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# Academic self-concept of low-achieving males and females in mathematics: A comparative study

*Autoconcepto académico de mujeres y varones con bajo rendimiento en matemática: un estudio comparativo*

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## Abstract

The research aimed to identify differences in academic self-concept between boys and girls with learning difficulties in mathematics. A qualitative approach with a case study design was used. The sample consisted of 24 students, divided equally into 12 girls and 12 boys, all with insufficient performance in mathematics. The results showed significant differences in the co-occurrence coefficients between the two groups, with specific values for the subcategories of relationships with others, assertiveness, commitment, and coping with school situations. For girls, these coefficients were 0.33, 0.24, 0.33, 0.39, 0.25, 0.48, 0.19, and 0.18; while for boys, values of 0.32, 0.31, 0.21, 0.14, 0.32, 0.14, 0.40, and 0.38 were observed. These findings show a clear contrast in how both genders perceive their academic self-concept. Therefore, it is concluded that gender is a fundamental variable that must be considered when designing and implementing strategies to improve mathematics learning, in order to address the specific needs of each group and promote their academic development.

**Keywords**: perception, mathematics, gender.

## Resumen

La investigación tuvo como objetivo identificar las diferencias en el autoconcepto académico entre varones y mujeres con dificultades para alcanzar aprendizajes en matemáticas. Para ello, se utilizó un enfoque cualitativo con un diseño de estudio de caso. La muestra estuvo compuesta por 24 estudiantes, divididos equitativamente en 12 mujeres y 12 varones, todos con rendimiento insuficiente en matemáticas. Los resultados evidenciaron diferencias significativas en los coeficientes de co-ocurrencia entre ambos grupos, con valores específicos para las subcategorías de relaciones con otros, asertividad, compromiso y afrontamiento de situaciones escolares. En las mujeres, estos coeficientes fueron 0.33, 0.24, 0.33, 0.39, 0.25, 0.48, 0.19 y 0.18; mientras que en los varones se observaron valores de 0.32, 0.31, 0.21, 0.14, 0.32, 0.14, 0.40 y 0.38. Estos hallazgos muestran un contraste claro en cómo ambos géneros perciben su autoconcepto académico. Por lo tanto, se concluye que el género es una variable fundamental que debe considerarse al diseñar e implementar estrategias de mejora en el aprendizaje de matemáticas, a fin de atender las necesidades específicas de cada grupo y favorecer su desarrollo académico.

**Palabras clave**: percepción, matemática, género.

## Introduction

Students who have repeatedly achieved unsatisfactory results in mathematics generally exhibit a negative self-perception. They often magnify their difficulties, express a lack of skills, and assign blame to themselves for these deficiencies. This negative perception can diminish their academic success expectations and may even lead to school dropout (Champan, 1988, as cited in Gil et al., 2006). In this regard, authors such as Hernández (2010), cited in Gamboa (2014), emphasize the importance of motivational and emotional factors in the learning process. These factors significantly influence what and how students learn. In particular, they highlight the relevance of intrinsic motivation, which drives students to engage in authentic learning. Therefore, it is essential to consider the affective aspect in mathematics education, as it can improve students' beliefs and attitudes toward this discipline.

Gaining a deeper understanding of academic self-concept among male and female secondary students is pertinent because it allows for gender-differentiated insights. Such information can inform the design of more effective pedagogical strategies to enhance mathematics learning. An individual's self-concept regarding their performance in mathematics is linked to their beliefs about themselves in this domain and results from the interplay of attitudes, their worldview regarding mathematics, and social identity (Gómez, 2011). It is also important to note that this self-concept is not static; rather, it evolves over time, influenced by cognitive development and interactions with the environment (Harter, 1999, as cited in Calero & Molina, 2016).

Arancibia et al. (2007) describe academic self-concept as a construct associated with academic performance that guides student behavior. This construct is divided into four dimensions established through observations of student behavior: relationships with others, assertiveness, commitment, and coping with academic situations. Various studies, such as that of George et al. (2024), have explored the relationship between emotions and the teaching and learning processes, indicating that positive emotional connections—such as mutual trust and respect—impact students' willingness to learn and their academic performance. The quality of the student-teacher relationship is, therefore, crucial for enhancing academic potential.

In their review, González and Molero (2023) examined the literature concerning the category “Relationships with others,” suggesting that the development of social skills contributes to positive performance across various contexts, thereby boosting the individual's self-esteem. Regarding the affective domain, Siza (2020) found that half of the students evaluate their self-concept as low or moderately low, leading to insecurity that adversely affects their mathematics learning. Some students attribute their poor performance to a lack of effort and disinterest, believing that increased motivation would yield better outcomes.

Regarding commitment, Núñez and González (2020) concluded that pedagogical strategies, such as workshops, are effective in sparking interest and motivation, ultimately reducing boredom and increasing participation. This, in the long run, supports effort and performance in mathematics. In the current context, the PISA 2022 assessment, encompassing numerous countries in Latin America and the Caribbean, revealed that the majority of students exhibit poor performance in mathematics. Self-efficacy and anxiety are key factors in understanding these results. Notably, male students tend to demonstrate higher self-efficacy and lower anxiety related to mathematics than their female counterparts (UMC – Ministerio de Educación del Perú, 2022).

Furthermore, the National Learning Achievement Assessment (ENLA, 2023) in Peru indicated that 53% of students experience anxiety during assessments, and 38% express concern when solving exercises. Females, in particular, report higher levels of anxiety and fear compared to males. Additionally, the results show that a significant percentage of students are at preliminary achievement levels, with males in Metropolitan Lima demonstrating a higher proportion of students at this initial stage than females (ENLA, 2023).

Given these findings, the purpose of this article is to investigate the differences in academic self-concept between male and female secondary students experiencing learning difficulties in mathematics within a Latin American context, with the intention of contributing to more tailored and effective pedagogical strategies.

## Methodology

This study adopted a qualitative approach, which allows for an analysis of both context and individuals from a holistic perspective (Taylor & Bogdan, as cited in Sandoval, 1996). The design utilized was a case study, characterized by an in-depth investigation of a specific phenomenon within a defined context, aimed at understanding its nuances and characteristics (Durán, 2014).

The research setting was a public school located in the Rímac district of Metropolitan Lima, with a population of 479 secondary students. The sample was selected using purposeful qualitative sampling, which involves selecting cases that provide relevant insights for detailed analysis, based on defined criteria established by the researcher (Izcara, 2014).

The sample consisted of 24 third-year secondary students, evenly divided between 12 females and 12 males.

**Table 1**
*Students interviewed*

| Participants | Gender | Grade | Sections |
|---|---|---|---|
| 12 students | F | Third | A -B -C |
| 12 students | M | Third | A -B -C |

The study included students enrolled in the third year of secondary education who were at the "beginning" level in three or four of the competencies assessed during the first and second bimesters of the mathematics course. Conversely, students without difficulties in the subject, as well as those with cognitive disabilities, were excluded.

Data collection involved the use of interviews, deemed by Fernández (2001) as the most suitable method for understanding individual perspectives on specific situations. A semi-structured interview guide was developed, which, according to Tejero (2021), allows the interviewer to include follow-up questions to expand or clarify aspects, facilitating a smooth conversation where participants can express themselves freely. In total, 13 open-ended questions were formulated based on theoretical review and the preliminary construction of a categorization matrix.

The organization, systematization, and analysis of the data were conducted using Atlas.ti 9 software, a versatile tool that facilitates the qualitative processing of information obtained from interviews and other textual sources (Lopezosa et al., 2022).

## Results

This section presents the co-occurrence coefficients obtained through analysis with Atlas.ti 9 software, which allow for the identification and quantification of relationships among the various emerging codes from the collected material. These coefficients reflect the frequency with which certain concepts or categories appear together, offering a clear view of the connections and patterns underlying the qualitative analysis. From these data, it is possible to interpret the dynamics and differences in perceptions and experiences of the participants concerning academic self-concept in mathematics.

**Table 2**
*Co-occurrence coefficients*

| Co-occurring Codes | Females | Males |
|---|---|---|
| Paying attention in class and Disruptive behavior in the classroom | 0.48 | 0.14 |
| Offering to do additional work and Academic reward | 0.39 | 0.14 |
| Clear expression of one's own ideas and Self-confidence | 0.33 | 0.21 |
| Relationship with peers and Asking for help | 0.33 | 0.32 |
| Paying attention in class and Active listening | 0.19 | 0.40 |
| Completing assignments carefully and Comparing work | 0.18 | 0.38 |
| Initiating new school activities and Lack of initiative | 0.25 | 0.32 |
| Relationship with teachers and Trust in the teacher | 0.24 | 0.31 |

**Note.** Table 2 presents the co-occurrences between the pre-established codes and those that emerged from the analysis of females and males, with coefficients greater than 0.30

The highest co-occurrence value for females is found between the codes *Paying attention in class and Disruptive behavior in the classroom*, with a coefficient of 0.48; in contrast, this value for males is only 0.14. This indicates that female students experience challenges in maintaining attention due to the disruptive behaviors of their peers, which may reflect a diminished appreciation for the importance of their own learning or a feeling of being unable to keep pace. This situation is exemplified by the following quote*: "Sometimes I don't pay attention*

*because (my classmates) make too much noise; the joking around distracts me; I end up chatting instead of paying attention to the teacher."*

The second-highest co-occurrence for females occurs between *Offering to do additional work and Academic reward*, with a coefficient of 0.39 compared to 0.14 for males. This indicates that female students are willing to take on additional tasks in hopes of receiving some form of reward, such as extra points necessary to pass. This behavior relates to both a lack of initiative and limited genuine motivation to learn, whether due to difficulties in the course or a suboptimal relationship with teachers. In this regard, a low self-concept is observed, conditioned more by external incentives than by authentic interest, as illustrated in the following quotes: *"For now, I don't offer to do additional work because I don't need to, but later I will because I need good grades to pass the course." "I offer to help because I want to pass the year and avoid repeating; it's unpleasant."*

The next co-occurrence involves the codes *Clear expression of one's own ideas and Self-confidence*, with coefficients of 0.33 for females and 0.21 for males, indicating that in both groups, there is a close relationship between personal confidence and the ability to express ideas openly. A lack of confidence is directly linked to a low academic self-concept, affecting personal security and classroom performance, as shown by the following expressions: *"I rarely express my ideas, especially when I don't understand; in those cases, I prefer to stay silent because I don't have confidence." "I didn't express myself because I lacked confidence."*

Another relevant co-occurrence connects *Relationship with peers and Asking for help*, with coefficients of 0.33 for females and 0.32 for males. This indicates that the quality of interpersonal relationships influences confidence in seeking support, sometimes limiting the willingness to ask questions due to fear of criticism, as reflected in this quote: *"Most of the time, I do ask for help, but only from my closest friends and those I interact with more; not with the others because I feel embarrassed and fear what they might think or say, like that I'm dumb or something."*

Concerning the co-occurrence between *Paying attention in class and Active listening*, coefficients of 0.19 for females and 0.40 for males suggest that male students associate active listening with behaviors such as remaining silent and closely observing the teacher to maintain concentration, as illustrated by the following assertion: *"I pay attention by watching and listening to the teacher because I want to learn mathematics."*

Conversely, the co-occurrence between *Completing assignments carefully and Comparing work* shows a coefficient of 0.18 for females and 0.38 for males, indicating that male students value reviewing their work against that of their peers as a means of ensuring the quality of their assignments, a practice less common among females. This comparison involves aspects such as self-confidence, interest in the subject, and peer relationships, as expressed by one participant: *"I compare my results with my classmates' assignments because I'm not very sure if what I'm doing is correct."*

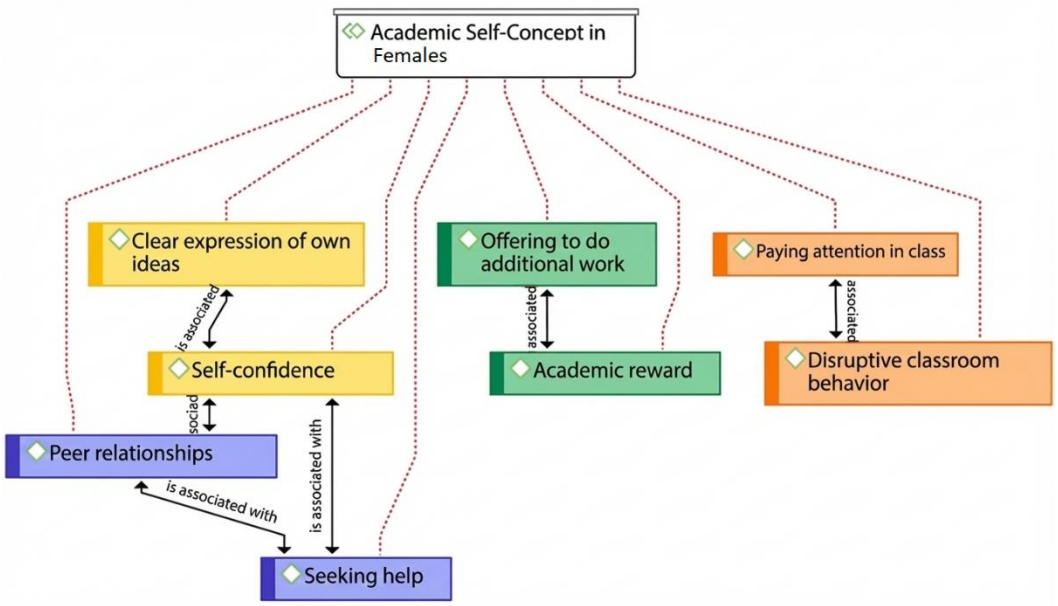
The co-occurrence between *Initiating new school activities and Lack of initiative* presents coefficients of 0.25 for females and 0.32 for males, indicating that the willingness to propose or develop new activities is directly related to personal initiative in both genders, as shown in these statements: *"I haven't proposed any activities because I'm not very interested in the course." "No, I haven't proposed anything because I don't like the subject very much, and I don't feel comfortable doing it."*

Finally, the co-occurrence between *Relationship with teachers and Trust in the teacher* reveals coefficients of 0.24 for females and 0.31 for males, demonstrating that the confidence and relationship established with teachers influence their openness to ask questions, share opinions, or participate in class, as illustrated by this quote: *"I don't have much trust in the teacher, which is why I prefer to avoid any contact."*

**Semantic networks**

**Figure 1**

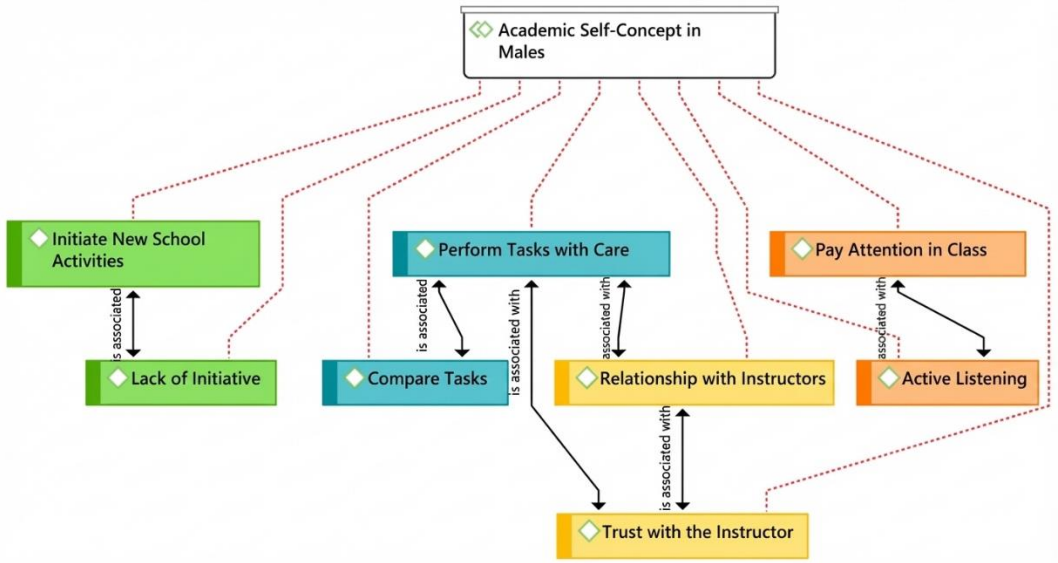
*General semantic network: academic self-concept in females*




**Note.** The figure shows that the category of this study, "Academic self-concept in females," is related to the codes Paying attention in class and Disruptive behavior in the classroom (0.48), Offering to do additional work and Academic reward (0.39), Clear expression of one's own ideas and Self-confidence (0.33), and Relationship with peers and Asking for help (0.33)

**Figure 2**

*General semantic network: academic self-concept in males*




**Note.** The figure indicates that the category of this study, "Academic self-concept in males," relates to the codes Paying attention in class and Active listening (0.40), Completing assignments carefully and Comparing work (0.38), Initiating new school activities and Lack of initiative (0.32), and Relationship with teachers and Trust in the teacher (0.31)

## Discussion

The co-occurrence between the codes *Relationship with teachers and Trust in the teacher*, with coefficients of 0.24 for females and 0.31 for males, reveals that the trust established with the teacher is fundamental for fostering a positive relationship. This relationship can enhance students' learning progress. This finding aligns with George et al. (2024), who state that emotional bonds influence the motivation to learn, the degree of student engagement, and ultimately, their academic achievement. Additionally, they mention that students' potential unfolds according to the quality of the relationship established with their teachers.

Regarding the co-occurrence between *Relationship with peers and Asking for help* (0.33 forfemales and 0.32 for males), it is evident that positive social interaction within the classroom is crucial for students to feel confident in seeking academic support. This contributes to improving their understanding and, consequently, strengthens their academic self-concept. These findings resonate with González and Molero (2023), who highlight that the development of social skills facilitates adaptation across various contexts, thereby also enhancing self-esteem.

Concerning the co-occurrence between *Paying attention in class and Disruptive behavior in the classroom* (0.48 for females and 0.14 for males), it is clear that motivational strategies are essential for improving concentration and reducing distractions caused by disruptive behaviors. This motivation also positively impacts the readiness for learning, as seen in the co-occurrence between *Offering to do additional work and Academic reward* (0.39 for females and 0.14 for males) and in the relationship between *Initiating new school activities and Lack of initiative* (0.25 and 0.32, respectively). Motivated students exhibit greater commitment to their learning and demonstrate more initiative in engaging in academic activities, driven by intrinsic rewards. This aligns with Núñez and González (2020), who report that workshop formats effectively engage interest and improve performance, highlighting a decrease in boredom in the classroom due to support strategies.

Finally, the co-occurrence between *Clear expression of one's own ideas and Self-confidence*, with coefficients of 0.33 for females and 0.21 for males, indicates that low confidence limits the capacity to communicate ideas, either due to fear or difficulties understanding the content. This correlates with Siza (2020), who found that half of the evaluated students present a low or moderately low academic self-concept, with limited confidence in their mathematical skills, resulting in feelings of frustration and hindering learning.

Collectively, these results emphasize the importance of strengthening interpersonal and emotional relationships in the educational environment to improve both motivation and academic self-concept, key elements for facilitating effective mathematics learning.

## Conclusions

The findings of this research highlight significant differences in academic self-concept between males and females encountering learning difficulties in mathematics. In particular, females tend to rely on their peers to tackle academic challenges, although this dynamic can be affected by fear of criticism and social judgment, which sometimes limits their ability to express themselves freely and persevere. Conversely, males place greater importance on their relationship with teachers as a source of trust, a decisive factor for their participation in class and willingness to ask for help.

Moreover, it was identified that the motivations for engaging with learning also differ by gender. Females often seek extrinsic rewards when making additional efforts, underscoring the need to foster a more intrinsic and self-driven motivation. In contrast, male commitment is closely linked to their level of self-confidence, emphasizing the importance of designing strategies that strengthen their academic self-assurance.

Finally, the ways in which both genders approach school situations vary: females demonstrate motivation linked to active listening to maintain attention, while males combine these attitudes with more observable behaviors, such as remaining silent and raising their hands to participate. In both cases, the teacher's role and their ability to implement actions that reduce distractions and foster a conducive environment are crucial for enhancing mathematics learning.

Overall, these results underscore the urgency of considering gender-specific characteristics in the design of pedagogical interventions that promote positive self-concept, authentic motivation, and social skills—key elements for academic success in mathematics.

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