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Attitudes towards mathematics and learning approaches in university students

Herrera Alvarez, Angela María*
Cumpa Valencia, Moisés**
Llanos Miranda, Kelva Nathali***
Cerna Figueroa, Edwin Angel****

Abstract

The study of attitudes toward mathematics has received much attention due to the influence it has on student learning and possibly the adoption of some approach. Therefore, the objective of this study was to analyze the association between attitudes towards mathematics and learning approach in a group of 228 university students of Pedagogy from a public university in Lima-Peru. The research has a quantitative approach and correlational design. Data collection was done using two instruments, the scale of attitudes towards mathematics and the revised Study Processes Questionnaire (R-CPE-2F). The results report that there is a direct association between the variables; it has also been found that learning approaches are associated to a greater extent with the dimensions of usefulness and motivation towards mathematics. Regarding the superficial approach, it has a positive association with the motivation and anxiety generated by mathematics, while the deep approach has a greater association with the usefulness, motivation, and confidence towards this subject. It is concluded, therefore, that the attitudes that students have towards mathematics would depend on several factors such as: Predisposition, motivation, and the usefulness they give it for their training.

Keywords: Attitudes mathematics; mathematical utility; learning approaches; deep approach; surface approach.

* Doctora en Ciencias de la Educación. Magister en Didáctica de la Ciencias Sociales. Licenciada en Educación Inicial. Docente en la Universidad Privada Norbert Wiener, Lima, Perú. E-mail: amheal1212@gmail.com ORCID: <https://orcid.org/0000-0002-6399-3850>

** Doctor en Ciencias de la Educación. Magister en Problemas de Aprendizaje. Licenciado en Lengua y Literatura. Docente de la Carrera de Comunicaciones de la Facultad de Comunicación en la Universidad San Ignacio de Loyola, Lima, Perú. E-mail: jmcuval@hotmail.com ORCID: <https://orcid.org/0000-0002-8393-5762>

*** Candidata a Doctor en Estadística Matemática. Magister en Ciencias con mención en Estadística Aplicada. Licenciada en Estadística e Informática. Docente Auxiliar en la Universidad Nacional Mayor de San Marcos, Lima, Perú. E-mail: kllanosm@unmsm.edu.pe ORCID: <https://orcid.org/0000-0002-6480-0408>

**** Magister en Ciencias con mención en Estadística Aplicada. Ingeniero Estadístico. Docente Auxiliar Tiempo Completo de la Facultad de Ciencias Empresariales en la Universidad San Ignacio de Loyola, Lima, Perú. E-mail: ecerna@usil.edu.pe ORCID: <https://orcid.org/0000-0002-0755-5354>

Actitudes hacia la matemática y enfoques de aprendizaje en estudiantes universitarios

Resumen

El estudio sobre las actitudes hacia las matemáticas ha recibido mucha atención debido a la influencia que tiene en el aprendizaje de los estudiantes y posiblemente sobre la adopción de algún enfoque. Por ello, el objetivo de este estudio fue analizar la asociación entre las actitudes hacia la matemática y el enfoque de aprendizaje en un grupo de 228 estudiantes universitarios de Pedagogía de una universidad pública en Lima-Perú. La investigación tiene un enfoque cuantitativo y diseño correlacional. La recolección de datos se hizo mediante dos instrumentos, la escala de actitudes hacia la matemática y el cuestionario revisado de procesos de Estudio (R-CPE-2F). Los resultados reportan que hay una asociación directa entre las variables; también se ha encontrado que los enfoques de aprendizaje se asocian en mayor medida con las dimensiones de utilidad y motivación hacia la matemática. En cuanto al enfoque superficial, tiene asociación positiva con la motivación y la ansiedad que genera la matemática; mientras que el enfoque profundo tiene mayor asociación con la utilidad, la motivación y la confianza hacia esta asignatura. Se concluye, por tanto, que las actitudes que tienen los estudiantes hacia las matemáticas dependen de varios factores como: La predisposición, la motivación y la utilidad que le den para su formación.

Palabras clave: Actitudes matemáticas; utilidad matemática; enfoques de aprendizaje; enfoque profundo; enfoque superficial.

Introduction

In the last two decades, the study of attitudes in the educational field has become an important variable to understand the behavior of students towards some phenomenon. Thus, attitudes towards research, homework, learning of different subjects, as well as attitudes towards mathematics, which is defined as the student's learned predisposition towards the subject, are studied. Mujica (2022), points out that attitudes are a set of representations of thought, so these can be positive or negative towards the content, which makes that thought is conditioned by a previous feeling (Duarte-Sepúlveda, Ricardo-Quiñones & Santos-López, 2018; Cardoso, 2019).

Regarding the learning of mathematics, it is understood that attitudes are a fundamental aspect of learning (Orjuela, Hernández & Cabrera, 2019), so the whole conglomerate of rational and abstract factors such as liking, usefulness, motivation, interest, among others, involved in its construction are taken into account. For Prada-Núñez, Fernández-

César & Jardey-Suárez (2022); and Huaire et al. (2023), attitudes are social constructs resulting from interactions between personal experiences and the influences of experiences with others. In fact, studies such as those of Hernández-Dzib & Euan-Mex (2023) show that the application of innovative strategies allows students to consider the subject as fun, interesting and useful.

However, history also shows that many students have negative attitudes towards mathematics, due to the fact that the subject is considered complicated, difficult, boring, uninteresting and useless (Duarte-Sepúlveda et al., 2018; Santiago-López & Farfán-Pimentel, 2023), which influences the teaching-learning process (Ávila-Toscano et al., 2023). Given this, scientific studies are key to understanding and improving educational activity (Gamboa-Araya, 2016; Meza-Cascante et al., 2019).

In the same context, approaches to learning transcend as one more factor to explain students' visions and integrate new perspectives to understand the nature of learning. The term (approaches to learning)

was coined by Marton & Säljö in 1976, to refer to learners' adoption of strategies to cope with tasks. Therefore, the responsibility for learning lies with the student and not with the teacher when presenting the task (López & López, 2013).

According to authors such as Biggs (1987); and Soler, Cárdenas & Hernández-Pina (2018), these processes are generated in the student when facing an academic task, the same ones that are influenced by personal characteristics, the nature of the task and the context. Specifically, Biggs (1987) describes three key elements in the learning process: the intention (motive), the process that follows (strategy) and the achievements obtained (performance).

From the perspective of Marton & Säljö (1976); Zamora, Gil & De Besa (2020); and Ampuero (2022), approaches to learning play an important role in academic success; therefore, they would be influenced by the very processes adopted by students and dependent on other contextual factors (Huairé & Arteta, 2018). From this perspective, two approaches are promoted: On the one hand, the superficial approach; and on the other, the deep approach to learning, according to the needs perceived by the task (López & López, 2013). The superficial approach, makes use of repetition strategies, memorization, requires minimal effort and low cognitive level, and its main objective is the fulfillment of the task (Soler et al., 2018; Pérez, Méndez & Pérez, 2020; Zamora et al., 2020). Likewise, it is based on extrinsic and instrumental motivation (Bernal et al., 2019).

For its part, the deep approach is related to thinking skills (Báez & Onrubia, 2016), which are described as a set of skills that are generated according to the type of tasks and/or activities (Soler et al., 2018; Quiroga & Lara, 2023). Thus, when the student is at a deep focus level, he/she has the ability to regulate his/her own process, adequately manages information, establishes a strategic plan of multiple actions and operations to learn in depth (Lv et al., 2022; Simón et al., 2023).

The aim of this research is to analyze

the association between attitudes towards mathematics and learning approaches in a group of university students of Pedagogy at a public university in Lima-Peru. No research has been found that associates both variables; however, it seems that they coincide in the formation and development of thinking. On the one hand, attitudes are positive or negative representations about an object and are built from interactions between personal experiences and the influences of experiences with others (Prada-Núñez et al., 2022). On the other hand, approaches are created through learning activities and are associated with personal and environmental factors to a lesser extent, so it is expected to find positive associations that allow building bridges to strengthen student learning.

1. Methodology

The research process was developed from the quantitative approach with descriptive and correlational design. The purpose of these designs is to describe the behavior of each variable in the same sample and subsequently measure the association between them (Huairé et al., 2022). That is, the design meets the objectives of the study which was to analyze the association between attitudes towards mathematics and learning approaches in university students.

The sampling was probabilistic of simple random type in which 228 Pedagogy students of both sexes participated (219 females and 9 males), with a mean of 21.46, all belonging to a public university in Metropolitan Lima, Peru.

Two instruments were used to collect data. The first, was the Scale of Attitudes towards Mathematics, proposed by Auzmendi (1992) and validated by Hurtado (2011), for Peruvian samples. This instrument consists of 25 items with five factors: Usefulness, liking, motivation, confidence and anxiety. Regarding standardization, it has a Cronbach's alpha of 0.797.

The second instrument, was the Revised Questionnaire of Study Processes (R-CPE-2F), developed by Biggs, Kember & Leung (2001), validated and adapted to Peruvian and Argentine samples by Freiberg-Hoffman, Merino-Soto et al. (2021). This instrument is composed of two dimensions: Deep focus and surface focus, each with 10 items. As for standardization, it has a Cronbach's Alpha of 0.828 for the general instrument; for deep focus 0.925 and for surface focus 0.904.

The data were collected using the Google Forms form in which alternatives were consigned to establish voluntary participation in the study by the students, as a criterion of compliance with the ethical aspect of the research. Once all the data were collected, they were analyzed statistically using SPSS software version 26.

2. Results and discussion

To present the results, a frequency and percentage analysis of the variable attitude towards mathematics and its dimensions was made (see Table 1). Attitudes are defined as the student's conscious predisposition towards mathematics; therefore, they can be negative or positive depending on the feeling they are causing. In general, students show a regular attitude towards this subject, so it is important to improve this aspect in order to have a better academic level. At the level of dimensions, most of the participants feel that the mathematics course is useful for their professional training. They also feel that they like it, so they have good motivation and confidence to learn. However, it is evident that it generates anxiety, which is an indicator that teaching should be improved.

Table 1
Levels of attitude towards mathematics and their dimensions

		Attitude towards mathematics	Usefulness	Pleasure	Motivation	Confidence	Anxiety
Low	Count	13	13	59	32	25	14
	% of total	5.7%	5.7%	25.9%	14.0%	11.0%	6.1%
Medium	Count	193	165	133	167	102	203
	% of total	84.6%	72.4%	58.3%	73.2%	44.7%	89.0%
High	Count	22	50	36	29	101	11
	% of total	9.6%	21.9%	15.8%	12.7%	44.3%	4.8%
Total	Count	228	228	228	228	228	228
	% of total	100%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Own elaboration, 2024.

Learning approaches have to do with the ways in which students conceive this activity, although they are influenced by the characteristic of the task and/or activity itself and also by the context. The approaches were analyzed considering the frequency and percentages at the general level, as well as their

dimensions. The results show that the students have a defined learning approach since they demonstrate a high level. As for the superficial approach, it seems that this is the lowest, since most of them are located in the deep learning approach (see Table 2).

Table 2
Levels of learning approaches and their dimensions

Superficial learning approaches	Deep learning approaches	Learning approaches
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Cont... Table 2

Low	Count	69	9	12
	% of total	30.3	3.9	5.3
Medium	Count	136	94	183
	% of total	59.6	41.2	80.3
High	Count	23	125	33
	% of total	10.1	54.8	14.5
Total	Count	228	228	228
	% of total	100.0	100.0	100.0

Source: Own elaboration, 2024.

Regarding the inferential results (see Table 3), the results are very relevant in terms of the model used, since they show varied correlations among the variables and among the dimensions. In principle, it is evident that there is a significant direct relationship between learning approaches and students' attitudes towards mathematics; that

is, being oriented by a certain approach has positive repercussions on students' attitudes. Moreover, approaches are positively related to two dimensions of attitudes: usefulness and motivation. As for the superficial approach, it has a greater relationship with motivation towards mathematics and with the anxiety generated by learning the subject.

Table 3
Correlations between variables and their dimensions

		Learning Approach	Pleasure	Usefulness	Motivation	Confidence	Anxiety	Superficial Approach
Attitude towards mathematics	Correlación de Pearson	0,445**						
	Sig. (unilateral)	0,000						
Learning Approach	Correlación de Pearson	1						
	Sig. (unilateral)							
Enjoyment	Correlación de Pearson	0,192**	1					
	Sig. (unilateral)	0,002						
Usefulness	Correlación de Pearson	0,395**	0,395**	1				
	Sig. (unilateral)	0,000	0,000					
Motivation	Correlación de Pearson	0,376**	0,062	0,381**	1			
	Sig. (unilateral)	0,000	0,174	0,000				
Confidence	Correlación de Pearson	0,197**	0,514**	0,431**	0,153*	1		
	Sig. (unilateral)	0,001	0,000	0,000	0,010			
Anxiety	Correlación de Pearson	0,313**	0,222**	0,331**	0,307**	0,239**	1	
	Sig. (unilateral)	0,000	0,000	0,000	0,000	0,000		
Superficial Approach	Correlación de Pearson	0,590**	0,084	0,196**	0,329**	0,069	0,207**	1
	Sig. (unilateral)	0,000	0,103	0,001	0,000	0,148	0,001	
Deep Focus	Correlación de Pearson	0,463**	0,236**	0,309**	0,304**	0,303**	0,243**	0,081
	Sig. (unilateral)	0,000	0,000	0,000	0,000	0,000	0,000	0,111
	N	228	228	228	228	228	228	228

Source: Own elaboration, 2024.

On the other hand, the deep approach to learning is positively related to the dimensions of usefulness, motivation and confidence towards learning mathematics. That is, this approach to learning is oriented both to the cognitive knowledge of the subject and to affective aspects, since affectivity plays an important role in learning.

The results indicate that students show a favorable attitude towards mathematics at a general level and in its dimensions. These results are concordant with reports from other studies (Flores & Auzmendi, 2018; Ramírez-Cruz, López-Mojica & Aké, 2018; Rojas, 2020), who found similar responses in research with university students. Consequently, it can be affirmed that there are positive tendencies towards cognitive, behavioral and affective components towards mathematics (López-Mojica et al., 2021). Thus, many students consider mathematics to be important for life, but, at the same time, they attribute little value to it in their professional training (Ramírez-Cruz et al., 2018).

Likewise, in learning approaches, students, for the most part, present a medium level, data that agrees with other findings (González-Marcos et al., 2021; Mercado-Guerra, Calderón-Carvajal & Palominos-Urquieta, 2022), that reported the predominance of a deep learning approach in university students, which is due to the fact that students face tasks in a particular way, making use of strategies that include motivations, intentions and behaviors (Speth, Namuth & Lee, 2007), as well as the context, in which the teacher plays an important role (Kember, Leung & McNaught, 2008; Romero et al., 2013). On the contrary, those students who are not at a deep focus level would be those who have difficulties in deepening knowledge and rely on literal reproduction of information (Romero et al., 2013).

At the inferential level, the reports show that there is a positive relationship between attitudes towards mathematics and learning approaches. Although there is no previous empirical evidence on the association between these variables, the data would have

to do with what the student himself does and very little with external influences. That is, it would be due to the nature of learning and attitudes that are modifiable and adaptable to the context (Romero et al., 2013). In this case, Gamboa & Moreira-Mora (2016) state that attitudes towards mathematics are not related to the didactic tendencies of teachers, but to the predisposition of each student to learn the course. For López & López (2013), in the development of learning approaches, the responsibility for learning lies with the student and not with the teacher when presenting the task.

Attitudes, for Mujica (2022), are representations of thought, which can be positive or negative and are built from interactions between personal experiences and the influences of experiences with others (Prada-Núñez et al., 2022), which has to do with feelings, beliefs and behaviors (Orjuela et al., 2019). While learning approaches are created by learning activities and are associated with motivational factors (Soler et al., 2018), course liking (Rojas-Kramer et al., 2017), confidence (Flores & Auzmendi, 2018), strategies used (Soler et al., 2018) or career choice.

In the context of the dimensions, a direct relationship was found between motivation and anxiety with surface approach. These results are in line with the findings of García, Guzmán & Monje (2023), who found that very high levels of mathematics anxiety are negatively related to self-confidence, which leads to poor academic performance. That is, low performance in the course is directly related to the superficial approach (Freiberg-Hoffmann, Vigh & Fernández-Liporace, 2021). This type of learning causes difficulty and anxiety before the course (Cardoso, 2019), scarce time, dedication and effort towards learning the subject (Ramudo-Andion et al., 2020), usually present at the beginning of the training (Ramírez-Cruz et al., 2018).

On the other hand, a positive relationship has been found between usefulness, motivation and confidence towards mathematics and deep learning approach.

These findings are concordant with the reports of Flores & Auzmendi (2018); Simón et al. (2023); and Hernández-Dzib & Euan-Mex (2023), who argue that students who present this type of learning have a valuable tool to construct meaningful learning and metacognitive strategies. Furthermore, this positive association would mean that students are able to establish analogies, solve mathematical problems, adequately explain a practical procedure, be creative and critical at the same time (James et al., 2022; Lv et al., 2022), without leaving aside the role of the teacher, who guides learning, but it is the student who contextualizes and accommodates to his/her context, so it is part of the so-called new pedagogies (Quiroga & Lara, 2023).

Conclusions

Attitudes, as well as learning approaches, are predispositions of the student to develop his or her own thought processes. The evidence is that the superficial approach to learning has a negative relationship with academic success, since it is oriented towards rote, literal learning with little depth. Therefore, it is necessary to move towards the deep approach to learning, since it generates better academic results.

When students opt for the deep approach, they develop a set of cognitive skills and strategies such as planning learning, managing resources, organizing time adequately, selecting motivational strategies, among others. In addition, the deep approach involves achieving reflective processes, develops critical thinking, learning through analogies, which is related to mathematical knowledge and allows them to improve attitudes towards the subject and minimize negative attitudes towards the course.

During the process of carrying out the study, no limitations were found, since time, resources and access to the sample were handled without inconveniences. What is important to analyze is that the study of learning approaches from different perspectives and research designs should

continue to be studied in depth. It is a variable that has been little studied in this context and deserves further study.

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