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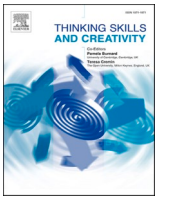

Innovative thinking skills and creative thinking dispositions in learning environments: Antecedents and consequences

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ABSTRACT

The purpose of this study is to investigate the antecedents and consequences of creative and innovative thinking in educational environments. The research group of this study consists of 110 students continuing undergraduate education in Turkey. The data were collected using a personal information form and three scales. As a result of this study, extrinsic motivation is a direct antecedent variable for creative thinking dispositions and innovative thinking skills, learning and performance-approach goal orientation is an indirect antecedent variable. Innovation search and inquisitive and opportunity-oriented dimensions are determinants of engagement. Supporting creative thinking dispositions, and innovative thinking skills does not affect academic achievement. Examining the variables associated with creative and innovative thinking will shed light on learning processes from many aspects such as creativity, innovation, commitment, performance, product development, achievement, and motivation.

1. Introduction

Creative and innovative thinking is seen as one of the 21st-century skills that teachers and schools should focus on. Enabling students to be creative and guiding them to create innovative products is an important goal of the education and training process (Gregory et al., 2013). Creative thinking and innovative thinking are closely related due to the novelty and motivating aspects of ideas, and both are based on product development (Dou et al., 2021). Creativity, innovation, collaboration, communication, and critical thinking are twenty-first-century skills that are considered "super skills" and prepare students for the new world and their careers (Kivunja, 2015). Creativity and innovation enable students to think differently and uniquely. If there is cooperation, communication takes place effectively. When these skills are used together, students' commitment and active participation in the learning process can increase, and academic achievement can come with it. Motivation is the magic touch that brings these skills together. Motivation is an internal state that initiates, directs, and maintains behavior. For the emergence of behaviors, people need motivational triggers in the field of education as well as in many areas of life (Kotkas et al., 2017). Engagement, and motivation of the students in the learning process are considered one of the most challenging tasks teachers have to deal with.

In the 21st century, many problems have become more intertwined, global, and complicated. In the rapidly growing world of 21st-century education, it is not enough for students to simply have strong knowledge and skills. There are high-level skills that every individual must possess in order to cope with the challenges of this century. Skills such as critical thinking, problem-solving,

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communication and cooperation, self-management, self-development, high motivation, self-engagement (Frydenberg & Andone, 2011), and creative thinking (Yudha et al., 2018) and innovative thinking (Barak & Yuan, 2021; Rotherham & Willingham, 2009) are examples of these. For this reason, a creative and innovative thinking approach is important for educators and students in terms of supporting the education process. According to Balakrishnan (2022), educational institutions should support effective learning practices that encourage students to think creatively and innovatively and motivate them to actively participate in the creative process. For this reason, from the point of view of 21st-century skills, creative and innovative thinking is important for learning-teaching processes. Motivation and achievement goal orientation, which can be considered as their predecessors, and academic achievement and commitment, which can be considered as its results, should be examined from an inclusive perspective. Examining these variables and the relationships between them will shed light on new learning processes from many aspects such as creativity, innovation, commitment, performance, product development, achievement, and motivation. In this context, the present study aims to investigate the antecedents and consequences of creative and innovative thinking in educational environments.

2. Conceptual and theoretical framework

2.1. Theoretical framework

Innovative and creative thinking is gaining more and more importance every year in education and professional life. Recently, the concepts of innovation and creativity have started to be used together in education-teaching processes in the literature. According to Rank et al. (2004), innovation can be expressed as idea implementation and creativity can be expressed as idea generation. West and Farr (1990) combine the concepts of creativity and innovation and considers the creativity process as the first stage of the innovation process. According to Kholikova (2021), an innovative approach involves not only the creation of a new creative product, but also effective thinking and its development during implementation. Many ways can be used to develop innovative and creative thinking in students: exploratory learning, contextual learning, authentic learning, problem-based learning, cooperative learning, inquiry, and exploratory learning can be listed among these. A learning model that can be applied to support and develop students' creative and innovative thinking skills is Research-Based Learning (RBL) (Krisdiana et al., 2019; Yudha et al., 2018). RBL is based on the philosophy of constructivism. The constructivist approach proposes a learning environment that allows all stakeholders of the learning process to question themselves, ask questions, and conduct research. RBL is a learning model that is associated with activities such as analyzing, synthesizing, and evaluating, using contextual, authentic, collaborative, hands-on learning, problem-solving, and an inquiry-exploratory approach (Dafik, 2015), which enables learners to assimilate, apply and develop knowledge (Susiani et al., 2018). Research activities at RBL can develop students' research skills and provide space for creative ideas. Innovative learning and research skills that can grow and develop in students include creative thinking skills (Prahmana & Kusumah, 2016). RBL encourages students' active participation in learning. RBL learning processes enable students to be equipped with innovative, reflective, critical, and creative thinking skills (Susiani et al., 2018). RBL not only enables students to gain knowledge and experience but also encourages the formation of high-level thinking skills such as innovative and creative thinking (Yudha et al., 2018).

2.2. Innovative thinking skills in learning environments

Innovative thinking skills are one of the 21st-century skills required for the development of education in the age of technology and the rapid transformation of the digital society (Rotherdam & Willingham, 2009). Innovative thinking skills can be defined as the skills that students show in presenting various probability answers and solving problems (Azizah et al., 2018). Innovative thinking can be expressed as the process of realizing the best and new ideas, including processes such as generating ideas, gathering information and analyzing the situation, imagining, and questioning (Sevinç & Uyangör, 2020). It is a powerful and complex mental orientation process that reveals non-existent or unknown original solutions or outputs (Jawad et al., 2021). Innovative thinking is to go beyond the routine way of thinking, to go beyond the patterns of the mind, to reveal flexible ideas, and to develop original ideas (Çellek, 2002).

2.3. Creative thinking dispositions in learning environments

Creative thinking is a way of thinking that enables one to come up with new and original products, find new solutions and reach a synthesis (Emir, 2001). The creative thinking process exists in all affective and intellectual activities, in all kinds of studies and occupations (Yenilmez & Yolcu, 2007). People who can think creatively can also look at events or situations critically. Creative thinking, which is the basis of art, science, philosophy, and technology, improves our adaptation to the environment and conditions (Chávez-Eakle et al., 2012). Creative thinking involves productivity, making what exists, transforming it, and even going beyond what was thought possible in an era. In today's world that requires creative solutions, creative thinking is a challenge and can change an individual's view and society (Zeki, 2001).

2.4. Antecedents variables

2.4.1. Achievement goal orientations

The achievement orientations that students adopt regarding learning activities and the behaviors they display to achieve achievement are closely related to the learning processes and the products. For this reason, it is significant to determine achievement goal orientations. Achievement goal orientations are a process in which specific goals and objectives are determined for achievement

and failure and strategies are selected to achieve them (Pintrich, 2000). What motivates students? The achievement goals (orientation) theory, which started with seeking an answer to the question, focuses on which motivational approach affects students' achievement in the classroom. This theory also helps to understand how competence is acquired and developed in the learning process. Achievement goals theory examines students' beliefs about achievement and the criteria and standards they use to evaluate their performance (Schunk, 1989). In the literature, there are two achievement goal orientations, namely learning goal orientation and performance goal orientation (Dweck, 1986; Dweck & Leggett, 1988). Learning orientation is related to the individual's desire to fully learn the material or subject in the learning process. Learning orientation helps students define achievement in terms of the task and evaluate their development according to their references rather than social comparison information (Pintrich, 2000). Performance orientation, on the other hand, reflects characteristics such as the student's emphasis on social comparison, performing his work by referencing others and trying to do better than them (Nichols et al., 2003).

2.4.2. Motivation

Motivation is one of the important elements that show students' willingness, need, and desire in both learning and individual processes (Bergin & Reilly, 2005). Motivation is an internal state that initiates, directs, and maintains behavior. Students who are motivated are those who are willing to participate in the learning process and have a goal of achievement. The source of desire and desire can be internal or external (Lepper, 1988). Therefore, motivation is divided into two as intrinsic and extrinsic motivation. Intrinsic motivation is a source of motivation that drives individuals to the task through their internal qualities, keeps them in the task, and makes them think that the task is useful and important (Ryan & Deci, 2000). Extrinsic motivation is a source of motivation that keeps individuals engaged with the application of extrinsic rewards such as sanctions, praise, feedback, and grades (Ryan & Deci, 2000).

2.4.3. Antecedent relationships

Motivation plays a critical role in the learning process. When looking at motivation theories, they tend to be related to explaining why individuals do what they do and their thoughts about the performance and learning goals that individuals are trying to achieve (Weiner, 1990). In the learning process, students have some goals that guide their behaviors and knowledge in their academic work processes. Achievement goal orientation, which is an important concept in achieving these goals, is closely related to the field of motivation. The achievement goals that students have for the future ensure their participation and commitment to their current duties more. Students who plan for their future goals and can follow their current situation are more motivated in the learning process (Simons et al., 2004).

Students' motivation to the learning process can have an impact on both learning outcomes and innovative and creative thinking skills (Audrey et al., 2019). With creative thinking skills, students can generate new ideas, discuss and organize ideas. Students with a tendency to think creatively can keep up with the rapidly changing world, face challenges and see opportunities (Ritter & Mostert, 2017). With innovative thinking, students can open new fields of thought by using new knowledge and experiences with the development of science and technology. Fluency, flexibility, and originality are essential components of innovative thinking. When students lack motivation for innovative thinking, they become passive learners (Fu, 2019). For these reasons, motivation can play a supporting role in innovative and creative thinking processes.

Motivation is closely related to achievement goal orientation, creative thinking dispositions, and innovative thinking skills in learning processes. In this context, the following hypotheses were investigated in this study:

2.5. Consequences variables

2.5.1. Engagement

Engagement is a multidimensional relational concept that includes psychological and behavioral features such as connecting and communicating, interacting, and participating at an individual, institutional or social level to achieve a result (Johnston, 2018). Students engagement means that students actively participate in learning tasks and activities to shape their learning experiences (Lei, Cui, & Zhou, 2018). Student engagement is very important for effective learning, as it provides active participation in learning activities that lead to academic achievement in educational environments (Filsecker & Kerres, 2014). Student engagement is an indicator of achievement and quality in student and institutional processes, as it becomes a focal point in efforts to improve teaching and learning (Groccia, 2018). Student engagement is the single best indicator of learning and personal development (Kuh, 2003). Learning begins with student engagement (Shulman, 2002).

2.5.2. Academic achievement

Academic achievement, in general, refers to the communicative and thinking skills that enable a student to be an achievement in school and society, and their competence in areas such as mathematics, science, and social sciences (Lindholm-Leary & Borsato, 2006). Academic achievement is perhaps one of the most used constructs in educational research. Because achievement, which is one of the important outputs in the learning process, is based on. The relationship between academic achievement and many variables has been the subject of studies for years. Standard achievement tests or grade point averages (GPA) are generally used to measure academic achievement.

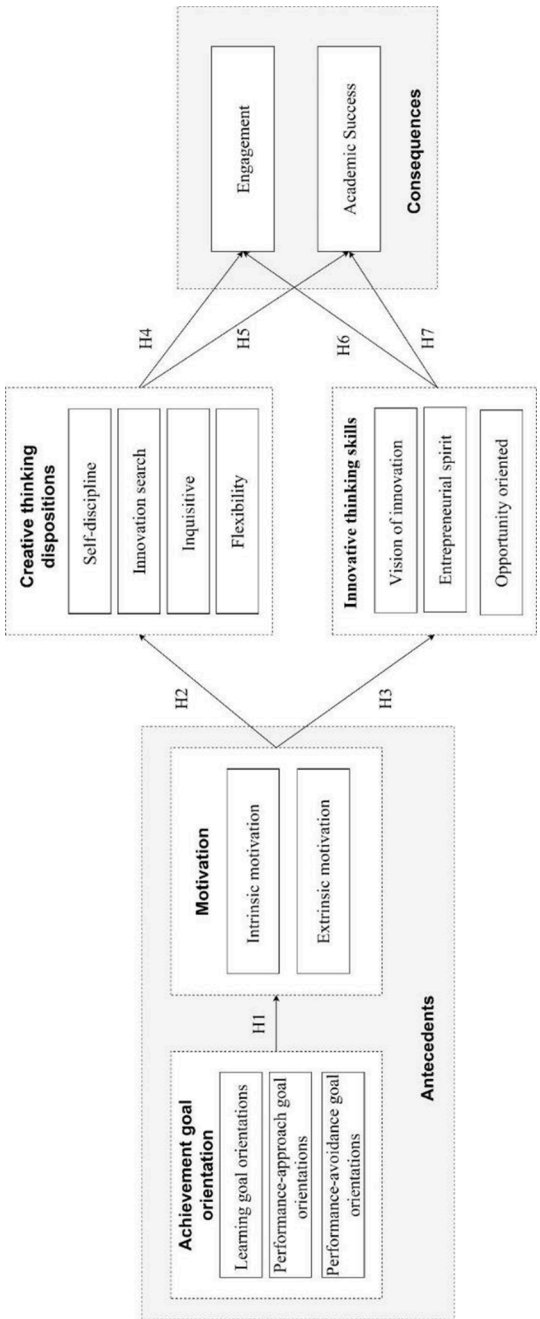

Fig. 1. The research model.

2.5.3. Consequence relationships

Creative thinking is the combination of knowledge and imagination. Students who think creatively are individuals who are interested in being curious, developing new ideas, finding new approaches, combining existing information with new ones, and creating an original product. Individuals who are actively committed to the learning process can demonstrate their ability to be creative more. However, individuals who are intrinsically motivated, willing, and curious show commitment behaviors such as participation and acceptance (Lee, 2007). Creative thinking occurs with this commitment, perception, and interaction of students. In the literature, those who are committed to their jobs are more determined about creativity by seeking new ways and methods (Slåtten & Mehmetoğlu, 2011). Similarly, there is a relationship between creative thinking and academic achievement (Akpur, 2020; Gajda, 2016; Surapuramath, 2014). According to Surapuramath (2014), creativity, which is one of the main factors of academic achievement, needs special attention since it can be related to academic achievement by its nature.

Commitment enables an individual to participate emotionally, physically, and cognitively, and the situation brings a positive attitude towards the work and voluntary participation (Kim & Park, 2017). All this formation facilitates collaborative work and business behavior to be developed with innovative thinking. Individuals in this work environment and students in schools may tend to think innovatively and creatively, such as seeking change opportunities and integrating new ideas into the current situation.

Innovative thinking is a thinking skill that includes different and complex mental activities that include remembering previous information, establishing cognitive connections with new information, and expanding existing knowledge to produce an innovative product (Jawad et al., 2021). Academic achievement requires both innovative and creative thinking and similar activities and efforts. In this respect, academic achievement is related to both thinking tendencies. In this context, the following hypotheses were investigated in this study:

3. Method

3.1. Research model

This study aims to reveal a model that explains and predicts the relationships between the variables determined in order to examine the creative and innovative thinking levels of university students studying computer science and to determine the antecedents and consequences of these thinking levels. This research is in the correlational survey model as it aims to reveal these relationships. The correlational survey model aims to give information about whether more than one variable differentiates together and the degree of differentiation (Karasar, 2005). Variables whose relationship will be examined are symbolized in survey patterns. In the correlational survey model, the existence and/or degree of co-changes of two or more variables is important. The relationships identified in this model should not be considered as a real cause-effect relationship when interpreting. However, since it provides important clues in the direction of the relationship, determining the situation in one variable gives useful results in estimating the situation of the other variable (Karasar, 2005).

In this study in the correlational survey model, the stages were carried out by "detection of the problem situation, determination of the sample group, application process, data collection, data analysis and interpretation of the results". In the first step, the literature on the research process was scanned and it was checked whether examining the research problem was worth researching. In the study, no research could be found that deals with the antecedents and outcome variables of creative and innovative thinking levels holistically. Based on this situation, the purpose of the study was determined, and in the second step, a suitable participant was formed in order to achieve the research purpose. In the third and fourth stages, data collection tools that will serve the purpose are listed. Studies in which these data collection tools were developed and used are reviewed. The validity and reliability values of the data collection tools listed in the mentioned studies were examined. It was decided to use the scales that best serve the purpose of the research and ensure validity and reliability in this study. In the fourth step, the application process through the online form was successfully carried out. In the fifth step, the data were analyzed using the Partial least squares (PLS) structural equation model (SEM). In the last stage, the findings obtained from these analyzes were interpreted and discussed in the context of the relevant literature.

In this study, a literature-based research model was created. The research model was given in Fig. 1.

In Fig. 1, the variables discussed in the research and the hypotheses about the relationships between these variables are shown in the direction of the arrows. When Fig. 1 is examined, the factors forming the antecedents of creative and innovative thinking levels are “achievement goal orientations and motivation”, while the outcome variables of creative and innovative thinking levels are “engagement and academic achievement”. Since it is thought that it is important to examine the relationship between each sub-dimension, which constitutes the antecedent and outcome variables of creative and innovative thinking levels, separately, in order to obtain more detailed results, sub-hypotheses were formed for each dimension.

3.2. Participants

The study group consists of 1st, 2nd, 3rd and 4th year students studying in computer science department at a university in Turkey in the fall semester of the 2021–2022 academic year. There are 110 undergraduate students in this group, 41 of whom are women (37.3%) and 69 of them (62.7%) are men. The average age of the participants is 21.34. However, the class distribution of the participants from the 1st to the 4th grade is evenly distributed. Participants came to the relevant university for university education from many regions of Turkey. In addition, the socioeconomic level of the participants is moderate.

3.3. Data collection tools and data collection procedure

In this study, data were collected using a personal information form and 3 scales. Data collection tools were applied online to university students who were actively continuing their education.

Self-description Form: There are 3 questions in the personal information form. These were created to collect information about gender, age, and grade. In addition, academic achievement was determined by taking the students' overall academic grade averages. Engagement is the total time spent by the student for learning activities in online and face-to-face learning environments outside and inside the classroom.

Motivation Scale: Pintrich et al. (1991) developed "Motivated Strategies for Learning Questionnaire" and Büyüköztürk et al. (2004) adapted it into Turkish. The "the motivation scale" dimension of the scale, which was adapted into Turkish, has 6 factors, and in this study, the intrinsic and extrinsic motivation dimensions of these factors were discussed. There are 4 items in each dimension. The scale is a 7-point Likert scale. The validity and reliability values of the scale were presented in part 4.

Achievement goal orientations scale: Midgley et al. (1998) developed this scale and the Turkish adaptation of this scale was carried out by Akın (2006). The purpose of the scale is to determine what purpose orientations university students have in a task or responsibility situation. The scale consists of 17 items and 3 sub-dimensions: learning goal orientation, performance-approach goal orientation, and performance-avoidance goal orientation. The scale is 5-point Likert type. The validity and reliability values of the scale are presented in part 4.

Marmara creative thinking dispositions scale: This scale was developed by Özgenel and Çetin (2017) to determine general creative thinking tendencies. The scale form is in 5-point Likert type. Among the factors, the dimensions of novelty seeking, self-discipline, curiosity, and flexibility were used in this study. The validity and reliability values of the scale are presented in part 4.

Innovative Thinking Skills Scale: This scale aiming to measure innovative thinking skills was developed by Sevinç and Uyangör (2020). The scale is in three dimensions and 5-point Likert type. The dimensions of the scale are innovation vision, entrepreneurial spirit, and opportunity orientation. The validity and reliability values of the scale are presented in part 4.

3.4. Data analysis

Partial least squares (PLS) were used in the analysis of the data. PLS is a non-parametric approach to evaluate the inter-structure relationships considered in the structural equation model. Among the reasons for choosing PLS, there are reasons to run the structural equation model with a multivariate structure (Hair, Hult, Ringle, & Sarstedt, 2014) without focusing on the normal distribution of the data. In this context, constructing the structural equation model with the PLS approach was considered a suitable method for the study. In the analysis, SmartPLS 3 program was used.

In the analysis process, a two-stage approach was used in which the measurement model was evaluated in terms of reliability and validity before the formal testing of the hypotheses (see Anderson & Gerbing, 1988). In the study, first the measurement model and then the structural model were tested. The measurement model was tested to examine the reliability and validity of the structural model. In the structural model, path coefficients were used to test the relationships between structures.

3.4.1. Measurement model-reliability and validity

A Cronbach's alpha value greater than 0.70 (Nunnally, 1978) is expected for a structure examined in the structural model to be considered reliable. In this study, all Cronbach's alpha values were greater than 0.70, except for flexibility and inquisitive constructs. The Cronbach's alpha of the flexibility and inquisitive constructs was very close to meeting the 0.70 thresholds, 0.68. This value was

Table 1
Construct reliability and validity.

Contructs		Cronbach's Alpha	rho_A	Composite reliability	Average variance extracted (AVE)
Creative thinking dispositions	self-discipline	0.801	0.850	0.855	0.547
	flexibility	0.678	0.701	0.824	0.613
	innovation search	0.895	0.904	0.916	0.577
	inquisitive	0.683	0.701	0.826	0.614
Innovative thinking skills	vision of innovation	0.891	0.898	0.917	0.649
	opportunity oriented	0.815	0.819	0.890	0.730
	entrepreneurial spirit	0.817	0.832	0.879	0.647
Achievement goal orientations	learning goal orientations	0.891	0.902	0.917	0.650
	performance-approach goal orientations _	0.889	0.904	0.915	0.643
	performance-avoidance goal orientations	0.937	0.946	0.952	0.798
Motivation	extrinsic motivation	0.731	0.790	0.831	0.560
	intrinsic motivation	0.776	0.780	0.856	0.599
Academic success	academic success	1.000	1.000	1.000	1.000
Engagement	engagement	0.745	0.754	0.886	0.796

considered close enough to include these constructs in subsequent analyses. Dijkstra and Henseler (2015) stated that Cronbach's alpha value can be accepted above 0.60. According to Hair et al. (2017), the recommended limit for composite reliability, and rho_A is 0.70. A threshold of 0.50 is recommended for Average Variance Extracted (AVE) values. The values obtained in this study are above the specified threshold values. Thus, it was assumed that convergent validity was ensured and thus the constructs in the study were reliable and had sufficient internal consistency. These values were presented in Table 1.

The 0.50 value for factor loads from the model was accepted as the threshold value. All items have factor loadings above the threshold value. Factor loads were presented in Table 2.

Fornell and Larcker's (1981) criteria were used to assess discriminant validity. According to the values presented in Table 3, all pairwise correlations between structures are lower than the diagonal values of the AVE. This indicates that discriminant validity was achieved.

4. Findings

4.1. Structural model-hypothesis testing

Hypotheses were tested in the second step, as the measurement model provided sufficient evidence of validity and reliability. The structural model was run with 5000 sub-samples. Path coefficients related to the structural model were presented in Fig. 2 and detailed results were presented in Table 4.

Fig. 2 shows the overall results of hypothesis testing. Details on hypothesis testing were presented in Table 4.

Hypothesis 1 argues that a relationship will be observed between achievement-goal orientation and motivation. There are 6 sub-hypotheses under this hypothesis. H1a, H1b, and H1c hypotheses were supported ($p<.05$). H1a and H1b show that students with more learning-goal orientation have higher intrinsic and extrinsic learning motivations. There is a significant relationship between H1c performance-approach goal orientation and intrinsic motivation. This indicates that students with more performance-approach goal orientation have higher intrinsic motivation. H1d, H1e, and H1f hypotheses were not supported ($p >0.05$). H1d shows that there is no significant relationship between performance-approach goal orientation and extrinsic motivation. When analyzed according to the H1e and H1f hypotheses, there is no relationship between performance-avoidance goal orientation and motivation for intrinsic and extrinsic learning.

Hypothesis 2 suggested that a significant relationship would be observed between motivation and creative thinking dispositions. There are 8 sub-hypotheses under this hypothesis. H2a, H2b, H2c, and H2d hypotheses were not supported ($p >0.05$). The hypotheses H2e, H2f, H2g, and H2h were supported ($p < .05$). Accordingly, it was seen that students with high external motivation for learning

Table 2
Factor loadings.

Contructs		Items	Factor loadings	Contructs		Items	Factor loadings
Innovative thinking skills	entrepreneurial spirit	IT1	0.834	Creative thinking dispositions	flexibility	CT1	.668
		IT2	0.689			CT2	.862
		IT3	0.828			CT3	.805
		IT4	0.856		innovation	CT4	.657
	opportunity oriented	IT5	0.843		search	CT5	.733
		IT6	0.874			CT6	.815
		IT7	0.845			CT7	.774
	vision of innovation	IT8	0.758			CT8	.786
		IT9	0.794			CT9	.772
		IT10	0.860			CT10	.822
		IT11	0.858			CT11	.707
		IT12	0.807		inquisitive	CT12	.682
		IT13	0.748			CT13	.809
Achievement goal orientations	learning goal orientations	AG1	0.878			CT14	.851
		AG2	0.817		self-discipline	CT15	.661
		AG3	0.853			CT16	.729
		AG4	0.810			CT17	.560
		AG5	0.736			CT18	.853
		AG6	0.730			CT19	.853
	performance-approach goal orientations	AG7	0.842	Motivation	extrinsic motivation	M1	.832
		AG8	0.791			M2	.862
		AG9	0.800			M3	.744
		AG10	0.788			M4	.503
		AG11	0.760		intrinsic motivation	M5	.713
		AG12	0.826			M6	.819
	performance-avoidance goal orientations	AG13	0.876			M7	.743
		AG14	0.933			M8	.815
		AG15	0.914	Academic Success Engagement		–	1.000
		AG16	0.869			–	.877
		AG17	0.873			–	.907

Table 3
Discriminant validity results -Fornell-Larcker criterion.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. academic success	1.000													
2. engagement	0.040	0.892												
3. entrepreneurial spirit	0.034	0.013	0.805											
4. extrinsic motivation	0.033	0.070	0.576	0.749										
5. flexibility	0.059	- 0.153	0.457	0.561	0.783									
6. innovation search	0.140	- 0.032	0.563	0.545	0.680	0.760								
7. inquisitive	0.137	- 0.218	0.538	0.549	0.722	0.834	0.784							
8. intrinsic motivation	- 0.012	0.079	0.362	0.529	0.175	0.368	0.288	0.774						
9. learning goal orientations	0.078	0.051	0.583	0.735	0.504	0.536	0.558	0.544	0.806					
1 . opportunity oriented	0.012	0.085	0.753	0.574	0.491	0.571	0.595	0.327	0.564	0.854				
11. performance-approach goal orientations _	0.214	0.155	0.299	0.264	0.168	0.281	0.152	0.566	0.372	0.274	0.802			
12. performance-avoidance goal orientations	0.057	0.100	0.022	0.016	- 0.116	0.009	- 0.143	0.378	0.083	0.033	0.576	0.894		
13. self-discipline	0.090	0.009	0.480	0.514	0.632	0.787	0.651	0.321	0.487	0.534	0.178	0.064	0.740	
14. vision of innovation	0.023	- 0.053	0.729	0.553	0.527	0.649	0.655	0.343	0.575	0.817	0.285	0.006	0.527	0.805

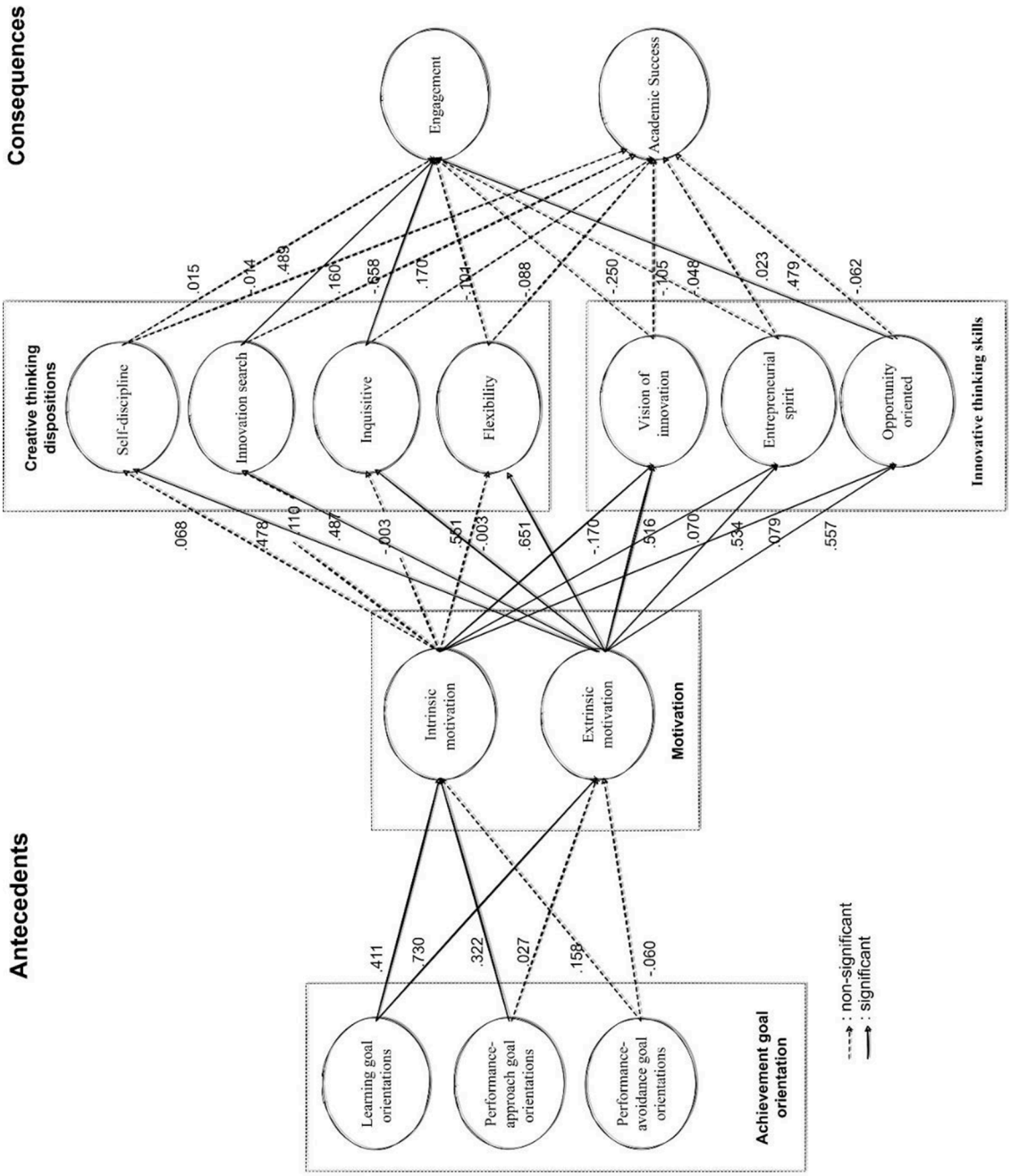

Fig. 2. Structural model.

Table 4
Hypothesis testing results.

	Paths	Path coefficient	T Statistics	*P* Values	Decision
H1a	Learning Goal Orientations -> İntrinsic Motivation	0.411	5.670	0.000	Accept
H1b	Learning Goal Orientations -> Extrinsic Motivation	0.730	13.784	0.000	Accept
H1c	Performance-Approach Goal Orientations -> Intrinsic Motivation	0.322	3.513	0.000	Accept
H1d	Performance-Approach Goal Orientations -> Extrinsic Motivation	0.027	0.297	0.767	Reject
H1e	Performance-Avoidance Goal Orientations -> İntrinsic Motivation	0.158	1.930	0.054	Reject
H1f	Performance-Avoidance Goal Orientations -> Extrinsic Motivation	- 0.060	0.709	0.478	Reject
H2a	Intrinsic Motivation -> Self-Discipline	0.068	0.595	0.552	Reject
H2b	Intrinsic Motivation -> Innovation Search	0.110	1.169	0.242	Reject
H2c	Intrinsic Motivation -> Inquisitive	- 0.003	0.035	0.972	Reject
H2d	Intrinsic Motivation -> Flexibility	- 0.170	1.698	0.089	Reject
H2e	Extrinsic Motivation -> Self-Discipline	0.478	4.248	0.000	Accept
H2f	Extrinsic Motivation -> Innovation Search	0.487	4.983	0.000	Accept
H2g	Extrinsic Motivation -> Inquisitive	0.551	5.720	0.000	Accept
H2h	Extrinsic Motivation -> Flexibility	0.651	6.546	0.000	Accept
H3a	Intrinsic Motivation -> Vision o Innovation	0.070	0.679	0.497	Reject
H3b	Intrinsic Motivation -> Entrepreneurial Spirit	0.079	0.755	0.450	Reject
H3c	Intrinsic Motivation -> Opportunity Oriented	0.032	0.368	0.713	Reject
H3d	Extrinsic Motivation -> Vision of Innovation	0.516	5.774	0.000	Accept
H3e	Extrinsic Motivation -> Entrepreneurial Spirit	0.534	5.645	0.000	Accept
H3f	Extrinsic Motivation -> Opportunity Oriented	0.557	6.881	0.000	Accept
H4a	Self-Discipline -> Engagement	0.015	0.091	0.928	Reject
H4b	Innovation Search -> Engagement	0.489	2.069	0.039	Accept
H4c	Inquisitive -> Engagement	- 0.658	3.680	0.000	Accept
H4d	Flexibility -> Engagement	- 0.101	0.623	0.533	Reject
H5a	Self-Discipline -> Academic Success	- 0.014	0.069	0.945	Reject
H5b	Innovation Search -> Academic Success	0.160	0.581	0.561	Reject
H5c	Inquisitive -> Academic Success	0.170	0.929	0.353	Reject
H5d	Flexibility -> Academic Success	- 0.088	0.560	0.576	Reject
H6a	Vision of Innovation -> Engagement	- 0.250	1.300	0.194	Reject
H6b	Entrepreneurial Spirit -> Engagement	- 0.048	0.374	0.708	Reject
H6c	Opportunity Oriented -> Engagement	0.479	2.873	0.004	Accept
H7a	Vision Of İnnovation -> Academic Success	- 0.105	0.586	0.558	Reject
H7b	Entrepreneurial Spirit -> Academic Success	0.023	0.129	0.897	Reject
H7c	Opportunity Oriented -> Academic Success	- 0.062	0.310	0.757	Reject

scored higher in all dimensions of creative thinking dispositions.

Hypothesis 3 suggested that a significant relationship will be observed between motivation and innovative thinking skills. There are 6 sub-hypotheses under this hypothesis. H3a, H3b, and H3c hypotheses were not supported ($p > 0.05$). H3d, H3e, and H3f hypotheses were supported ($p < .05$). Accordingly, it was seen that the innovative thinking skills of the students who had higher extrinsic motivation for learning were higher.

In this context, extrinsic motivation for learning was found to be an antecedent variable for creative thinking dispositions and innovative thinking skills. On the other hand, learning goal orientations and performance-approach goal orientations variables are also indirectly antecedents variables.

Hypothesis 4 suggested that a significant relationship would be observed between creative thinking dispositions and engagement. There are 4 sub-hypotheses under this hypothesis. Hypotheses H4a and H4b were rejected ($p > 0.05$), while hypotheses H4c and H4d were supported ($p < .05$). Accordingly, students who score more in the innovation search and inquisitive dimensions of creative thinking dispositions, except for the dimensions of self-discipline and flexibility, have a higher engagement for the course.

Hypothesis 5 suggested that a significant relationship would be observed between creative thinking dispositions and academic achievement. There are 4 sub-hypotheses under this hypothesis. Hypotheses H5a, H5b, H5c, and H5d were rejected ($p > 0.05$).

Hypothesis 6 suggested that a significant relationship will be observed between innovative thinking skills and engagement. There are 3 sub-hypotheses under this hypothesis. Hypotheses H6a and H6b were rejected ($p > 0.05$), while hypothesis H6c was supported ($p < 0.05$). Accordingly, students who score more in the opportunity-oriented dimension of innovative thinking skills have a higher engagement for the course.

Hypothesis 7 suggested that a significant relationship would be observed between innovative thinking skills and academic achievement. There are 3 sub-hypotheses under this hypothesis. Hypotheses H7a, H7b, and H7c were rejected ($p > 0.05$).

In this context, the findings show that supporting creative thinking dispositions, and innovative thinking skills does not affect academic achievement. In addition, the findings indicate that supporting the innovation search and inquisitive dimensions of creative thinking dispositions and the opportunity-oriented dimension of innovative thinking skills will positively increase engagement.

Additionally, the percentages of variance explained were 46.6% for intrinsic motivation and 54.3% for extrinsic motivation. It is 26.8% for self-discipline, 30.6% for innovation search, 30.1% for inquisitive and 33.6% for flexibility. 30.9% for the vision of innovation, 33.6% for entrepreneurial spirit, and 33.0% for opportunity-oriented. It was calculated as 19.1% for engagement and 3.7% for academic success. The implications of these findings will be discussed in the next section.

5. Discussion

This study aims to investigate the antecedents and consequences of creative and innovative thinking in educational environments. In this study, research findings show that students who have more learning-goal orientation have higher intrinsic and extrinsic learning motivations. According to Akın (2006), learning-goal orientation is the tendency of individuals to better understand the tasks they encounter in the learning process, to learn completely, to develop task-related competencies, and to acquire new skills. Ryan and Deci (2000) define intrinsic motivation as the desire to participate in a learning activity due to the pleasure and perception of efficacy gained by the action, while extrinsic motivation is defined as the desire to participate in learning activities to connect the learning effort to a result. In this context, it can be interpreted as an expected result that students with high learning-goal orientation have high intrinsic and extrinsic motivation. Students who have more performance approaches and goal orientation have higher intrinsic motivation. Elliott and Harackiewicz (1996) explained two orientations as performance-approach and performance-avoidance. Students who exhibit performance-approach outperform students who exhibit avoidance behavior. In this context, the high intrinsic motivation of the students who exhibit performance approach behavior is directly related to their busyness with the task and high-value perceptions. Students with high extrinsic motivation for learning have higher creative thinking dispositions and innovative thinking skills. According to Mathisen and Bronnick (2009), creative effort is a challenging activity that usually requires time and effort, and it is crucial to maintain persistence in this challenging process. Extrinsic motivation is important at this point to support creative thinking dispositions and ensure their sustainability. On the other hand, Kalelioğlu and Gülbahar (2014) highlighted that critical thinking dispositions are directly related to motivation and it is effective to integrate various instructional and motivational methods to encourage critical thinking in online learning environments. Dou et al. (2021) emphasized that providing students with rewards, practical applications, or various opportunities to be creative and innovative can motivate them to innovate and create their products. In this regard, the literature supports that extrinsic motivation for learning is an antecedent variable for creative thinking dispositions and innovative thinking skills. On the other hand, learning goal orientations and performance-approach goal orientations variables are also indirectly antecedents variables. In this context, external motivational sources/results and environmental supports play an important role in critical thinking that comes into play in the process of becoming aware of a problem in the learning process. In addition, nurturing internal motivational resources (for example, tasting the sense of achievement, supporting self-efficacy, etc.) as well as external and environmental supports are important in supporting innovative thinking in the learning process.

Apart from the self-discipline and flexibility dimensions, students who score more in the innovation search and inquisitive dimensions of creative thinking dispositions have a higher engagement for the course. Creative self-efficacy is related to the belief that one can produce creative results (Tierney & Farmer, 2002; Yildiz- Durak, 2022). Students' high self-efficacy for creative production, curiosity, and high willingness to follow innovations can also enable them to have a high perception of pleasure and value from what they do, and as a result, to be actively engaged in the learning process. Students who score higher in the opportunity-oriented dimension of innovative thinking skills have a higher engagement for the course. The findings show that supporting creative thinking dispositions, and innovative thinking skills does not affect academic achievement. Although the findings of this study were expected in terms of engagement, they contradict the literature in terms of academic achievement. For example, in a study by Akpur (2020), creative thinking explains academic achievement in a positive and meaningful way. The reason for these results may be related to the situation stated by Chamorro-Premuzic (2006) that the effect of creative thinking on academic achievement changes according to the evaluation methods applied. Additionally, the findings indicate that supporting the innovation search and inquisitive dimensions of creative thinking dispositions and the opportunity-oriented dimension of innovative thinking skills will positively increase engagement. This result supports the theoretical framework that creative and innovative thinking interact, and these ways of thinking are ways of thinking that enable individuals to identify areas where they are sufficient or insufficient with innovative behaviors. In this context, this result supports engagement in the course in the context of their contribution to innovation-seeking, inquiry, and opportunity-oriented innovative thinking skills, identifying the learning deficiencies of students, researching and planning innovations and actions that will increase their learning processes and development. This study has some limitations. To measure academic achievement, the overall grade point averages of the participants at the end of the period in which the data were collected were taken as a basis. The resulting academic achievement grades may have been created with different evaluation methods in different courses. No data was collected on this subject within the scope of the study. Achievement grades obtained with different assessment methods may lead to different results. In future studies, differences can be evaluated according to evaluation methods.

6. Conclusion

As a result of this study, extrinsic motivation is a direct antecedent variable for creative thinking dispositions and innovative thinking skills, and learning and performance-approach goal orientation is an indirect antecedent variable. It was revealed that creative and innovative thinking did not have a positive and significant predictive power on engagement, but did not have significant power on academic achievement. Therefore, this study provides support to the literature that higher-order thinking skills support engagement and do not adequately support academic achievement.

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Data availability

The data that support the findings of this study are available from the corresponding author upon request.

CRediT authorship contribution statement

Ümmühan Avcı: Data curation, Conceptualization, Writing – original draft, Resources. **Hatice Yildiz Durak:** Formal analysis, Methodology, Data curation, Writing – original draft.

Declaration of Competing Interest

The authors declare that they have no conflict of interest.

Data availability

The authors do not have permission to share data.

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