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Motivation and learning strategies used by engineering students at universities

Motivación y estrategias de aprendizaje que utilizan los estudiantes de ingeniería de las universidades

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Abstract

The main objective of this study was to determine the relationship between motivation and learning strategies used by engineering students at universities in the province of Santa during 2024, in line with Sustainable Development Goal 4 (Quality Education). The research also contributes to University Social Responsibility by supporting the reduction of gaps and deficiencies in education at all levels, promoting a more equitable and just society. The methodology was basic, with a quantitative approach and correlational design. The population and sample consisted of 408 engineering students. The Motivated Strategies for Learning Questionnaire (MSLQ) was used as an instrument, administered through the Google Forms platform. The results showed that the variables of motivation and learning strategies have a non-parametric distribution, showing a high level of positive correlation, with a Spearman's rho value of 0.779 and a significance level of p = 0.000, less than 0.05. Finally, it was concluded that there is a direct relationship between the two variables: the higher the level of motivation, the greater the use of learning strategies by students.

Keywords: motivation, learning strategies, questionnaire (MSLQ).

Resumen

El presente estudio tuvo como objetivo principal determinar la relación entre la motivación y las estrategias de aprendizaje utilizadas por los estudiantes de ingeniería de las universidades de la provincia del Santa durante el año 2024, en alineación con el Objetivo de Desarrollo Sostenible 4 (Educación de calidad). Asimismo, la investigación contribuye a la Responsabilidad Social Universitaria, al apoyar la reducción de brechas y carencias en la educación en todos sus niveles, fomentando una sociedad más equitativa y justa. La metodología fue de tipo básica, con enfoque cuantitativo y diseño correlacional. La población y muestra estuvo conformada por 408 estudiantes de ingeniería. Se empleó como instrumento el cuestionario Motivated Strategies for Learning Questionnaire (MSLQ), aplicado a través de la plataforma Google Forms. Los resultados evidenciaron que las variables motivación y estrategias de aprendizaje presentan una distribución no paramétrica, mostrando un alto nivel de correlación positiva, con un valor de rho de Spearman de 0.779 y un nivel de significancia de p = 0.000, inferior a 0.05. Finalmente, se concluyó que existe una relación directa entre ambas variables: a mayor nivel de motivación, mayor es el uso de estrategias de aprendizaje por parte de los estudiantes.

Palabras clave: motivación, estrategias de aprendizaje, cuestionario (MSLQ).

Introduction

Research concerning university students highlights significant challenges that range from a lack of interest and intellectual stimulation to low participation and inadequate recognition of the student role, all of which are linked to motivational aspects (Bragagnolo et al., 2024). These factors negatively impact knowledge retention and application, as well as the development of essential skills for facing academic evaluations, directly relating to learning processes (Calafato, 2023). Addressing these issues is fundamental to improving the educational experience and promoting student success, in alignment with Sustainable Development Goal 4 (SDG 4: Quality Education). Furthermore, this research contributes to University Social Responsibility by supporting the reduction of educational gaps and deficiencies at all levels, fostering more equitable and just societies (Bernabé et al., 2022).

Internationally, the International Institute for Higher Education in Latin America and the Caribbean (IESALC) reported that between 2000 and 2018, participation rates in higher education increased in countries with middle and high incomes (Castellano et al., 2020). In contrast, low-income nations recorded the least expansion, due to factors such as economic constraints, political and social issues, costs associated with tuition and fees, admission assessments, geographical location of universities, and structural inequalities in educational systems (UNESCO-IESALC, 2020). It is important to note that the presence of public universities does not automatically guarantee higher levels of access. For instance, Argentina and Uruguay, with a high enrollment representation in public institutions, also report elevated access rates; while Peru and Chile, with different realities, similarly present high levels of entry into higher education (UNESCO, CEPAL & UNICEF, 2022).

At the national level, the study of motivation among university students assumes critical relevance, considering the persistent challenges they face in higher education. Many students perceive a disconnect between the content taught in the classroom and its application in real life, which undermines their intrinsic motivation. Additionally, the lack of pedagogical and technological innovation in courses limits intellectual challenges, generating demotivation and low engagement in the learning process.

In this context, university students face specific difficulties regarding the use of learning strategies, particularly in preparing academic presentations and assessments. The absence of clear training on how to structure and develop effective presentations results in disorganized and minimally impactful interventions. This situation raises the following research question: What relationship exists between motivation and the learning strategies employed by engineering students in universities?

In coherence with this, the general objective was to determine the relationship between motivation and learning strategies among engineering students at universities. The specific objectives were articulated as follows: (a) to identify the level of motivation characterizing the students, (b) to recognize the most commonly used learning strategies, (c) to establish the relationship between the value scale and these strategies, (d) to establish the relationship between the expectation scale and the strategies, and (e) to establish the relationship between the affective scale and learning strategies.

The formulated general hypothesis posits that there exists a significant relationship between motivation and learning strategies in engineering students. Specifically, it was proposed that there is a significant relationship between each of the scales (value, expectation, and affect) and the learning strategies employed by the students. Regarding previous research, Gavín et al. (2024) emphasize that motivation and the use of effective learning strategies correlate with greater participation and readiness toward academic tasks. Ratinho and Martins (2023) highlight that gamification strategies positively impact extrinsic motivation in the short term, although prolonged use may lead to adverse effects. Meanwhile, Calafato (2023) underscores the importance of continuous monitoring of motivation and self-efficacy beliefs, while Nieto et al. (2024) provide evidence that factors such as emotional well-being, motivation, and learning strategies mediate the relationship between academic performance and emotional intelligence.

In the same vein, Pérez et al. (2023) confirmed causal relationships between various learning strategies and levels of motivation, with t-statistics exceeding 1.96, thereby affirming the consistency of the model. Odontides et al. (2024) concluded that the use of cognitive learning strategies predicts better performance ($\beta = 0.269$), while motivation showed a negative association ($\beta = -0.277$) when students perceived time constraints for examinations. Almeida (2024) argues that this pressure negatively impacts motivation and, consequently, performance.

Regarding theoretical frameworks, self-regulated learning theory emphasizes the use of metacognitive, motivational, and behavioral strategies to achieve academic goals (Zimmerman & Risemberg, 1997). Moreover, Zimmerman (2000) highlights that learning strategies constitute an essential component of the cyclical model of self-regulated learning, as they guide processes toward the achievement of personal goals. In relation to the conceptual definition of the variables, motivation is understood as the internal process that drives behavior toward academic goals, regulating the actions that enable their attainment (Outerbridge et al., 2024). It can be classified as intrinsic, when arising from personal interests, or extrinsic, when responding to external factors (Theobald, 2021; Vujačić et al., 2022). On the other hand, learning strategies are consciously planned techniques that students use to enhance their understanding, retention, and application of knowledge (Cervin et al., 2020). These include metacognitive processes, resource management, summarization, schematics, and self-assessments (Theobald, 2021; Vujačić et al., 2022).

Finally, various studies indicate that motivation plays a key role in the selection and use of learning strategies. Students with higher intrinsic motivation tend to employ deep and self-regulated strategies—such as planning, monitoring, and self-evaluation—which favor academic performance and adaptation to demanding contexts (Biwer et al., 2025). In contrast, those with low motivation often resort to superficial and less effective

approaches (Nelson et al., 2015), confirming the need to strengthen motivation as a means to enhance effective learning strategies and promote academic success in engineering programs (Wang et al., 2024).

Methodology

The research is classified as basic, focused on theoretical exploration with the aim of discovering fundamental principles and generalizations. This type of study plays a crucial role in advancing scientific knowledge by testing and validating theories related to phenomena or relationships (Villanueva, 2022).

The research employs a quantitative approach, analyzing measurable and quantifiable elements to examine associations between variables. Samples from the population are taken with a specific level of error and confidence, allowing for generalizations and principles grounded in theory (Castellano et al., 2020).

The design is non-experimental, as the variables were not deliberately manipulated. This type of design is characterized by the observation of phenomena in their natural context, without researcher intervention. Additionally, the study is cross-sectional, as data were collected over a specific period to characterize the variables and examine their relationships (Arias & Covinos, 2021).

The research has a descriptive and correlational scope. This level is particularly useful in contexts where data are limited or dispersed, allowing for the identification of the most relevant factors even when complete information is unavailable (Pérez et al., 2020). Furthermore, it is framed within a correlational-causal cross-sectional design, aiming to define the connection between two or more categories or variables over a specified time period (Hernández et al., 2014).

The population consisted of engineering students from universities in the province of Santa. At the public university, according to the report for the 2024-1 cycle, there were 1,863 students, while the private university had an enrollment of 2,440 students, yielding a total population of 4,303. The inclusion criterion was enrollment in the engineering faculty, while students from other faculties were excluded.

To determine the sample size, the formula for finite populations was used, resulting in a sample of 153 students from the public university and 201 students from the private university, totaling 354 students.

The data collection technique employed was the survey, with the instrument being the Motivated Strategies for Learning Questionnaire (MSLQ), developed by Pintrich, David Smith, Teresa, and Wilbert McKeachie (Pintrich et al., 1991) and adapted into Spanish as the Cuestionario de Motivación y Estrategias de Aprendizaje. This questionnaire consists of 81 items distributed across two components. The first corresponds to the Motivation variable, composed of three dimensions: value scale (D1), expectation scale (D2), and affect scale (D3). The second corresponds to the Learning Strategies variable, which includes two dimensions: cognitive and metacognitive strategies (D1) and resource management strategies (D2). The items are structured on a five-point Likert scale.

In the first phase, the instrument underwent a pilot test applied to 20 engineering students (10 from each university). The results yielded Cronbach's alpha values of 0.875 for the motivation variable and 0.934 for the learning strategies variable, indicating high reliability. In the second phase, the questionnaire was administered to the total sample. For this, authorization was obtained from the instructors responsible for each classroom, the objectives of the research were explained to the students, and informed consent was obtained. The administration took place in the classroom, lasting approximately 20 minutes.

Data analysis was conducted using IBM SPSS software, applying descriptive and inferential statistics. For the inferential analysis, the distribution of the data was assessed using the Kolmogorov-Smirnov goodness-of-fit test, which indicated that both the variables and their dimensions followed a non-parametric distribution, presenting significance values less than 0.05. Consequently, considering the ordinal nature of the data, the Spearman correlation coefficient was applied.

Regarding ethical aspects, fundamental principles were rigorously adhered to. Firstly, the principle of autonomy was respected, ensuring that participation was voluntary and mediated by informed consent. Participants were clearly informed about the objectives and procedures of the study, as well as their right to refuse or withdraw their participation at any time. Additionally, confidentiality of the information was ensured, protecting participants' identities and any sensitive data that could be linked to them.

Results and discussion

Table 1

Correlation between motivation and learning strategies among engineering students according to Spearman

Correlation		Correlation coefficient	Sig. (two-tailed)	N
Variable 1	Variable 2			
Motivation	Learning strategies	0.779	0.000*	408

Table 1 presents data evidencing a moderate to strong positive correlation between the variables of study, Motivation and Learning Strategies. The Spearman correlation coefficient was 0.779, with a significance level of p = 0.000 (< 0.001). Therefore, the alternative hypothesis (H11) is accepted, which posits the existence of a high level of motivation among engineering students at the analyzed universities, and the null hypothesis (H01) is rejected. Consequently, it is interpreted that as motivational aspects increase among students, the use of learning strategies improves from moderate to strong, confirming a positive correlation between both variables.

Table 2

Distribution level of the Motivation variable among engineering students

Variable - Levels		Frequency	Percentage (%)	Cumulative percentage (%)
Motivation	Low	17	4.2	4.2
	Medium	209	51.2	55.4
	High	182	44.6	100.0
	Total	408	100.0	

Table 2 displays the frequency and percentage distribution related to the Motivation variable. Of the 408 surveyed students, 209 exhibit a medium level (51.2%) and 182 a high level (44.6%). These results indicate that 95.8% of students fall within a medium to high level, reflecting elevated motivation indicators among engineering students, supported by the dimensions of value scale, expectation, and affect.

Table 3

Distribution level of the Learning Strategies variable among engineering students

Variable - Levels		Frequency	Percentage (%)	Cumulative percentage (%)
Learning Strategies	Low	18	4.4	4.4
	Medium	246	60.3	64.7
	High	144	35.3	100.0
	Total	408	100.0	

Table 3 presents the frequency and percentage distribution of the Learning Strategies variable. It is observed that 246 students show a medium level (60.3%), and 144 have a high level (35.3%) out of a total of 408 respondents. This indicates that the medium level is predominant; however, together, 95.6% fall within the medium to high range. In other words, the use and application of learning strategies are significant among engineering students, particularly in the dimensions of cognitive and metacognitive strategies and resource management strategies. Nonetheless, there is an approximate 25% gap between the two levels, suggesting that while students apply learning strategies, these are not always effective in every case.

Table 4

Spearman correlation of the Value Scale and Learning Strategies among engineering students

Correlation		Correlation coefficient	Sig. (two-tailed)	N
Dimensions	Variable 2			
D1: Value Scale	Learning Strategies	0.746	0.000*	408
D2: Expectation Scale		0.742	0.000*	408
D3: Affect Scale		0.421	0.000*	408

Table 4 shows a moderate to strong positive correlation between the motivation dimension of the Value Scale and Learning Strategies. The Spearman coefficient reached a value of 0.746 with a significance of p = 0.000 (< 0.001). Therefore, the alternative hypothesis (H13) is accepted, which establishes a significant relationship between both variables, and the null hypothesis (H03) is rejected.

Additionally, a moderate to strong positive correlation is evident between the motivation dimension of the Expectation Scale and Learning Strategies, with a Spearman coefficient of 0.742 and significance of p = 0.000 (< 0.001). In this case, the alternative hypothesis (H14) is accepted, and the null hypothesis (H04) is rejected.

Finally, the Affect Scale dimension showed a weak positive correlation with Learning Strategies, reaching a Spearman coefficient of 0.421 and significance of p = 0.000 (< 0.001). Thus, the alternative hypothesis (H15), which posits a significant relationship between both variables, is accepted, and the null hypothesis (H05) is rejected.

In line with the general objective of determining the relationship between motivation and learning strategies among engineering students, the results obtained (Spearman rho = 0.779, p = 0.000 < 0.001) reveal a substantial positive association between both variables. Therefore, the alternative hypothesis (H11) is confirmed, and the null hypothesis (H01) is rejected. In other words, as motivation levels increase, students employ learning strategies more frequently and effectively.

These findings align with those reported by Pérez et al. (2023), who, using the PLS-SEM statistical model, determined that motivation has a strong relationship with the use of various learning strategies aimed at achieving goals, demonstrating high predictive and explanatory capacity.

Similarly, the results coincide with those of Odontides et al. (2024), who, while studying first-cycle medical students, found correlations between motivation and learning strategies, particularly in the use of metacognitive strategies (r = 0.255, p = 0.008) and resource management strategies (r = 0.435, p < 0.001).

In that same line, Gewerc et al. (2023) and Hoces (2023) also utilized the MSLQ questionnaire to analyze the relationship between motivation and learning strategies. Gewerc et al. (2023) reported significant medium to high correlations between motivation and various dimensions of learning strategies (rho: 0.414 – 0.420, p = 0.05). Meanwhile, Hoces (2023) identified that most students presented medium and high levels of motivation, as well as frequent use of learning strategies, achieving 58.4% in motivation (high level) and 61.9% in learning strategies (medium level).

Conclusions

It was determined that there is a moderate to strong positive relationship between motivation and learning strategies among engineering students at universities in the province of Santa. This finding indicates that an increase in motivation levels is associated with a considerable improvement in the implementation of learning strategies.

Furthermore, it was identified that the level of motivation characterizing engineering students is predominantly medium to high. Specifically, 51.2% present a medium level of motivation and 44.6% a high level, representing a total of 95.8% in these two categories. This reflects that students possess consistent and favorable motivation, supported by factors such as perceived value, academic expectations, and positive emotions—elements that contribute to significant willingness towards learning and academic achievement.

Regarding the use of learning strategies, it was established that students employ these resources at predominantly medium and high levels, with 60.3% and 35.3%, respectively. Collectively, 95.6% of participants utilize cognitive, metacognitive, and resource management strategies. However, the 25% gap between medium and high levels suggests that, although strategies are frequently applied, their effectiveness and consistency are not always optimal.

Concerning the dimensions of motivation, it was found that the value scale presents a moderate-high and statistically significant positive relationship with learning strategies. This indicates that as students perceive greater value in tasks, content, and goals (both intrinsic and extrinsic), the use of effective learning strategies also increases.

Similarly, the expectation scale showed a strong and statistically significant positive relationship with learning strategies. This result suggests that students with higher academic expectations and greater confidence in achieving their goals tend to apply learning strategies more effectively.

Finally, it was found that the affect scale has a weak positive relationship, albeit statistically significant, with learning strategies. This implies that although the affective component does not carry the same explanatory weight as the other dimensions, it consistently influences the academic performance of engineering students.

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