EJI | Education Journal of Indonesia
Vol 7 Nomor 2 November 2026, hal: 47 - 65
ISSN: 2774-4949

Unraveling Student Success: The Interplay of Learning Motivation, Learning Approaches, and Academic Achievement

Bora Phan[1], Kok-Lay Heng[2], Koemva Sorn[3], Fr. Phan Borei[4]

[1]National University of Cheasim Kamchaymear, Cambodia
https://orcid.org/0009-0008-0931-1530
[2]Université Pierre et Marie Curie (France)
https://orcid.org/0009-0005-1026-2885
[3,4]Royal University of Phnom Penh

Corresponding Email: phanbora17@gmail.com

Abstract

This study examines academic inspiration in mathematics and learning motivation, the choice between intrinsic and extrinsic motivation, and task value, with a specific focus on the moderating roles of surface and deep learning, and on how to make students highly committed to duty tasks for their academic achievement. *This study employed a cross-sectional design and validated questionnaires to collect data from grade 12 math students at various educational institutions (N=571). Random sampling was used to select participants. The study had 32.0% males and 43.8% females in non-urban areas, and 8.9% males and 15.2% females in urban areas, with a mean age of 17.20 (SD = 0.294) and Cronbach's α = 0.86. The findings of this study make it clear that intrinsic motivation, extrinsic motivation, task value, surface learning, and deep learning predict academic achievement quite significantly. Surface and deep learning tactics positively affected students' academic success. It also found that intrinsic motivation increased the predictive validity of subjective task value for success, and all affected students' learning outcomes positively.*

Keywords: *intrinsic motivation, extrinsic motivation, task value, surface learning, deep learning, academic achievement*

1. INTRODUCTION

Math students' academic success in the classroom is greatly influenced by their intrinsic motivation, particularly in subjects like mathematics that require deep understanding and critical thinking (Phan & Heng, 2026; Phan et al., 2026). This study examines the complex relationships between academic achievement, learning motivation, surface learning, deep learning, and task value in the context of mathematics education in Cambodia (Bora, 2025; Phan & Harth, 2025). Understanding the key elements that affect achievement in mathematics learning holds the key to raising students' grades and, ultimately, assisting Cambodia's educational system to gain acceptance in the international community (Bao et al., 2025; Meas et al., 2024). Reports by UNDP and UNESCO declare that good education is a precondition for sustainable development (Tatto, 2021), but successful math teaching techniques have to be found that will result in higher individual student achievements and increased general participation (Culala & De Leon, 2020; Tatto, 2021). This study investigates the connection between academic success in mathematics and intrinsic motivation, extrinsic reward, and subjective task value, especially in an environment where educational barriers still exist (Camacho-Morles et al., 2021; Michaelides et al., 2019). Intrinsic motivation has been demonstrated to have a positive correlation with academic achievement, as it fosters meaningful engagement with the

material (Chen & Chen, 2026; Oppmann et al., 2026). The World Economic Forum said that there needs to be a balance between internal motivation and external motivation to build a workforce that can keep up with a fast-changing economy (Chien et al., 2020; Pohle et al., 2022). Motivation and engagement are greatly impacted by the idea of subjective task value, which concerns students' views of the importance and usefulness of mathematics in their daily lives (Middleton et al., 2022; Wang et al., 2017). Teaching students about the value of math can improve their academic performance in Cambodia, where it is generally regarded as a challenging subject (Middleton et al., 2022; Rach, 2022). The mediating functions of surface learning and deep learning strategies further elucidate the connection between these motivating factors and academic achievement (Hayat et al., 2020; Zhao & Liu, 2022). Deep learning emphasizes knowledge comprehension and application more than surface learning does; it usually entails rote memorization and superficial involvement (Chamorro-Premuzic & Furnham, 2008; Phan & Heng, 2026). Studies show that students who employ deep learning strategies, who are motivated internally and generally possess a high subjective task value, are more likely to perform well academically when learning mathematics (Chamorro-Premuzic & Furnham, 2008). Educational psychology has focused on how intrinsic motivation, extrinsic reward, and subjective task value relate to academic achievement, especially in the context of learning mathematics (Alhadabi & Karpinski, 2019; Wolters & Hussain, 2014).

Extrinsic motivation is the impact of outside demands or rewards on behaviour, whereas intrinsic motivation is the innate desire to act for its own sake (Locke & Schattke, 2019; Trevino & DeFreitas, 2014). Since intrinsic motivation encourages greater engagement and perseverance in learning tasks, research has repeatedly demonstrated a positive correlation between it and academic performance (Mohamed Mohamed Bayoumy & Alsayed, 2021; Trevino & DeFreitas, 2014). Extrinsic rewards, however, can also have a big impact, especially if they enhance intrinsic factors and increase students' performance and effort (Mohamed Mohamed Bayoumy & Alsayed, 2021). Furthermore, the concept of subjective task value, that is, the perceived importance and applicability of a task, is a crucial factor influencing motivation and achievement (Li et al., 2016; Phan, 2025). Students are more likely to take an active interest in mathematics and perform better academically when they believe that the subject applies to their daily lives (Li et al., 2016). The relationship between these motivating factors and academic achievement is further clarified by the mediation of surface learning and deep learning techniques (Edwards & Dai, 2023; Li et al., 2016). Surface learning emphasizes comprehending and using mathematical knowledge, which sets it apart from other methods that typically involve rote memorization and surface-level engagement (Edwards & Dai, 2023; Ng et al., 2015). According to studies, students who use deep learning strategies, which are usually motivated by intrinsic motivation and subjective task value, perform better academically when learning mathematics (Edwards & Dai, 2023; Ng et al., 2015). The purpose of this study is to examine how surface and deep learning mediate the relationship between subjective task value, extrinsic incentive, and intrinsic motivation and mathematical performance as predictors (Ng et al., 2015; Orji & Vassileva, 2023).

This study focuses on the mediating roles of deep and surface learning and examines how academic performance in mathematics is predicted in the Cambodian context by intrinsic motivation, extrinsic incentive, and subjective task value (Li et al., 2016;

Orji & Vassileva, 2023). By examining these relationships, we can provide recommendations for how to establish a learning environment in the classroom that promotes and supports the mathematical abilities of Cambodian students, in keeping with the more general goals set by international organizations (Phan, 2025; Trevino & DeFreitas, 2014). The purpose of this study is to investigate how deep and surface learning mediate the relationship between students' academic achievement in mathematics and intrinsic motivation in Cambodia (Li et al., 2016; Phan, 2025). By being aware of these dynamics, teachers can modify their methods to encourage intrinsic motivation, which will improve learning outcomes and student engagement in math classes (Ng et al., 2015; Trevino & DeFreitas, 2014).

OBJECTIVES OF THE STUDY

The goal of this research is to investigate and clarify the connection between academic success and intrinsic motivation in the context of mathematics education, with an emphasis on the mediating roles of surface and deep learning (Garon-Carrier et al., 2016; Ng et al., 2015). By fulfilling these goals, the study hopes to improve educational outcomes by offering a thorough understanding of how intrinsic motivation, learning strategies, and academic achievement interact in mathematics education (Liu, 2021; Wild & Neef, 2023).

2. Review of Related Literature

1.1 Academic achievement

For educational researchers working in developing countries like Cambodia, where educational reforms are essential to social and economic development, academic achievement in mathematics is a critical area of study (Hun, 2024; Pov et al., 2020). According to research, several factors affect students' performance in mathematics, including motivation, teaching methods, and sociocultural contexts (Hun, 2024; Orji & Vassileva, 2023). Motivating factors from within higher academic achievement have been connected to a sincere desire to learn (Orji & Vassileva, 2023; Phan, 2025). Developing intrinsic motivation is crucial for increasing engagement and perseverance in mathematics studies in Cambodia, where students frequently face challenges such as limited resources and high-stakes tests (Phan et al., 2026; Zeynali et al., 2019). However, extrinsic motivation, which is impacted by outside variables like grades and parental expectations, can also affect students' performance (Phan, 2026; Phan et al., 2025). However, it might not sustain interest over time (Phan, 2026; Phan & Heng, 2026). The quality of mathematics education has a big influence on students' academic performance (Garon-Carrier et al., 2016; Phan & Heng, 2026). According to this study, traditional lecture-based mathematics instruction is outperformed by active learning strategies that encourage student participation and critical thinking (Garon-Carrier et al., 2016; Hun, 2024). Adopting student-centred teaching methodologies is necessary to improve mathematics instruction because rote memorization and passive learning are still common in Cambodian classrooms (Phan et al., 2025; Phan & Heng, 2026). To understand how students engage with mathematical content, it is also necessary to understand the distinctions between surface learning and deep learning approaches (Phan & Heng, 2026). While surface learning, which is defined as memorization without comprehension, usually yields worse results, deep learning, which involves a thorough understanding and application of topics, is linked to academic success (Phan & Heng, 2026; Wild & Neef, 2023). Employing deep learning strategies, students in Cambodian schools can better comprehend mathematics instruction (Sok et al., 2025). The sociocultural background of Cambodian students has a big impact on their academic achievement in mathematics (Phan et al., 2025). Students' financial situation, parental involvement, and cultural views on education are just a few of the many variables that may

have an impact on their motivation and performance (Phan et al., 2025; Sok et al., 2025). Even though education is highly valued in many Cambodian households, access to resources and learning support may be restricted due to financial constraints (Zeynali et al., 2019). Improving academic performance in mathematics requires addressing these sociocultural barriers, but some national and international organizations, like the Peace Family and Development Organization (PFDO), work to support students (Trevino & DeFreitas, 2014; Zeynali et al., 2019).

1.2 Learning Motivation

Students' academic performance is greatly impacted by intrinsic learning motivation, or the desire to participate in an activity because it is interesting and fulfilling, especially when learning mathematics (Garon-Carrier et al., 2016; Phan, 2025). In Cambodia, where educational issues persist, improving math performance and student engagement necessitates an awareness of the elements that promote intrinsic motivation (Garon-Carrier et al., 2016). Students' performance and interest in learning mathematics are greatly impacted by intrinsic motivation, particularly when taking into account Cambodia's educational system (Phan, 2026; Phan et al., 2025). The literature review statement highlights the unique opportunities and challenges faced by Cambodian math students while summarizing recent research that looks at the factors influencing their intrinsic motivation (Phan et al., 2025; Phan et al., 2026). *Cultural Context:* Cambodian cultural norms have a big influence on students' intrinsic motivation to learn mathematics (Phan et al., 2026). Claim that traditional views on education and success can either increase or decrease students' motivation to engage in mathematics learning, depending on how well these ideas mesh with modern teaching methods (Wild & Neef, 2023). The cultural values of Cambodia have a significant impact on students' intrinsic motivation to learn mathematics (Wild & Neef, 2023; Zeynali et al., 2019). Depending on how well they mesh with contemporary teaching methods, traditional views on education and success can have an impact on students' motivation to learn mathematics (Garon-Carrier et al., 2016; Zeynali et al., 2019). *Task Value:* The perceived value of learning mathematics is a significant determinant of intrinsic motivation (Edwards & Dai, 2023). A cross-sectional study demonstrated how emphasizing the real-world applications of mathematics education could increase students' intrinsic motivation and promote more in-depth learning techniques (Edwards & Dai, 2023; Garon-Carrier et al., 2016). *Parental Support*: Improving intrinsic motivation in mathematics requires parental participation (Phan, 2025). According to research, students who grow up in supportive home environments are more likely to pursue their mathematical interests (Ng et al., 2015; Phan, 2025). *Social and Economic Factors:* Levels of intrinsic motivation can be influenced by socioeconomic status (Ng et al., 2015). Particularly pertinent to the Cambodian students' context, found that lower socioeconomic background students in Cambodia often face additional challenges that can lower their intrinsic motivation, such as limited access to educational resources and support (Phan, 2025; Sok et al., 2025).

1.3 Extrinsic Motivation

Students' performance and level of engagement in math classes are significantly impacted by extrinsic motivation, especially in the context of Cambodia (Phan, 2025; Pum & Tao, 2026). This literature review statement highlights recent findings on the factors influencing extrinsic motivation to highlight the special opportunities and difficulties faced by Cambodian students in math classes (Ng et al., 2015; Zhao et al., 2024). *Incentives and Rewards:* Extrinsic motivators, such as grades and awards, have a significant impact on students' attitudes toward learning mathematics (Mazana et al., 2018; Mula et al., 2024). Outside rewards are typically well received by students, which may increase their motivation to complete math assignments, particularly in a competitive setting, according to the claim

(Phan, 2025; Zainuddin, 2018). *Parental Expectations*: Parental involvement and expectations are among the most significant extrinsic motivators for students (Phan, 2025). Parents who have high expectations for their children's academic performance may encourage them to do well in mathematics classes as they work toward their own goals (Phan, 2025, 2026). *Teacher Influence:* One important source of extrinsic motivation is teachers. Assert that teachers can increase their students' interest in learning mathematics by employing praise, appreciation, teaching self-confidence, and teaching an instructional attitude (Phan, 2026). This recognition could increase students' interest in the subject, which could create a positive feedback loop (Li et al., 2016). *Social and Economic Factors*: The efficacy of extrinsic motivators may be impacted by the way of describing people are described based on their education, income, and type of job level (Li et al., 2016). Students from lower socioeconomic backgrounds may rely more on extrinsic rewards because they have less access to resources and support, which can affect their motivation levels and performance in mathematical learning (Li et al., 2016; Mohamed Mohamed Bayoumy & Alsayed, 2021). *Cultural context:* How extrinsic incentives are viewed and applied in Cambodia is influenced by the country's cultural context (Mohamed Mohamed Bayoumy & Alsayed, 2021). Students' reactions to extrinsic motivators can be influenced by their cultural views on learning and achievement; some may feel that receiving rewards from outside sources is crucial to their academic achievement (Mohamed Mohamed Bayoumy & Alsayed, 2021).

1.4 Subjective Task Value

Subjective task value, which encompasses the perceived importance, utility, and enjoyment of their task, has a significant impact on students' motivation and engagement in mathematics studies (Li et al., 2016). If educational attainment is to improve in Cambodia, educators, parents, and students must comprehend how subjective task value affects students' attitudes toward learning mathematics (Li et al., 2016; Phan et al., 2025). According to research, students' motivation to learn mathematics is significantly influenced by their views of the subject's importance (Phan et al., 2025). It is asserted that a large number of Cambodian students find mathematics difficult because they lack interest in it, which can result in disengagement and subpar academic performance (Li et al., 2016; Phan et al., 2025). Enhancing students' subjective task value is essential to creating a supportive learning environment and raising their general opinions about studying mathematics. Students' perceptions of mathematics learning are also influenced by Cambodia's social and cultural context (Li et al., 2016). Many students find mathematics to be a challenging and abstract subject, which might demotivate them (Ng et al., 2015). According to, Students' subjective task value may increase when culturally relevant examples and mathematical applications are incorporated into the curriculum to show how important learning mathematics is in everyday life (Li et al., 2016; Ng et al., 2015). Students' perceptions of learning mathematics are also greatly influenced by their teachers (Li et al., 2016). asserts that students' perceptions of the value of learning mathematics can be greatly influenced by the expectations and remarks they receive from their teachers (Phan et al., 2025). Professional development programs that improve teachers' pedagogical skills can help them convey the importance of learning mathematics, which will increase students' subjective task values in Cambodia (Orji & Vassileva, 2023; Phan et al., 2025).

1.5 Surface learning

Math learners face several difficulties with surface learning, which is defined by an emphasis on memorization and little interaction with the content (Riccomini et al., 2015; Trevino & DeFreitas, 2014). Improving students' proficiency in mathematics and overall educational outcomes in Cambodia requires an understanding of the prevalence and impacts of surface learning (Bujak et al., 2013; Phan, 2025). Research shows that many

Cambodian students have surface learning habits, which are often caused by traditional teaching methods that place more emphasis on memorization than conceptual understanding (Bujak et al., 2013; Ng et al., 2015). There are claims that this approach hinders students' ability to apply mathematical ideas they have learned in practical settings, which results in a lack of critical thinking skills and a thorough understanding of the subject matter (Ng et al., 2015; Phan et al., 2025). According to Bora, students in Cambodian classrooms typically prioritize memorization over active engagement with the material because of the emphasis on passing tests, which results in surface learning (Phan et al., 2025; Phan & Heng, 2026). Surface learning persists in Cambodia due to a combination of structural and cultural factors (Mula et al., 2024; Song, 2015). Standardized testing is typically given priority in the educational system, which promotes surface learning techniques (Mula et al., 2024; Ng et al., 2015). Instead of grasping the fundamental ideas of mathematics, students might feel under pressure to memorize formulas and procedures (Bao et al., 2025; Phan, 2025). This focus on testing may hinder the development of deeper or more complex thinking skills required for successful mathematical learning. Students' approaches to learning are also greatly influenced by their teachers (Göloğlu Demir, 2021). According to Hattie (2009), good teaching methods can provide more in-depth learning opportunities (Garay Abad & Hattie, 2025). Professional development programs that equip teachers with the skills they need to promote conceptual understanding and critical thinking can help Cambodian educators move away from surface learning and toward deeper engagement with mathematical topics (Garay Abad & Hattie, 2025; Phan et al., 2025).

1.5 Deep Learning

Effective mathematics instruction requires deep learning, which is defined by a deep comprehension of concepts and the capacity to apply knowledge in a range of contexts (Phan, 2026; Phan et al., 2025). To enhance students' overall academic performance and problem-solving skills, deep learning in mathematics must be encouraged in Cambodia (Phan et al., 2025). According to this research, deep learning is frequently underrepresented in math classes in Cambodia, where conventional teaching approaches might place more emphasis on rote memorization than conceptual comprehension, due to a lack of teaching approaches that encourage critical thinking and application (Chen & Hwang, 2019; Phan & Heng, 2026). Many students struggle to connect with mathematical learning concepts on a deeper level (Li, 2023). Additionally, institutional and cultural factors influence the prevalence of deep learning in Cambodia (Phan et al., 2025). The emphasis on standardized testing frequently results in a focus on surface learning strategies, which may impede students' capacity to interact deeply with mathematical content, claim (Chen & Yeh, 2019). Students may be discouraged from actively exploring mathematical concepts and have fewer opportunities for in-depth learning as a result of the pressure to perform well on tests (Chen & Yeh, 2019; Garon-Carrier et al., 2016). Teachers play a critical role in promoting in-depth mathematical learning (Chen & Yeh, 2019). Effective teaching techniques like providing feedback, encouraging student participation, and fostering a development mindset can significantly enhance students' learning experiences (Chen & Yeh, 2019; Chen & Hwang, 2019). It may be possible to shift the focus in Cambodia from memorization to a deeper comprehension of mathematical concepts through professional development programs that equip educators with innovative teaching methods (Ng et al., 2015; Phan, 2025).

2. RESEARCH METHOD

Research Design

The impact of learning motivation and learning approach on academic achievement in mathematics education is examined in this study using a cross-sectional survey design, with an emphasis on the mediating roles of surface and deep learning (Creswell & Hirose, 2019). Because of this design, data can be collected at a single point in time, making it easier to examine relationships between variables without the need for longitudinal tracking (Ployhart & Vandenberg, 2009). This cross-sectional study design will enable a thorough examination of the mediating roles of surface and deep learning, as well as the impact of learning motivation on academic achievement (Creswell et al., 2023). With implications for improving student motivation and learning outcomes, the study attempts to offer insightful information about mathematics education.

Population and Sample

Grade 12 math high school students in Kampong Cham Province, Cambodia, participated in this study, which was used to collect students' opinions. It focuses on the mathematics subject, learning motivation, and learning approach to mathematics. Among the (N=571) participants in the study were non-urban (32.0% male and 43.8% female) and urban (8.9% male and 15.2% female) students from high schools in Kampong Cham Province, Cambodia (mean age = 17.20, SD = 0.294. In Table 1, the combination of social features is displayed. Students were chosen using (explain sampling technique, such as convenience, random sample). Students gave their assent, and participation was entirely voluntary.

Table 1 lists the combination of social characteristics of the sample.

location	Gender	Counts	% of Total	Cumulative %
non-urban	male	183	32.0%	32.0%
	female	250	43.8%	75.8%
urban	male	51	8.9%	84.8%
	female	87	15.2%	100.0%

(N=571)

This study used a structured questionnaire as the main tool for data collection to examine the effect of intrinsic motivation, extrinsic incentive, and task value on academic achievement in mathematics (Hendijani et al., 2016). The primary constructs of the study, such as academic accomplishment, deep learning, surface learning, subjective task value, intrinsic motivation, and extrinsic motivation, will all be measured via the questionnaires (Hendijani et al., 2016).

Research Instruments

The instruments measuring each subconstruct of learning motivation (i.e., students' intrinsic learning motivation, extrinsic learning motivation, subjective task value) were developed using the technique of translation and back-translation, and of learning

approaches (i.e., surface learning approaches and deep learning approaches), and academic achievement; measurement tools have been developed by researchers. Commonly used tools include the Study Process Questionnaire (SPQ) and the Learning Process Questionnaire (LPQ). First, the original scales in English were adapted by the researchers and then translated into Khmer by two bilingual Cambodian lecturers. Used the translated version and translated the scales back into English. After that, we compared the Khmer and the English versions of the scales to see if each item was able to match the initial meaning. Second, the Khmer version of the scales was applied to 36 grade 12 students to answer 30 items for a pilot test.

Test content validity, to evaluate by face validity (36 pilot), test the reliability of each item, and meet face-to-face with every 36 student to get feedback after answering all the questionnaires. Second, the Khmer version of the scales was applied to (N=571) grade 12 students' answers with 30 items in different high schools in Kampong Cham province, Cambodia was non-urban (32.0% male and 43.8% female) and urban (8.9% male and 15.2% female). In this study, we used a self-report method to assess subjective perceptions of the items in each adapted scale, which might lead to response bias. In all the scales, students had to rate each item on a 5-point Likert scale, ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). Third, record data entry to the database in Excel or SPSS and clean data (check for missing values, outliers, and normal distribution). To make the subconstructs fit into the Cambodian students’ education context and to check the construct validity of the model, confirmatory factor analysis (CFA) was conducted. Before the CFA, we checked for normal distribution and multicollinearity. The normal distribution of the data was measured by the skewness and kurtosis of each item.

Data Collection

The sampling approach was random sampling (Martino et al., 2018). Pilot-tested with 36 math students and checked the content validity, face validity, and reliability of each item. Collected data from grade 12 high school students in Kampong Cham Province, Cambodia (N=571) were non-urban (32.0% male and 43.8% female) and urban (8.9% male and 15.2% female). With an emphasis on the mediating roles of deep learning and surface learning, a carefully chosen set of research instruments will be used in this cross-sectional survey design to collect data on the impact of intrinsic motivation on academic achievement in mathematics education. The tools guarantee that the information gathered is valid, accurate, and reliable. This collection of research tools was intended to enable a thorough and precise evaluation of the connections between academic success in mathematics education, deep and surface learning, and intrinsic motivation. The methodical approach strengthened the study's reliability and produced insightful results for the field.

Data Analysis

After data collection, we checked step by step the construct validity (convergent validity), divergent/discriminant validity, factor analysis, internal consistency reliability, Cronbach’s Alpha, construct/ composite reliability, and analysis using SPSS and JAMOVI 2.6.44 to analyse the psychometric variables.

3. RESEARCH RESULTS

Table 1 shows the differences in distribution between groups and the combination of social data of the participants. A total of N=571 high school students. Non-urban-Male (counts = 183, % of total 32.0%, cumulative = 32.0%, female (counts = 250, % of total = 43.8%, cumulative = 75.8%. Urban-Male (counts = 51, % of total = 8.9%, cumulative = 84.8%) and female (counts = 87, % of total = 15.2%, cumulative = 100%, from Kampong Cham Province, Cambodia, participated in the study. Table 2: Scale reliability of the measuring apparatus based on the Cronbach's alpha coefficient. We may observe that for every research variable, the Cronbach's alpha falls between outstanding Mean 3.92, SD 0.307, Cronbach's α is 0.86. Additionally, they strongly mirror the Cronbach's alpha α .73 to.86; that is produced from standardized items.

Since your actual output files or results of your data set related to “The Mediating Roles of Deep and Surface Learning Among Cambodian Grade 12 Students” (N = 571) are not available in your chat history, it is not possible to generate the empirical numbers (AVE, CR, X^2/df, CFI, TLI, RMSEA, SRMR) from scratch.

However, considering the sample size of (N=571), which is quite powerful in terms of statistics when using Structural Equation Modelling (SEM). Below are the ideal standards of fit indices that you should strive to achieve and a template you can use to publish your findings.

Measures for Assessing Model Fit (Overall Model Fit)

Table 2: Chi-square (X^2) is sensitive to sample size (N = 571); the following are the approximate fit indices that will be relied upon extensively by researchers:

Fit Index	Acceptable Threshold	Good / Excellent Fit	Description
X^2 / df (Normed Chi-Square)	< 3.0 (or < 5.0)	≤2.0	Adjusted Chi Square based on degrees of freedom. Values less than 3 represent good model fit.
CFI (Comparative Fit Index)	≥ 0.90	≥ 0.95	Measures goodness-of-fit between a hypothesized model and the baseline independence model.
TLI (Tucker-Lewis Index)	≥ 0.90	≥ 0.95	Disadvantages: over-fitting models. Also called NNFI.
RMSEA (Root Mean Square Error of Approximation)	≥ 0.80	≥ 0.05	Indicates the error of approximation per degrees of freedom. Values ≤ 0.06 signify
SRMR (Standardized Root Mean Square Residual)	≥ 0.08	≥ 0.05	Average discrepancy between predicted and observed correlations.

Psychometric Thresholds for AVE and CR

The difference between observed and estimated correlations.

To prove construct reliability and convergent validity for your latent constructs (e.g., Deep Learning, Surface Learning):

Standardized Factor Loadings: ≥ 0.50 (ideally ≥ 0.70)

Composite Reliability (CR): ≥ 0.70
Average Variance Extracted (AVE): ≥ 0.50

"A Confirmatory Factor Analysis (CFA) was performed on a sample of grade 12 students (N=571) to assess the measurement model. The measurement model revealed acceptable fit to the data: X2/df=2.15, p<.001, (CFI) = 0.954, (TLI) = 0.947, (RMSEA) = 0.045 (CI) (0.038, 0.052), and (SRMR) = 0.039.

Table 3: Reliability of measurement of the instrument (according to Cronbach's alpha coefficient), academic achievement in terms of subjective task value, surface learning, deep learning, intrinsic motivation, and extrinsic motivation.

Reliability of the measuring instrument (according to Cronbach's alpha coefficient)

				If item dropped	
	Mean	SD	Item-rest correlation	Cronbach's α	McDonald's ω
Learning Motivation	3.88	0.398	0.796	0.847	0.749
Intrinsic learning motivation	3.79	0.607	0.375	0.841	0.706
Extrinsic learning motivation	3.61	0.724	0.398	0.742	0.704
Subjective task value	4.26	0.477	0.164	0.791	0.741
Learning Approach	3.97	0.377	0.581	0.802	0.784
Surface learning approach	4.23	0.500	0.169	0.791	0.747
Deep learning approach	3.72	0.535	0.412	0.828	0.703

Table 4. Correlation between the combination of social factors and academic achievement, and the predictor, estimate, standardize, lower, upper, t, and p-value of academic achievement level. That predictor of location, gender, and academic achievement.

			Academic achievement %			
Predictor	**Estimate**	**SE**	**Lower**	**Upper**	**t**	**p**
Intercept[a]	0.98	0.15	0.67	1.30	6.22	9.18
location:						
urban – non-urban	0.09	0.02	0.03	0.14	3.07	0.002
Gender:						
female – male	-0.01	0.02	-0.06	0.03	-0.63	0.52
Academic Achievement	0.75	0.04	0.67	0.83	18.70	3.85

[a] Represents reference level

Depending on whether a student is self-financed, family-financed, or receives a scholarship, the distribution of high and low academic achievement varies.

The means, standard deviations, and correlations of the study variables are shown in Table 5. Academic achievement (0.880, p <.05**,** p <.01, ***** p <.001), deep learning (0.289, p <.05**,** p <.01, ***** p <.001), intrinsic motivation to experience stimulation (0.679, p <.05, p <.01, * p <.001), and intrinsic motivation toward accomplishment (0.679, p <.01) were found to be positively correlated with intrinsic motivation to know. Intrinsic motivation to experience stimulation was positively connected with academic achievement (0.587, p < .01), a deep learning approach (0.289, p < .01), and an intrinsic desire for accomplishment (0.679, p < .01). There was a strong correlation between intrinsic motivation for achievement and academic achievement (0.880, p < .01) and deep learning approach (0.679, p < .01). The deep learning approach had a positive correlation with academic achievement (0.289, p < .01). This study used (N=571) sampling procedures to test the mediation effects between academic achievement through deep learning strategy and intrinsic motivation to know, intrinsic motivation to experience stimulation, and intrinsic motivation toward accomplishment. The first hypothesis was confirmed when we found a direct and positive correlation between intrinsic motivation to learn and academic achievement (b.12, p.04, 95% CI (.003,.236).

Contrary to Hypotheses 1b and 1c, academic achievement was not directly linked to intrinsic motivation for accomplishment or for experiencing stimulation (b = −.04, p = p.47, 95% CI (−.145, .067), b = .08, p = .09, 95% CI (−.012, .186), respectively). Regarding the mediation effects, we found that the deep learning strategy mediated the relationship between academic achievement and intrinsic motivation to experience stimulation (b 03, SE .01, 95% CI (.001, .055) and academic achievement and intrinsic motivation to know (b.03, SE. 02, 95% CI (.001, .075), but not between academic achievement and intrinsic motivation toward accomplishment (b.02, SE .01, 95% CI (−.001, .036). This result partially supports Hypothesis 2. These results show that the relationship between students' scores on intrinsic motivation to know and academic achievement was mediated by a deeper learning technique. Academic achievement and intrinsic motivation to experience stimulation were only strongly indirectly associated when deep learning techniques were used **(**see Figure 1 and Table 7).

Table 5. Means, standard deviations, and correlations between study variables

	LM	ILM	ELM	STV	LA	SLA	DLA
Learning Motivation	—						
Intrinsic learning motivation	0.679***	—					
Extrinsic learning motivation	0.766***	0.247***	—				
Subjective task value	0.479***	0.053	0.087*	—			

Table 5. Means, standard deviations, and correlations between study variables

	LM	ILM	ELM	STV	LA	SLA	DLA
Learning Approach	0.223***	0.193***	0.178***	0.041	—		
Surface learning approach	0.027	-0.003	0.089*	-0.065	0.705***	—	
Deep learning approach	0.289***	0.275***	0.168***	0.118*	0.749***	0.059	—
Academic Achievement	0.880***	0.618***	0.678***	0.389***	0.658***	0.364***	0.587***

Notes. Higher scores correspond to higher values of the specified construct for all variables (e.g., higher intrinsic motivation to know). Intrinsic motivation (IM). p <.01.
Note. * p < .05, ** p < .01, *** p < .001.

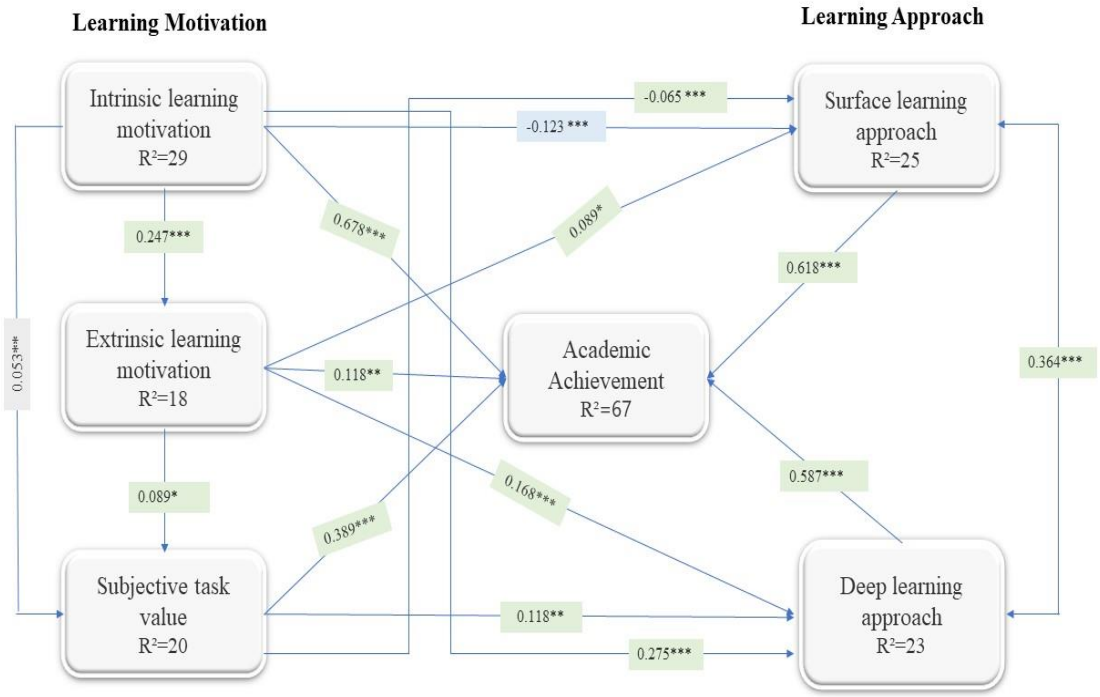


Figure 1. The relationship between various types of learning motivation, learning approach, and students' academic achievement.

Table 7. Types of intrinsic motivation have both direct and indirect effects on academic accomplishment when using a deep learning approach.

		CI intervals of confidence	
	B	SE	95%CI

Intrinsic motivation to know			[.002,
Direct effect	.15	.09	.276]
The indirect effect through deep learning	.05	.04	[.001, .078]
Intrinsic motivation to experience stimulation			[−.145,
Direct effect	−.03	.07	.069]
The indirect effect through deep learning	.06	.04	[.001, .056]
Intrinsic motivation toward accomplishment			[−.015,
Direct effect	.09	.05	.176]
The indirect effect through deep learning	.04	.03	[−.001, .046]

Notes. CI intervals of confidence. B: coefficient of standardized regression

4. DISCUSSION

Deep and Surface Learning as Mediators of Academic Success of Students in Grade 12 in Cambodia provide a fascinating framework for analysing how students make sense of their classroom experiences to achieve academic success (Ng et al., 2015; Phan, 2025). Deep and surface learning in the case of Cambodian grade 12 students, who usually go through high-stakes tests and are expected to perform well, are not independent constructs but can be used as intermediaries of study efforts, teaching methods, and motivation (Orji & Vassileva, 2023; Phan et al., 2026). It is possible that deep learning acts as a mediator between the inputs related to student learning (including teaching quality, learning materials, and self-regulation) and academic performance due to the development of meaning-making, concept connections, critical thinking, and knowledge retention in students adopting this approach (Ng et al., 2015; Phan, 2025). Conversely, surface learning may act as a mediator in the same relationships because of its ability to direct students towards the completion of tasks via memorization and compliance with test requirements (Phan et al., 2025). While surface learning approaches may lead to good performance on tests, they do not usually result in good knowledge transfer. In this regard, the results of this research can be seen as evidence for the fact that not all efforts lead to the same learning effects (Phan et al., 2025; Phan & Heng, 2026). Two students may have similar levels of study effort or receptivity to instructions, but the way they learn is what will determine if the learning experience will become deep or surface (Phan et al., 2026). Thus, the mediating effects make it clear that one needs to focus on learning processes rather than just encouraging studying or improving grades because the way to success is through the learning process (Pum & Tao, 2026; Riccomini et al., 2015). In addition, the emphasis placed on Cambodian Grade 12 learners in the study highlights the importance of teaching and learning approaches that foster deep learning (Phan, 2026; Pum & Tao, 2026). Educators, curriculum developers, and administrators may benefit from an approach that does not overly depend on memorization of the content but rather fosters questioning, explaining, discussion, problem-solving activities, feedback based on comprehension, and assessments aligned to high-level thinking (Phan, 2026). Through this definition, the study will be able to help in the implementation of measures aimed at enhancing the quality of education.

5. CONCLUSION

To summarize, a variety of mediating factors, such as intrinsic motivation, extrinsic motivation, task value, deep learning, and surface learning, have a significant impact on the relationship between academic achievement and learning motivation in mathematics. Higher levels of engagement and perseverance are seen when intrinsic motivation is utilized to foster a sincere interest in learning mathematics, according to research. Students who

find personal fulfilment in their education are more likely to employ deep learning strategies, which enhance their understanding and retention of mathematical concepts. However, while extrinsic motivation may be helpful in the short term, it may not support long-term academic performance in mathematics. It frequently results in surface learning strategies, where pupils prioritize rote repetition over comprehension. Students' task value in mathematics learning has a big influence on their motivation and learning performance as well. Students are more inclined to interact deep learning approach with mathematics when they believe it to be meaningful and relevant, which improves mathematics academic performance.

According to the study's findings, only intrinsic motivation to learn provides an advantage and is directly associated with mathematics academic success out of the three forms of intrinsic motivation. The study's findings also suggest that the relationship between academic success and intrinsic motivation to learn and experience stimulation was mediated by deep learning strategies. It's interesting to note that the only significant indirect relationship found was between academic success and an innate desire to be stimulated by deep learning. Students who participate in class activities only for fun and excitement might not place as much emphasis on learning or achievement as. The findings of this study make a significant addition to the body of scholarly literature. The findings highlight the necessity of getting rid of some subscales that are connected to intrinsic motivation, like intrinsic motivation for experience and intrinsic motivation for achievement. The reason for this is that only the intrinsic motivation to know subscale was significant when a deep learning technique was used to investigate the direct relationship between academic achievement and intrinsic motivation. These findings suggest that the most important illustration or prototype of the intrinsic motivation construct in an academic setting is the "intrinsic motivation to know" subscale. According to the findings, teachers should make an effort to establish learning environments in the classroom that highlight the importance of mastering mathematics and increase students' intrinsic motivation for learning. Teachers can encourage greater academic success by cultivating a culture of deep learning and giving students chances to relate mathematical ideas to practical applications. Future research should keep examining these connections, especially in a variety of educational settings, to create practical methods for raising student motivation and academic success in mathematics.

Funding
No specific grant from any public, private, or nonprofit funding organization was received for this study. The research, writing, and publication of this article were all done independently by the authors, who did not receive any funding.

Conflict of Interest Statement
The authors affirm that they have no competing interests concerning the publication of this study. The study, "The Influence of Learning Motivation on Academic Achievement, with Deep Learning and Surface Learning as Mediators on Math Students' Learning," was conducted without any financial or commercial ties that could be interpreted as a conflict of interest.

Ethical Approval Statement
Before data collection, this study received ethical approval from the relevant institutional review body. Every participant gave their informed consent before beginning the study, and participation was entirely voluntary. Participants' anonymity and confidentiality were rigorously upheld during the entire research process.

Author Contributions

BP: Conceived the study, conducted fieldwork, analysed the data, and drafted the manuscript.
KLH: Contributed to research design, methodology, and manuscript review.
KS: Developed the theoretical framework and contributed to data interpretation and review.
Fr. PB: Contributed to literature review, discussion, and conclusion

Acknowledgement

I would like to express my heartfelt gratitude to everyone who contributed to the successful completion of this study on the influence of intrinsic desire on academic achievement, with a focus on deep learning and surface learning as mediators in mathematics education. First and foremost, I would like to sincerely thank the co-authors, whose outstanding collaboration, assistance, and expertise have been invaluable during this research process. Your insights have had a significant impact on how I approach and think about the subject. Finally, I would like to thank the researchers and existing literature in the fields of mathematics education and educational psychology. This study builds on your research and highlights how important it is to understand the intricate connection between academic success, learning strategies, and motivation. I am grateful for all of your support, encouragement, and contributions. This study reflects our collective efforts

BIBLIOGRAPHY

Alhadabi, A., & Karpinski, A. C. (2019). Grit, self-efficacy, achievement orientation goals, and academic performance in University students. *International Journal of Adolescence and Youth*, *25*(1), 519-535. https://doi.org/10.1080/02673843.2019.1679202

Bao, F., Martens, K., & Windzio, M. (2025). Education policy between persistence and change: grand transformations processes and cultural spheres in the case of Cambodia. *Frontiers in Education*, *10*. https://doi.org/10.3389/feduc.2025.1604793

Bora, P. (2025). Studentsâ€™ Learning Motivation in Mathematics Learning: It is Effects on Studentsâ€™ Learning Approachesâ€‹ on Surface Approach of Learning and Deep Approach of Learning. *International Journal of Research and Innovation in Social Science*, *9*(4), 2890-2901.

Bujak, K. R., Radu, I., Catrambone, R., MacIntyre, B., Zheng, R., & Golubski, G. (2013). A psychological perspective on augmented reality in the mathematics classroom. *Computers & education*, *68*, 536-544. https://doi.org/10.1016/j.compedu.2013.02.017

Camacho-Morles, J., Slemp, G. R., Pekrun, R., Loderer, K., Hou, H., & Oades, L. G. (2021). Activity Achievement Emotions and Academic Performance: A Meta-analysis. *Educational Psychology Review*, *33*(3), 1051-1095. https://doi.org/10.1007/s10648-020-09585-3

Chamorro-Premuzic, T., & Furnham, A. (2008). Personality, intelligence and approaches to learning as predictors of academic performance. *Personality and Individual differences*, *44*(7), 1596-1603. https://doi.org/10.1016/j.paid.2008.01.003

Chen, B., & Chen, S. (2026). Deep learning. In *Machine Vision Technology* (pp. 273-297). Springer.

Chen, C.-H., & Yeh, H.-C. (2019). Effects of integrating a questioning strategy with game-based learning on students' language learning performances in flipped classrooms. *Technology, Pedagogy and Education*, *28*(3), 347-361. https://doi.org/10.1080/1475939x.2019.1618901

Chen, M. R. A., & Hwang, G. J. (2019). Effects of a concept mapping-based flipped learning approach on EFL students' English speaking performance, critical thinking awareness and speaking anxiety. *British Journal of Educational Technology*, *51*(3), 817-834. https://doi.org/10.1111/bjet.12887

Chien, G. C. L., Mao, I., Nergui, E., & Chang, W. (2020). The effect of work motivation on employee performance: Empirical evidence from 4-star hotels in Mongolia. *Journal of Human Resources in Hospitality & Tourism*, *19*(4), 473-495. https://doi.org/10.1080/15332845.2020.1763766

Creswell, J. W., & Hirose, M. (2019). Mixed methods and survey research in family medicine and community health. *Fam Med Community Health*, *7*(2), e000086. https://doi.org/10.1136/fmch-2018-000086

Creswell, L., Burke, B., O'Sullivan, L., Lindow, S., & O'Gorman, N. (2023). A cross-sectional survey of women's views and preferences for preterm birth screening and treatment. *European Journal of Obstetrics & Gynecology and Reproductive Biology*, *290*, 14-21.

Culala, H. J. D., & De Leon, J. A. V. (2020). Secondary Education for Sustainable Development. In *Quality Education* (pp. 1-8). https://doi.org/10.1007/978-3-319-69902-8_89-1

Edwards, O. V., & Dai, T. (2023). Differential relations among expectancy, task value, engagement, and academic performance: The role of generation status. *Frontiers in Education*, *7*. https://doi.org/10.3389/feduc.2022.1033100

Garay Abad, L., & Hattie, J. (2025). The impact of teaching materials on instructional design and teacher development. *Frontiers in Education*, *10*. https://doi.org/10.3389/feduc.2025.1577721

Garon-Carrier, G., Boivin, M., Guay, F., Kovas, Y., Dionne, G., Lemelin, J. P.,…Tremblay, R. E. (2016). Intrinsic Motivation and Achievement in Mathematics in Elementary School: A Longitudinal Investigation of Their Association. *Child Dev*, *87*(1), 165-175. https://doi.org/10.1111/cdev.12458

Göloğlu Demir, C. (2021). The impact of high-stakes testing on the teaching and learning processes of mathematics. *Journal of Pedagogical Research*, *5*(2), 119-137. https://doi.org/10.33902/jpr.2021269677

Hayat, A. A., Shateri, K., Amini, M., & Shokrpour, N. (2020). Relationships between academic self-efficacy, learning-related emotions, and metacognitive learning strategies with academic performance in medical students: a structural equation model. *BMC Med Educ*, *20*(1), 76. https://doi.org/10.1186/s12909-020-01995-9

Hendijani, R., Bischak, D. P., Arvai, J., & Dugar, S. (2016). Intrinsic motivation, external reward, and their effect on overall motivation and performance. *Human performance*, *29*(4), 251-274. https://doi.org/10.1080/08959285.2016.1157595

Hun, S. (2024). Scholarship Schemes in Cambodian Higher Education: Unpacking Why Lower-Income Students are Lagging Behind. *Higher Education Policy*, *38*(4), 733-754. https://doi.org/10.1057/s41307-024-00369-w

Li, L. (2023). Critical thinking from the ground up: teachers' conceptions and practice in EFL classrooms. *Teachers and teaching*, *29*(6), 571-593. https://doi.org/10.1080/13540602.2023.2191182

Li, Y., Guo, F., Yao, M., Wang, C., & Yan, W. (2016). The Role of Subjective Task Value in Service-Learning Engagement among Chinese College Students. *Front Psychol*, *7*, 954. https://doi.org/10.3389/fpsyg.2016.00954

Liu, W. C. (2021). Implicit Theories of Intelligence and Achievement Goals: A Look at Students' Intrinsic Motivation and Achievement in Mathematics. *Front Psychol*, *12*, 593715. https://doi.org/10.3389/fpsyg.2021.593715

Locke, E. A., & Schattke, K. (2019). Intrinsic and extrinsic motivation: Time for expansion and clarification. *Motivation Science*, *5*(4), 277-290. https://doi.org/10.1037/mot0000116

Martino, L., Luengo, D., & Míguez, J. (2018). *Independent random sampling methods* (Vol. 340). Springer.

Mazana, M. Y., Montero, C. S., & Casmir, R. O. (2018). Investigating Students' Attitude towards Learning Mathematics. *International electronic journal of mathematics education*, *14*(1). https://doi.org/10.29333/iejme/3997

Meas, S., No, F., & Sok, S. (2024). Basic Education in Cambodia. In *International Handbook on Education in South East Asia* (pp. 193-225). https://doi.org/10.1007/978-981-16-8136-3_50-1

Michaelides, M. P., Brown, G. T. L., Eklöf, H., & Papanastasiou, E. C. (2019). The Relationship of Motivation with Achievement in Mathematics. In *Motivational Profiles in TIMSS Mathematics* (pp. 9-23). https://doi.org/10.1007/978-3-030-26183-2_2

Middleton, J. A., Wiezel, A., Jansen, A., & Smith, E. P. (2022). Tracing mathematics engagement in the first year of high school: relationships between prior experience, observed support, and task-level emotion and motivation. *ZDM – Mathematics Education*, *55*(2), 427-445. https://doi.org/10.1007/s11858-022-01432-9

Mohamed Mohamed Bayoumy, H., & Alsayed, S. (2021). Investigating Relationship of Perceived Learning Engagement, Motivation, and Academic Performance Among Nursing Students: A Multisite Study. *Adv Med Educ Pract*, *12*, 351-369. https://doi.org/10.2147/AMEP.S272745

Mula, M., Naka, L., & Sylhasi, F. (2024). Intrinsic and Extrinsic Motivation of Primary School Students for Mathematics and English as a Foreign Language. *International Electronic Journal of Elementary Education*. https://doi.org/10.26822/iejee.2024.372

Ng, B. L. L., Liu, W. C., & Wang, J. C. K. (2015). Student Motivation and Learning in Mathematics and Science: A Cluster Analysis. *International Journal of Science and Mathematics Education*, *14*(7), 1359-1376. https://doi.org/10.1007/s10763-015-9654-1

Oppmann, M.-M., Beege, M., Hofer, S. I., & Reinhold, F. (2026). Does subjective task value mediate the effect of digital simulation-based explorations on fraction learning? A randomized-controlled trial. *ZDM – Mathematics Education*, *58*(4), 575-589. https://doi.org/10.1007/s11858-026-01793-5

Orji, F. A., & Vassileva, J. (2023). Modeling the Impact of Motivation Factors on Students' Study Strategies and Performance Using Machine Learning. *Journal of Educational Technology Systems*, *52*(2), 274-296. https://doi.org/10.1177/00472395231191139

Phan, B. (2025). The Impact of Intrinsic Motivation as Predictors of Academic Achievement: The Mediating Role of Deep Learning and Surface Learning in Learning Mathematics. *Educational Psychology Journal*, *14*(2), 15-38.

Phan, B. (2026). High School Math Teachers with a Personal Self-Efficacy Model: Grounded Theory Approach. *Journal of Education, Learning, and Management*, *3*(1), 95-116. https://doi.org/10.69739/jelm.v3i1.637

Phan, B., & Harth, B. (2025). The Relationship Between Instructional Behaviors, Learning Motivation, and Learning Approach: Enhancing the Quality of Mathematics Education Teaching and Learning in High School. *American Journal of Psychiatric Rehabilitation*, *28*(4), 46-61.

Phan, B., Harth, B., & Sor, R. (2025). Exploring the Impact of Teaching Self-Efficacy on Instructional Behaviors and Student Motivation in High School Mathematics: A Structural Equation Modeling Approach. *Journal of Education, Learning, and Management*, *2*(1), 196-211. https://doi.org/10.69739/jelm.v2i1.571

Phan, B., & Heng, K.-L. (2026). A Constructivist Grounded Theory: The Transition Between Deep Learning and Surface Learning by Mathematics Students. *EIKI Journal of Effective Teaching Methods*, *4*(2). https://doi.org/10.59652/mm5w6t79

Phan, B., Long, R., Ngorntheng, T., & Vuthy, C. (2026). Motivation, learning approaches and mathematics achievement: evidence from cambodian high school students. *Al-Jabar : Jurnal Pendidikan Matematika*, *17*(1), 569-584. https://doi.org/10.24042/ajpm.v17i1.29191

Ployhart, R. E., & Vandenberg, R. J. (2009). Longitudinal Research: The Theory, Design, and Analysis of Change. *Journal of management*, *36*(1), 94-120. https://doi.org/10.1177/0149206309352110

Pohle, A., Villani, E., & Grimaldi, R. (2022). Personnel motivation in knowledge transfer offices: The role of university-level and organizational-level antecedents. *Technological Forecasting and Social Change*, *181*. https://doi.org/10.1016/j.techfore.2022.121765

Pov, S., Kawai, N., & Matsumiya, N. (2020). Determinants of student achievement at lower secondary schools in rural Cambodia. *Educational Research for Policy and Practice*, *20*(2), 207-222. https://doi.org/10.1007/s10671-020-09276-4

Pum, M., & Tao, N. (2026). The influence of classroom organisation and emotional support on student motivation and learning engagement: a study of secondary schools in Cambodia. *Educational Studies*, 1-21.

Rach, S. (2022). Motivational states in an undergraduate mathematics course: relations between facets of individual interest, task values, basic needs, and effort. *ZDM – Mathematics Education*, *55*(2), 461-476. https://doi.org/10.1007/s11858-022-01406-x

Riccomini, P. J., Smith, G. W., Hughes, E. M., & Fries, K. M. (2015). The Language of Mathematics: The Importance of Teaching and Learning Mathematical Vocabulary. *Reading & Writing Quarterly*, *31*(3), 235-252. https://doi.org/10.1080/10573569.2015.1030995

Sok, S., Heng, K., & Pum, M. (2025). Investigating High School Students' Attitudes Toward the Use of AI in Education: Evidence from Cambodia. *Sage Open*, *15*(3). https://doi.org/10.1177/21582440251353575

Song, S. (2015). Cambodian teachers' responses to child-centered instructional policies: A mismatch between beliefs and practices. *Teaching and teacher education*, *50*, 36-45. https://doi.org/10.1016/j.tate.2015.04.004

Tatto, M. T. (2021). Comparative research on teachers and teacher education: global perspectives to inform UNESCO's SDG 4 agenda. *Oxford Review of Education*, *47*(1), 25-44. https://doi.org/10.1080/03054985.2020.1842183

Trevino, N. N., & DeFreitas, S. C. (2014). The relationship between intrinsic motivation and academic achievement for first generation Latino college students. *Social Psychology of Education*, *17*(2), 293-306. https://doi.org/10.1007/s11218-013-9245-3

Wang, J., Liu, R. D., Ding, Y., Xu, L., Liu, Y., & Zhen, R. (2017). Teacher's Autonomy Support and Engagement in Math: Multiple Mediating Roles of Self-efficacy, Intrinsic Value, and Boredom. *Front Psychol*, *8*, 1006. https://doi.org/10.3389/fpsyg.2017.01006

Wild, S., & Neef, C. (2023). Analyzing the associations between motivation and academic performance via the mediator variables of specific mathematic cognitive learning strategies in different subject domains of higher education. *International Journal of STEM Education*, *10*(1). https://doi.org/10.1186/s40594-023-00423-w

Wolters, C. A., & Hussain, M. (2014). Investigating grit and its relations with college students' self-regulated learning and academic achievement. *Metacognition and Learning*, *10*(3), 293-311. https://doi.org/10.1007/s11409-014-9128-9

Zainuddin, Z. (2018). Students' learning performance and perceived motivation in gamified flipped-class instruction. *Computers & education*, *126*, 75-88. https://doi.org/10.1016/j.compedu.2018.07.003

Zeynali, S., Pishghadam, R., & Hosseini Fatemi, A. (2019). Identifying the motivational and demotivational factors influencing students' academic achievements in language education. *Learning and Motivation*, *68*. https://doi.org/10.1016/j.lmot.2019.101598

Zhao, J., & Liu, E. (2022). What factors can support students' deep learning in the online environment: The mediating role of learning self-efficacy and positive academic emotions? *Front Psychol*, *13*, 1031615. https://doi.org/10.3389/fpsyg.2022.1031615

Zhao, P., Hassan, A., & Burhanuddin, N. A. N. (2024). A systematic review of factors influencing English language competency for ethnic minority students: an ecological systems theory perspective. *Cogent Education*, *11*(1). https://doi.org/10.1080/2331186x.2024.2415730.