EMP Educação Matemática Pesquisa
ISSN 1983-3156
Qualis A1
http://dx.doi.org/10.23925/1983-3156.2025v27i3p098-123

Research workshop on sociocultural practices in the formation of Mathematics teachers

Taller de investigación sobre prácticas socioculturales en la formación de profesores de Matemáticas

Atelier de recherche sur les pratiques socioculturelles dans la formation des enseignants de mathématiques

Ateliê de pesquisa em práticas socioculturais na formação de professores de Matemática

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Abstract

The object of this article is the interconnections involving mathematics, society, cognition, and culture and their implications for the training of mathematics teachers and the teaching of mathematics. This is an applied research project carried out with postgraduate students in Science and Mathematics Education, which investigated sociocultural practices in the training of Mathematics teachers. The question that drove the research was the following: how investigations into sociocultural practices can contribute to the development of didactic approaches to be used in teaching Mathematics from an interdisciplinary perspective? Our objective was to discuss how the development of investigation into sociocultural practices contributes to the organization of ethnographic dossiers of the investigated practices, to offer possibilities for didactic explorations of these practices in the implementation of training actions for Mathematics teachers. The research was carried out as a research workshop that aimed to explore these practices through guided investigations in the classroom, followed by bibliographic and field research, aiming to organize dossiers of the investigated practices, in order to offer contributions to the training of Mathematics teachers in basic education. The results of the research have shown that, during the educational-training process, participants challenged themselves to develop their methods of searching, understanding, and connecting

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knowledge explicitly found in sociocultural practices and various representations that can be materialized, based on the mathematical knowledge acquired throughout their educational trajectory.

Keywords: Sociocultural practices, Study of Reality, Mathematics Teacher Training, Mathematics Teaching, Interdisciplinarity.

Resumen

Las interconexiones que involucran Matemáticas, sociedad, cognición y cultura, con sus implicaciones para la formación de profesores de Matemáticas y la enseñanza de las Matemáticas, constituyen el objeto de este artículo. Se trata de una investigación aplicada, realizada con estudiantes de posgrado stricto sensu en Educación en Ciencias y Matemáticas, que abordó investigaciones sobre prácticas socioculturales en la formación continua. La pregunta de investigación planteó: ¿cómo pueden las investigaciones sobre prácticas socioculturales contribuir al desarrollo de enfoques didácticos para ser utilizados en la enseñanza de las matemáticas desde una perspectiva interdisciplinaria? Nuestro objetivo fue discutir cómo el desarrollo de investigaciones sobre prácticas socioculturales contribuye a la organización de dossiers etnográficos de las prácticas investigadas, para ofrecer posibilidades de exploraciones didácticas de estas prácticas en la implementación de acciones de formación de profesores. La investigación se realizó bajo la modalidad de taller de investigación que tuvo como objetivo explorar estas prácticas por medio de investigaciones guiadas en el aula, seguidas de investigación bibliográfica y de campo, buscando organizar dossiers de las prácticas investigadas, con el fin de ofrecer contribuciones a la formación de profesores de Matemática en la educación básica. Los resultados mostraron que, en el proceso educativo-formativo, los participantes se desafiaron a construir sus métodos de búsqueda, comprensión y conexión de los conocimientos explícitos en las prácticas socioculturales y las diversas representaciones que pueden materializarse, a partir de los conocimientos matemáticos adquiridos a lo largo de su trayectoria educativa.

Palabras clave: Prácticas socioculturales, Estudio de la realidad, Formación del profesorado de matemáticas, Enseñanza de las matemáticas, Interdisciplinariedad.

Résumé

Les interconnexions impliquant les mathématiques, la société, la cognition et la culture, avec leurs implications pour la formation des enseignants de mathématiques et l’enseignement des mathématiques, constituent l’objet de cet article. Il s’agit d’une recherche appliquée, menée

auprès d'étudiants de troisième cycle stricto sensu en éducation scientifique et mathématique, qui a abordé des enquêtes sur les pratiques socioculturelles dans la formation continue. La question de recherche était la suivante : comment les recherches sur les pratiques socioculturelles peuvent-elles contribuer au développement d'approches didactiques à utiliser dans l'enseignement des mathématiques dans une perspective interdisciplinaire ? Notre objectif était de discuter de la manière dont le développement d'enquêtes sur les pratiques socioculturelles contribue à l'organisation de dossiers ethnographiques des pratiques étudiées, afin d'offrir des possibilités d'explorations didactiques de ces pratiques dans la mise en œuvre d'actions de formation des enseignants. La recherche a été réalisée sous la forme d'un atelier de recherche qui visait à explorer ces pratiques à travers des enquêtes guidées en classe, suivies de recherches bibliographiques et de terrain, visant à organiser des dossiers des pratiques étudiées, afin d'offrir des contributions à la formation des enseignants de mathématiques dans l'éducation de base. Les résultats ont montré que, dans le processus éducatif-formatif, les participants se sont mis au défi de construire leurs méthodes de recherche, de compréhension et de connexion des connaissances explicites dans les pratiques socioculturelles et les différentes représentations qui peuvent être matérialisées, à partir des connaissances mathématiques acquises tout au long de leur parcours éducatif.

Mots-clés : Pratiques socioculturelles, Étude de la réalité, Formation des enseignants de mathématiques, Enseignement des mathématiques, Interdisciplinarité.

Resumo

As interconexões envolvendo Matemática, sociedade, cognição e cultura, com suas implicações na formação de professores de Matemática e no ensino de Matemática, constituem-se o objeto deste artigo. Trata-se de uma pesquisa aplicada, realizada junto a estudantes de pós-graduação *stricto sensu* em Educação em Ciências e Matemática, que abordou investigações sobre práticas socioculturais na formação continuada. A questão da pesquisa indagou sobre: como as investigações sobre práticas socioculturais podem contribuir para a elaboração de encaminhamentos didáticos a serem utilizados no ensino de Matemática sob um enfoque interdisciplinar? Nosso objetivo foi discutir como o desenvolvimento de investigações sobre práticas socioculturais contribui na organização de dossiês etnográficos das práticas investigadas, para oferecer possibilidades de explorações didáticas dessas práticas na implementação de ações formativas de professores. A pesquisa foi efetivada na forma de um ateliê de pesquisa que objetivou a exploração dessas práticas por meio de investigações orientadas em sala de aula, seguida de pesquisas bibliográfica e de campo, visando a

organização de dossiês das práticas investigadas, a fim de oferecer contribuições à formação de professores de Matemática da educação básica. Os resultados mostraram que, no processo educativo-formativo, os participantes se desafiaram a construir seus métodos de busca, de compreensão e de conexão entre os conhecimentos explícitos nas práticas socioculturais e as diversas representações que podem ser materializadas, partindo dos conhecimentos matemáticos adquiridos ao longo de sua trajetória educativa.

Palavras-chave: Práticas socioculturais, Estudo da Realidade, Formação de Professores de Matemática, Ensino de Matemática, Interdisciplinaridade.

Research workshop on sociocultural practices in the training of Mathematics teachers

Studies and discussions on the issue of Education related to cultural studies are not new, if we consider each generation's interest in their ancestry, and the trajectories established between the past and the present as a sociodynamic of culture.

As Abraham Moles (2012) emphasizes, in the transformation of ideas and mentalities, the notion of culture was proposed by philosophers around two and a half centuries ago, since the word culture already appears in a German dictionary from 1793. From this inflection we can infer that, during the 19th century, the humanities began to organize their ideas in the creation of the field of Human and Social Sciences, with an emphasis on the human operator, and research began to be interpreted as sociocultural research. Researchers began to invest in a descriptive, explanatory, and interpretative language that could explain the symbolic language identified in his investigations, which would no longer involve only the field of the nature of things, but also culture, so that the objects of investigation began to be interpreted as both nature and culture and society.

In this regard, Moles (2012) considers that the focus of the knowledge investigated began to be interpreted as objective knowledge of the human species, characteristic of a reactive system – a reaction to everything that is proposed to it by the environment, that is, a dynamic that is operationalized by the problematization of the context or environment in which things happen, causing the generation of material or immaterial cultural facts. If we reflect on the subject, we may think that the awakening of culture already appears in the representations of cave paintings engraved on the walls of caves and in the artifacts produced over millennia, such as the tools and utensils that make up the diversity of human cultural heritage on the planet, originated from sociocultural practices, as stated by Klein and Edgar (2005).

However, whenever any area of knowledge advances in relation to this sociodynamics of culture, it adds something new to the History of science. Such progress occurs through the visitation or revisitation of other areas, other disciplinary domains of the scientific field or non-scientific knowledge. The relationship between Mathematics and sociocultural practices can be understood as an example of this movement. From the second half of the 20th century onwards, several works produced in the field of Mathematics and its teaching (Mathematics Education) took elements from culture and produced new interpretations and teaching materials to teach different contents of this discipline, which began to make sense in the reality in which students were and are inserted. If we consider that all knowledge arises from local, individual knowledge, in the form of experimentation, research and questioning, we will see that most of

these questions originate from elements of culture, which hold a cognitive capital that encompasses both universal and diverse elements, as highlighted by Mendes and Farias (2014) and Mendes and Silva (2018).

For this reason, Farias and Mendes (2014) argue that culture is the distinctive mark of human groups. Everything related to science and knowledge is born and has its roots in culture, in the specificities of cultural diversity. This means that the concept of culture evolves over time and socially established practices. According to the sociocultural dynamics of some groups, it is possible to perceive what remains and what changes over time. Understanding this cultural sociodynamics allows us to reframe the content taught in schools and universities, based on the exploration of everyday sociocultural practices established in social contexts, when interconnected by the triad of society, sociocultural practices, and education.

In this regard, the research question that gave rise to this article was as follows: How can *research on* sociocultural practices contribute to the development of didactic approaches to be used in mathematics teaching from an interdisciplinary perspective? In this same vein, the objective was to provide a commented description of the development of a research workshop on investigations of sociocultural practices that enable the didactic exploration of practices aspects for teaching Mathematics.

In this vein, the reflections presented here originated from studies and debates carried out during a curricular activity in the graduate course in Science and Mathematics Education, at the Federal University of Pará, in the northeastern region of Brazil, from August to December 2023, in the form of a research workshop on sociocultural practices and Mathematics Education, with a 60 hour class hours.

We adopted the term *workshop* based on the concept established in artistic activities, as an environment made up of artists, artisans and creative professionals who carry out their work through practical experience. That is, a place of creation where works of art, crafts, fashion costumes, among others, are produced.

In the case of this the curricular activity carried out, the workshop was structured in three moments: (1) presentation and discussion of the theoretical basis; (2) elaboration and execution of research projects, and writing of ethnographic reports of the practices investigated; and, finally, (3) seminar to present the results in the form of a textual report. In the three moments, theoretical and practical aspects regarding sociocultural practices, interconnected with Mathematics Education, were discussed through bibliographic, videographic and field research, with the aim of producing ethnographic dossiers by the students. In the activities developed in the workshop, we attributed to sociocultural practices the meaning of ways of

doing things specific in to a culture, whether in material or immaterial aspects (Farias; Mendes, 2014; Mendes; Silva, 2017, 2018).

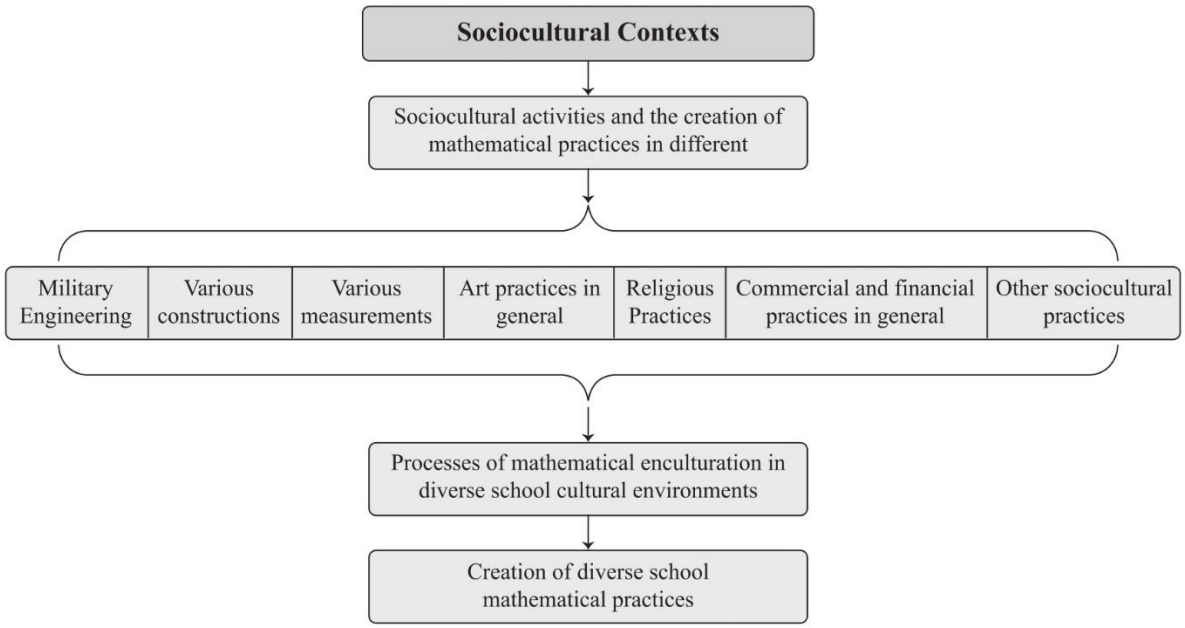

Figure 1.

Descriptor of historical sociocultural practices (Prepared by the authors, 2023)[3].

The workshop on sociocultural practices and Mathematics Education was carried out with guidelines for an ethnographic incursion research in the sociocultural field, in order to allow participants to investigate to understand alternative ways of assess measurements, weights, values, quantities, groups, similarities, symmetries, asymmetries, etc.

It was, therefore, only through exercises related to ethnographic research that participants were able to better describe these elements (or contents) in a distinct cultural diversity, since this knowledge makes sense in the communities where the individuals are born and raised.

In the preparation and development stage of the workshop activities, we employ knowledge related to sociocultural practices as cognitive operators capable of leading us to another school science, in this specific case, school Mathematics. We therefore consider it is important to take this knowledge as a way of understanding some of the current problems in society that commonly drive students away from schools. This knowledge may suggest the reorganization of creative and relevant content to students from social realities in which the

[3] This descriptor was prepared by the authors of this article during the 2023 workshop to present the foundations and research methods on the topic.

diversity of expressions is a greater value. These reserves of knowledge, values, techniques and ways of living may be capable of becoming the emergence of a new reorganization of school knowledge, as argued by Farias e Almeida (2025).

School can and should constitute itself as important agent of cultural interface, involving different communities, so that members of these social groups can recognize themselves also as a social context of belonging also for children and young people from diverse cultural sectors and their families, respecting and expanding their expectations, as a factor of success. The integration of communities will only be effective when there is a culture of community participation in the construction of a shared space where they can contribute to the construction of a society that embraces cultural diversity and where, at the same time, they also feel comfortable with the concessions made, that is, a space that does not call into question the basic cultural values of the communities. The school thus assumes an important role, not only with the students it educates, but also with the communities in which the schools are located, reaching the families of these same students.

Still regarding our understandings on the topic, we assert that, according to reflections presented by Mendes and Silva (2017, p. 106), "sociocultural practices are understood as the cultural knowledge and practices of social groups within a specific culture and are developed in the search for solutions to unique problems that arise in the lives of different human communities". Some of this cultural knowledge can be found on all continents because it emerged as a solution to common problems in people's daily lives, regardless of time and place (Mendes; Silva, 2018).

However, other forms of knowledge can only be found in a certain places because they were generated to solve specific issues that arose in those locations. This mathematical knowledge, and all other kinds of knowledge, are transmitted from generation to generation through a wide variety of non-formal educational processes and cultural transmission (Khidir; Mendes, 2023, p. 16-17).

In research carried out in the Kalunga do Mimoso quilombola[4] territory, in the Brazilian state of Tocantins, Khidir and Mendes (2023) report the construction and development of measurement units and measuring instruments created by the Kalunga people to solve everyday problems related to situations in which different types of measurements were necessary. This territory is the largest quilombo in Brazil, covering 261,000 hectares, with thirty-nine

[4] A quilombola is a person who is part of a remaining community of quilombos, ethnic-racial groups with their own cultural identity, specific historical trajectory, and particular territorial relations, with roots in black ancestry and resistance to slavery.

communities of around eight thousand quilombolas in the Chapada dos Veadeiros region, in Goiás, and in the southeast of the Brazilian state of Tocantins.

Thus, we can infer that the different sociocultural practices feature elements marked by the needs of the community that developed them, aiming to meet their interests, and, over time, they may undergo changes depending on the needs that arise in the process. The authors also point to a dialogue between the daily mathematical practices of each people and school mathematics, since some solutions proposed for specific problems in the communities are close to the mathematical concepts taught at school. They draw attention to the fact that right and wrong depend on the cultural frame of reference in which one is inserted and the resources that can be used to solve a given problem situation (Khidir; Mendes, 2023).

Objectives of the workshop

The research workshop aimed to discuss the development of investigation on sociocultural practices concerning several social groups, with a view to organizing ethnographic dossiers on such practices, so they could offer possibilities for didactic exploration of these practices in the implementation of formation activities for Mathematics teachers for the exercise of their teaching in schools.

To achieve our objective, we initially selected ceramic practices, fishing, agricultural practices, cassava flour production, and cistern construction[5], among other professional activities. We intended to emphasize sociocultural characteristics present in these activities to guide ethnography in the investigation processes. The next step was to organize dossiers with useful information for the elaboration of teaching guidelines to be used in Mathematics classes, under an interdisciplinary approach.

The workshop had the following specific objectives: 1) to discuss socio-epistemological principles that underpin Mathematics and its relations with Education, society, and culture; 2) to identify implications of socio-epistemological and cultural principles, as knowledge that is established in school contexts, and their importance in Mathematics and Science Education for the formation of a citizen and learning society; and 3) to guide research practices focused on the problematization of themes and concepts related to the diversity of topics addressed in school, which encompass socio-historical and cultural aspects, from inter and transdisciplinary perspectives in basic education.

[5] A cistern is a reservoir that is used to collect, store, and preserve water, similar to a water tank, and can contain drinking water, rainwater, or reused water. There are several types of cisterns. The masonry cistern model is buried in the ground and requires engineering work.

Theoretical basis of the research

One of the main foundations of the research involving the workshop refers to the concept of culture. Roy Wagner (2012) asserts that there is a presumption of culture regarding power over social behavior, that is, culture is understood as a general pattern that encompasses all aspects of human life. In this regard, Moles (2012) reiterates that:

> An essential characteristic of human beings is to live in an environment that they themselves have created. The trace left by this artificial environment in the spirit of each man [and woman] is what we call "culture", a term so loaded with diverse values that its role varies remarkably from one author to another and for which there are more than 250 definitions enumerated (Moles, 2012, p. 9).

In this regard, in a book titled *Cultura: em 250 conceitos e definições* (Culture: in 250 concepts and definitions), Luiz Nilton Corrêa (2021) reiterates Moles' assertion and presents a survey of around 250 references, concepts, and definitions of culture and its meanings over the last two centuries. The author starts with bibliographical research, which frames the main anthropological currents and ideas of the last 150 years, highlighting the polyphony of this concept in its interpretations, renewals, and innovations.

Likewise, we interpret that culture can be invented, renewed, and innovated as a creative set of ongoing activities in social contexts. Hence its dynamic transformation of sociocognitive processes, since it involves, in an interconnected way, social, cultural, and cognitive heritage, in the form of *artifacts*, *mental facts* and *sociofact* [6], expressed through languages and representations, all involved in the invention of self and us (individual and society), in the institution and institutionalization of invented and validated sociocultural practices, which become incorporated into the traditions and cognitive models generated in the sociocultural interactions related to mathematical culture (figures 2 and 3, below).

[6] See HUXLEY, J. S. Evolution, cultural and biological. Yearbook of Anthropology. Chicago, IL: University of Chicago, 1955.

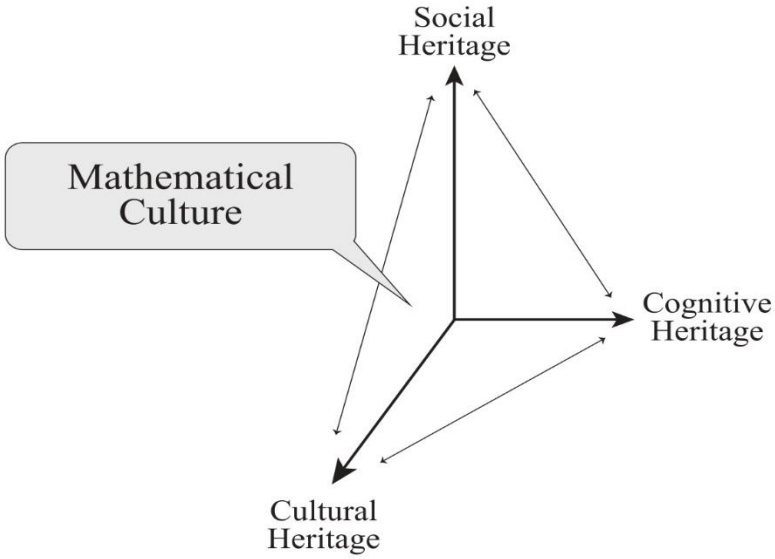

Figure 2.

The invention of mathematical culture interconnecting social, cultural and cognitive heritage. (prepared by the authors)

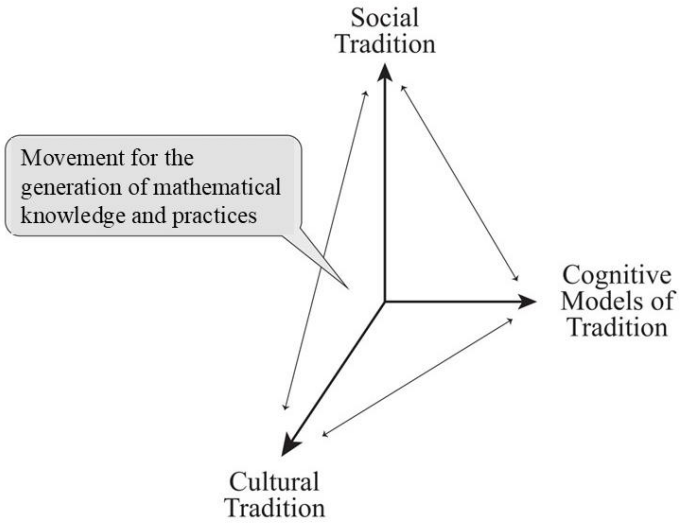

Figure 3.

Generation, renewal and innovation of sociocultural mathematical knowledge and practices (prepared by the authors.)

The dynamics of producing cultural knowledge and sociocultural practices, presented in the descriptors represented in Figure 2 and Figure 3 are expressed as a set of social contingencies that involve continuously interconnected contexts and imply a social dynamic that generates facts leading to invention, renewal, and cultural innovation. These novelties are

embodied in cultural practices demonstrated in individual or collective behaviors, characterizing processes of mediation of diverse social activities and validation of the practices generated in this group behavioral dynamic.

For Almeida (2010), no culture can be built without the foundation and mortar of the past. The substrate of the anteriority in culture is, however, only one side of the issue, and we can say that this process is reasonably described in History and Anthropology books. However, it is also necessary to highlight the characteristics of permanence and relevance of the knowledge and understanding of populations that live far from scientific progress. Such knowledge, passed on orally and experimentally, is responsible for the maintenance of hundreds of communities spread across various parts of the planet, which live far from the logic of the market system that standardizes everything.

In her studies and theoretical reflections, Almeida (2010) also assures that what we are today did not happen overnight, since the fabulous culture and enormous scientific and technological progress that we enjoy today were created through various experiments and learning experiences of human populations over the centuries, since it was necessary to respond to the challenges of the environment to guarantee our permanence on Earth. This is how societies consolidated knowledge that, transformed and expanded, has reached the present day as legacies from different cultures.

Thus, Snow (1995) considers that the term culture often carries ambiguous and profound nuances. On the one hand, it refers to intellectual development, the development of the mind. But it must also be conceived as cultivation, as "the harmonious development of the qualities and faculties that characterize our humanity" (Coleridge apud Snow, 1995, p. 86). The word is also "used by anthropologists to denote a group of people living in the same environment, linked by common habits, common postulates and a common way of life" (idem, p. 88).

Culture, as a set of knowledge, practices, rules, beliefs, strategies, and myths, is expressed through diversity, creativity, and innovation, and is always unfinished. We are marked by cultural unity and diversity (Farias, Mendes, 2014) and are individuals who reorganize ourselves through the brain-mind-environment symbiosis, according to Berger and Luckmann (2012).

This is how the concept of culture became a notion that inhabits various territories of scientific knowledge, especially those grouped under the designation of Human and Social Sciences. Originally confined to the scope of Anthropology, the understanding of culture is now mediated by a multiplicity of concepts that stem from the scientific development of each era and the distinct meanings based on the main theoretical matrices of the Social Sciences,

expressed by different schools of Anthropology, such as evolutionism, functionalism, structuralism, and Marxism, among others.

These theoretical frameworks weave the threads that allow movement within the labyrinth of culture, while at the same time foreshadowing distinct intellectual and historical commitments – in some cases, divergent and antagonistic; in others, opposed, but complementary. This is how the concept of culture has been treated, sometimes as a separation from and domination of nature (evolutionism); sometimes as the functionality of institutions and cultural traits (functionalism); sometimes as the articulation of symbolic and unconscious structures (structuralism); sometimes as a totality articulated by materialities and idealities (Marxism) (Farias, Mendes, 2014).

In this regard, we understand that, when certain knowledge is understood as something that grows and develops historically in several directions, times, and spaces, it becomes clear that it deals with cultural objects produced and used in each phase of the development of societies spread across the planet, over many centuries, accumulating a limitless socio-scientific archive. In the case of Mathematics, the transformation of the cultural objects that constitute it occurs to the extent that other cultural objects, not necessarily mathematical in nature, are transformed and incorporated into the *modus vivendi* of each society, at each historical moment of its organization (Mendes, 2023).

We know that Mathematics is a cultural knowledge generated by human society and, consequently, has a history. However, this knowledge certainly expands in its content, writing, and symbolism over time, like *ideographic writing* (Lévy, 1997), in a non-linear way, but traced by controversies, debates, divergences, renewals, and incessant updates.

In general, the production of mathematical knowledge throughout its historical-constructive development is characterized by constant creation and formal (re)organization, through the combination of codes representative of the interpretation of ideas related to everyday situations imagined, observed, and experienced by society (models and languages), coming to be considered as objectified knowledge (Mendes, 2023).

It is, therefore, based on the results originating from this constructive dynamic that we start to incorporate this knowledge into the cultural framework we organize and disseminate through its institutionalization in society and in the form of school institutions over time. However, the processes of historical (re)construction of this Mathematics have significant pedagogical implications for the interpretation of students' every day, school and scientific knowledge for its insertion into the most varied teaching models. To this end, we must use the most diverse historical information related to the production of Mathematics, with the intention

of updating the cognitive exercises to generate mathematical knowledge by students (Mendes, 2023).

As already mentioned by Farias and Mendes (2014) and by Mendes and Silva (2017; 2018), we are simultaneously marked by universality and diversity, in which the singularity of each individual is what makes him unique. Even though each of us lives within a diverse cultural context marked by the universal, we differ from others because of our individual and family history, etc. Therefore, it is necessary for teachers to realize that the classroom universe is marked by both universality, diversity, and singularity.

Research methodological procedures

The methodology proposed for the development of investigative actions in the workshop was done from a dialogical perspective, so that everyone could participate in the research activities in mutual collaboration, that is, in search of a collective production, followed by debates, personal testimonies and joint clarifications. We considered it was important that everyone recorded as much information as possible during the meetings that took place to enrich the discussion on the topics that emerged during the study.

To achieve the objectives set for the workshop, we established as focal programmatic objects: (1) the nature of mathematical knowledge (Davis; Hersh, 1989); (2) the cultural basis of Mathematics: historical cultural object (Wilder, 1981; 1998); (3) the social roots of Mathematics: socially produced knowledge (Restivo, 1998); (4) general aspects of the sociology of Mathematics (Struik, 1998); (5) some naturalist approaches to Mathematics (Bloor, 1998b); (6) methods and codes of mathematical reading of sociocultural realities (Vergani, 2000; 2009); (7) observation, interpretation and mathematical and scientific understanding of sociocultural phenomena in everyday practices (Bloor, 1998a; 1998c); (8) mathematical enculturation from a sociocultural perspective (Bishop, 1999); (9) the hybrid nature of Mathematics and its implications for the foundation of multicultural Mathematics Education (Vergani, 1991); (10) Mathematics Education as a dialogue between society, cognition and culture, both inter- and extra-school (Vergani, 1991); (11) teaching and learning Mathematics in a multicultural context (Vergani, 1991); (12) curricular reorientation and innovation in teacher formation and basic education, with a focus on sociocultural relations;

(13) cultural apprehension and inclusion plan in the classroom: educational actions (production of activities and videos).

For each of the focal programmatic objects mentioned in the previous paragraph, we developed collective reading, presentation by the participants, in the form of a mini-conference, followed by thematic discussions that aimed at grounding the theoretical-methodological formation of the group so that, later, everyone could have access to some sociocultural practices that were presented by the teachers in the form of thematic sessions of short videos – around 20 to 30 minutes each. The workshop sessions also included activities, such as reading and discussing various texts; planning; presentation and evaluation of thematic seminars by participants based on thematic micro-research and production of texts that reported such research.

Initially, we promoted the presentation and discussion of the workshop teaching plan, followed by an initial exposition on the nature of human knowledgeand mathematical knowledge, sociocultural practices, and knowledge production, culminating in a seminar by the participants on the Sociology of Mathematics. In a second moment, we gave a thematic presentation, connected to the seminar, about the cultural basis of Mathematics and its historical cultural object, relating it to the social roots of Mathematics as socially produced knowledge. We concluded this second stage with discussions on some naturalist approaches to Mathematics and a second seminar, which focus was on the book *Práticas Socioculturais e Educação Matemática* (Sociocultural Practices and Mathematical Education) (Mendes; Farias, 2014).

We held theoretical discussions on the importance of studies on sociocultural practices and their implications in Mathematics teaching, according to the programmatic objects of the workshop, which were later directly applied in the process of observing videos about a few of these practices, with the aim of supporting studies that were proposed to the participants.

Next, we held another thematic exhibition that covered methods and codes for mathematical reading of sociocultural realities, observation, interpretation, and mathematical and scientific understanding of sociocultural phenomena in everyday practices, mathematical enculturation from a sociocultural perspective, ending with guidance and the third seminar on the book *Enculturación Matemática* (Mathematical Enculturation) (Bishop, 1999).

At the next meeting, the workshop session began with a new thematic exhibition, which addressed topics such as: (1) the hybrid nature of Mathematics and its implications for the foundation of multicultural Mathematics Education; (2) Mathematics Education as a dialogue between society, cognition, and inter- and extra-school mathematical culture, and (3) teaching and learning Mathematics in a multicultural context. We concluded with guidance on extracurricular activities and referrals for research on *sociocultural practices and Mathematics Education*.

Three guidance sessions were held, each lasting four hours, for research on sociocultural practices, as well as on the treatment and systematization of the information obtained through research. Thus, participants were able to answer their research questions and, eventually, hold seminars to present the results of their investigation. These seminars were the basis for all participants to receive new guidance, with the aim of writing of the final reports – the new guidance sessions were held in three meetings, each lasting four hours.

We also guided the students in empirical research, which consisted of a survey of studies related to anthropological research that contributed to the proposed work. We carried out a survey of scientific works and studies relevant to sociocultural practices, which could support mathematical contextualization in the basic education classroom. This moment was important for allowing us to select some of the practices investigated, in order to carry out a study of cultural reality through ethnographic research.

Next, in the empirical stage of the workshop, we had open and dialogued interviews were conducted with groups of fishermen, farmers, potters, herbalists[7] from street markets, among other groups, in order to obtain information to support the preparation of dossiers on sociocultural practices and their mathematical problems, which would later be involved in the teaching activities in Mathematics classes.

Based on the material obtained from empirical research, collective studies were planned and carried out in the classroom. In the following workshop sessions, collective guidance

[7] In this article, the meaning of the term *herbalist* refers to a person who sells or works with medicinal and aromatic plants. In our case, the Brazilian term is given to a seller of phytotherapeutic and purifying oils and essences based on traditional knowledge about the plants and herbs of the Brazilian Amazon.

meetings were held on the written work (descriptive report), produced based on the field survey and interviews.

Next, each participant organized a printed report, containing the systematized information gathered and the interviews conducted with the groups surveyed. The organization and analysis of the information were aimed at pointing out contributions to the formation of Mathematics teachers based on the reflections established by the group involved in the study.

To conclude the workshop, we held seminars to present the reports and deliver the printed reports, with the conclusion of the activities that comprised the research workshop on Sociocultural Practices and Mathematical Education.

Results achieved

The results achieved in the workshop were important for the continuing formation of the participants, since the materials collected in the research were of significant value for the preparation of dossiers, which could probably be used in formation processes of Mathematics teachers, based on the didactic exploration of sociocultural practices in Mathematics Education, as well as for teaching Mathematics in schools.

The actions developed and the results of the research contributed to enabling teachers in continuing training to reflect on the use of sociocultural practices in the development of problems and didactic situations that provide elements for the development of Mathematics teaching in schools (Brasil, 1998a; 1998b; 2000). Let us look at some of the results:

1. Mud, wattle and daub, or clay houses – mathematical construction processes

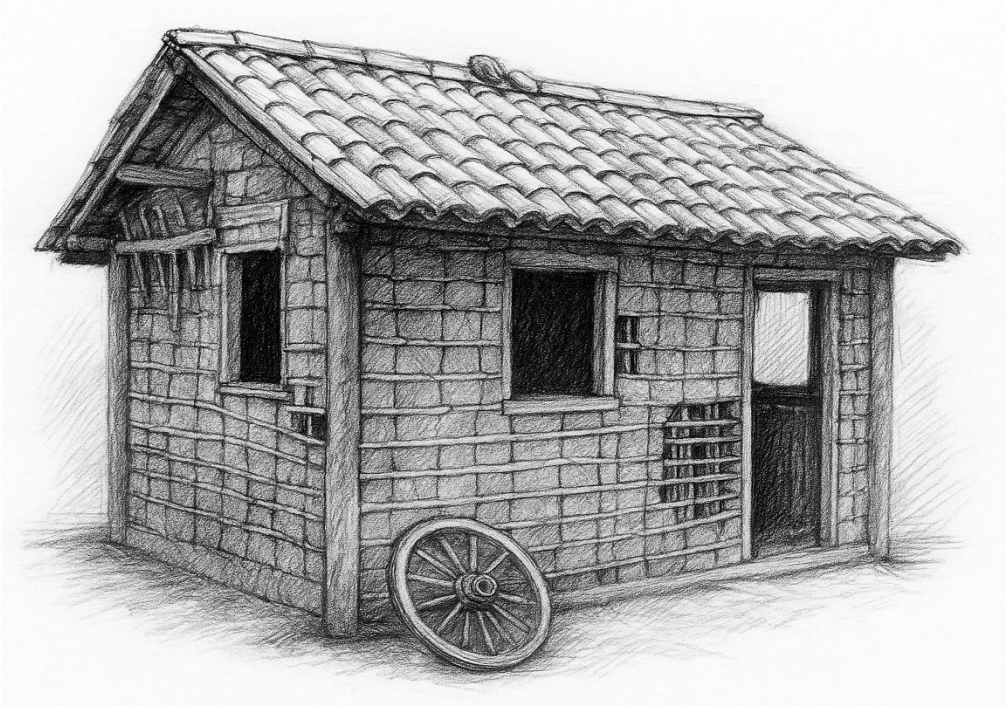

Figure 4.

Example of a house made of mud, wattle and daub, or clay (Prepared by the authors, 2025).

In this work, the construction of mud houses was analyzed through a mathematical perspective that described categories, such as dimensions, shapes, and spatial relations, as well as the organization of the structure, the distribution of materials, and the optimization of the use of space, with its stakes, bars, and layers of soil, involving geometric concepts, such as angles, straight lines, parallelism, and areas. Likewise, the mathematical calculation involves the volume of soil required for the construction of the house, with the objective of optimizing the use of wood for the structure or the distribution of clay for the sealing, and to analyze the stability and strength of the structure. Mathematics also analyzes how this type of building adapts to climate changes, such as variations in humidity and exposure to the sun.

2. Ceramics – artisanal production, uses, and geometric shapes

The crafts involved in making ceramics include manual modeling, such as the pinch technique – modeling with the hands, pushing and squeezing a piece of clay –, clay turning, extruding, pressing, and gluing, as well as decoration by painting, glazing, and other methods. Ceramics generally involves shaping the raw material (clay), drying, firing in a kiln, and decorating.

In this area of ethnographic research, bibliographic surveys on the topic were conducted and some concrete contexts of production, commercialization, and use of utilitarian ceramic pieces for domestic and decorative purposes were presented. In each case, the descriptive aspects of these practices were explored *in loco*, interpreting the potential connections between cultural knowledge and practices of ceramics and possible knowledge, as well as mathematical practices that could be incorporated into classroom activities, using an interdisciplinary approach.

Ethnographic reports were presented on the ceramics activity developed in the state of Pará (Brazil), regarding on the manufacture of handcrafted ceramics in geographical locations with ancient traditions, such as Icoaraci, Marajó Island, and Tapajós. These practices include the selection and preparation of clay, the modeling of the pieces – using clay turning, extrusion, and pressing techniques – painting with natural pigments and, finally, the use of a kiln.

3. Cassava flour – planting practices, artisanal production, and commercialization

As mentioned by Conceição, Farias, and Mendes (2024), this study presented a detailed description of the mathematical aspects involved in the sociocultural practice of cassava flour production, which takes place in a rural community, in the municipality of Acará, in the Brazilian state of Pará. Field data were recorded in October 2023, through the recording of a semi-structured interview with a farmer and cassava flour producer who lives at the Vila Centro Alegre community. The objective was to characterize the mathematical knowledge implicitly in the sociocultural practice of cassava flour production that can be explored to address school topics in the early years of elementary school. The results point to similarities between the knowledge developed in this practice and some of the mathematical school content that can be worked on by teachers, especially in the early years. Lastly, a school mathematics activity based on this sociocultural practice was proposed to be put into practice in the classroom. This work was presented and published in the proceedings of the 7th Brazilian Congress of Ethnomathematics, held in Macapá (Brazil), in September 2024, under the responsibility of the authors (Conceição; Farias; Mendes, 2024).

4. Highwaterman catfish fishing and the mathematics involved

An investigation was conducted into the practice of highwaterman catfish[8] fishing and its connection with riverside Mathematics. How can we take elements of the highwaterman

[8] The highwaterman catfish (Hypophthalmus *edentatus*) is a species of osseous, siluriform fish, from the hypophthalmid family, which can be found in the Amazon as well as in the Paraná River. It has a blue colored

catfish fishing techniques and establish relationships with the mathematical content worked on in the classroom? This research question leads us to the objective of verifying the social relations, fishing techniques, and mathematical organization implemented by traditional fishermen who live in riverside communities in the municipality of Cametá, in Pará, Brazil, during the highwaterman catfish fishing season. The methodological procedures were bibliographical research – articles and academic works – on the topic, a YouTube video, and an interview with a teacher who is the daughter of a fisherman. Thus, we realized the need to appropriate this fishing knowledge and the experiences of fishermen, considered here as "intellectuals of tradition," so that we can make analogies and comparisons between the mathematics of riverside dwellers and school Mathematics.

In this regard, the topic was analyzed taking into account essential aspects, such as the protein levels in the highwaterman catfish; the growth and spawning period; the ideal weight for consumption; the question of whether it is possible to breed the highwaterman catfish in captivity; the annual amount of highwaterman catfish caught at the opening of the fishing season; and the reasons for the ban on fishing, selling, and consuming highwaterman catfish *fifiti* (in Brazilian Portuguese), that is, when it is not yet fully grown. This work was also presented and published in the proceedings of the 7th Brazilian Congress of Ethnomathematics, held in Macapá, Brazil, in September 2024, under the responsibility of the authors (Oliveira; Mendes; Farias, 2024).

5. Construction of cisterns – geometric and measurement processes

The proposal for this theme referred to the exploration of a sociocultural practice that aimed to build a reservoir to capture and store rainwater. The technique is well known and widespread in the Brazilian semi-arid region, but not widely used in other geographical regions of Brazil. This practice can be useful in the current context of the global water crisis, after so many years of climate imbalance and with trends toward water scarcity in the coming decades.

This practice was presented as a video documentary that described the entire process of building a cistern, so that workshop participants could assimilate this information and its relationships with the geometric and measurement aspects that can be explored in Mathematics classes.

Our initial idea was to show the use of cisterns in small properties and rural communities. It is necessary to develop techniques aimed at generating and/or adapting water

back and a white belly. In Brazilian Portuguese, it is known as *mapará*, *cangatá*, *mandubi*, *mapará-de-cametá*, and *mapurá*.

infrastructures that makes it possible to change the profile of human coexist with adverse climatic conditions, as well as providing stimuli for the development of the rural sector, as mentioned by Araújo (2020), when addressing aspects related to the construction of cisterns as a technology for water storage in the Brazilian semi-arid region.

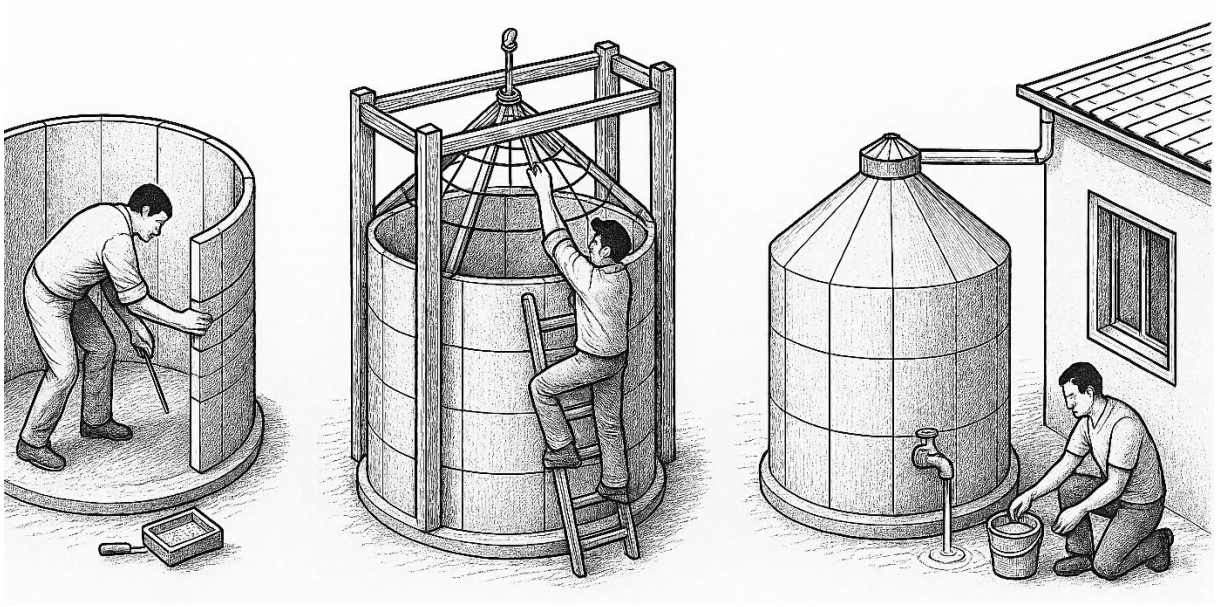

Figure 5.

Sketch of the cistern construction process (Source: Prepared by the authors, 2025)

Evaluation of the activities developed during the workshop

The evaluation process of the activities developed in the workshop was carried out based on the following criteria: (1) participation of graduate students in these activities – reading, discussion, bibliographic and field research, presentation of work in the classroom – and (2) individual written production, referring to ethnographic dossiers.

We found that the guidance sessions were fundamental for the participants' writing exercise on an exploratory practice of sociocultural reality as a process of constructing school Mathematics centered on the society-cognition-culture relationship, according to Vergani (1991), when using his metaphor *zero and infinity* to emphasize the singular and plural related to the diversity of sociocultural practices. Thus, it was possible to organize the thematic ethnographic dossiers planned and supervised by us during the workshop. By carrying out these actions, we intended to promote interaction between graduate students in the field of Mathematics Education, as well as between the individuals investigated in each problematized situation through studies of sociocultural reality.

We also assessed that, during the process of producing ethnographic dossiers on the socio-historical and cultural realities investigated, as well as on the sociocultural practices identified in the investigated contexts, the collective study sessions enabled the development of planned by the *stricto sensu* graduate students in Mathematics Education. Likewise, they perceived concrete evidence of the hybrid nature of Mathematics and its implications for interdisciplinary teaching, centered on the dialogue between society, cognition, and inter- and extra-school mathematical culture, which promotes comprehensive learning of this discipline based on the cultural context in which students are inserted, as proposed by Bishop (1999).

In this sense, at each stage of the workshop, step by step, the research exercises were done according to the partial objectives set to be achieved during the research process, namely, the contributions that the research could offer to the production of knowledge about the topics and how it could contribute to the continuing formation of the teachers who took part in the workshop.

Final reflections

The investigative experience carried out in the workshop, with the guidance of the teachers in formation, led us to reiterate what had already been verified by Mendes and Farias (2014; 2017; 2018), when their previous research results showed that, during their educational-formation process for teaching Mathematics, teachers need to adopt teaching approaches that enable them to problematize and explore diverse sociocultural practices for interdisciplinary teaching. Likewise, the results showed that participants identified elements that help answer our research question, presented at the beginning of this article, regarding the development of didactic approaches to be used in mathematics teaching from an interdisciplinary perspective.

The results indicated that teachers need to challenge themselves to build their processes of searching, understanding, and connecting established knowledge in sociocultural practices and the various representations that can be materialized, based on the mathematical knowledge acquired throughout their educational trajectory.

In this regard, we identified that the investigative and elaborative exercise experienced in the sociocultural practices workshop should be materialized through the problematization of the investigated practices, with didactic approaches to teaching Mathematics to explore such practices in relation to the content to be address in class, with a view to obtain didactic, conceptual, and formative implications for teachers and their students.

We also could identify that this same principle of building competencies and skills for the exercise of problematization and mathematical expression, used in the workshop, should be

established for the initial formation of teachers. We consider the need to put practice research into practice in the classroom with Mathematics Education programs students, especially during their supervised internship in elementary and high school. In this way, it is possible to give these students the opportunity to become fully involved in the search for their own socio-cognitive and cultural construction in Mathematics.

Given what was described above, it is possible to admit that experiences such as ours can be carried out successfully and contribute to strengthening the formation of all those involved in the process, provided that an environment conducive to such experiences is established. This formative process occurs because, based on the didactic-investigative experience carried out, we included themes of sociocultural relevance directly related to the reality of the group of graduate students who participated in the workshop. We followed each participant's criteria for joining, considering that this would be an exclusively personal decision, since it was a choice based on the interest of each participant.

We also found that the participants showed that the improvement and clarity of mathematical topics addressed in the research can be approached in the classroom in basic education through mathematical problematizations. They assured us that problematizations add to mathematical knowledge can be used in schools, since this type of action contributes to the production of knowledge. However, they also pointed out that there are limitations to this type of approach, since there are schools in which not all teachers have had adequate formation to take a problem-solving and investigative stance in their classes. They also pointed out that there are limitations in terms of students and the time to carry out activities.

In addition, other participants consider that the problematization of the sociocultural practices investigated is relevant for all educational levels, presenting real situations and encouraging students to apply what they have learned in classroom (theory). Problematization is important for the development of student' creativity. However, it is necessary to guide him, as there are still limitations in relation to doing or showing how it should be made. This is because investigative activities and projects enable students to see Mathematics from an investigative point of view in their current reality.

Participants also reported that the exercise of problematizing on investigated realities can broaden the teacher's perspectives on systematizing their students' learning. Their limitations may arise from the social, cultural, and economic environment of each school involved. The limitation of this didactic approach relates to the materials to be used and the worldview of teachers and students. However, these activities can create greater integration

between teachers and students, in the sense that they increase student interaction with the world around him due to the need to produce his own knowledge.

Our future perspective is that the research results are important for the continuing formation of teachers directly or indirectly involved in the project, as well as for elementary and high school students, and also for future Mathematics teachers. Our statement is based on the fact that the products resulting from the research, such as bibliographic surveys related to sociocultural and professional practices, can support the preparation of dossiers to be used for pedagogical issues, both in the formation of Mathematics teachers and to increase teaching actions in basic education. In particular, it can help teachers to overcome the conceptual and didactic difficulties teachers in their teaching practice, which may contribute to these professionals advancing creatively in their classroom practice.

Based on the results obtained during the research, we interpreted how much progress had been made in terms of the growth of the group involved, as well as the levels of the contribution in the results generated in the participants' work. In the end, it was suggested that academic articles be written for presentations at conferences and published in scientific journals. We obtained, as an immediate result, the publication of two papers, a partnership between the teacher-researchers Conceição, Farias, and Mendes (2024) and Oliveira, Mendes, and Farias (2024).

Likewise, these results made it clear that this significant increase in the degree growth of the group involved was evident in relation to overcoming their conceptual difficulties by engaging in bibliographic survey, readings and thematic discussions, as well as in the experience of exploring the practices researched and, thus, realizing the possibility of using these practices in Mathematics teaching.

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