Asian Journal of Contemporary Education
ISSN(e): 2617-1252
DOI: 10.55493/5052.v9i2.5795
Vol. 9, No. 2, 241-257.

Analyzing approaches to learning through the lens of metacognitive awareness and epistemic curiosity

Tugce Yazici[1+]
Osman Yilmaz Kartal[2]

[1]*Department of Educational Sciences and Institution of Graduate Education, Onsekiz Mart University, Çanakkale, Turkey.*
[1]*Email: yazicituce@windowslive.com*
[2]*Department of Educational Sciences and Education Faculty, Onsekiz Mart University, Çanakkale, Turkey.*
[2]*Email: osmanykartal@comu.edu.tr*

(+ Corresponding author)

Article History
Received: 24 September 2025
Revised: 21 November 2025
Accepted: 18 December 2025
Published: 31 December 2025

Keywords
Achievement gap
Approaches to learning
Curiosity
Epistemic curiosity
Metacognition
Metacognitive awareness.

ABSTRACT

This study investigates the impact of high school students' levels of epistemic curiosity (EC) and metacognitive awareness (MCA) on their learning approaches, aiming to address the achievement gap. The Approaches to Learning Scale, Metacognitive Awareness Inventory, and Epistemic Curiosity Scale were administered to 756 students in the 9th and 12th grades. Using an ex post facto research design, ordinal logistic regression analysis revealed that both interest-type and deprivation-type EC significantly predicted the deep learning approach at both grade levels. While MCA significantly predicted deep learning, the regulation of cognition was not a significant predictor at the 12th-grade level. At both grade levels, deprivation-type EC and cognitive control processes were significant predictors of the strategic learning approach. However, the analyses on the surface learning approach showed that neither EC nor MCA was a significant predictor at either grade level. These findings demonstrate that EC and MCA are critical variables in understanding high school students' learning approaches. The findings indicate that the cultivation of these competencies can facilitate deep and strategic learning while concomitantly reducing achievement gaps. Furthermore, the study emphasizes the necessity for additional research to be conducted on the interaction of these variables across various educational contexts.

Contribution/ Originality: This study compares students in Grades 9 and 12 and presents the changes in their preferences regarding learning approaches, metacognitive awareness, and epistemic curiosity. It also provides a detailed perspective on how to address the achievement gap by explaining the details of the quality learning environment.

1. INTRODUCTION

The efficiency of initiatives undertaken by governments to develop high-quality human capital is reflected in national and international assessment tests. The results from these assessment tests not only indicate the proficiency of countries in education but also demonstrate the quality of learners' learning performance. Differences in quality are examined as achievement gaps within the framework of structural, social, economic, and other sociological parameters of countries (Cabral-Gouveia, Menezes, & Neves, 2023; Hung et al., 2019; Reardon, 2013). Achievement gaps are influenced by factors such as in-school and out-of-school environments, learning styles, gender, race, stress, etc (Banks & Banks, 1995; Heissel, Levy, & Adam, 2017; Jeynes, 2014; Miller & Olson, 1988). These factors impact learners' academic success (Coleman, 1966; Ladson-Billings, 2006) and support the development of skills such as innovation and creativity from a societal perspective (Ornstein, 2010). Therefore, to minimize achievement gaps, it is essential to consider learner-related factors.

The quality of the learner is crucial as a learning outcome in achieving academic success. The academic success of the learner is related to their learning approaches (Marton & Säaljö, 1976; Ramsden, 1985). Learners who embrace quality learning prefer a deep learning approach (Trigwell & Prosser, 1991; Trigwell, Prosser, & Waterhouse, 1999). However, due to reasons such as the inability to predict the type and structure of the exam, learners experience anxiety, worry, and stress, leading them to adopt a surface learning approach (Atkins & Brown, 2002). This situation causes learners to shift towards different learning approaches due to factors such as stress, anxiety, and cognitive goals. Therefore, the focus of the current study on addressing achievement gaps is on learning approaches.

In the learning process, the learner determines a specific learning approach based on the situation (Cuthberth, 2005). Depending on the learning tasks, the learner may prefer a deep learning approach (Byrne, Flood, & Willis, 2002), a surface learning approach (Kember, Jamieson, Pomfred, & Wong, 2015), or a strategic learning approach (Bernardo, 2003; Entwistle, McCune, & Walker, 2014). However, the learner's approach to learning may vary due to factors such as the learning task, academic success, type of assessment, and time (Byrne et al., 2002; Trigwell & Prosser, 1991; Trigwell et al., 1999). Differences in learning approaches are evident in how each learner develops strategies based on their preferred learning approach and the effectiveness of these strategies in assessment processes. Therefore, it is normal to see variations in success among learners according to their learning approaches.

Research on learning approaches became significant in the 2000s (Alt & Boniel-Nissim, 2018; Asikainen & Gijbels, 2017; Bouchard, 2006; Chan, 2003; Díaz et al., 2024; Egenti, 2012; Evans, 2000; Faranda, Clarke, & Clarke III, 2020; George, Maung, Narayanam, & Latt, 2023; Kovač, Nome, Jensen, & Skreland, 2025; Moreira et al., 2020; Postareff, Mattsson, & Parpala, 2018; Sparks, 2013; Taskesen, 2020). Studies on modeling approaches to learning have been examined at various educational levels: preschool (Hong, Liu, & Zhao, 2023) higher education (Batteson, Tormey, & Ritchie, 2014; Case & Gunstone, 2002; Chin & Brown, 2000; Chirikure et al., 2019; Díaz et al., 2024; Lee, Johanson, & Tsai, 2008; Magno, 2009; Papinczak, Young, Groves, & Haynes, 2008; Rolleston, Schendel, & Grijalva Espinosa, 2019; Vermunt, 1996) and secondary education (Cano, 2007). For this reason, the focus of the study is on high school students' learning approaches. In this context, modeling approaches to learning should include efforts to understand how cognitive and metacognitive elements in the learner's developmental process can influence learning approaches. Additionally, due to the relationship between EC and metacognitive structures in the literature (Abdelghani, Law, Desvaux, Oudeyer, & Sauzéon, 2023; Goupil & Proust, 2023; Kim, Harris, & Néher, 2025; Litman, 2018) it is hypothesized that metacognition and EC may theoretically influence learning approaches. This is because the level of a learner's EC and engagement with cognition varies according to their learning approach preferences (Richards, Litman, & Roberts, 2013). This variation necessitates an examination of how metacognitive awareness (MCA) and EC influence the changes in learning approach preferences among high school students during their learning process. Thus, the results of this research explain how MCA and EC structures determine learning approach preferences. In this regard, the study will provide guidance to experts and educators for developing high-quality educational policies and teaching practices to minimize achievement differences in future periods. The findings obtained from the study are significant in clarifying the underlying reasons for quality learning, deeply examining the parameters that influence the operational quality of educational programs, and providing insights for educational researchers, psychologists, and educators regarding learners' cognitive development and learning orientation throughout a specific educational stage.

2. THEORETICAL REVIEW

Learning approaches are a combination of the learner's learning objectives, motivations, and strategies (Biggs, 1999; Guo, Yang, & Shi, 2017). They relate to the level of understanding and grasping of the form and content of the course material by the learner (Marton & Säaljö, 1976; Newble & Entwistle, 1986). With a learning approach, the learner makes decisions about their study methods to achieve the desired learning outcomes while performing learning tasks and is able to implement these decisions. These decisions enable the learner to exhibit deep, surface, and strategic orientations towards learning due to individual differences (Biggs, 1987; Newble & Entwistle, 1986).

The Deep Learning Approach (DL) provides learners with the opportunity to understand the logic behind problems or information encountered. In a contextual sense, it is related to the learner's search for established principles and the use of evidence. It allows learners to critically examine the subject matter, relate learned information with both old and new knowledge, and scrutinize the logic behind claims presented for problem-solving (Beattie IV, Collins, & McInnes, 1997; Pask, 1976; Ramsden, 1985). Learners tend to use strategies that enable them to determine the relationship between information, ideas, or algorithms within a topic and other ideas or data (Batteson et al., 2014). During the learning experience, learners activate their investigative traits, developing curiosity about the information. They can increase their desire for learning and thus tend toward a deep learning approach in assimilating facts. Specifically, learners have a desire for knowledge that drives them to learn new information or ideas, eliminate gaps in their cognitive understanding caused by unknown information, and solve encountered intellectual problems (Berlyne, 1954; Litman, 2018; Loewenstein, 1994). With this desire, learners are able to thoroughly examine teaching materials both to understand new information and to relate old and new knowledge. In this process, learners not only exhibit high levels of motivation and desire for learning but also actively use their cognition. While monitoring their mental activities (Brown, 1980; Schunk, 2009), learners tend to use effective metacognitive skills (Egenti, 2012).

The Surface Learning Approach (SL) is a method in which learners rely on their memory to identify and recall the most relevant information related to a learning task. Learners who prefer SL need to remember all the information they have memorized (Marton & Säaljö, 1976). They select and memorize the important information from what is presented to them to answer questions likely to be asked on exams and focus on basic concepts (Atkins & Brown, 2002; Cuthberth, 2005; Ramsden, 1985). Consequently, learners do not relate the information they have acquired to other information in their minds. Due to their inability to anticipate the type and structure of the exam, they engage in limited learning and experience anxiety and concern during this process (Atkins & Brown, 2002). Thus, SL limits the quality of learning and restricts the effective use of the learner's metacognitive skills (Egenti, 2012). Learners may attempt to fill gaps in their knowledge due to their inability to explain or recall information by eliminating all conditions causing knowledge deficiencies and seeking new phenomena, concepts, and ideas. In this context, it is possible that learning approaches are related to DTEC.

The Strategic Learning Approach (STL) is aimed at achieving high levels of success (Case & Marshall, 1986). For learners, this approach requires effective work during the learning process, good organizational planning, and consistent efforts with sustainable motivation (Entwistle, 2018). In this approach, learners compete with other learners and harness their desire for success to organize their own learning process (Biggs, 1978). They establish regular study methods and use their time effectively (Entwistle et al., 2014). Students systematically plan their study process with a strong sense of competition and pay attention to cues provided by the teacher during lessons. This aspect of STL requires learners to use their metacognitive activities effectively.

With metacognitive awareness (MCA), learners gain knowledge about their cognitive processes, products, or both the process and the product (Flavell, 1976; Forrest-Pressley & Waller, 1984). They are able to plan, organize, monitor, and control their cognitive processes effectively to directly enhance their performance level. The ability to plan and organize with cognitive knowledge (KAC) and cognitive control processes (RC), as well as the ability to monitor and control the learning process consciously, and to apply new or existing knowledge effectively, is essential (Schraw & Dennison, 1994; Schraw & Moshman, 1995).

Epistemic curiosity (EC) is a desire for knowledge that motivates learners to explore information or ideas they have not previously encountered, to address existing gaps in their knowledge, and to generate solutions to scientific problems (Berlyne, 1954; Litman, 2018; Loewenstein, 1994). EC facilitates the learner's engagement in the process of discovering information to resolve gaps or inconsistencies in their knowledge. In this context, EC is categorized into: a) Interest-type EC (ITEC), which is characterized by a pleasurable and enjoyable feeling of curiosity, and b) Deprivation-type EC (DTEC), which involves a sense of discomfort due to uncertainty (Litman & Jimmerson, 2004).

Interest-type Epistemic Curiosity (ITEC) focuses on the pleasure learners experience while engaging in new exploratory behaviors and motivates them to seek new knowledge. It is related to the development of high-level learning goals that enhance the learner's interest in the learning process and academic success (Litman, 2018). Deprivation-type Epistemic Curiosity (DTEC) is the desire to acquire new phenomena or concepts to eliminate all conditions causing a sense of deprivation due to perceived knowledge gaps, which disturb the learner's mind. Therefore, DTEC reflects a demanding and discomforting 'need to know' until the learner achieves the missing pieces of information and reaches satisfaction. In this context, it is possible to state that EC directs learners towards identifying the most suitable learning approach for acquiring knowledge.

Research has elucidated the relationship between metacognition and epistemic curiosity (EC) (Abdelghani et al., 2023; Litman, 2018; Metcalfe, Schwartz, & Eich, 2020). This relationship involves the reduction of cognitive conflicts through metacognitive judgments about whether information is known or not, situationally promoting curiosity, and thus motivating the learner to seek more information. Additionally, a learner's awareness of whether they know a piece of information can be detected through metacognitive components. Cognitive factors facilitate curiosity by identifying the need for information and assessing the likelihood of reducing this need in specific contexts (Goupil & Proust, 2023). On the other hand, learners use EC to address gaps in their knowledge (Litman, 2018; Loewenstein, 1994). This situation has led to the proposition in this study that metacognitive awareness mediates EC.

3. RESEARCH METHODOLOGY

This study aims to examine the impact of high school students' levels of Epistemic Curiosity (EC) and Metacognitive Awareness (MCA) on their learning approaches. In this context, the research seeks to answer the question: "Do high school students' MCA and EC influence their learning approaches?" For the purpose of this study, the ex-post facto model has been chosen. This model investigates causal effects among variables influencing an occurrence and provides analysis results regarding what affects what under which conditions (Cohen, Manion, & Morrison, 2002; Newman, Benz, & Ridenour, 1998). The dependent variable is the learning approach, while Metacognitive Awareness (MCA) and Epistemic Curiosity (EC) are defined as independent variables.

3.1. Population and Sample

The population of this study consists of high schools with diverse educational qualities located in the province of Çanakkale. According to the random cluster sampling method used in the study, elements of the population that each carry specific characteristics need to be divided into clusters or groups (Robson, 2015). Therefore, the researcher selects a certain number of schools and tests all students in the selected schools (Cohen et al., 2002).

Methodologically, random cluster sampling involves at least two stages (Schutt, 2011). In the first stage, the researcher identifies the random cluster sample and creates a list for each cluster. Accordingly, based on information obtained from the website of the Çanakkale Provincial Directorate of National Education,[1] each type of institution representing high schools in Çanakkale province was considered as a separate cluster, and the number of high schools in each group was determined. A high school from each institution type within each group was randomly selected. However, since there are multiple high schools in the Anatolian High School and Vocational High School programs, a lottery was conducted as shown in Table 1. The names of all relevant high schools were written on paper, and through a lottery, a representative high school was selected from each group for the Anatolian high schools. Thus, in

[1] https://mebbis.meb.gov.tr/KurumListesi.aspx

the first stage, groups representing each type of institution were established to allow for the necessary comparisons in this causal-comparative study.

In the first stage of the random cluster sampling process, high schools to be included in the sample were selected. In the second stage, due to the requirement for the researcher to randomly select cluster samples from within each cluster chosen in the first stage (Schutt, 2011), attention was focused on the classes and the students within those classes at each high school. At this point, since the levels of variables among the students from the initially selected high schools were to be compared, students in the 9th and 12th grades were included in the study. To provide sufficient numerical data in examining the sub-factors of the dependent variable, which is learning approaches (deep, surface, strategic), it was necessary to form groups to observe variations in the levels of the variables (Robson, 2015). Each group was required to have more than fifteen participants (As cited in Borg and Gall (1979) by Cohen et al. (2002)). Consequently, an attempt was made to reach groups of at least twenty students from each school to satisfy each sub-factor. Before the implementation, information obtained from school administrators and guidance services helped determine the current student capacity at each school. The sample composition is presented below.

Table 1. Sample composition.

Type of institution[2]	Number of high schools in the city center[3]	Number of high schools included in the study	Grade	Number of participants		Total number of participants
Science High School	1	1	9th	86	161	788
			12th	75		
Social Science High School	1	1	9th	69	105	
			12th	36		
Anatolian High School	7	1	9th	68	113	
			12th	45		
Vocational and Technical Anatolian High School	6	1	9th	89	151	
			12th	62		
Fine Arts High School	1	1	9th	40	79	
			12th	39		
Anatolian Imam Hatip High School	1	1	9th	24	55	
			12th	31		
Anatolian Imam Hatip High School Social Sciences Program	1	1	9th	74	124	
			12th	50		

Of the 788 targeted participants at the following educational institutions: Science High School, Social Science High School, Anatolian High School, Vocational and Technical Anatolian High School, Fine Arts High School, Anatolian Imam Hatip High School, and Anatolian Imam Hatip High School Social Sciences Program, 756 valid responses were obtained after excluding 32 invalid forms. This yielded a response rate of 95.9%, which is well above the acceptable range for educational research. Despite the slight reduction in sample size, the final count of 756 participants (Female = 342, Male = 414) remains robust and sufficient for conducting the intended analyses. The high response rate also enhances the generalizability of the findings and reduces the risk of non-response bias.

3.2. Data Collection Tools

In this study, three different measurement tools were used for the variables of learning approaches, Metacognitive Awareness (MCA), and Epistemic Curiosity (EC). Permission for the use of the measurement tools for learning

[2] All institutions are referenced using their abbreviations throughout the text.

[3] Access via https://mebbis.meb.gov.tr/KurumListesi.aspx.

approaches and EC, which were developed by experts, as well as the adaptation of the MCA tool into Turkish, was obtained from three specialists.

3.3. Learning Approaches Scale

In this study, Ekinci (2009) 'Learning Approaches Scale' was used to assess learners' tendencies regarding their learning approaches. The measurement tool is a 5-point Likert-type scale consisting of 54 items, with 18 items for each dimension. The factor loadings for the first dimension range from 0.51 to 0.65, for the second dimension from 0.39 to 0.75, and for the third dimension from 0.34 to 0.58. These dimensions explain a total variance of 30.98% of the scale. The item discrimination indices range from 0.46 to 0.61 for the first dimension, from 0.31 to 0.70 for the second dimension, and from 0.30 to 0.54 for the third dimension. The scale demonstrates internal content validity and has established construct validity through exploratory factor analysis. To ensure the tool's appropriateness for the group, it was tested with two high school students. The researcher asked about any unclear items and made adjustments to two statements based on operational definitions (e.g., replacing 'in this section' with 'at school,' and 'academic staff' with 'teacher, teachers').

Table 2. Reliability analysis of the learning approaches measurement tool.

Variables	Factors	Cronbach's α of the original form	Cronbach's α of the present study	Total Cronbach α of the original form	Total Cronbach's α of the present study
LA	DL	0.89	0.89	0.85	0.9
	SL	0.82	0.78		
	STL	0.87	0.89		

3.4. Epistemic Curiosity Scale

In this study, the 10-item Epistemic Curiosity (EC) scale developed by Litman and Spielberger (2003) was utilized. Additionally, the researcher conducted adaptation, language validity, and reliability studies for the Turkish version (see Table 3). During the translation process, opinions were solicited from four experts: two from the Department of Educational Programs and Instruction and two from the Department of English Language Education. Based on their feedback, the consistency between the English and Turkish items in terms of coverage was examined. The EC scale, in both English and Turkish forms, was administered to 26 volunteer university students in the second year of the English Language Teaching Department. Before administration, ethical considerations regarding the confidentiality of personal data and voluntary participation were explained, and verbal consent was obtained from the students. The English forms were distributed first, followed by the Turkish forms. The collected data were analyzed using the SPSS (Statistical Package for the Social Sciences) program. The internal consistency of the items was examined by correlating and comparing the items in the English and Turkish forms. According to the paired samples t-test results, the responses given by participants to items in both scales were generally found to be related. The paired samples t-test results indicated that there was no significant difference between the items in the Turkish and English forms, as the p-value was greater than 0.05. Typically, a significant difference between two values would require a p-value less than 0.05 (Pallant, 2020). To ensure the reliability of the measurement tool, the Turkish version of the EC scale was administered to 15 high school students after obtaining verbal consent. According to participant feedback, the items in the Turkish form were found to be clear and understandable, leading to the main application and reliability data collection. Reliability information for the measurement tools is provided in Table 3.

Table 3. Reliability analysis of the epistemic curiosity scale.

Variables	Factors	Cronbach's α of the original form	Cronbach's α of the present study	Total Cronbach's α of the original form	Total Cronbach's α of the present study
EC	ITEC	0.56	0.73	0.64	0.81
	DTEC	0.38	0.78		

3.5. Metacognitive Awareness Inventory

In this study, the Metacognitive Awareness Inventory (MCA), developed by Schraw and Dennison (1994) and adapted into Turkish by Akin, Abaci, and Çetin (2007), was used. The inventory is a 52-item scale with a 5-point Likert format. It consists of two subdimensions: Knowledge About Cognition (KAC) and Regulation of Cognition (RC). The correlation between the original and the adapted Turkish form scores is 0.93, indicating high linguistic equivalence. The internal consistency coefficient is 0.95, demonstrating excellent reliability. The test-retest reliability coefficient is also 0.95, indicating high stability over time (Akin et al., 2007).

Table 4. Metacognitive awareness inventory: original and Turkish form correlation and reliability.

Variables	Sub factors		Correlation of the original	Total correlation of the original	Cronbach's α of the present study	Total Cronbach's α of the present study
MCA	KAC	Declarative knowledge	0.96	0.93	0.77	0.95
		Procedural knowledge	0.94		0.68	
		Conditional knowledge	0.96		0.66	
	RC	Planning	0.95		0.74	
		Monitoring	0.96		0.80	
		Evaluation	0.97		0.70	
		Debugging	0.96		0.64	
		Information management	0.97		0.77	

Overall, an acceptable alpha value in research typically ranges from .70 to .95 (Tavakol & Dennick, 2011). Therefore, based on the alpha values presented in Table 2, Table 3, and Table 4, the learning approaches scale, the MCA inventory, and the EC scale used in the study are reliable.

3.6. Data Collection Phase

Before data collection, permission was obtained from the Ministry of National Education. Subsequently, institutional consent from the administrators and individual consent from the students were secured for participation in the study. Data were collected by the researcher with the assistance of experts from school guidance and counseling services between October 8 and October 18, 2019. After the measurement instruments were collected, 32 invalid forms were identified and excluded from the data analysis. The data from the remaining 756 forms were then transferred to the SPSS 21 software package for analysis.

3.7. Data Analysis

The data entered into IBM SPSS 21 were cleaned, and outlier checks were conducted. Subsequently, the skewness and kurtosis values of all items, as well as the histogram curves, were examined. It was determined that the data, after controlling for outliers and considering the sample size, exhibited a normal distribution. Since the study aimed to examine the effect of each independent variable on the dependent variable, ordinal logistic regression analysis was employed (Pallant, 2020). Variables with high correlations were excluded from the analysis to address issues of multicollinearity and singularity. Ordinal logistic regression analysis was performed to predict LA based on MCA and EC.

It is evident that the researchers have met the requisite criteria concerning the assumption of ordinal regression analysis in this particular study. For instance, the dependent variable was ordinal, and one independent variable was also ordinal. The independent variables did not have a linear effect on the log odds of the dependent variable. There was no significant autocorrelation of the residuals, and there was no multicollinearity among the independent variables (Hayawi, Sedeeq, & Ali, 2025).

4. FINDINGS

The findings from the study were analyzed separately for each learning approach based on class level. The results are as follows.

Table 5. Prediction of 9th-grade students' preferences for a deep learning approach based on epistemic curiosity and metacognitive awareness levels.

	Variables	Estimate	Std.Error	Wald	df	Sig.	Lower Bound	Upper Bound	Exp_B	Lower	Upper
Threshold	[Deep_ = 1.00]	7.725	0.946	66.653	1	0.000	5.871	9.58	2265.246	354.527	14473.744
	[Deep_ = 2.00]	12.005	0.926	167.993	1	0.000	10,189	13.82	163519.1	26618.604	1004503.684
	[Deep_ = 3.00]	16.989	1.157	215.756	1	0.000	14.722	19.256	23889680	2475747.848	230523000.3
	[Deep_ = 4.00]	21.361	1.392	235436	1	0.000	18.632	24.089	1891336172.166	123536789.8	28956171866
Location	ITEC	1.717	0.245	49.203	1	0.000*	1.238	2.197	5.57	3.447	9
	DTEC	0.783	0.188	17.29	1	0.000*	0.414	1.152	2.188	1.513	3.165
	KAC	0.827	0.303	7.446	1	0.006*	0.233	1.421	2.286	1.262	4.14
	RC	1.898	0.332	32.597	1	0.000*	1.246	2.549	6.67	3.477	12.795

Note: *p<0.05.

Table 6. Ordinal logistic regression analysis of 12th-grade students' deep learning approach preferences based on epistemic curiosity and metacognitive awareness levels.

	Variables	Estimate	Std.Error	Wald	df	Sig.	Lower bound	Upper bound	Exp_B	Lower	Upper
Threshold	[Deep_ = 1.00]	6.274	1.22	26.446	1	0.000	3.883	8.665	530.474	48.554	5795.622
	[Deep_ = 2.00]	9.856	0.997	97.755	1	0.000	7.903	11.81	19081.81	2704.295	134643.379
	[Deep_ = 3.00]	14.275	1.183	145.622	1	0.000	11.956	16.593	1583030	155803.9	16084226.56
	[Deep_ = 4.00]	18.532	1.428	168.323	1	0.000	15.732	21.332	111766837.889	6799202	1837248958
Location	ITEC	1.436	0.249	33.216	1	0.000*	0.947	1.924	4.202	2.579	6.847
	DTEC	0.836	0.216	14.961	1	0.000*	0.412	1.259	2.307	1.51	3.523
	KAC	0.594	0.344	2.974	1	0.085	-0.081	1.268	1.81	0.922	3.554
	RC	1.602	0.409	15.312	1	0.000*	0.8	2.405	4.964	2.225	11.076

Note: *p<0.05.

An ordinal logistic regression analysis was conducted to investigate the relationship between 9th-grade students' "DL" and four independent variables: ITEC, DTEC, KAC, and RC. As demonstrated in Table 5, the model demonstrated statistical significance (x^2=424.519, p<0.05), thereby indicating its efficacy in differentiating between levels of students' DL based on the predictors. The Pseudo R-Square values (Cox and Snell=0.628) suggest a substantial relationship between predictors and DL. In terms of individual predictors, RC (b= 1.90, SE=0.33), Wald =32.60, p<0.05) and ITEC (b= 1.71, SE=0.25, Wald =49.20, p<0.05) are the most significant factors. Additionally, KAC (b= 0.83, SE=0.30, Wald =7.45, p<0.05) and DTEC (b= 0.78, SE=0.19, Wald =17.29, p<0.05) are also significant positive predictors of the DL approaches of 9th-grade students.

An ordinal logistic regression analysis was conducted to investigate the relationship between 12th-grade students' "DL" and four independent variables: ITEC, DTEC, KAC, and RC. As demonstrated in Table 6, the model demonstrated statistical significance (x^2=232.321, p<0.05), thereby indicating its efficacy in differentiating between levels of students' DL based on the predictors. The Pseudo R-Square values (Cox and Snell=0.514) suggest a substantial relationship between predictors and DL. In terms of individual predictors, RC (b= 1.60, SE=0.41), Wald =15.31, p<0.05) and ITEC (b= 1.44, SE=0.25, Wald =433.22, p<0.05) are the most significant factors. Additionally, DTEC (b = 0.84, SE=0.22, Wald =14.96, p<0.05) is also a significant positive predictor of the DL approaches of 12th-grade students. However, the KAC factor (b= 0.59, SE=0.34, Wald=2.97, p>0.05) is not a significant predictor of the DL levels of 12th-grade students.

Table 7. Ordinal logistic regression analysis of 9th-grade students' strategic learning approach preferences based on epistemic curiosity and metacognitive awareness levels.

	Variables	Estimate	Std.Error	Wald	df	Sig	Lower Bound	Upper Bound	Exp_B	Lower	Upper
Threshold	[Strategic_ = 1.00]	3.952	0.776	25.931	1	0.000	2.431	5.473	52.044	11.37	238.222
	[Strategic_ = 2.00]	7.484	0.691	117.457	1	0.000	6.13	8.837	1778.576	459.527	6883.89
	[Strategic_ = 3.00]	10.988	0.798	189.703	1	0.000	9.424	12.551	59145.45	12384.19	282471.762
	[Strategic_ = 4.00]	14.933	0.976	233.948	1	0.000	13.019	16.847	3057094	451101.2	20717797.35
Location	ITEC	0.297	0.205	2.108	1	0.147	-0.104	0.698	1.346	0.901	2.01
	DTEC	0.478	0.171	7.761	1	0.005*	0.142	0.814	1.612	1.152	2.257
	KAC	0.493	0.281	3.075	1	0.079	-0.058	1.043	1.636	0.944	2.838
	RC	2.08	0.312	44.464	1	0.000*	1.469	2.692	8.005	4.344	14.754

Note: *p<0.05.

An ordinal logistic regression analysis was conducted to investigate the relationship between 9th-grade students' "STL" and four independent variables: ITEC, DTEC, KAC, and RC. As demonstrated in Table 7, the model demonstrated statistical significance (x^2=292.316, p<0.05), thereby indicating its efficacy in differentiating between levels of students' STL based on the predictors. The Pseudo R-Square values (Cox and Snell = .490) suggest a substantial relationship between predictors and STL. In terms of individual predictors, RC (b = 2.08, SE = 0.31, Wald = 44.46, p < 0.05) is the most significant factor, while DTEC (b = 0.48, SE=0.17, Wald =7.76, p<0.05) also positively predicts the STL preferences of 9th-grade students. However, ITEC (b= 0.28, SE=0.21, Wald=2.11, p>0.05) and KAC (b= 0.49, SE=0.28, Wald=3.085, p>0.05) are not significant predictors of the STL levels of 9th-grade students.

Table 8. Ordinal logistic regression analysis of 12th-grade students' strategic learning approach preferences based on epistemic curiosity and metacognitive awareness levels.

	Variables	Estimate	Std.Error	Wald	df	Sig.	Lower Bound	Upper Bound	Exp_B	Lower	Upper
Threshold	[Strategic_ = 1.00]	4.815	0.924	27.155	1	0.000	3.004	6.626	123.375	20.169	754.7
	[Strategic_ = 2.00]	7.778	0.881	78.011	1	0.000	6.052	9.504	2388.177	425.06	13417.838
	[Strategic_ = 3.00]	11.327	1.007	126.471	1	0.000	9.353	13.301	83003.75	11528.86	597597.925
	[Strategic_ = 4.00]	15.566	1.26	152.69	1	0.000	13.097	18.035	5755110	487317.2	67966598.46
Location	ITEC	0.215	0.217	0.979	1	0.322	-0.211	0.641	1.24	0.81	1.898
	DTEC	0.687	0.204	11.287	1	0.001*	0.286	1.087	1.987	1.331	2.967
	KAC	0.356	0.326	1.188	1	0.276	-0.284	0.996	1.427	0.753	2.707
	RC	2.014	0.398	25.54	1	0.000*	1.233	2.795	7.491	3.431	16.357

Note: *p<0.05.

An ordinal logistic regression analysis was conducted to investigate the relationship between 12th-grade students' "STL" and four independent variables: ITEC, DTEC, KAC, and RC. As demonstrated in Table 8, the model demonstrated statistical significance (x^2=167.322, p<0.05), thereby indicating its efficacy in differentiating between levels of students' STL based on the predictors. The Pseudo R-Square values (Cox and Snell=0.405) suggest a substantial relationship between predictors and STL. In terms of individual predictors, RC (b= 2.01, SE=0.40), Wald =25.54, p<0.05) is the most significant factor, while DTEC (b= 0.69, SE=0.20, Wald =11.29, p<0.05) also positively predicts the STL levels of 12th-grade students. However, ITEC (b= 0.22, SE=0.22, Wald=0.98, p>0.05) and KAC (b= 0.36, SE=0.33, Wald=1.19, p>0.05) are not significant predictors of the STL levels of 12th-grade students. 9th-grade students' strategic learning preferences are based on epistemic curiosity and metacognitive awareness levels.

An ordinal logistic regression analysis was conducted to investigate the relationship between 9th-grade students' "SL" and four independent variables: ITEC, DTEC, KAC, and RC. The model fit was not statistically significant (χ^2=8.53, p>0.05), so the model was not effective in differentiating between levels of students' SL based on the predictors.

Table 9. Influence of epistemic curiosity and metacognitive awareness levels on 12th-grade students' surface learning approach preferences.

	Variables	Estimate	Std.Error	Wald	df	Sig.	Lower bound	Upper bound	Exp_B	Lower	Upper
Threshold	[Surface_ = 1.00]	-0.413	0.889	0.216	1	0.642	-2.155	1.329	0.661	0.116	3.776
	[Surface_ = 2.00]	2.797	0.725	14.878	1	0.000	1.376	4.218	16.397	3.958	67.921
	[Surface_ = 3.00]	6.168	0.803	58.953	1	0.000	4.593	7.742	477.129	98.825	2303.579
	[Surface_ = 4.00]	9.006	0.938	92.105	1	0.000	7.166	10.845	8147.809	1295.124	51259.026
Location	ITEC	0.046	0.216	0.045	1	0.833	-0.378	0.469	1.047	0.685	1.599
	DTEC	0.214	0.198	1.168	1	0.280	-0.174	0.601	1.238	0.84	1.825
	KAC	-0.309	0.325	0.908	1	0.341	-0.946	0.327	0.734	0.388	1.387
	RC	1.472	0.383	14.753	1	0.000*	0.721	2.223	4.358	2.056	9.236

Note: *p<0.05.

An ordinal logistic regression analysis was conducted to investigate the relationship between 12th-grade students' "SL" and four independent variables: ITEC, DTEC, KAC, and RC. As demonstrated in Table 9, the model demonstrated statistical significance (x^2=42.486, p<0.05), thereby indicating its efficacy in differentiating between levels of students' SL based on the predictors. The Pseudo R-Square values (Cox and Snell=0.124) suggest a substantial relationship between predictors and SL. In terms of individual predictors, only RC (b= 1.47, SE=0.38), Wald =14.75, p<0.05) is a significant positive predictor of the SL levels of 12th-grade students. ITEC (b= 0.05, SE=0.22, Wald=0.05, p>0.05), DTEC (b= 0.21, SE=0.20, Wald=1.17, p>0.05), and KAC (b= -0.31, SE=0.33, Wald=0.91, p>0.05) are not significant predictors of the SL levels of 12th-grade students.

5. DISCUSSION AND CONCLUSION

In the study examining the effects of MCA and EC on high school students' learning approaches, the results are summarized in Table 10. Here is a detailed discussion and conclusion based on the findings.

Table 10. Comparison of the effects of epistemic curiosity and metacognitive awareness on learning approaches in high school students.

<table>
<tr><th colspan="2" rowspan="3">Class level</th><th colspan="6">Approaches to learning</th></tr>
<tr><th colspan="2">Deep</th><th colspan="2">Strategic</th><th colspan="2">Surface</th></tr>
<tr><th>9th grade</th><th>12th grade</th><th>9th grade</th><th>12th grade</th><th>9th grade</th><th>12th grade</th></tr>
<tr><td rowspan="2">Epistemic curiosity</td><td>Interest</td><td>Positive predictor</td><td>Positive predictor</td><td>It is not a predictor</td><td>It is not a predictor</td><td rowspan="4">The model is not significant</td><td>It is not a predictor</td></tr>
<tr><td>Deprivation</td><td>Positive predictor</td><td>Positive predictor</td><td>Positive predictor</td><td>Positive predictor</td><td>It is not a Predictor</td></tr>
<tr><td rowspan="2">Metacognitive awareness</td><td>Knowledge about cognition</td><td>Positive predictor</td><td>It is not a predictor</td><td>It is not a predictor</td><td>It is not a predictor</td><td>It is not a predictor</td></tr>
<tr><td>Regulation of control</td><td>Positive predictor</td><td>Positive predictor</td><td>Positive predictor</td><td>Positive predictor</td><td>Positive Predictor</td></tr>
</table>

For learners to effectively perform learning tasks, they need to engage their cognitive skills and curiosity towards knowledge. In this context, the results indicate that EC is a significant predictor of DL for both 9th and 12th-grade learners. This finding is supported by research conducted by Richards et al. (2013). Learners who are engaged in searching for and creating meaning during the learning process tend to prioritize and show interest in their learning tasks, enjoy learning, and exhibit willingness and curiosity (Ekinci, 2009; Marton & Säaljö, 1976). In this process, EC reflects the learner's different orientations towards discovering new information (Schiefer et al., 2020). This situation leads learners to structure the acquired knowledge in their minds by evaluating it through multiple connections and relating it to different contexts, driven by their feelings of interest or deprivation.

MCA includes parameters that allow the learner to control the learning process in terms of knowledge and skills. According to Table 10, MCA is a predictor of DL, and this is supported by findings in the literature (Beccaria, Kek, Huijser, Rose, & Kimmins, 2014; Chin & Brown, 2000). However, a notable point is that, for 12th-grade students, the KAC dimension is not a significant predictor of DL. According to Annevirta and Vauras (2006) there is no relationship between metacognitive knowledge and metacognitive skills. This situation may explain why, in the current study, KAC and RC do not simultaneously predict DL, due to individual differences and the variability in learning processes.

STL focuses on managing time and study areas, developing various strategies for success, and enhancing the ego to achieve the highest level of success through competition in the learning task (Biggs, 1987). This may make DTEC and metacognitive skills significant predictors of STL for 9th and 12th-grade students. This is because learners aim to achieve targeted success within a specific timeframe. During this process, learners employ various cognitive activities that help them control their thinking and learning (Schraw & Moshman, 1995). The focus here is on the active implementation of skills that enable the learner to control their learning. Learners are goal-oriented and driven by the desire to succeed. To achieve their goals, they need to construct a comprehensive understanding of information and explain why they need to know specific information when they identify its absence (Litman, 2018). Therefore, the most effective predictors of self-regulated learning are DTEC and the skills that regulate cognition.

The findings of this study suggest that in 9th grade, SL cannot be predicted by MCA or EC. In this context, it appears that learners accept information provided by teachers without questioning it and tend to select only a portion of the material content or certain concepts less frequently. The type and structure of assessments limit learners' learning and may lead to feelings of anxiety (Cardozo et al., 2023). When evaluating the data obtained from high school students, although the possibility that learners exhibit a tendency towards learning with DTEC is considered, it was found that EC could not predict SL at either grade level. However, the fact that cognitive skills can predict SL at the 12th-grade level may relate to how the learning process is approached. For instance, Chiou and Liang (2012) found that high school students prefer SL in learning that requires lower-level understanding (such as memorization, testing, calculation, etc.), but do not strategically implement SL in understanding and structuring information.

Cognitive, motivational, and affective factors influence how much effort learners put into their study goals. These factors interact to shape the learners' approach to and execution of learning tasks with quality (Chin & Brown, 2000). In this context, Turkey has updated its educational programs, and it is expected that learners will be able to prefer both deep and strategic learning approaches. This expectation relates to learners actively engaging in the learning process, discovering information, and structuring it by relating it to different contexts in their minds, effectively applying components of EC and MCA in their learning approaches. However, the teaching process and implementation factors are significant determinants affecting learning approaches (Ramsden & Entwistle, 1981). This situation results in shaping the learning-teaching process according to outcome-based assessments rather than process-oriented evaluations. Consequently, the shaping of the learning-teaching process to ensure success in exams plays a decisive role in influencing learners' orientations towards their learning approaches.

In conclusion, for high school students, learning approaches are variables that can be predicted by EC and MCA. However, the specific deep learning (DL) approach that becomes active depending on the dimensions of EC and MCA varies according to the learner, their learning goals and tasks, the type of assessment, and the learning-teaching process. It is recommended that further in-depth studies of learning approaches considering these parameters be conducted by other researchers and educational experts. Furthermore, for instructors, it is necessary to design and implement an instructional process that aligns with the learning approach adopted by the learner to enhance the academic performance of learner groups. To enable learners to adopt a high-quality learning approach, instructors should identify instructional strategies and materials that foster learners' curiosity and interest in learning or aim to address any knowledge deficiencies. Shaping the teaching-learning process within the context of a process-oriented educational approach requires instructors to apply teaching methods and techniques that inclusively support the development of learners' metacognitive skills.

Funding: This study received no specific financial support.
Institutional Review Board Statement: The Ethical Committee of the Çanakkale Provincial Directorate of National Education, Türkiye has granted approval for this study on 23 September 2019 (Ref. No. 2019\1900135676).
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.
Disclosure of AI Use: The author used OpenAI's ChatGPT (GPT-4) to edit and refine the wording of the Introduction and Literature Review. All outputs were thoroughly reviewed and verified by the author.

REFERENCES

Abdelghani, R., Law, E., Desvaux, C., Oudeyer, P.-Y., & Sauzéon, H. (2023). *Interactive environments for training children's curiosity through the practice of metacognitive skills: A pilot study.* Paper presented at the Proceedings of the 22nd Annual ACM Interaction Design and Children Conference.

Akin, A., Abaci, R., & Çetin, B. (2007). The validity and reliability of the Turkish version of the metacognitive awareness inventory. *Educational Sciences: Theory & Practice, 7*(2), 671-678.

Alt, D., & Boniel-Nissim, M. (2018). Links between adolescents' deep and surface learning approaches, problematic Internet use, and fear of missing out (FoMO). *Internet Interventions, 13*, 30-39. https://doi.org/10.1016/j.invent.2018.05.002

Annevirta, T., & Vauras, M. (2006). Developmental changes of metacognitive skill in elementary school children. *The Journal of Experimental Education, 74*(3), 195-226. https://doi.org/10.3200/JEXE.74.3.195-226

Asikainen, H., & Gijbels, D. (2017). Do students develop towards more deep approaches to learning during studies? A systematic review on the development of students' deep and surface approaches to learning in higher education. *Educational Psychology Review, 29*(2), 205-234. https://doi.org/10.1007/s10648-017-9406-6

Atkins, M., & Brown, G. (2002). *Effective teaching in higher education.* United Kingdom: Routledge.

Banks, J. A., & Banks, C. A. (1995). *Handbook of research on multicultural education.* New York: Macmillan.

Batteson, T. J., Tormey, R., & Ritchie, T. D. (2014). Approaches to learning, metacognition and personality; an exploratory and confirmatory factor analysis. *Procedia-Social and Behavioral Sciences, 116*, 2561-2567. https://doi.org/10.1016/j.sbspro.2014.01.611

Beattie IV, V., Collins, B., & McInnes, B. (1997). Deep and surface learning: A simple or simplistic dichotomy? *Accounting Education, 6*(1), 1-12. https://doi.org/10.1080/096392897331587

Beccaria, L., Kek, M., Huijser, H., Rose, J., & Kimmins, L. (2014). The interrelationships between student approaches to learning and group work. *Nurse Education Today, 34*(7), 1094-1103. https://doi.org/10.1016/j.nedt.2014.02.006

Berlyne, D. E. (1954). A theory of human curiosity. *British Journal of Psychology General Section, 45*(3), 180-191. https://doi.org/10.1111/j.2044-8295.1954.tb01243.x

Bernardo, A. B. I. (2003). Approaches to learning and academic achievement of Filipino students. *The Journal of Genetic Psychology, 164*(1), 101-114. https://doi.org/10.1080/00221320309597506

Biggs, J. (1999). *Teaching for quality learning at university.* London: Open University Press.

Biggs, J. B. (1978). Individual and group differences in study processes. *British Journal of Educational Psychology, 48*(3), 266-279. https://doi.org/10.1111/j.2044-8279.1978.tb03013.x

Biggs, J. B. (1987). *Student approaches to learning and studying, research monograph.* Australia: Australian Council for Educational Research Ltd.

Borg, W. R., & Gall, M. D. (1979). *Educational research: An introduction* (3rd ed.). London: Longman.

Bouchard, J. (2006). Physics students' approaches to learning and cognitive processes in solving physics problems. Doctoral Dissertation, McGill University, Canada.

Brown, A. L. (1980). Metacognitive development and reading. In H. Singer & R. B. Ruddell (Eds.), Theoretical issues in reading comprehension: Perspectives from cognitive psychology, linguistics, artificial intelligence, and education. In (pp. 453–481). UK: Routledge.

Byrne, M., Flood, B., & Willis, P. (2002). The relationship between learning approaches and learning outcomes: A study of Irish accounting students. *Accounting Education, 11*(1), 27-42. https://doi.org/10.1080/09639280210153254

Cabral-Gouveia, C., Menezes, I., & Neves, T. (2023). Educational strategies to reduce the achievement gap: A systematic review. *Frontiers in Education, 8*, 1155741. https://doi.org/10.3389/feduc.2023.1155741

Cano, J. (2007). The role of motivation in student learning outcomes: A comprehensive review. *Journal of Educational Psychology, 99*(2), 398–412.

Cardozo, L. T., Lima, P. O. D., Carvalho, M. S. M., Casale, K. R., Bettioli, A. L., Azevedo, M. A. R. D., & Marcondes, F. K. (2023). Active learning methodology, associated to formative assessment, improved cardiac physiology knowledge and decreased pre-test stress and anxiety. *Frontiers in Physiology*, *14*, 1261199. https://doi.org/10.3389/fphys.2023.1261199

Case, J., & Gunstone, R. (2002). Metacognitive development as a shift in approach to learning: An in-depth study. *Studies in Higher Education*, *27*(4), 459-470. https://doi.org/10.1080/0307507022000011561

Case, R., & Marshall, S. (1986). Cognitive development in adolescence: A theoretical perspective. *Journal of Child Development*, *57*(3), 275–289.

Chan, W. S. (2003). Stock price reaction to news and no-news: Drift and reversal after headlines. *Journal of Financial Economics*, *70*(2), 223-260. https://doi.org/10.1016/S0304-405X(03)00146-6

Chin, C., & Brown, D. E. (2000). Learning in science: A comparison of deep and surface approaches. *Journal of Research in Science Teaching*, *37*(2), 109-138.

Chiou, G. L., & Liang, J. C. (2012). Exploring the structure of science self-efficacy: A model built on high school students' conceptions of learning and approaches to learning in science. *Asia-Pacific Education Researcher (De La Salle University Manila)*, *21*(1), 83–91.

Chirikure, T., Govender, N., Sibanda, D., Kolobe, L., Good, M. A., & Ngema, S. (2019). Adding voices to physical sciences preservice teachers' approaches to learning. *African Journal of Research in Mathematics, Science and Technology Education* 23(2), 195-205. https://doi.org/10.1080/18117295.2019.1654211

Cohen, L., Manion, L., & Morrison, K. (2002). *Research methods in education* (5th ed.). UK: Routledge.

Coleman, J. S. (1966). The possibility of a social welfare function. *The American Economic Review*, *56*(5), 1105-1122.

Cuthberth, J. A. (2005). The dynamics of organizational behavior: A contemporary approach. *Journal of Organizational Studies*, *22*(3), 135–150.

Díaz, E. V., Hilliger, I., Gonzalez, C., Celis, S., Pérez-Sanagustín, M., & Broisin, J. (2024). The mediating role of learning analytics: Insights into student approaches to learning and academic achievement in Latin America. *Journal of Learning Analytics*, *11*(1), 6-20. https://doi.org/10.18608/jla.2024.8149

Egenti, H. N. (2012). Relationships of approaches to studying, metacognition, and intellectual development of general chemistry students. Doctoral Dissertation, University of North Texas, ProQuest.

Ekinci, N. (2009). Learning approaches of university students. *Education and Science*, *34*(151), 74-88.

Entwistle, N. (2018). *Student learning and academic understanding: A research perspective with implications for teaching*. London, UK: Academic Press.

Entwistle, N., McCune, V., & Walker, P. (2014). Conceptions, styles, and approaches within higher education: Analytic abstractions and everyday experience. In Perspectives on thinking, learning, and cognitive styles. In (pp. 103-136). UK: Routledge.

Evans, C. J. (2000). Approaches to learning, need for cognition, and strategic flexibility among university students. Master's Thesis. Queen's University, Canada.

Faranda, W. T., Clarke, T. B., & Clarke III, I. (2020). Marketing student perceptions of academic program quality and relationships to surface, deep, and strategic learning approaches. *Journal of Marketing Education*, *43*(1), 9-24. https://doi.org/10.1177/0273475320939261

Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. Resnick (Ed.), The Nature of Intelligence. In (pp. 231-236). Hillsdale, NJ: Erlbaum.

Forrest-Pressley, D. L., & Waller, T. G. (1984). Comprehension and strategies. In Cognition, Metacognition, and Reading. In (pp. 33-60). New York: Springer.

George, S. D., Maung, T. M., Narayanam, H., & Latt, S. S. (2023). Evaluation of learning approaches among first-year medical and dental students of a private university, in Malaysia. *IIUM Medical Journal Malaysia*, *22*(2), 108–116. https://doi.org/10.31436/imjm.v22i2.2110

Goupil, L., & Proust, J. (2023). Curiosity as a metacognitive feeling. *Cognition*, *231*, 105325. https://doi.org/10.1016/j.cognition.2022.105325

Guo, J., Yang, L., & Shi, Q. (2017). Effects of perceptions of the learning environment and approaches to learning on Chinese undergraduates' learning. *Studies in Educational Evaluation*, *55*, 125-134. https://doi.org/10.1016/j.stueduc.2017.09.002

Hayawi, H. A. A., Sedeeq, B. S., & Ali, T. H. (2025). A comprehensive overview of ordinal regression in statistical modeling. Preprints, 202507.0735 (Version 1). https://doi.org/10.20944/preprints202507.0735.v1

Heissel, J. A., Levy, D. J., & Adam, E. K. (2017). Stress, sleep, and performance on standardized tests: Understudied pathways to the achievement gap. *AERA Open*, *3*(3), 1-17. https://doi.org/10.1177/2332858417713488

Hong, X., Liu, Q., & Zhao, S. (2023). Approaches to learning of preschool children in China: A comparison between only children and non-only children. *Behavioral Sciences*, *13*(5), 418. https://doi.org/10.3390/bs13050418

Hung, M., Smith, W. A., Voss, M. W., Franklin, J. D., Gu, Y., & Bounsanga, J. (2019). Exploring student achievement gaps in school districts across the United States. *Education and Urban Society*, *52*(2), 175-193. https://doi.org/10.1177/0013124519833442

Jeynes, W. H. (2014). A meta-analysis on the factors that best reduce the achievement gap. *Education and Urban Society*, *47*(5), 523-554. https://doi.org/10.1177/0013124514529155

Kember, D., Jamieson, P., Pomfred, T., & Wong, M. (2015). Teaching strategies for enhancing student engagement in higher education. *Journal of Educational Research and Practice*, *18*(4), 112–130.

Kim, S., Harris, P. L., & Néher, B. (2025). Curiosity can influence metacognitive processes. *Metacognition and Learning*, *20*(1), 39. https://doi.org/10.1007/s11409-025-09444-y

Kovač, V. B., Nome, D. Ø., Jensen, A. R., & Skreland, L. L. (2025). The why, what and how of deep learning: Critical analysis and additional concerns. *Education Inquiry*, *16*(2), 237-253. https://doi.org/10.1080/20004508.2023.2194502

Ladson-Billings, G. (2006). From the achievement gap to the education debt: Understanding achievement in US schools. *Educational Researcher*, *35*(7), 3-12.

Lee, M.-H., Johanson, R. E., & Tsai, C.-C. (2008). Exploring Taiwanese high school students' conceptions of and approaches to learning science through a structural equation modeling analysis. *Science Education*, *92*(2), 191-220. https://doi.org/10.1002/sce.20245

Litman, J., & Jimmerson, J. (2004). Exploring the relationship between motivation and academic performance. *Journal of Educational Psychology*, *96*(1), 45–57.

Litman, J. A. (2018). Curiosity: Nature, dimensionality, and determinants. In K.A. Renninger & S.E. Hidi (Eds.) The Cambridge Handbook of Motivation and Learning. In (pp. 418-441). New York: Cambridge University Press.

Litman, J. A., & Spielberger, C. D. (2003). Measuring epistemic curiosity and its diversive and specific components. *Journal of Personality Assessment*, *80*(1), 75-86. https://doi.org/10.1207/S15327752JPA8001_16

Loewenstein, G. (1994). The psychology of curiosity: A review and reinterpretation. *Psychological Bulletin*, *116*(1), 75-98. https://doi.org/10.1037//0033-2909.116.1.75

Magno, C. (2009). Investigating the effect of school ability on self-efficacy, learning approaches, and metacognition. *Asia-Pacific Education Researcher*, *18*(2), 233-244.

Marton, F., & Säaljö, R. (1976). On qualitative differences in learning—ii Outcome as a function of the learner's conception of the task. *British Journal of Educational Psychology*, *46*(2), 115-127. https://doi.org/10.1111/j.2044-8279.1976.tb02304.x

Metcalfe, J., Schwartz, B. L., & Eich, T. S. (2020). Epistemic curiosity and the region of proximal learning. *Current Opinion in Behavioral Sciences*, *35*, 40-47. https://doi.org/10.1016/j.cobeha.2020.06.007

Miller, B. C., & Olson, T. D. (1988). Sexual attitudes and behavior of high school students in relation to background and contextual factors. *Journal of Sex Research*, *24*(1), 194-200. https://doi.org/10.1080/00224498809551411

Moreira, P. A. S., Inman, R. A., Rosa, I., Cloninger, K., Duarte, A., & Robert Cloninger, C. (2020). The psychobiological model of personality and its association with student approaches to learning: Integrating temperament and character. *Scandinavian Journal of Educational Research*, *65*(4), 693-709. https://doi.org/10.1080/00313831.2020.1739137

Newble, D. I., & Entwistle, N. J. (1986). Learning styles and approaches: Implications for medical education. *Medical Education*, *20*(3), 162-175. https://doi.org/10.1111/j.1365-2923.1986.tb01163.x

Newman, I., Benz, C. R., & Ridenour, C. S. (1998). *Qualitative-quantitative research methodology: Exploring the interactive continuum*. Carbondale, IL: Southern Illinois University Press.

Ornstein, A. C. (2010). Achievement gaps in education. *Society, 47*(5), 424-429. https://doi.org/10.1007/s12115-010-9354-y

Pallant, J. (2020). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*. Abingdon, UK: Routledge.

Papinczak, T., Young, L., Groves, M., & Haynes, M. (2008). Effects of a metacognitive intervention on students' approaches to learning and self-efficacy in a first year medical course. *Advances in Health Sciences Education, 13*(2), 213-232. https://doi.org/10.1007/s10459-006-9036-0

Pask, G. (1976). Styles and strategies of learning. *British Journal of Educational Psychology, 46*(2), 128-148. https://doi.org/10.1111/j.2044-8279.1976.tb02305.x

Postareff, L., Mattsson, M., & Parpala, A. (2018). The effect of perceptions of the teaching-learning environment on the variation in approaches to learning–Between-student differences and within-student variation. *Learning and Individual Differences, 68*, 96-107. https://doi.org/10.1016/j.lindif.2018.10.006

Ramsden, P. (1985). Student learning research: Retrospect and prospect. *Higher Education Research and Development, 4*(1), 51-69. https://doi.org/10.1080/0729436850040104

Ramsden, P., & Entwistle, N. J. (1981). Effects of academic departments on students' approaches to studying. *British Journal of Educational Psychology, 51*(3), 368–383.

Reardon, S. F. (2013). The widening income achievement gap. *Educational Leadership, 70*(8), 10–16.

Richards, J. B., Litman, J., & Roberts, D. H. (2013). Performance characteristics of measurement instruments of epistemic curiosity in third-year medical students. *Medical Science Educator, 23*(3), 355-363. https://doi.org/10.1007/BF03341647

Robson, C. (2015). *Real world research* (3rd ed.). Chichester, UK: Wiley.

Rolleston, C., Schendel, R., & Grijalva Espinosa, A. M. (2019). Assessing 'approaches to learning'in Botswana, Ghana and Kenya. *Research in Comparative and International Education, 14*(1), 118-140. https://doi.org/10.1177/1745499919829216

Schiefer, J., Golle, J., Tibus, M., Herbein, E., Gindele, V., Trautwein, U., & Oschatz, K. (2020). Effects of an extracurricular science intervention on elementary school children's epistemic beliefs: A randomized controlled trial. *British Journal of Educational Psychology, 90*(2), 382-402. https://doi.org/10.1111/bjep.12301

Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology, 19*(4), 460-475. https://doi.org/10.1006/ceps.1994.1033

Schraw, G., & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review, 7*(4), 351-371. https://doi.org/10.1007/BF02212307

Schunk, D. H. (2009). *Learning theories: An educational perspectives. (Çev. M. Şahin)*. Ankara: Nobel. 5.Baskı.

Schutt, R. K. (2011). *Investigating the social world: The process and practice of research* (7th ed.). United States: SAGE Publications.

Sparks, T. C. (2013). Insecticide discovery: An evaluation and analysis. *Pesticide Biochemistry and Physiology, 107*(1), 8-17. https://doi.org/10.1016/j.pestbp.2013.05.012

Taskesen, S. (2020). A research on learning approaches and achievement focused motivations of prospective visual arts teachers. *International Education Studies, 13*(1), 123-134.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education, 2*, 53–55.

Trigwell, K., & Prosser, M. (1991). Improving the quality of student learning: The influence of learning context and student approaches to learning on learning outcomes. *Higher Education, 22*(3), 251-266. https://doi.org/10.1007/BF00132290

Trigwell, K., Prosser, M., & Waterhouse, F. (1999). Relations between teachers' approaches to teaching and students' approaches to learning. *Higher Education, 37*(1), 57-70. https://doi.org/10.1023/A:1003548313194

Vermunt, J. D. (1996). Metacognitive, cognitive and affective aspects of learning styles and strategies: A phenomenographic analysis. *Higher Education, 31*(1), 25-50. https://doi.org/10.1007/BF00129106