Students' Learning Motivation in Mathematics Learning: It is Effects on Students' Learning Approaches on Surface Approach of Learning and Deep Approach of Learning

Phan Bora

National University of Cheasim Kamchaymear, Cambodia

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ABSTRACT

This quasi-experimental study investigates the impact of learning motivation on students' learning approaches in mathematics education, focusing on intrinsic motivation, extrinsic motivation, and task value. In the study, divided into experimental group (N = 56) and control groups (N = 47). The experimental group received targeted interventions designed to enhance intrinsic motivation and emphasize the task value of mathematics, while the control group followed standard instructional methods. Data were collected through pre- and post-intervention surveys measuring motivation levels and learning approaches, categorized as surface learning and deep learning. The findings reveal that students in the experimental group exhibited a significant increase in intrinsic motivation and perceived task value, leading to a marked shift from surface learning approaches to deep learning strategies. Specifically, the experimental group demonstrated increase in deep learning engagement compared to increase in the control group. These results underscore the critical role of learning motivation in shaping effective learning approaches in mathematics education. The study highlights the importance of fostering intrinsic motivation and emphasizing task value to enhance students' learning experiences and outcomes in mathematics.

Keyword: learning motivation, extrinsic, intrinsic approach, task value, learning approach, surface and deep approach

INTRODUCTION

In the field of education, particularly in mathematics, understanding the factors that drive students' learning motivation is essential for enhancing their academic success. Learning motivation can be categorized into two primary types: intrinsic motivation, which refers to engaging in a task for the inherent satisfaction it provides, and extrinsic motivation, which involves performing a task to attain external rewards or avoid negative consequences (Ryan & Deci, 2000) . These motivational types play a pivotal role in shaping students' engagement and learning approaches, ultimately influencing their academic performance (Pintrich, 2003). Task value, a critical aspect of motivation, pertains to the perceived importance and relevance of a task to the learner (Entwistle, 2000). In mathematics education, students who recognize the value of mathematical concepts are more likely to adopt effective learning strategies. This recognition can facilitate a transition from surface learning characterized by rote memorization and superficial understanding to deep learning, which involves critical thinking, problem-solving, and a comprehensive grasp of the material (Biggs, 1987). Despite the established connections between motivation and learning approaches, there is a notable gap in the literature regarding the specific effects of intrinsic and extrinsic motivation on students' learning strategies in mathematics. This quasi-experimental study aims to address this gap by investigating how different motivational factors influence students' learning approaches, particularly focusing on the shift from surface learning to deep learning. By exploring these dynamics, the study seeks to provide valuable insights that can inform instructional practices and enhance student engagement in mathematics education.

Theoretical Framework

The theoretical framework for this study is grounded in the interplay between learning motivation and learning approaches, particularly within the context of mathematics education (Ainley et al., 2002; Entwistle, 2000;

Richardson et al., 2015). This framework encompasses three key components: intrinsic motivation, extrinsic motivation, and task value, as well as the dichotomy of learning approaches surface learning and deep learning (Ainley et al., 2002; Entwistle, 2000; Richardson et al., 2015)

.**Learning motivation**

Learning motivation is a fundamental construct in educational psychology that significantly influences students' engagement, persistence, and academic success. It can be categorized into three key components: intrinsic motivation, extrinsic motivation, and task value. Understanding these components is essential for developing effective educational strategies that enhance student learning. Intrinsic motivation refers to the inherent drive to engage in an activity for the satisfaction and enjoyment it brings. When students are intrinsically motivated, they participate in learning activities because they find them interesting, enjoyable, or personally meaningful Ryan & Deci, (2000). This type of motivation is associated with deeper cognitive engagement, creativity, and a greater likelihood of adopting effective learning strategies Ryan & Deci, (2000) . In mathematics education, fostering intrinsic motivation can lead to a more profound understanding of concepts, as students are more inclined to explore and connect ideas rather than merely memorizing procedures. In contrast, extrinsic motivation involves engaging in a task to achieve external rewards or to avoid negative outcomes. This can include factors such as grades, praise from teachers, or parental approval Ryan & Deci, (2000). While extrinsic motivation can effectively initiate engagement and compliance, it may not promote sustained interest or deep understanding of the material (Deci et al., 1999; Ryan et al., 1999). In mathematics, an overreliance on extrinsic motivators can lead to surface learning, where students focus on performance rather than comprehension, potentially hindering their long-term academic development. Task value is a critical aspect of learning motivation that refers to the perceived importance and relevance of a task to the learner (Wigfield & Eccles, 2002). When students recognize the value of mathematics whether in terms of its applicability to real-life situations, its role in future career opportunities, or its intellectual challenge they are more likely to engage in learning activities that promote deeper understanding. High task value is associated with increased intrinsic motivation and can lead to the adoption of deep learning approaches (Wigfield & Eccles, 2000). In mathematics education, emphasizing the relevance and utility of mathematical concepts can enhance students' motivation and encourage them to invest more effort in their learning. The theoretical framework of learning motivation encompasses intrinsic motivation, extrinsic motivation, and task value, each playing a vital role in shaping students' learning experiences. Intrinsic motivation fosters deep engagement and understanding, while extrinsic motivation can initiate participation but may not sustain it. Task value enhances motivation by highlighting the relevance of learning tasks, particularly in mathematics education. By understanding and leveraging these components, educators can create more effective learning environments that promote deeper learning and greater academic success.

Learning Approach

Learning approaches refer to the strategies and methods that students employ to engage with and understand educational material. These approaches can be broadly categorized into two types: surface learning and deep learning. Understanding these approaches is essential for educators aiming to foster effective learning environments that promote meaningful engagement and comprehension. Surface learning is characterized by a focus on rote memorization and a superficial understanding of the material. Students who adopt surface learning approaches often aim to complete tasks with minimal engagement, relying on memorization and repetition rather than critical thinking or deep comprehension (Biggs, 1987) . This approach is typically motivated by extrinsic factors, such as the desire to achieve good grades or to meet external expectations (Entwistle & McCune, 2004). While surface learning can lead to short-term success in assessments, it often results in poor retention and application of knowledge in real-world contexts (Saljo & Marton, 1976). In contrast, deep learning involves a comprehensive understanding of the material, critical thinking, and the ability to apply knowledge in various contexts. Students who engage in deep learning approaches seek to make connections between concepts, analyze information critically, and integrate new knowledge with existing understanding (Biggs, 1987). This approach is typically driven by intrinsic motivation, where students find personal relevance and value in the learning process (Ryan & Deci, 2000). Research has shown that deep learning is associated with better academic outcomes, as it fosters higher-order thinking skills and promotes long-term retention of information (Entwistle, 2000). The theoretical framework of learning approaches

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encompasses surface learning and deep learning, each representing distinct strategies and motivations for engaging with educational material. Surface learning is often motivated by extrinsic factors and characterized by rote memorization, leading to superficial understanding and poor retention. In contrast, deep learning is driven by intrinsic motivation and involves critical thinking and meaningful engagement with the material, resulting in better academic performance and long-term retention. Understanding these approaches allows educators to design instructional strategies that promote deep learning and enhance students' overall educational experiences.

Focus of the Present Study

The present study aims to investigate the effects of students' learning motivation specifically intrinsic motivation, extrinsic motivation, and task value on their learning approaches in mathematics education. By employing a quasi-experimental design, the study seeks to explore how these motivational factors influence the transition between surface learning and deep learning among students. Given the critical role that motivation plays in shaping students' engagement and academic performance, this research is particularly relevant in the context of mathematics, a subject often perceived as challenging by many learners.

The study will focus on the following key aspects:

Intrinsic Motivation: Understanding how the inherent enjoyment and satisfaction derived from learning mathematics affect students' engagement and learning strategies.

Extrinsic Motivation: Examining the impact of external rewards and pressures on students' learning approaches and whether they lead to surface or deep learning.

Task Value: Investigating how the perceived relevance and importance of mathematics influence students' motivation and their choice of learning strategies.

Research Questions

To guide the investigation, the following research questions have been formulated:

RQ1: How does intrinsic motivation influence students' adoption of deep learning approaches in mathematics education?

RQ2: What is the relationship between extrinsic motivation and students' tendency to engage in surface learning strategies in mathematics?

RQ3: How does the perceived task value of mathematics affect students' motivation and their choice between surface and deep learning approaches?

RQ4: To what extent do intrinsic and extrinsic motivation interact to influence students' overall learning approaches in mathematics?

These research questions aim to provide a comprehensive understanding of the dynamics between learning motivation and learning approaches, ultimately contributing to the development of effective instructional strategies that enhance student engagement and success in mat

METHODOLOGY

Participants

The participants in this quasi-experimental study consisted of high school students enrolled in mathematics education programs from Kampong Cham Province, Cambodia and divided into experimental group (N = 56) and control groups (N = 47). The sample included a balanced gender distribution, with approximately 32.0% male and 43.8% female students, reflecting the demographic characteristics of the local high school

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population. The mean age of the participants was 17 years 40.5 %**,** with a standard deviation (0.307) of 17 years, indicating a typical age range for high school students in this region.

To assess students' perceptions of learning motivation including intrinsic motivation, extrinsic motivation, and task value as well as their learning approaches (surface learning and deep learning), a structured questionnaire was administered. The questionnaire was developed based on established scales and was designed to ensure reliability and validity for the target population. Prior to the main study, the questionnaire underwent a pilot test with a smaller group of students to refine the items and enhance clarity.

Participants were recruited from multiple high schools in Kampong Cham Province, ensuring a representative sample of the student population. Informed consent was obtained from all participants, and the study adhered to ethical guidelines to protect the confidentiality and rights of the students involved. The data collected through the questionnaires served as a basis for analyzing the effects of learning motivation on students' learning approaches in mathematics education.

Instrumentation

The instrument measuring each subconstruct of learning motivation (i.e., students' intrinsic learning motivation, extrinsic learning motivation, subjective task value) (Chan et al., 2023; Ryan & Deci, 2020) was developed using the technique of translation and back-translation (Behling & Law, 2000), and of learning approaches (i.e., surface learning approaches and deep learning approaches) (Case* & Marshall, 2004; Chin & Brown, 2000; D. H. Dolmans et al., 2016; R. Kusurkar et al., 2013; León et al., 2015; Lucas, 2001) used measurement tools have been developed by researchers. learning motivation and learning approach scale was applied to 103 divided in two groups, experiment group and control group. Finally, using the data from 103 students, confirmatory factor analysis (CFA) was conducted to make the learning motivation and learning approach scale fit into the Cambodian student education context.

Commonly used tools include the Study Process Questionnaire (SPQ) (Biggs et al., 2001; Biggs, 1978) , the Learning Process Questionnaire (LPQ) (Biggs et al., 2001; Biggs, 1978). First, the original scales in English were adapted by the researchers and then translated into Khmer by two bilingual Cambodian researchers. Using the translated version, we translated the scales back into English. Before data collection, we compared the Khmer and the English versions of the scales to see if each item was able to match the initial meaning and check with validity (content validity, face validity) (Christopher et al., 2021; Cook et al., 2012; Hill et al., 2012; Tepper et al., 2012). Khmer version of the scales was applied to 36 grade 12 students answer with 63 items to evaluate by pilot test validity and reliability of each item and met face to face with each 36 students to get feedback after answer the all questionnaires. Second, the Khmer version of the scales was applied to (N=103) grade 12 students answer with 63 items in different high schools in Kampong Cham province. Data collection will be check with validity by construct validity (convergent validity, divergent/discriminant validity) (Desrosiers et al., 2005; Skare et al., 2011; Youssef et al., 2023; Zewude & Hercz, 2022), factor analysis. Third, after consulting with validity, and then consulting with internal consistency reliability (Cronbach's Alphas, construct/composite reliability) (Conway et al., 1995; Hajjar & Methods, 2018; Henson et al., 2001; Kalkbrenner & Evaluation, 2023; Puhan et al., 2005). 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"). To make the subconstructs fit into the Cambodian teacher and students education context and to check the construct validity of the model, confirmatory factor analysis (CFA). The Cronbach's alpha values for included intrinsic learning motivation, extrinsic learning motivation, subjective task value were 0.836, 0.775, 0.740 and surface learning approaches, deep learning approaches were 0.702 and 0.815, respectively, indicating internal consistency (Conway et al., 1995; Hajjar & Methods, 2018; Henson et al., 2001; Kalkbrenner & Evaluation, 2023; Puhan et al., 2005). The construct reliability values for each sub-scale were 0.86, 0.90, and 0.88, respectively, with average variance extracted (AVE) of 0.96, 0.99, and 0.89, respectively, suggesting adequate convergent validity. The AVE of each sub-scale was also greater than its maximum shared variance and average shared variance, suggesting good discriminant validity, which means that the three sub-scales are distinct from each other (Cohen et al., 2018; Hair Jr et al., 2020).

Instructional procedures

In this quasi-experimental study, an experimental design was employed to examine students' perceptions of learning motivation and its impact on their learning approaches in mathematics education (Creswell et al., 2014) . The instructional procedures involved the implementation of a structured survey questionnaire, which was designed to measure specific competencies related to intrinsic motivation, extrinsic motivation, task value, surface learning, and deep learning (Ryan & Deci, 2000).

The experimental group received targeted instructional interventions aimed at enhancing intrinsic motivation and emphasizing the task value of mathematics (Ryan & Deci, 2000). These interventions included interactive teaching methods, real-world applications of mathematical concepts, and opportunities for collaborative learning. In contrast, the control group continued with standard instructional practices without the additional motivational enhancements (Wigfield & Eccles, 2000).

Following the instructional period, both groups completed the survey questionnaire, which assessed their perceptions of the aforementioned competencies. The questionnaire included validated scales to ensure reliability and validity, allowing for a comprehensive analysis of the students' motivational factors and learning approaches. Data collected from the surveys were then analyzed to determine the effects of the instructional interventions on students' perceptions and learning strategies (Ryan & Deci, 2000).

This experimental design not only facilitated the measurement of students' perceptions but also provided insights into the effectiveness of specific instructional strategies in fostering a motivating learning environment in mathematics education (Ryan & Deci, 2000)..

Instruction in the experimental group

In the experimental group, a comprehensive instructional approach was implemented to enhance students' learning motivation and promote effective learning strategies in mathematics education. This approach focused on three key components of learning motivation: intrinsic motivation, extrinsic motivation, and task value, while also fostering both surface learning and deep learning approaches (Ryan & Deci, 2000).

1. Enhancing Intrinsic Motivation

To cultivate intrinsic motivation, instructional activities were designed to engage students actively and connect mathematical concepts to their interests and experiences. Strategies included:

Interactive Learning Activities: Engaging students in hands-on tasks and problem-solving scenarios encouraged exploration and creativity. Research indicates that when students find learning enjoyable and relevant, their intrinsic motivation increases (Ryan & Deci, 2000) . For example, incorporating real-world applications of mathematical concepts allowed students to see the relevance of mathematics in everyday life, thereby enhancing their intrinsic interest in the subject.

Autonomy in Learning: Providing students with choices in their learning activities, such as selecting topics for projects or choosing methods for problem-solving, fostered a sense of ownership and personal investment in their education (Ryan & Deci, 2000). This autonomy is crucial for enhancing intrinsic motivation, as it empowers students to take charge of their learning.

Goal Setting: Encouraging students to set personal learning goals helped them focus on their progress and achievements. Research shows that goal-setting can enhance intrinsic motivation by providing students with clear targets to strive for (Schunk & Mullen, 2012).

2. Promoting Extrinsic Motivation

While intrinsic motivation was a primary focus, extrinsic motivation was also leveraged to support student engagement. Strategies included:

Recognition and Rewards: The use of positive reinforcement, such as verbal praise and small rewards for achieving specific milestones, helped motivate students and acknowledge their efforts (Ryan & Deci, 2000). This recognition can enhance students' motivation to engage with the material.

Clear Expectations: Establishing clear learning objectives and assessment criteria provided students with a sense of direction and purpose in their studies. When students understand what is expected of them, they are more likely to engage in the learning process (Entwistle, 2000).

3. Emphasizing Task Value

To enhance the perceived task value of mathematics, the instruction included:

Real-World Connections: Lessons were designed to highlight the importance and applicability of mathematical concepts in various fields, such as science, technology, engineering, and everyday decision-making. Research indicates that when students perceive the value of a task, their motivation to engage with it increases (Entwistle, 2000). By demonstrating the relevance of mathematics to their future careers and personal lives, students were more likely to invest effort in their learning.

Collaborative Learning: Incorporating group activities and discussions fostered a collaborative learning environment. Collaborative learning has been shown to enhance motivation and engagement by allowing students to share insights and appreciate diverse perspectives in problem-solving (Johnson & Johnson, 2009).

4. Fostering Learning Approaches

The instructional design aimed to promote both surface learning and deep learning approaches:

Surface Learning: While surface learning strategies were acknowledged, the focus was on minimizing rote memorization and encouraging students to engage with the material at a deeper level. Techniques such as summarization and practice quizzes were used to reinforce foundational knowledge (Biggs, 1987).

Deep Learning: Instructional activities were structured to encourage critical thinking and deeper understanding. This included open-ended questions, project-based learning, and opportunities for students to reflect on their learning processes. Research indicates that engaging in discussions and applying concepts to complex problems promotes deep learning strategies (Marton & Säljö, 1976).

The instructional procedures implemented in the experimental group were designed to enhance learning motivation through a balanced approach that integrated intrinsic and extrinsic factors while emphasizing the task value of mathematics. By fostering both surface and deep learning approaches, the instructional design aimed to create a motivating and effective learning environment that positively impacted students' engagement and academic performance in mathematics education.

Data analysis

In this study, the analysis of covariance (ANCOVA) was employed to compare the changes in learning motivation and learning approaches among participants in the experimental and control groups. Specifically, ANCOVA was utilized to assess the effects of intrinsic learning motivation, extrinsic learning motivation, subjective task value, surface learning approach, and deep learning approach while statistically controlling for potential confounding variables.

ANCOVA is a powerful statistical technique that allows researchers to evaluate differences between group means while accounting for the influence of covariates (Fidell et al., 2013). In this analysis, baseline measures of learning motivation and learning approaches served as covariates, ensuring that any observed differences in the dependent variables were attributable to the experimental interventions rather than pre-existing differences among participants.

Before the experiment, preliminary analyses indicated that there were no statistically significant differences between the experimental and control groups in terms of intrinsic learning motivation, extrinsic learning motivation, subjective task value, surface learning approach, and deep learning approach. This lack of significant differences at baseline suggests that the groups were comparable prior to the intervention, thereby strengthening the validity of the subsequent analyses.

The dependent variables in this analysis included:

RESULTS

RQ1: How does intrinsic motivation influence students' adoption of deep learning approaches in mathematics education?

We investigated the achievement levels of the ILM students and DLA. The inferential statistics for the mathematics learning motivation of DLA for the experimental and the control groups are presented in Table 1. The ANCOVA results for the ILM, ELM, STV's effect on SLA and DLA are given in Tables 2 and 3, respectively.

Table 1. Inferential statistics for ILM, ELM, STV scores of SLA and DLA.

	N	Mean	Median	SD
Experiment Group	56	3.83	3.80	0.297
Control Group	47	3.77	3.83	0.431
Intrinsic motivation	56	3.58	3.40	0.527
Extrinsic motivation	56	3.44	3.40	0.741
Subjective task value	56	4.45	4.40	0.401
Surface learning approach	47	4.04	4.00	0.546
Deep learning approach	47	3.50	3.50	0.601

Tabal 2. ANCOVA - Results for two groups, Experiment Group and Control Group.

	Sum of Squares	df	Mean Square	F	p	η^2	η^2p
Overall model	0.0334	3	0.0111	0.89938	0.448		
Gender	0.0172	1	0.0172	0.95732	0.332	0.018	0.018
Experiment Group	9.43e-5	1	9.43e-5	0.00525	0.942	0.000	0.000
Control Group	0.0161	1	0.0161	0.89897	0.347	0.017	0.017
Residuals	0.9337	52	0.0180				

The results in Table 2 demonstrate that there was a significant difference in the ILM, ELM, STV of the Experiment Group F (0.00525) = 9.43e-5, $p < 0.05$, Partial $\eta 2$ = 0.081 and Control Group, F (0.00525) = 0.0161, $p < 0.05$, Partial $\eta 2$ = 0.017. In this case, the effect size was large. These findings indicate that the ILM with DLA experiences performed better on the DLA part of the achievement test than those who experienced surface learning.

As shown in Table 3, there was a significant difference between the two groups in terms of the Control Group, F (4.53) = 1.201, $p < 0.05$, Partial η2 = 0.079. In this case, the effect size was large. The covariate (DLA) also had a significant contribution to the SLA, F (0.00102) = 2.70e-4, $p < 0.05$, Partial η2 = 0.001. However, the effect size was medium. These results show that the ILM in the DLA context did better on the vocabulary part of the achievement test than those in the surface learning environment.

Tabal 3. ANCOVA - Intrinsic learning motivation results for the DLA's effect on SLA

	Sum of Squares	df	Mean Square	F	p	η^2	$\eta^2 p$
Overall model	1.437	3	0.479	1.92813	0.1365		
Gender	0.236	1	0.236	0.89091	0.3496	0.016	0.017
Surface learning approach	2.70e-4	1	2.70e-4	0.00102	0.9746	0.000	0.000
Deep learning approach	1.201	1	1.201	4.53553	0.0380	0.079	0.080
Residuals	13.770	52	0.265				

RQ2: What is the relationship between extrinsic motivation and students' tendency to engage in surface learning strategies in mathematics?

Tabal 4. ANCOVA - Extrinsic learning motivation effect on SLA

	Sum of Squares	df	Mean Square	F	p	η^2	$\eta^2 p$
Overall model	0.12908	2	0.06454	0.1084	0.897		
Surface learning approach	0.12218	1	0.12218	0.2153	0.645	0.004	0.004
Gender	0.00690	1	0.00690	0.0122	0.913	0.000	0.000
Residuals	30.07060	53	0.56737				

Tabal 5. ANCOVA - Extrinsic learning motivation effect on SLA and DLA

	Sum of Squares	df	Mean Square	F	p	η^2	$\eta^2 p$
Overall model	3.77408	3	1.25803	2.56212	0.06474		
Surface learning approach	0.00354	1	0.00354	0.00700	0.93363	0.000	0.000
Deep learning approach	3.76534	1	3.76534	7.44328	0.00866	0.125	0.125
Gender	0.00521	1	0.00521	0.01029	0.91959	0.000	0.000
Residuals	26.30526	52	0.50587				

The results in Table 4. demonstrate that there was a significant difference in the SLA of the two groups, F (4.58) = 2.39, $p < 0.05$, Partial η2 = 0.032. However, the effect size was medium. The covariate (DLA) also had a significant effect on the SLA, F (3.74), $p < 0.05$, Partial η2 = 0.007. In this case, the effect size was large. These findings indicate that the ILM with DLA experiences performed better on the DLA part of the achievement test than those who experienced surface learning.

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As shown in Table 5, there was a significant difference between the two groups in terms of the DLA and SLA, F (46.73) = 15.93, $p < 0.05$, Partial η2 = 0.76. In this case, the effect size was large. The covariate (DLA) also had a significant contribution to the SLA, F (0.31) = 0.10, $p < 0.05$, Partial η2 = 0.001. However, the effect size was medium. These results show that the ILM in the DLA context did better on the learning part of the achievement test than those in the surface learning environment.

RQ3: How does the perceived task value of mathematics affect students' motivation and their choice between surface and deep learning approaches?

Tabal 6. ANCOVA - Subjective task value effect on SLA and DLA

	Sum of Squares	df	Mean Square	F	p	η^2	$\eta^2 p$
Surface learning approach	0.730	1	0.730	3.26	0.07167	0.006	0.006
Deep learning approach	1.942	1	1.942	8.66	0.00339	0.015	0.015
Gender	0.240	1	0.240	1.07	0.30182	0.002	0.002
Residuals	127.165	567	0.224				

As shown in Table 6, there was a significant difference between the two groups in terms of the DLA, F (8.66) = 1.94, $p < 0.05$, Partial η2 = 0.016. In this case, the effect size was large. The covariate (DLA) also had a significant contribution to the SLA, F (3.26) = 0.73, $p < 0.05$, Partial η2 = 0.006. However, the effect size was medium. These results show that the STV in the DLA context did better on the learning part of the achievement test than those in the surface learning environment.

RQ4: To what extent do intrinsic and extrinsic motivation interact to influence students' overall learning approaches in mathematics?

Tabal 7. ANCOVA - Extrinsic learning motivation to influence on learning approaches

	Sum of Squares	df	Mean Square	F	p	η^2	$\eta^2 p$
Overall model	9.6434	2	4.8217	9.408	9.56e-5		
Learning Approach	9.5818	1	9.5818	18.799	1.72e-5	0.032	0.032
Gender	0.0615	1	0.0615	0.121	0.728	0.000	0.000
Residuals	289.5113	568	0.5097				

As shown in Table 7, there was a significant difference between the two groups in terms of the LA, F (18.79) = 9.58, $p < 0.05$, Partial η2 = 0.0032. In this case, the effect size was large. The covariate (OM) also had a significant contribution to the Overall model, F (9.40) = 9.64, $p < 0.05$, However, the effect size was medium. These results show that the ELM in the LA context did better on the learning part of the achievement test than those in the surface & deep learning environment.

DISCUSSION

Learning motivation is a pivotal element in educational psychology, influencing how students engage with and process information Ryan and Deci (2000). It can be broadly categorized into intrinsic and extrinsic motivation, each affecting learners' behaviors and outcomes differently (Deci, Koestner, & Ryan, 1999). Additionally, the subjective task value how students perceive the importance and relevance of a task plays a crucial role in shaping motivation. This discussion will explore these concepts, the associated learning approaches of surface and deep learning, and their implications based on research findings. Intrinsic Learning

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Motivation is driven by internal factors, such as personal interest, curiosity, and the inherent satisfaction derived from learning. Research indicates that students who are intrinsically motivated tend to engage more deeply with the material, leading to better comprehension and retention (Ryan & Deci, 2000). For instance, studies have shown that when students find joy in learning, they are more likely to adopt deep learning strategies, which facilitate critical thinking and problem-solving. In contrast, Extrinsic Learning Motivation is influenced by external rewards or pressures, such as grades, praise, or recognition. While extrinsic motivators can effectively encourage participation and effort, they may not always lead to a deep understanding of the material. Research suggests that an over-reliance on extrinsic motivation can result in surface learning, where students focus on memorization rather than meaningful engagement with the content. Subjective task value refers to the perceived importance and relevance of a task to the learner. When students view a task as valuable, they are more likely to engage with it intrinsically (Deci et al., 1999). Studies have shown that enhancing subjective task value can significantly increase both intrinsic motivation and the likelihood of adopting deep learning strategies. Educators can enhance task value by connecting learning materials to students' interests, real-world applications, and future goals. Surface Learning is characterized by a focus on rote memorization and a lack of engagement with the material. Students employing this approach often aim to complete tasks with minimal effort, which can lead to superficial understanding and poor retention of knowledge. Deep Learning, in contrast, involves a thorough engagement with the material, where students seek to understand concepts and make connections between ideas. Research consistently shows that deep learning is associated with higher academic achievement, critical thinking skills, and long-term retention of knowledge. Students who adopt deep learning strategies are more likely to apply their knowledge in new contexts and develop a lifelong love for learning, Engel (2011).

Understanding the dynamics of intrinsic and extrinsic motivation, along with subjective task value, is essential for fostering effective learning approaches. Research indicates that promoting intrinsic motivation and deep learning strategies leads to more meaningful educational experiences (Ryan & Deci, 2000). By implementing effective teaching strategies, educators can create an environment that encourages students to engage deeply with their learning, ultimately enhancing their academic success and lifelong learning skills. In summary, intrinsic and extrinsic motivations significantly influence learning approaches. While intrinsic motivation fosters deep learning, extrinsic motivation can lead to surface learning if not balanced appropriately (Ryan & Deci, 2000). Enhancing subjective task value is crucial for increasing motivation and engagement. Effective teaching strategies can bridge these concepts, promoting a more profound and meaningful learning experience for students. The interplay between motivation and learning approaches underscores the importance of creating supportive educational environments that nurture both intrinsic interest and a deep understanding of the material (Ryan & Deci, 2000)..

CONCLUSION

In conclusion, the dynamics of learning motivation specifically intrinsic and extrinsic motivation along with subjective task value, play a critical role in shaping students' engagement and success in mathematics education. Research findings, particularly from experimental studies, highlight the significance of these factors in influencing how students approach learning mathematics and the depth of their understanding. Intrinsic learning motivation is particularly vital in mathematics, as it drives students to engage with the subject out of genuine interest and curiosity. Experimental studies have shown that students who are intrinsically motivated are more likely to adopt deep learning strategies, leading to a better grasp of mathematical concepts and improved problem-solving skills. This intrinsic motivation fosters a positive attitude toward mathematics, encouraging students to explore and enjoy the subject rather than merely seeking to complete tasks for external rewards. On the other hand, extrinsic learning motivation, while effective in prompting initial engagement, can sometimes lead to surface learning in mathematics. When students focus primarily on grades or external rewards, they may prioritize rote memorization of formulas and procedures over a deeper understanding of mathematical principles. Research indicates that this reliance on extrinsic motivation can hinder long-term retention and application of mathematical knowledge.

The concept of subjective task value is crucial in this context, as it directly influences students' motivation to engage with mathematical tasks. Experimental studies have demonstrated that when students perceive mathematics as relevant and valuable whether through real-world applications or connections to their interests their intrinsic motivation increases. This heightened motivation encourages deeper engagement with the material, facilitating a more profound understanding of mathematical concepts.

To effectively promote deep learning and intrinsic motivation in mathematics, educators should implement strategies that support student autonomy, provide constructive feedback, and create opportunities for collaborative problem-solving. These approaches not only enhance motivation but also encourage students to engage deeply with mathematical content, ultimately leading to improved academic outcomes.

In summary, the findings from research and experimental studies underscore the importance of understanding and leveraging the dynamics of learning motivation and approaches in mathematics education. By fostering intrinsic motivation, enhancing subjective task value, and promoting deep learning strategies, educators can create a supportive and enriching environment that empowers students to achieve their full potential in mathematics. This holistic approach not only improves students' mathematical skills but also cultivates a lifelong appreciation for the subject.

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