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Artículos científicos

El autoconcepto académico en matemáticas: ruta hacia una categorización a través del método de análisis conceptual

Academic-mathematical Self Concept: on the Road to a Categorization through the Conceptual Analysis Method

O autoconceito acadêmico em matemática: um caminho para uma categorização através do método de análise conceitual

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Resumen

El autoconcepto académico es un constructo relevante dentro del dominio afectivo de los estudiantes, pues ha sido identificado en diversas investigaciones como un factor de gran influencia en el aprendizaje y rendimiento académico en matemática. Sin embargo, su estudio se hace difícil sin una categorización apropiada. Por eso, con el objetivo de ofrecer una propuesta de categorización, el presente artículo empleó la metodología del análisis conceptual para identificar algunas categorías de dicho constructo, así como las ideas clave en cada una de ellas. Esta categorización puede orientar tanto la observación como la intervención en el aula, y brindar espacios más claros para incidir en cómo los estudiantes, especialmente en la adolescencia, se perciben a sí mismos dentro de la clase de matemática.

Palabras clave: autoconcepto, autoconcepto académico, educación matemática, análisis conceptual.

Abstract

Academic self-concept is a significant construct in the emotional domain of students, as it has been identified in multiple research studies as a highly influential factor in math learning and academic performance. However, studying it without appropriate categorization is challenging. To address this issue and offer a categorization proposal, this article utilized the conceptual analysis methodology to identify different categories and key ideas associated with academic self-concept. This categorization can assist in guiding classroom observation and intervention, providing clearer opportunities to impact how students perceive themselves within the mathematics class, especially during adolescence.

Keywords: Self Concept, Academic Self Concept, Mathematics Education, Conceptual Analysis.

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Resumo

O autoconceito acadêmico é um constructo relevante dentro do domínio afetivo dos alunos, pois tem sido identificado em diversas investigações como um fator de grande influência na aprendizagem e no desempenho acadêmico em matemática. No entanto, seu estudo torna-se difícil sem a devida categorização. Portanto, com o objetivo de oferecer uma proposta de categorização, este artigo utilizou a metodologia da análise conceitual para identificar algumas categorias desse construto, bem como as ideias-chave em cada uma delas. Essa categorização pode orientar tanto a observação quanto a intervenção em sala de aula, além de proporcionar espaços mais claros para influenciar como os alunos, principalmente na adolescência, se percebem na aula de matemática.

Palavras-chave: autoconceito, autoconceito acadêmico, educação matemática, análise conceitual.

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Introduction

Despite the fact that not all mathematics teachers have training in evolutionary or learning psychology, these professionals consider that the affective domain of their students has a significant load on the teaching and learning dynamics. Indeed, learning is a phenomenon that encompasses different aspects of human life, which are known as cognition or cognitive domain, execution or psychomotor domain, and affectivity or affective domain. The latter, according to McLeod (1992), comprises the set of beliefs, feelings and moods that a person presents. Affectivity, therefore, is constituted as the individual's response to what happens in his life (Gil et al., 2005) and is responsible for a large number of actions and behaviors that people manifest towards the objects that are presented to them. , in this case, within the learning processes (Martínez, 2005). In other words, it is a dynamic domain that is nourished by new experiences and emotional reactions, which again influence behaviors and, in a cyclical way, throughout life.

According to Pierre and Oughton (2007), the affective domain, although it significantly conditions the depth of learning, is a subject feared by many teachers, who prefer an environment in which cognitive phenomena predominate and leave affectivity aside. since the former are more controllable than the responses of the students within a more emotional environment. Furthermore, according to these authors, this last aspect is more complex to address due to the difficulty in categorizing and classifying students' emotional

responses. However, there are efforts to define clear study spaces within the affective domain, such as the categories of feelings, beliefs, and emotions proposed by McLeod (1992).

In the affective sphere, the category of beliefs, as indicated by Cooney (1999), refers to a set of dispositions for action that the individual possesses, in which he has certain evidence to act according to what he considers to be true. . For his part, Villoro (2004) argues that beliefs are objects that the subject accepts as true, and that they condition the way in which he responds to the events that occur to him. The key concept in this component is the truth, that is, what is accepted as true and the way in which this influences the rationality of the action.

Researchers such as Gil et al., (2005) have given significant cognitive weight to this component. In fact, it can be affirmed that beliefs are located in the affective domain because, unlike knowledge, they are debatable rather than verifiable, as Hannula (2007) refers to. If one goes to what was exposed by Aguilar (2003), believing implies more than feeling, since it involves thought and constitutes a disposition for action. For example, emotions and feelings are valid by themselves, but they cannot be considered true or false, since they are not the product of reason. If I feel happiness, that feeling does not imply a cognitive content, so it does not need to be considered as true or false. The opposite occurs when a belief is built, such as thinking that a certain activity will make me feel happy.

According to Gómez-Chacón et al. (2006), and based on the contributions of McLeod (1992), it is recognized that the belief system that a student has is a factor of great importance in mathematical learning. Although beliefs have an affective character, they have a solid cognitive component that makes them more stable and durable. In this sense, according to these authors, it is possible to identify three types of beliefs in mathematics education:

- *Beliefs about mathematics education:* They refer to everything that the student believes to be true about learning and teaching mathematics, as well as the characteristics of school mathematics itself, such as the difficulty in solving problems or in understanding the principles and concepts. basic.
- *Beliefs about themselves in the mathematics class:* They arise from how the student perceives their own performance, how it relates to their learning goals and how much control they have over their learning process.

- *Students' beliefs about the specific context of their class:* These refer to how students perceive their teacher's way of working, the role of their classmates and the way in which mathematics is constructed in the classroom.

For Gil et al. (2005) and Chaves et al. (2008), the self-concept is a belief that is built from the perception that an individual has about himself and the messages that he receives from his social environment. The self-concept can be subdivided into different areas of a person's life, and one of them is the academic self-concept (Campo, 2014; Roa, 2013). However, some researchers indicate that the academic self-concept should be examined specifically according to the disciplinary area, which gives rise to the term academic self-concept in mathematics (Gil et al., 2005).

Although no agreed definition of this word has been found in the reviewed literature, the aim of this paper is to try to categorize it accurately. With this, it seeks to identify the aspects that compose it in order to intervene in the mathematics classroom and support students in achieving successful levels of learning, performance and school performance in this area, especially at the secondary level.

This work consists of seven sections. The first explores the concept of self-concept from various authors, while the second focuses on academic self-concept and the instruments available for its evaluation. The third section describes the methodology used to achieve the objective of the article, in this case, the conceptual analysis, presented from the perspective of three researchers. The fourth section describes the selected methodology and its application: first to self-concept, then to academic self-concept, and finally to academic self-concept in mathematics. In the fifth section, the categorization obtained from the conceptual analysis of the academic self-concept in mathematics is presented, and finally, the results are discussed and the conclusions are presented.

What is the self-concept?

The main objective of this work is to analyze the term self-concept, which is highly relevant for studies in mathematics education, as highlighted by González-Pienda et al. (1997), since it is related to the personal factors that influence learning. To define this word, it is necessary to consider what was stated by Roa (2013) regarding its nature. This author emphasizes that it is about the perception that the subject has about himself, without issuing a value judgment on the characteristics that he attributes to it, and that it is built from the perception that he has about himself and the messages that he receives. from their

environment of influence, such as family, teachers, friends and authority figures, among others (Chaves et al., 2008; Gil et al., 2005). Likewise, it is important to consider the perspective of Naranjo (2006), who points out the uniqueness of the self-concept, that is, that the subject has at each moment a single construction about himself that he considers true.

According to Holenstein et al. (2021), self-concept can be defined as the global perception that each individual has about himself, which is built around said perception, and is not innate, but rather modifies throughout life when facing different situations. For his part, Campo (2014) proposes to define it as the way in which the individual represents himself, integrating the different dimensions of his being to mentally elaborate a construction on his reality. In this sense, the self-concept is made up of beliefs that the subject recognizes as true regarding himself, which arise from the messages and experiences he receives from his immediate environment, and are accepted as temporary truths, since they can be modified when the subject receives new information (González-Pienda et al., 1997). In summary, the self-concept is a complex and dynamic belief that is built from various sources of information and that influences the learning and academic performance of individuals.

In the field of psychology and education, self-concept is a word of great relevance, since it is related to various factors that influence learning and academic performance of students. For Campo (2014) and Roa (2013), the self-concept is composed of various dimensions that the subject recognizes as part of his "being". These dimensions include the physical, the academic, the social, the personal and the emotional, and from them, it is possible to distinguish different types of self-concept.

For example, the physical self-concept has to do with the perception that the subject has about his body and his performance in physical activities, while the academic self-concept refers to the image that the individual builds about his school performance and his level of success in the academic field. For its part, the social self-concept is associated with the idea that the subject has about himself in his interaction with others and his role in society, while the personal self-concept focuses on how the subject is perceived by his individual characteristics. . Finally, the emotional self-concept refers to the concept that the subject has about his emotional balance, his self-confidence and his ability to manage his emotions.

For González-Pienda et al. (1997), self-concept plays an important role in regulating students' motivation, learning, and academic performance. The self-concept is made up of statements that the subject makes about himself, and it is a multidimensional construct in which its more general dimensions remain stable, while the more specific dimensions may

be more unstable. The level of generality or particularity of the self-concept depends on how punctual are the experiences that generate perceptions on which the subject makes statements about himself. In other words, if a student perceives himself as disciplined and dedicated, a failure to turn in a punctual assignment will not affect or change his general perception of himself.

The self-concept is built through the processing of information from two different sources: one's own perception and the message received from the environment (Campo, 2014). This construction process begins from the moment the individual recognizes himself and, based on the conditions that surround him and his self-awareness, he knows himself, evaluates himself, and chooses how to behave in each circumstance based on that knowledge. When facing different situations, the individual receives new information about himself that contrasts with what he already possessed and selects all knowledge that complements, reinforces or demonstrates enough truth to replace the self-concept that he had developed up to that moment. It is important to note that the truth of the statements that arise from this perception can be distorted if the subject decides to lean towards information that reinforces one of the two extremes —positive or negative— of his self-concept. (Campo, 2014).

Likewise, it is appropriate to carry out an exploration of the meaning of self-concept to establish the difference between it and self-esteem. Although they are similar and are built under the same references, self-esteem is part of the emotions and, therefore, it is not usually so stable and lasting in the affectivity of the individual. On the contrary, the self-concept migrates from the pure affective domain to the construction of cognition: what the subject affirms about himself is no longer fleeting, but becomes part of the cognitive system of the personality (González-Pienda, 1997). ; Sanchez et al., 2011). This is consistent with the multidimensional nature of the self-concept, since people tend to manifest different facets of their personality in different circumstances.

The multidimensionality of the self-concept —which has been mentioned by González-Pienda et al. (1997), as well as by Gálvez et al. (2017), among others— is what makes it difficult to intervene in the general self-concept and guides the investigation or intervention in what the authors have called the operational self-concept. This term refers to the self-concept built during a well-defined period and in the context of a particular activity, such as the academic self-concept.

The academic self-concept

Marín and Restrepo (2016) indicate that there is a high relationship between self-concept and academic performance, in a reciprocal relationship: as one increases, the other increases (or in the opposite direction). Furthermore, according to Gálvez et al. (2016), the dynamics of relationships with other students, the comparison between what is achieved and family expectations, the enjoyment of learning and the assessment of the contributions made influence the construction of the academic self-concept. These same researchers point out that the individual's expectations towards the future also have an impact on their academic self-concept. For this reason, authors such as Álvarez et al. (2015) have called this type of self-concept academic self-concept, which is defined as the perception that an individual has about himself as a student, and that has to do with his regular performance, his ability to learn new knowledge and their academic performance reflected in their grades.

However, knowing the academic self-concept of a student is not limited to observing, listening or evaluating the products that he produces. In recent years, various research efforts have been carried out (Díaz, 2021; Minchekar, 2019; Qalavand et al., 2013) to categorize this construct so that it can be valued and its positivity evaluated. A positive self-concept is recognized as one that leads the person to manifest balanced attitudes, eliminate guilt and be optimistic (Naranjo, 2006), while the negative self-concept causes pessimistic or aggressive attitudes. The academic self-concept scale (EAA) emerged from these efforts, designed in Argentina in 2008. In this, the subject responds to 14 items, with values ranging from 1 (completely disagree) to 5 (completely agree). Seven of the items refer to academic performance (understood as performance) and the other seven to the abilities that the subject perceives in himself to learn and function in school (Gálvez et al., 2016).

Academic self-concept has proven to be a good predictor of academic performance, as mentioned by Chaves et al. (2008), which invites educators to take an interest in it and to consider how the teaching activity they carry out can modify it.

Materials and method

To identify the categories that make up the academic self-concept in mathematics, the conceptual analysis method proposed by Furner (2004), Rico (2001) and Tathinen and Havila (2019) has been used. Furner (2004) explains that conceptual analysis, as a technique, considers concepts as classes of objects or fields, and seeks to know the conditions in which an object can be classified within them. This implies that it is useful to identify those

categories that differentiate said concept from others that may be similar. Rico (2004) distinguishes conceptual analysis as a method in which language use is examined when referring to specific conceptual fields. To do this, he pays special attention to the ways of defining and interconnecting meanings, as well as differentiating those descriptions or definitions that correspond to other intentions of use. Finally, Tahtinen and Havila (2019) argue that conceptual analysis, more than a method to develop new and exhaustive definitions, allows concepts to be deconstructed in order to discover their fundamental elements.

The conceptual analysis methodology, by its nature, requires certain precautions for its application. According to Furner (2004), it is necessary to establish two assumptions prior to the conceptual analysis to consider it useful in the study of a case. The first is the belief that those who make use of the concept can reach agreements regarding the nature of the circumstances in which it will be used. The second assumption is the belief that reaching that level of agreement is a prerequisite for the development of useful or interesting knowledge. Once both are assumed, it is appropriate to consider Rico's (2001) recommendations.

Rico (2001) suggests taking into account four key questions before beginning the conceptual analysis. The first refers to the importance behind the characterization or definition of the concept; the second inquires about the level of depth that said definition will acquire; the third tries to establish what distinctions will be made between this concept and the others; and finally, a fourth question refers to the level of generality that will be given to the definition that is sought to be achieved. Only after making this reflection will it be possible to start the formal analysis.

In the present study, the categorization of the academic self-concept in mathematics was considered as a starting point for its definition, or to accept an existing one. In order to complement this conceptual analysis process, it was considered pertinent to use the steps proposed by Tahtinen and Havila (2019), which consist of the following: (1) collect data (definitions or descriptions) of the concepts or terms that are analyzed , (2) compare the concepts and terms to identify the keywords, and (3) categorize the limits and meanings of the concepts and terms, paying special attention to the categories that emerge from the analysis based on the matching keywords among the different definitions and descriptions.

It is important to highlight that the affective domain is identified as a determining factor for learning and achievement within school mathematics, even more than intelligence or some type of predisposition (Álvarez et al. 2015; Gil et al., 2006; Gómez- Chacón et al.,

2006; Martínez, 2005). Self-concept, when located within beliefs, has been considered as part of the components of the affective domain, which links it to learning and performing in mathematics (González-Pienda et al., 1997). Therefore, levels of specificity for the concept explored in this paper were examined, organizing the analysis into three layers: (a) categorization of the self-concept in general, (b) conceptual analysis of the academic self-concept, and (c) conceptualization of the self-concept. academic self-concept in mathematics.

As an auxiliary tool, tables were built that include the following: the definitions identified in the literature, the authors that define them, the keywords that are detected in each definition and the number of times that the works in which these definitions are included have been published. cited according to the search engine Google. The purpose of these tables is to detect the ideas that all definitions share in order to develop a categorization of academic self-concept in mathematics that allows intervention on it and choosing or applying the appropriate instrument to measure it.

It should be noted that the conceptual analysis of the academic self-concept in mathematics is supported by previous studies, such as those by Carmona et al. (2011), Castro et al. (2021), Diaz et al. (2013), González-Pienda et al. (1997), Alvarez et al. (2015) and Gálvez et al. (2017), among others. These studies contribute to a better understanding of the academic self-concept in mathematics, which allows a more precise categorization that facilitates its analysis and application in different educational contexts.

Self-concept categorization

In this analysis, the central idea refers to self-concept, whose definition is based on two key words: perception and individual. Perception is a biocultural construct that originates from the information received by the senses and is validated through categories established by value systems that develop from childhood and that respond to cultural, ideological, social, and historical structures (Vargas, 1994).). On the other hand, when referring to the individual, an allusion is made to what in psychology is known as the self (González-Pienda et al., 1997), that is, the personality.

If it is recognized that the construction of the personality includes the construction of the self-concept, and that the latter is formed from the perceptions that the individual has about himself, it is necessary to also recognize the influence of the environment, as pointed out by Vargas (1994). and Carmona et al. (2011).

Regarding the categorization of self-concept, González-Pienda et al. (1997) select the model proposed by Shavelson et al. (1976), which includes the following elements:

- Multidimensional structure.
- Hierarchical ordering.
- Stability in its more generic dimensions and instability in its more specific ones.
- With its own entity.

Taking into account the references of Carmona et al. (2011), Castro et al. (2021), Diaz et al. (2013) and González-Pienda et al. (1997), we can affirm that the self-concept refers to the perception that the individual has about himself, based on the sensory information that he receives from the environment and that he selects according to his value systems. It is a multidimensional construct that is hierarchically organized by levels of complexity and is more stable at its most general level. In addition, it is clearly distinguished from other constructs within the affective domain and its construction is only possible through the elaboration of reasoning that leads to accepting its veracity, although it is susceptible to modifications over time.

The keywords identified in the works of Carmona et al. (2011), Castro et al. (2021), Diaz et al. (2013) and González-Pienda et al. (1997) are perception and individual. Both terms can be grouped within the same category, since the first is an attribute of the second. Perception is the interpretation that the brain makes of the information that the subject receives through the senses (Vargas, 1994). The terms messages and information are also used to refer to the content and ideas that the individual receives, which can be included in a category related to communication.

Conceptual analysis of academic self-concept

At a second level of specificity in the conceptual analysis is the academic self-concept, which is a main specific dimension within the self-concept, according to Roa (2013) and Campo (2014). The keywords that distinguish it from other types of self-concept can be useful to intervene in it, especially since they are related to the performance and learning of each individual (Chaves et al., 2008). According to González-Pienda et al. (1997), the more specific the self-concept is, the less stable it is.

Based on the work of Carmona et al. (2011), Alvarez et al. (2015), Galvez et al. (2017) and Diaz et al. (2013), some categories of academic self-concept can be identified. It is recognized that academic self-concept: a) is a belief system constructed in the school

environment, b) involves individual perceptions of their ability to learn and achieve academic results, and c) is strengthened or modified through student interactions. in the classroom —with their classmates, teachers, learning media—, as well as from their academic successes or failures, based on their grades and the opinion of their immediate social environment.

Conceptual analysis of academic self-concept in mathematics

The objective of the present work, as mentioned above, is the categorization of the academic self-concept in mathematics, which is considered an important factor for the understanding of other phenomena in the classroom, related to the affective domain, such as mathematics anxiety (Naderi et al. al., 2021), and is directly linked to academic performance (Carmona et al., 2011; Chaves et al., 2008).

At a more detailed level of specificity, the essential categories that distinguish academic self-concept in mathematics were identified, considering it important to take into account the differences between it and other school disciplines. The most reiterated idea in the works reviewed is that, in this type of self-concept, the perception that the person has about their ability to solve mathematical problems is crucial for their understanding (Carter et al., 2014; Lee & Kung, 2018). Problem solving is related to two terms used by the authors: mathematical skills and tasks (Carter et al., 2014; Gil et al., 2005; Naderi et al., 2021). In addition, words such as individual academic ability and competence are included in these texts, which are considered part of the academic progress, successes and failures referred to in the previous section of this work.

Based on the work of Gil et al. (2005), Lee and Kung (2018), Carter et al. (2014) and Naderi et al. (2021), the descriptions of the academic self-concept in mathematics have been identified. The following stand out:

- It is an individual perception of one's own performance in the mathematics course.
- It is related to the capacity that the person considers to possess to learn mathematics.
- It involves the ability to solve mathematical tasks and, particularly, the resolution of mathematical problems.

Categorization of the academic self-concept in mathematics

The proposed categorization of academic self-concept in mathematics includes some categories of academic self-concept that can be adapted to school mathematics. For this reason, to study academic self-concept in general, researchers such as Díaz (2021) and Minchekar (2019) have designed specific instruments or adapted existing ones. In these instruments, Likert-type scales are mainly used.

The academic self-concept scale (EAA) instrument, validated by Díaz (2021), includes fourteen concatenated items with five options ranging from totally disagree (1) to totally agree (5). Statements on this scale range from the individual's perception of their own learning ability, to how effective they consider themselves in terms of successfully completing academic tasks and getting good grades. All the items are written in the first person and none refers to other individuals (teachers, parents, classmates).

In relation to the instrument designed by Minchekar (2019) to measure academic self-concept in adolescents, called ASCS (academic self-concept scale), it is made up of 57 items that measure, through a Likert scale, statements in categories such as academic ability, academic effort , expectations, test performance, academic interest, study habits, among others.

It has been observed that the characteristics considered in this instrument coincide with those identified in this study, through conceptual analysis, since both include statements that represent the beliefs that students may have regarding their performance.

Discussion

It is possible to relate the dimensions of academic self-concept in mathematics, identified through conceptual analysis, with those included in the Minchekar (2019) instrument. In his proposal, the researcher suggests the observation of some categories involved with the academic self-concept.

- Academic ability
- Academic interests.
- About the study.
- About academic assessments and tests.
- Academic interactions.
- Academic effort.

- Curriculum of the different subjects.
- Academic future.

It is possible to observe the similarity of the criteria used in this work for the categorization of the academic self-concept in mathematics (presented in Table 1) with several of these eight categories. It is considered that, when referring to mathematics, it is important to reflect on certain qualities that distinguish it from other curricular areas, such as natural sciences or social sciences. Therefore, the importance of working under pressure, using mathematical techniques and tools, applying particularly useful work habits for learning this discipline, among others, is underlined.

In this paper it is assumed that the academic self-concept in mathematics is part of a belief system. Gomez-Chacon et al. (2006) distinguished three categories of beliefs that individuals construct regarding school mathematics. On the other hand, the dimensions considered by Minchekar (2019) within his instrument can be identified in said categories.

The categories of academic self-concept in mathematics identified from the conceptual analysis carried out are the following:

a) Self-concept related to the ability to learn mathematics.

b) Self-concept related to the applicability of mathematical principles.

c) Self-concept related to academic interest in mathematics.

d) Self-concept related to the willingness to make the necessary effort to complete mathematical tasks (academic effort).

e) Self-concept related to the perception of the ability to achieve academic goals in mathematics.

f) Self-concept related to solving mathematical challenges under pressure.

The conceptual analysis allows the identification of subcategories of the academic self-concept in the case of mathematics, which can be the input of a specific instrument to assess the academic self-concept in this area. These subcategories are presented below.

Table 1. Categorization of academic self-concept in mathematics from the general academic self-concept

General academic self-concept	Proposed categorization of academic self-concept in mathematics
Ability to learn	Ability to learn mathematics. Ability to understand mathematical language and symbolism. Ability to understand the theoretical and procedural principles of school-level mathematics.
Ability to successfully complete school tasks	Ability to apply mathematical principles. Ability to perform mathematical tasks and exercises. Ability to solve mathematical problems.
Academic interest	Academic interest in mathematics. Interest in learning mathematical topics. Interest in applying mathematics to problem-solving. Interest in carrying out mathematical tasks and exercises.
Academic effort	Willingness to exert the effort necessary to complete mathematical tasks. Assessment of time dedicated to learning and completing mathematical tasks. Conduction of assignments in a mathematics course using cleanliness, order, and neatness.
Possibility of obtaining good grades	Perception of the ability to achieve academic goals in mathematics. Confidence in achieving more than the passing grade Satisfaction with results obtained to date.

Source: Elaborated by the author based on Minchekar (2019)

It is important to take into account that comparing the categories proposed by Minchekar (2019) with the work carried out during the conceptual analysis to specify each one in the context of the mathematics class will allow the study of said construct through adaptations of existing instruments or of the own instrument design. Categorization also offers clearer intervention spaces to influence how students, especially in adolescence, perceive themselves within their mathematics class.

Conclusions

At the end of this work, it is possible to reflect on the usefulness and applicability of the conceptual analysis method. Despite being a laborious and meticulous method, it allows preventing some errors in the definition or categorization of a concept, such as ambiguity in the use of language. By reviewing all the definitions available for the same concept, the essentials of each one can be extracted to establish what distinguishes it from other similar ones or to specify its field of application. This is the case of academic self-concept in mathematics, where the method allowed the construction of subcategories and establishing a relationship with academic self-concept in general.

The analysis carried out in this research served to recognize categories and subcategories that have to do with beliefs about one's own performance and abilities, but also about personal beliefs regarding mathematics in the classroom and the interaction between elements and people within it. she. This categorization includes the self-concept related to the ability to learn mathematics, the application of mathematical principles, the academic interest in mathematics, the academic effort in mathematics, the perception of one's own ability to achieve academic goals and, finally, the resolution of challenges. mathematicians under pressure

In any case, this work intends to be the starting point in the exploration towards a more solid knowledge about the academic self-concept in mathematics, and the reported findings open the door to the proposal of interventions within the classroom to modify, in a directed way, said construct. From the positive development of the academic self-concept in mathematics, the willingness to learn and the academic performance of students in this subject can be improved.

Future lines of research

The identification of categories for the academic self-concept in mathematics that is focused on in this work opens the doors to the following lines of research. In the first place, having such categories will allow the construction of an instrument that serves to assess the academic self-concept variable in mathematics, since adequately delimiting the fields of observation is how it can be correctly estimated and valued. Secondly, action-research or design-based research projects can be developed, for example, in which it is desired to intervene in this variable. In this regard, it should be considered that —according to researchers such as Gómez-Chacón et al. (2006) and Gil et al. (2005)— the affective domain to which the academic self-concept in mathematics belongs determines the predisposition to successfully learn mathematics.

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