for Knowing	3.87	.56	2.00	5.00
Justification for Knowing	4.27	.50	2.44	5.00
Achievement Goals				
Mastery-Approach Goal	4.57	.51	3.00	5.00
Performance-Approach Goal	4.41	.68	2.00	5.00
Mastery-Avoidance Goal	3.51	1.04	1.00	5.00
Performance-Avoidance Goal	3.77	.86	1.00	5.00
Motivational Beliefs				
Self-Efficacy	5.27	1.20	1.00	7.00
Task Value	5.49	1.18	1.00	7.00
Learning Strategies				
Cognitive Strategies	4.93	1.12	1.00	7.00
Metacognitive Strategies	5.06	1.01	1.00	7.00
Procrastination	2.29	.80	1.00	5.00
Science Achievement	8.14	3.22	.00	14.00

*The subscale was reversed coded for the path analysis so that higher scores indicate more sophisticated beliefs than lower sores.

Path analysis

The path model was proposed to investigate the relationships among the study variables: incremental theory of science ability, epistemological beliefs, motivational beliefs, achievement goals, learning strategies, procrastination, and science achievement (see Figure 2). The analysis result revealed a good model fit (RMSEA=.09, SRMR =.02, NFI=.99, CFI=.99, GFI=.99). The following subsections provide an individual summary of the results for each endogenous variable in the model.

Achievement goals. According to the path analysis results, students' beliefs explained 29% of the variance in the mastery-approach goal, 5% of the variance in mastery-avoidance goal, 12% of the variance in the performance-approach goal, and 12% of the variance in the performance-avoidance goal.

Table 2. Path analysis results for achievement goals

	Direct Effect	Indirect Effect	Total Effect	t
Mastery-Approach Goal				
of Incremental Theory of Science Ability	.05	-	.05	3.78*
of Source of Knowing	.01	-	.01	.68
of Certainty of Knowledge	.01	-	.01	.64
of Development of Knowledge	-.02	-	-.02	-1.43
of Justification for Knowing	.15	-	.15	8.98*
of Self-Efficacy	.19	-	.19	8.70*
of Task Value	.30	-	.30	13.20*
Performance-Approach Goal				
of Incremental Theory of Science Ability	-.05	-	-.05	-3.20*
of Source of Knowing	.02	-	.02	.89
of Certainty of Knowledge	-.09	-	-.09	-4.58*
of Development of Knowledge	.00	-	.00	-.24
of Justification for Knowing	.13	-	.13	7.17*
of Self-Efficacy	.16	-	.16	7.02*
of Task Value	.09	-	.09	3.95*
Mastery-Avoidance Goal				
of Incremental Theory of Science Ability	-.08	-	-.08	-5.11*
of Source of Knowing	-.06	-	-.06	-3.03*
of Certainty of Knowledge	-.08	-	-.08	-3.76*
of Development of Knowledge	.05	-	.05	2.64*
of Justification for Knowing	.06	-	.06	3.56*
of Self-Efficacy	-.10	-	-.10	-4.29*
of Task Value	.12	-	.12	5.21*
Performance-Avoidance Goal				
of Incremental Theory of Science Ability	-.14	-	-.14	-8.76*
of Source of Knowing	-.07	-	-.07	-3.73*
of Certainty of Knowledge	-.18	-	-.18	-8.93*
of Development of Knowledge	.04	-	.04	2.41*
of Justification for Knowing	.07	-	.07	3.86*
of Self-Efficacy	-.01	-	-.01	-.52
of Task Value	.05	-	.05	1.95

*Significant at .05 level

As the details were presented in Table 2, students' incremental theory of science ability is only positively linked with their master-approach goal. In contrast, students who believe that science ability can change or improve are less likely to set mastery-avoidance, and performance goals in science courses. Regarding students' epistemological beliefs, results indicated that sophisticated beliefs about source of knowing and certainty of knowledge are negatively associated with both avoidance goals. Besides, the sophisticated student belief in the certainty of knowledge is negatively linked to the performance-approach goal. However, the relationships turn direction for the development of knowledge and justification for knowing dimensions; sophisticated beliefs concerning those dimensions are positively related to avoidance goals. Further, the sophisticated student belief related to justification for knowing is positively associated with approach goals. Other examined students' beliefs were motivational beliefs in the present study. While both self-efficacy and task-value were found to be positively related to approach goals, those beliefs' associations with the mastery-avoidance goal. Also, the results indicated that self-efficacy is negatively, but task-value positively linked to the mastery-avoidance goal.

Learning strategies. The path analysis results indicated that students' beliefs and achievement goals accounted for 74% of the variance in cognitive learning strategies use and 58% of the variance in metacognitive learning strategies used in science classes.

Table 3. Path analysis results for learning strategies

	Direct Effect	Indirect Effect	Total Effect	t
Cognitive Learning Strategies				
of Incremental Theory of Science Ability	-.02	.01	-.01	-2.21*
of Source of Knowing	-.04	-.02	-.06	-3.40*
of Certainty of Knowledge	-.05	.01	-.04	-4.30*
of Development of Knowledge	.02	.00	.03	2.71*
of Justification for Knowing	.00	.10	.10	.24
of Self-Efficacy	.16	.23	.39	11.35*
of Task Value	.11	.22	.33	7.74*
of Mastery-Approach Goal	.00	.07	.07	-.51
of Performance-Approach Goal	-.01	.00	-.01	-.85
of Mastery-Avoidance Goal	.04	.02	.06	5.08*
of Performance-Avoidance Goal	.03	.01	.04	2.21*
Metacognitive Learning Strategies				
of Incremental Theory of Science Ability	.03	.00	.03	2.57*
of Source of Knowing	-.03	.00	-.03	-1.71
of Certainty of Knowledge	.03	-.01	.02	1.97*
of Development of Knowledge	.00	.00	.00	-.31
of Justification for Knowing	.13	.02	.15	10.37*
of Self-Efficacy	.35	.02	.37	20.20*
of Task Value	.31	.04	.35	17.28*
of Mastery-Approach Goal	.11	-	.11	8.99*
of Performance-Approach Goal	.00	-	.00	.05
of Mastery-Avoidance Goal	.03	-	.03	2.74*
of Performance-Avoidance Goal	.02	-	.02	1.63

* Significant at .05 level

Table 3 presents the details of the binary relations between learning strategies and other variables included in the model. Mainly, students' incremental theory of science ability is negatively related to their cognitive learning strategies use and positively linked to metacognitive learning strategies. Concerning epistemological beliefs, sophisticated beliefs about source of knowing and certainty of knowledge were found to be negatively associated with cognitive learning strategies use, while sophisticated beliefs about the development of knowledge dimension are positively related to that learning strategies use. Also, path analysis revealed that sophisticated beliefs regarding certainty of knowledge and justification for knowing dimensions are positively linked with metacognitive learning strategies use. Regarding motivational beliefs, students' self-efficacy and task-value are positively related to their cognitive and metacognitive learning strategies use. In terms of achievement goals, positive connections were detected between the avoidance goals and cognitive learning strategies use, also between mastery goals and metacognitive learning strategies use. Likewise, the association between cognitive learning strategies use, and metacognitive learning strategies use was found to be positive.

Procrastination. The path analysis results showed that seventh-grade elementary students' beliefs, achievement goals, and learning strategies explained 38% of the variance in procrastination in science courses.

Table 4. Path analysis result for procrastination

	Direct Effect	Indirect Effect	Total Effect	t
Procrastination				
of Incremental Theory of Science Ability	-.04	-.03	-.07	3.23*
of Source of Knowing	-.07	.00	-.07	-3.89*
of Certainty of Knowledge	-.02	-.02	-.05	-1.39
of Development of Knowledge	.11	.01	.12	7.90*
of Justification for Knowing	-.08	-.08	-.16	-5.54*
of Self-Efficacy	-.04	-.18	-.22	-1.85
of Task Value	-.08	-.17	-.25	-3.60*
of Mastery-Approach Goal	-.14	-.05	-.19	-9.44*
of Performance-Approach Goal	-.01	.00	-.01	-.71
of Mastery-Avoidance Goal	.09	-.01	.08	6.69*
of Performance-Avoidance Goal	-.01	-.01	-.02	-.39
of Cognitive Learning Strategies	.09	-	.09	3.80*
of Metacognitive Learning Strategies	-.50	.06	-.44	-20.45*

* Significant at .05 level

Details of the paths' statistics can be seen in Table 4 for procrastination. Accordingly, students' incremental theory of science ability is negatively related to their procrastination. For epistemological beliefs, procrastination is positively linked to the sophisticated beliefs about development of knowledge dimension. However, its associations are negative with sophisticated beliefs about source of knowing and justification for knowing dimensions. In terms of motivational beliefs, only the link of task-value gave a significant result which indicated a negative relationship. Concerning achievement goals, only mastery goals are significantly related to procrastination, but the direction of relations is different. While procrastination is negatively associated with the mastery-approach goal, the link is positive for the mastery-avoidance goal. Likewise, the connections between procrastination and learning strategies use are different. Accordingly, it is positive for cognitive learning strategies use and negative for metacognitive learning strategies use.

Science achievement. The results indicated that seventh-grade students' beliefs, learning strategies use, and procrastination accounted for 20% of the variance in their science achievement.

Table 5. Path analysis result for science achievement

	Direct Effect	Indirect Effect	Total Effect	t
Science Achievement				
of Incremental Theory of Science Ability	.06	-	.06	4.15*
of Source of Knowing	.07	-	.07	3.82*
of Certainty of Knowledge	.26	.01	.26	13.79*
of Development of Knowledge	-.02	-	-.02	-1.14
of Justification for Knowing	.19	.01	.19	10.54*
of Self-Efficacy	.18	-	.18	8.15*
of Task Value	.00	.01	.01	.06
of Cognitive Learning Strategies	-.08	-	-.08	-2.89*
of Metacognitive Learning Strategies	.08	-.04	.04	2.82*
of Procrastination	-.01	-	-.01	-.76

* Significant at .05 level

As the details of the result given in Table 5, the science achievement of students is positively connected to their incremental theory of science ability. For epistemological beliefs, the analysis indicated that sophisticated beliefs in source of knowing, certainty of knowledge, and justification for knowing dimensions of epistemological beliefs are positively linked to the science achievement. In terms of motivational beliefs, self-efficacy and achievement is positively related. About learning strategies use, science achievement of the students is negatively related to cognitive learning strategies use, and the association is positive for metacognitive learning strategies use.

Discussion and Conclusion

Achievement goals

The evaluation of achievement goals is closely tied to students' beliefs, as Stodolsky et al. (1991) noted. The present study examined the associations between students' beliefs and achievement goals to explore this relationship further. The results indicated that students with an incremental theory of ability tend to set more mastery-approach goals but fewer performance and avoidance goals. This finding is consistent with Dweck and her colleagues' social-cognitive model (Dweck, 1999; Dweck & Legget, 1988; Elliott & Dweck, 1988), which posits that such students view science ability as evolving, leading them to pursue self-improvement and deep learning. They tend not to shy away from challenging tasks and do not focus heavily on avoidance or normative standards related to their learning and performance. Although the present study focuses on elementary students and the science domain, its findings align with those of previous studies (e.g., Cury et al., 2006; Elliot & McGregor, 2001; Ommundsen, 2001b; Robins & Pals, 2002), thereby lending support to the coherence of the associations between these variables. The relationship between students' epistemological beliefs and achievement goals has been the subject of several studies, with varying results based on different classifications and frames. According to theoretical expectations, students' sophisticated beliefs are positively linked with mastery-approach goals, while they have a negative association with performance and avoidance goals in the 2x2 framework of achievement goals (Muis & Franco, 2009). However, the results of the current study have shown that the development of the knowledge and justification for knowing dimensions has a positive association with performance and avoidance goals, which differs from the theoretical expectations. Expressly, students who believe in the evolving nature of scientific knowledge set more avoidance goals to avoid being wrong and performing poorly in science classes. Furthermore, students who believe in evidence's role in rationalizing scientific knowledge tend to focus more on avoidance and performance goals related to self-competence. Although the path analysis result differs in specific points from the conceptual expectations, similar results have been reported for similar student groups and domains using the same instruments by Pamuk (2014). But it is important to note that discrepancies among the findings of different studies may arise from assessing epistemological beliefs using different instruments and theoretical approaches and the assessment of achievement goals using different frameworks. Also, the current study examined motivational beliefs with student performance in science classes, explicitly focusing on self-efficacy and task-value. The results revealed that students who exhibit high levels of self-efficacy are more likely to set approach goals and have fewer mastery-avoidance goals. These findings are consistent with the social-cognitive model Dweck and her colleagues developed, emphasizing the importance of perceived ability in shaping behavior. Specifically, students who perceive themselves as capable are more likely to take on challenging tasks and persevere in the face of difficulty, while those who doubt their abilities are likelier to avoid such challenges. Also, the result is parallel to the previous studies' findings (Liem et al., 2008; Sungur, 2007; Wolters et al., 1996). The study also examined the role of task-value in motivating student. The results of path analysis revealed a positive association between task-value and mastery and approach goals, suggesting that students who view the task as necessary, attractive, and useful are more likely to focus on learning and achieving positive outcomes. These findings align with the theoretical framework of the expectancy-value model developed by Eccles, Wigfield, and their colleagues, as well as with more recent research in the field (e.g., Kahraman & Sungur, 2013; Senler & Sungur-Vural, 2014).

Learning strategies

The present study investigated the associations between the use of learning strategies by seventh-grade elementary students, their beliefs, and achievement goals. The results of the path analysis revealed a positive link between the students' incremental theory of science ability and their use of metacognitive learning strategies. However, the relationship is negative for cognitive learning strategies. These findings are partially consistent with fundamental studies on Dweck and her colleagues' model, which emphasize that learners who believe in the flexibility of ability to learn in a more adaptive pattern seek more effective strategies while they engage in learning activities (Diener & Dweck, 1978, 1980; Dweck & Leggett, 1988; Elliott & Dweck, 1988). Besides, relatively current studies investigating the association also reported positive relationships between these variables (Doron, Stephan, Boiché, & Scanff, 2009; Ommundsen, 2003). Although the standardized coefficient is not large (γ = -.02) for the connection between the incremental theory of ability and cognitive learning strategies in the current study, further research is needed to clarify their associations in more detail. The other beliefs of students examined in the present study are epistemological beliefs. Based on the theoretical assumptions, it was presumed that if students have more sophisticated beliefs on the nature of knowledge and knowing, they consciously use more mental activities (Kardash & Howell, 2000). As expected, some positive associations were detected between students' sophisticated epistemological beliefs and their learning strategies. However, the study revealed negative links between the use of cognitive learning strategies and the beliefs held by students regarding the source of knowing and certainty of knowledge dimensions. Contextual factors may play a role in these unexpected results. For instance, when teaching science subjects, the idea that scientific knowledge is absolutely correct and can be accessed from specific sources such as teachers and textbooks may be emphasized. In such cases, students who hold coherent beliefs in line with the learning environment may be motivated to use cognitive strategies to remember and organize this fixed knowledge from specific sources, while those whose beliefs conflict with the learning environment may not. However, further research is required to investigate these explanations. The conducted path analysis has confirmed the proposed relationships regarding motivational beliefs examined in the current study. That is students' self-efficacy and task-value beliefs were positively correlated with utilizing cognitive and metacognitive learning strategies. In the socio-cognitive studies, Dweck and Bandura pioneered, it is mentioned that learners' beliefs about their ability affect their strategies use. Besides, subsequent studies validate the associations between cognitive and metacognitive learning strategies (e.g., Kıran, 2010; Pintrich & De Groot, 1990; Taş & Çakır, 2014). Also, Wigfield and Eccles (2000) underscored the pivotal role that students' perceptions of the value concerning a given activity play an essential role in their academic choices and performance.

The attainment of learners' goals significantly impacts their learning patterns, with different strategies employed accordingly (Dweck & Elliott, 1983). The path analysis results indicate that all significant links are positive between students' achievement goals and learning strategies. Specifically, avoidance goals are positively connected to cognitive learning strategies, while mastery goals are positively related to metacognitive learning strategies. Prevalently, related literature implies that students who focus on positive outcomes regarding their learning are more likely to improve and control their learning strategically to regulate the process (Pintrich, 2000). But it is crucial to note that both achievement goals and learning strategies are highly sensitive to the educational context and circumstances (Ames & Archer, 1988; Somuncuoğlu & Yıldırım, 1999). Therefore, avoidance goals may provide more positive outcomes in competitive learning environments (King & McInerney, 2014). A similar finding to the current study about avoidance goals was reported in another study conducted in the same educational context (Sungur & Senler, 2009). Accordingly, further studies are needed to explore contextual factors that may explain these results. Also, the path analysis result revealed a positive relationship between cognitive and metacognitive learning strategies as it is expected.

Procrastination

Procrastination is prevalently identified as a maladaptive behavioral outcome in the related literature. Moreover, learners' adaptive or maladaptive behavior patterns are influenced by their implicit beliefs about ability, whether the entity or incremental (Bandura & Dweck, 1985; Leggett & Dweck, 1986). The path analysis result of the current study is in the same direction as this theoretical assumption. Accordingly, students believe the improvable nature of science ability fewer delays their course-related activities. Nevertheless, if students have entity theory, they give up quickly when faced with difficulty and procrastinate the academic task, which brings them academic failure (Mouratidis, Michou, & Vassiou, 2017).

The associations between students' epistemological beliefs and procrastination were examined through the path analysis with the assumption that students' beliefs about the nature of knowledge and knowing may influence the result in the failure of learners' self-regulation and trigger maladaptive behaviors. Besides, guided by a rare study on this topic, sophisticated epistemological beliefs were expected to be negatively associated with students' procrastination (Boffeli, 2007). This anticipation is partly verified by the results for source of knowing and justification for knowing dimensions. However, results surprisingly indicated that students conscious of the progressive nature of scientific knowledge procrastinate more. A possible explanation for this unexpected result may be that students' awareness of rapid development in scientific knowledge may create a fear of failure -a trait of procrastinators- to not catch up with it. Also, the discrepancy between students' beliefs and the learning environment may result in motivational difficulties and bring about procrastination. Namely, if scientific knowledge is presented as absolute facts in a science course, students with contrasting beliefs may be frustrated in such a learning environment and delay their academic activities. However, these explanations need to be clarified with further studies.

Negative relations were proposed before the path analysis concerning motivational beliefs and procrastination in light of the theoretical assumptions. The results of the analysis confirmed this association only for task-value. Although this is an expected result and consistent with previously conducted studies (Corkin, 2012; Hensley, 2013; Taura et al., 2015), it is an essential finding since it is identical for elementary students and the science domain. Procrastinators prefer non-diagnostic tasks which provide them social visibility and do not harm their self-esteem and public image, but they tend to delay tasks that need more cognitive effort (Ferrari, 1991a, 1991b, 1991c). Accordingly, if students focus more on self-improvement to learn and understand new things, they procrastinate less. However, this situation differentiates for mastery goals' approach and avoidance valences. Students who concentrate on avoiding misunderstanding may delay or fail to complete academic tasks due to the anxiety generated by these goals (Scher & Ferrari, 2000). In parallel to the findings of the current study, previously conducted studies also reports that while students with mastery-approach goal procrastinate less (Howell & Buro, 2009; Howell & Watson, 2007; Kandemir, 2010; Scher & Osterman, 2002), they are prone to delay academic activities if they have mastery-avoidance goals (Howell & Buro, 2009; Howell & Watson, 2007).

The association between elementary students' procrastination with their learning strategies use for science course is also examined through the path analysis of the current study. Considering procrastinators' personality traits, the negative relationships between procrastination and both cognitive and metacognitive learning strategy use were proposed before the analysis. The results of the previous studies confirm these expectations, although they were conducted with different age groups and domains (Howell & Watson, 2007; Klingsieck et al., 2012). However, it is partly supported by the present study. The path analysis result indicated that students using more cognitive learning strategies procrastinate the science course activities while procrastinating less if they use more metacognitive learning strategies. Since students having low level of learned resourcefulness procrastinate more (Milgram et al., 1992), the negative association with metacognitive learning strategies was in prospect. The positive association between procrastination and cognitive learning strategies use was unforeseen, even though it is rarely reported by some studies (Cao, 2012). A possible explanation for this link may be that the current study sample may mainly comprise active procrastinators. They procrastinate as procrastinators, but their outcomes are similar to non-procrastinator since they choose to study under stress (Chun Chu & Choi, 2005). Nevertheless, this explanation involves speculation and needs further investigation.

Science achievement

Achievement is regarded as an essential indicator of educational systems' efficiency. Accordingly, this study explores the complex relationship between elementary school students' performance and various variables in the science domain. One crucial factor that affects student performance is their implicit theory of ability (Dweck, 2002, 2006a; Dweck et al., 1995). The findings from the path analysis indicate that students who believe in the malleability of their ability tend to perform better. These results align with the theoretical assertions and empirical evidence from previous studies, demonstrating the validity of this finding for the science domain and elementary grade levels. Students' beliefs about the nature of knowledge and knowing are also in the scope of the current study. These beliefs undeniably impact their learning processes, shaping their standards and performance (Hofer & Pintrich, 1997; Ryan, 1984). Therefore, this study proposes that students with sophisticated beliefs about scientific knowledge and knowing tend to perform better in science. The path analysis results confirm this expectation, particularly regarding the source of knowing, certainty of knowledge, and justification for knowing dimensions of elementary school students. Another type of belief examined in the current study is the students' motivational beliefs. The positive association between students' motivational beliefs – self-efficacy and task-value- and their performance is clearly and powerfully emphasized in both Bandura's social cognitive theory and Eccles, Wigfield, and colleagues' expectancy-value model. Although the result of path analysis failed to give a significant link for task-value, it verifies that if elementary students believe in their capacity in science, they perform highly.

Learning or completing a task needs mental processes and various strategies used in those processes. High-achiever students use more learning strategies, while low achievers use less (Pintrich & De Groot, 1990; Zimmerman & Martinez-Pons, 1986, 1988). Although the path analysis results of the present study confirm this association for elementary students' metacognitive learning strategies use in science, it revealed a reverse connection for cognitive learning strategies use. Romainville (1994) reported that even high achiever university students have difficulty 'surely' identifying their cognitive learning strategies use. While this explanation is plausible, it does not necessarily have to be the sole explanation for this situation. Therefore, further research is needed to clarify this relationship. Examining young students' procrastination and its association with their achievement is among the aim of the current study. Since procrastination is commonly identified as a maladaptive study habit and lies behind failure, it was proposed that elementary students having low achievement in science courses are more prone to delay their academic activities about the course. Nevertheless, the results of a path analysis revealed that the investigated relationship is nonsignificant. Dissimilatory aspect of the current study from the majority of the previously conducted ones are its sample and the domain, but the same nonsignificant result is reported by other studies (e.g., Blatt & Quinlan, 1967; Ferrari, 1992; Howell & Watson, 2007; Mendelson, 2007; Solomon & Rothblum, 1984).

Suggestions

The present study aims to investigate ways to achieve through a path model. As well as their contribution to the common education literature, the study's findings are essential for the elementary education level and science education domain. Therefore, the implications of the present study include both the elementary education level and the science domain.

The model tested in the current study revealed that students’ affirmative and sophisticated beliefs positively related to their achievement, just as their metacognitive learning strategies use. Therefore, to improve students’ achievement, it is necessary to benefit from these ways. Accordingly, deliberative classroom environment arrangements help to draw on those revealed ways. For example, the learning environment could be enriched with argumentation-based activities and collaborative debates. Especially for science course, these environments will help students cooperate to identify, comprehend and solve problems while doing this, they develop hypotheses, test them through designing experiments, revise their hypotheses, and draw conclusions. These processes in science classes help to improve students' content, scientific process, and nature of scientific knowledge (Chen & Pajares, 2010). Additionally, these environments can enhance students' metacognitive activities; encouraging them to monitor and evaluate their learning and increase their beliefs about their ability to learn science successfully, thereby helping them realize the connection between their efforts and accomplishments.

In science education, various instructional approaches have demonstrated efficacy in elevating students' epistemological beliefs. Among these approaches are crisscrossing the landscape, reflective inquiry, and teaching history of science (Qian & Alvermann, 2000). Crisscrossing the landscape entails exposing students to the multifaceted nature of complex scientific concepts. Rather than oversimplifying such topics, teachers should adopt multiple instructional strategies, including diverse demonstrations and refutation texts. On the other hand, reflective inquiry involves students constructing a deeper theoretical understanding of natural phenomena by formulating and testing hypotheses, designing experiments, and critically evaluating their work. This approach is implemented in two phases, with the first phase involving students reflecting on their inquiry process and understanding of the subject matter and the second phase entailing group discussions. Using images of renowned scientists and their historical activities has also enhanced students' comprehension of scientific work. Both engaging in reflective inquiry and using images of scientists' activities from history can be designed to bring students to explanation level of knowledge from description level. Writing-to-learn activities are another effective mechanism for advancing students' epistemological beliefs. In these activities, science subject matter is linked to one dimension of epistemological belief to improve its sophistication (Atasoy & Küçük, 2020). Besides, designing a learning environment based on the constructivist approach also promotes the learners' sophisticated epistemological beliefs (Smith, Maclin, Houghton, & Hennessey, 2000). However, teachers' implementation of the written curriculum may not adhere to the original constructivist approach, potentially leading to the naive development of students' epistemic beliefs (Genç & Küçük, 2003; Dindar & Yangın, 2007). As such, pre-service and in-service teacher education programs should raise awareness of the appropriate implementation of written curriculums. Additionally, the current study’s findings revealed that adopting mastery goals and having adaptive task-value beliefs can improve students' science achievement due to their effect on metacognitive strategies use. Based on this finding, it can be suggested to teachers, they can help their students adopt mastery goals and develop adaptive task-value beliefs to enhance students' science achievement. Moreover, students should be allowed to make the connection between academic knowledge and their daily lives, engage in various challenging and meaningful learning activities, realize the importance of schoolwork, and have control and choice in and to have greater control and choice in science classrooms. Additionally, when assessing students their learning and progress should be considered (Ames, 1992).

The last variable correlated positively to students' achievement is their beliefs about the evolving nature of science ability. Implicit theories of ability can be influenced and directed, even through direct instruction on the nature of abilities. It has been shown that abilities can be improved and developed through effort and hard work, resulting in significant outcomes (Blackwell et al., 2007; Good et al., 2003). Creating a conducive learning environment and utilizing practical instructional approaches to enhance students' abilities can also contribute to their achievement.

Limitations of the study

This study is subject to limitations; for example, the present study is a cross-sectional research design, so no causal relationships among the study variables can be implied. Experimental or longitudinal research designs might establish causal relations among the variables in future research. Additionally, the current study used self-report instruments to assess its variables, which are limited in that they may not capture students' actual motivation, cognition, beliefs, or behavior. Therefore, future studies can adopt mixed-design methods, allowing qualitative data collection to confirm and yield a better understanding of observed relations. Finally, the relationships among the present study variables were investigated based on the data gathered from seventh-grade elementary science students; consequently, the study's findings are limited to seventh-grade students and science domains.

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