Sociedade Brasileira de Educação Matemática

RIPEM

Mathematical literacy through comic books

Elias Santiago de Assis
Universidade Federal da Bahia
Salvador, BA — Brasil
✉ eliassan@ufba.br
0000-0002-5925-8810

Maria Izabel Lopes de Araujo
Universidade do Estado da Bahia
Salvador, BA — Brasil
✉ mlaraujo@uneb.br
0000-0001-7571-9077

Zulma Elizabete de Freitas Madruga
Universidade Federal do Recôncavo da Bahia
Amargosa, BA — Brasil
✉ betemadruga@ufrb.edu.br
0000-0003-1674-0479

2238-0345 ISSN

10.37001/ripem.v16i1.4648 doi

Received • 17/06/2025
Aprooved • 09/02/2026
Published • 18/02/2026

Editorial • Edvonete Souza de Alencar
Veridiana Rezende

Abstract: This study aims to identify and analyze the mathematical literacy competencies mobilized by prospective mathematics teachers during the reading and interpretation of comic books that address mathematical content. This is a qualitative field study conducted with twenty-five undergraduate students in Mathematics at a public university in the state of Bahia. The participants selected, interpreted and problematized comic strips (short comics) that include content on plane Euclidean geometry. The data were collected through observation and a questionnaire designed to stimulate mathematical literacy skills highlighted in the National Common Curricular Base: reasoning, visualization, communication, and mathematical argumentation. Findings indicate that reading and discussing comic books with mathematical content foster the mobilization of these competencies, highlighting the potential of comic literature as a didactic resource in the initial training of mathematics teachers.

Keywords: Mathematical literacy. Comics. Initial Training of Mathematics Teachers.

O letramento matemático por meio de histórias em quadrinhos

Resumo: Este artigo tem como objetivo identificar e analisar as competências do letramento matemático mobilizadas por futuros professores de matemática durante a leitura e interpretação de histórias em quadrinhos (HQ) que abordam conteúdos matemáticos. Trata-se de uma pesquisa de campo, de abordagem qualitativa, realizada com 25 estudantes de um curso de licenciatura em Matemática de uma universidade pública do estado da Bahia. Os participantes selecionaram, interpretaram e problematizaram tirinhas (pequenas HQ) que contemplam conteúdos de geometria euclidiana plana. Os dados foram coletados por meio da observação e de um questionário elaborado com o intuito de estimular as competências de letramento matemático destacadas na Base Nacional Comum Curricular: raciocínio, visualização, comunicação e argumentação matemática. Os resultados indicam que a leitura e as discussões em torno de HQ favorecem a mobilização dessas competências, evidenciando o potencial da literatura em quadrinhos como recurso didático no processo de formação inicial de professores de matemática.

Palavras-chave: Letramento Matemático. Histórias em Quadrinhos. Formação Inicial de Professores de Matemática.

Alfabetización matemática a través de historietas

Resumen: Este trabajo tiene como objetivo identificar y analizar las competencias de la alfabetización matemática movilizadas por futuros profesores de matemáticas durante la lectura e interpretación de historietas que abordan contenidos matemáticos. Este es un estudio de campo y cualitativo, realizado con veinticinco estudiantes de pregrado de Matemáticas en una universidad pública del estado de Bahía. Los participantes seleccionaron, interpretaron y problematizaron tiras cómicas que incluyen contenido sobre geometría euclidiana plana. Los datos se recopilaron mediante observación y un cuestionario diseñado para estimular las habilidades de alfabetización matemática, según lo establecido en la Base Curricular Común Nacional: razonamiento, visualización, comunicación y argumentación matemática. Los hallazgos indican que la lectura y las discusiones en torno a las historietas favorecen la movilización de dichas competencias, haciendo evidente el potencial de la literatura en historietas como recurso didáctico en el proceso de formación inicial de profesores de matemáticas.

Palabras clave: Alfabetización Matemática. Historietas. Formación Inicial de Profesores de Matemáticas.

1 Introduction

The *Program for International Student Assessment* (PISA) is a large-scale assessment system that seeks to identify the learning of 15-year-old students in reading, mathematics, and science areas. It was established in 2000, and it is held every three years, coordinated by the Organization for Economic Co-operation and Development (OECD) (Anísio Teixeira National Institute for Educational Studies and Research [Inep], 2020). The most recent edition took place in 2022, with the participation of 81 countries, including Brazil, and focused on mathematical literacy of students, as noted by Lima and Moreira (2024).

According to PISA, mathematical literacy consists of a student's ability to "formulate, employ and interpret mathematics in a range of contexts, which includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena" (Inep, 2020, p. 100). Therefore, a mathematically literate individual should be able to use their mathematical knowledge to identify, interpret, and solve problems in a variety of contexts.

Regarding to Brazil, the data presented in the latest edition of the exam are worrying. Students' mathematical proficiency revealed that they can "interpret and recognize situations in contexts that require nothing more than direct inference" (OCDE, 2003, quoted by Lima & Moreira, 2022). In other words, the answers provided by students demonstrate difficulty in performing more complex calculations and limitations in understanding and solving less trivial problems. Even considering the study's margin of error, Brazil's position was not satisfactory: it fluctuated between 62nd and 69th place among the 81 participating countries (Lima & Moreira, 2024).

Research focused on teacher literacy has been carried out by Souza (2018) and Sostisso (2014). In both cases, participants were undergraduate students in mathematics programs, in Rio Grande do Sul and Pará, respectively. The object of both investigations was so-called *scientific literacy*, not mathematical literacy. Findings indicated that Mathematical Modeling (MM) favors the creation of environments conducive to the development of scientific literacy, understood as the ability to use scientific knowledge in solving practical everyday situations (Jolandek; Kato, 2021). According to the National Common Curriculum Base (BNCC in its

Portuguese acronym), scientific literacy "involves the ability to understand and interpret the world (natural, social and technological), but also to transform it based on theoretical and procedural contributions of science" (Ministry of Education [MEC], 2018, p. 321).

In addition to investigations that promote a connection between literacy and MM (Multimedia Mathematics), there is research that links statistical literacy to the reading and interpretation of comic books. Queiroz, Nunes and Pereira (2024, p. 1) advocate the use of this text genre in the classroom to promote "creativity, critical thinking, and reflection in line with the principles of statistical literacy [SL]". By SL, we mean the ability to understand, interpret, and use statistical data appropriately in daily life, at work, and at school (Gal, 2002). These authors present a comic book of their own creation and suggest possibilities for its use in teaching the concept of "arithmetic mean". However, the research presented by the authors does not provide empirical data, nor does it specify which grade level the proposed promotion of SL through a comic book is intended for.

Menezes (2021) also advocates the use of comic books in the classroom. Although he does not directly reference mathematical literacy, the author highlights the contributions of comic book literature to the development of students' written communication. According to PISA (Brazil, 2020), communication is one of the skills developed (or under development) by mathematically literate students. Among the contributions identified by Menezes (2021), the mobilization and articulation of mathematical concepts through written language stands out. Furthermore, the author points out that student records allow the teacher to identify conceptual mistakes and, consequently, promote their correction.

According to Jolandek and Kato (2021), most research on mathematical literacy is focused on basic education. This fact highlights the existence of a still nascent field regarding initial teacher training (Quadros, 2017). On the other hand, studies such as those by Queiroz, Nunes and Pereira (2024) and by Menezes (2021) point to the use of comic books as a strategy to stimulate literacy-related skills, whether statistical or mathematical ones. In this context, the present research aims to identify and analyze the mathematical literacy skills mobilized by future mathematics teachers during the reading and interpretation of comic strips that address mathematical content.

This qualitative research involved 25 undergraduate students from a Mathematics degree program at a public university in the state of Bahia, all enrolled in the Plane Euclidean Geometry course. At the time, this subject was taught by this paper first author, who simultaneously worked as a teacher and researcher. Further details regarding the participants and the procedures adopted are presented in the methodology section. Before that, we focused on the research theoretical foundation, as described in the following two sections.

2 Mathematical literacy

The term literacy emerges, in part, as a response to the limitations of the alphabetization[1] concept. While the latter is limited to the ability to read and write functionally, literacy broadens this perspective to encompass the competence of reading and writing in a critical and reflective manner (Soares, 2004). According to D'Ambrosio (2004), an individual who is alphabetized but still in the process of becoming literate may have their autonomy compromised in situations that require more elaborate reading and writing skills, depending on the support of someone who already can master these practices.

[1] Translator's note: many Romance languages use the term *alfabetização* (such as *alphabétisation* in French, or *alfabetismo* in Spanish), which implies a more advanced level of critical reading and writing skills would correspond to *literacy*.

According to BNCC, *mathematical literacy* refers to the "skills and abilities to reason, represent, communicate and argue mathematically" (MEC, 2018, p. 266). This refers to the ability to apply mathematical knowledge critically and reflectively, both inside and outside the school environment (Arruda, Ferreira & Lacerda, 2020). A mathematically literate person possesses the ability to correctly interpret numerical data and, from that data, create mathematical models that characterize them, as D'Ambrosio (2021) points out. This concept is related to the conscious, active, and reflective use of mathematical knowledge in formulating ideas, constructing conjectures, and solving problems. Thus, a mathematically literate individual can apply mathematical concepts to analyze and understand situations in the world, adopting an investigative stance towards the issues that surround them.

Mathematical reasoning, the first competency of mathematical literacy mentioned in the BNCC, can be understood as the ability to identify patterns, formulate conjectures, establish relationships, generalize, and justify procedures and conclusions (MEC, 2018). For Ponte, Brocardo and Oliveira (2021), it is not limited to the application of rules and algorithms, but involves logical thinking, argumentation, and the ability to make informed decisions in diverse contexts. Its development occurs as the student can relate new knowledge to what they already have, attributing meaning to it, whether in practical terms or from a theoretical point of view (Duval, 1998).

According to Duval (1993), *representation* of a mathematical concept can occur in at least three distinct ways: iconic, symbolic, and native language. Iconic representations maintain a resemblance to the object depicted, imitating it or simulating its appearance. This occurs, for instance, when a student draws a triangle with the intention of representing a mathematical concept. Symbolic representations, in turn, are not concerned with resembling the object represented. They are established through social conventions and aim to make communication more directly. Finally, representations in the mother language correspond to those expressed through spoken or written language in everyday life. It is the textual form used to explain concepts with words, exactly the one used to create this text.

Mathematical communication is not limited to sharing ideas. It represents an essential component in students' education, as it enables them to interpret, represent, and express different mathematical situations and reasoning in a meaningful way (Menezes, 2021). Mathematical writing, especially, plays an important role in this process, as it allows the individuals to review their own ideas, organize their thoughts, and establish new conceptual connections. As claimed by Martinho and Rocha (2018, p. 34), "students write to learn and learn by writing". Therefore, writing (and more broadly, communication) should be continually encouraged in mathematics education. Through this practice, students gradually become familiar with different forms of mathematical representation - numerical, algebraic, graphical, and verbal - incorporating symbols and meanings inherent to mathematical language into their expressive and cognitive repertoire.

Developing a *mathematical argument* involves strategic choices, both in content and in sequence in which it is presented. These elements need to be logically articulated so that the progression of ideas gradually strengthens the thesis being defended (Douek, 1999). Although there is a tradition among many mathematicians that privileges only formal proofs as a form of argumentation, as Reid and Knipping (2010) observe, this view is limited. Mathematical argumentation encompasses more than just the deductive proof of theorems (Balacheff, 1999). Solving a problem by formulating and solving an equation, for example, also constitutes a legitimate form of mathematical argumentation.

The ability to *reason*, *represent*, *communicate*, and *argue mathematically*, identified by

the BNCC as competencies of mathematical literacy (MEC, 2018), depends on the pedagogical choices adopted by teachers. The way content is presented, the types of problem situations selected, and the knowledge-building processes valued in the classroom directly influence the development of these skills. In that regard, Skovsmose (2001) identifies three didactic-pedagogical perspectives that guide teaching practice: structuralism, pragmatism, and process-orientation.

Structuralism refers to approaches that emphasize mathematical content and its logical structure. Mathematics is understood as an abstract and closed system of ideas constructed deductively. In *pragmatism*, applications of mathematics stand out. The primary role of mathematics is problem-solving. *Process-orientation*, on the other hand, prioritizes the construction of meaning by the students. Classroom activities focus on exploration, reasoning, and argumentation. The emphasis shifts from results to the process. Discoveries are valued, and mistakes are understood as a natural part of learning. Mathematics is seen as a human practice in a permanent process of construction (Bennemann & Allevato, 2012).

Process-orientation, as cited by Skovsmose (2001), appears to be a promising perspective regarding the formation of mathematically literate individuals. However, both structuralism and pragmatism carry important educational values and, therefore, also contribute to the development of students' literacy. It is natural to assume that some students respond more effectively to one perspective than another, depending on their prior experiences and their own conceptions about mathematics. Then, in this text, we propose a division of mathematical literacy into three types, according to their alignment with each of the aspects pointed out by Skovsmose (2001): conceptual mathematical literacy, contextual mathematical literacy, and critical mathematical literacy.

By *conceptual mathematical literacy*[2] we are referring to the identification of mathematical concepts, the recognition of the properties involved, the conscious manipulation of formulas, the understanding of theorems, etc. C*ontextual mathematical literacy* refers to the ability to use mathematics to solve real-world problems. It is geared towards the applicability of concepts. Finally, *critical mathematical literacy* corresponds to the ability to question, evaluate, and make decisions based on mathematically structured problem situations. It is the result of activities that encourage argumentation, student positioning, and the interpretation of real-world problems. These three types of literacy are in line with structuralism, pragmatism, and process orientation, in that order, as summarized in Table 1.

Table 1: Types of mathematical literacy and their characteristics

Types of Mathematical Literacy	Didactic-pedagogical emphasis	Main Characteristics
Conceptual-ML	Structuralism	Mastering concepts, formulas, properties, and theorems
Contextual-ML	Pragmatism	Applying mathematics in real-world, everyday contexts
Critical-ML	Process-orientation	Reflective posture, questioning, decision-making

Source: the authors.

[2] The term *conceptual literacy* is used by Ruppenthal, Coutinho, and Marzari (2020, cited by Prado, Ruppenthal & Spohr, 2024) as a way of classifying scientific literacy. According to these authors, it is about applying "conceptual framework of a science to explain, understand, and make decisions in your life" (p. 7).

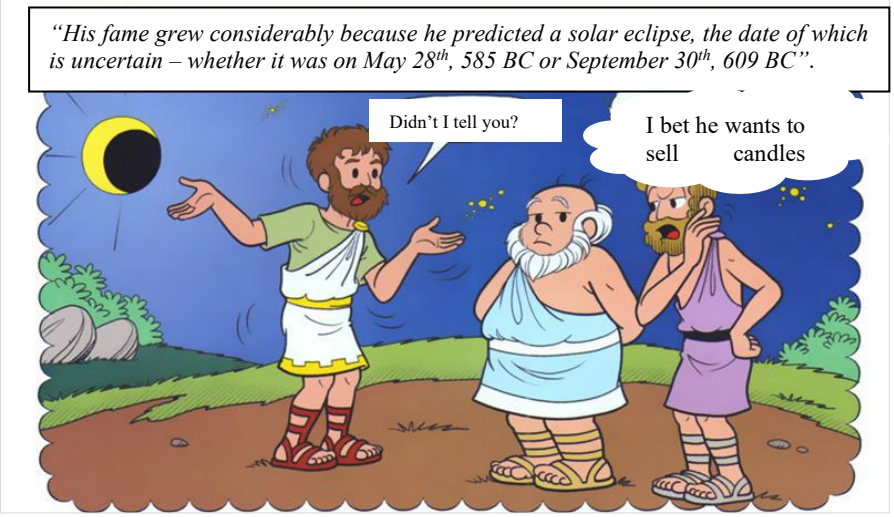
Critical reading of the world is one of the roles of Mathematics Education, and thereunto, Skovsmose (2001) suggests the use of open materials that allow for multiple interpretations, and enhancers capable of expanding the possibilities of mathematical learning. Among the materials that can fulfill this role, comic books stand out, as they present contextualized situations and accessible language, enabling diverse analyses and creative approaches in mathematics education. Next, we delve deeper into this discussion, highlighting the educational potential of comic books.

3 Comic books and Mathematics teaching

Comic books are narratives formed by a hybrid language that establishes relationships between verbal and visual elements. For Vergueiro (2006, p. 22), by using these two communication codes, comic book literature "expands the understanding of concepts in a way that either code, in isolation, would have difficulty achieving". Interaction between text and image enhances understanding of the message conveyed, allowing the reader to assign meaning to it. Afrilyasanti and Basthomi (2011) state that the inclusion of multimodal language in student education corresponds to a demand of the globalized world and constant technological advancement.

Encouraging reading is one of the contributions of comic books, as highlighted by Luyten (2011). Comic book narratives can serve as a gateway for students to access other textual genres, as they develop their interest in reading. Furthermore, they contribute to the development of textual interpretation skills, since the reader, even unconsciously, fills in the narrative gaps left between one panel and another (Upson & Hall, 2013). Comic books also represent a means of disseminating information of a scientific or cultural nature, as highlighted by Francis Pelton and Pelton (2019). As an example, we can cite the comic book series "Learn More about the History of Mathematics" by Maurício de Sousa. An excerpt from this publication is shown in Figure 1.

Figure 1: Solar eclipse[3]



Source: Sousa (2011).

Figure 1 depicts one of the discoveries by the mathematician Thales of Miletus. Notable for his ability to use mathematics to solve real-world problems, such as the height of an Egyptian pyramid, Thales was also able to predict a solar eclipse. In addition to this episode in the history of mathematics, Sousa (2011) presents, through his comic book, curiosities related

[3] T. N.: Comic strips were translated or substituted by the originals, when originally published in English.

to Euclid of Alexandria, among other mathematicians.

Another graphic novel that presents historical facts about mathematics, with an emphasis on the history of logic, is the book *Logicomix*, by Apostolos Doxiadis and Christos H. Papadimitriou. Through a graphic novel narrative, the work portrays the life and intellectual output of the British philosopher and mathematician Bertrand Russell (1952–1970). The plot follows his attempt to ground all of mathematics in pure logic, revealing the tensions and challenges he faced. Throughout history, other mathematicians are also mentioned, whether they were contemporaries of Russell or not. Among them, names like David Hilbert and Henri Poincaré appear in contexts that illustrate the debates of the time about the foundations of mathematics, helping to portray the complexity and diversity of thought that marked the period (Doxiadis & Papadimitriou, 2008).

From a perspective indirectly linked to the history of mathematics, the Frenchman Jean Pierre Petit also used the language of comics to present mathematical concepts. His work *Les Adventures d'Anselme Lanturlu: Le Géometricon*[4] (1982) presents situations in which the results of Euclidean geometry are not always satisfied. Then, the author reveals to the reader the existence of other geometric models, such as spherical and hyperbolic geometry.

Santos and Assis (2024) investigated how Petit's work (1982) contributes to the learning process of spherical geometry among students in a mathematics degree program. Findings revealed that participants were able to identify the distinctions between this type of geometry and Euclidean geometry, understanding, for example, that in spherical geometry, lines are represented by great circles (that is, circles with the same radius as the sphere and centered at its center) located on the spherical surface. Once again, a careful reading of a comic book provided information of a, shall we say, scientific (or rather, academic) nature.

In addition to reading, text interpretation, and the dissemination of information, comic books can also be used to promote mathematical communication. In that Regard, Menezes (2021) analyzed the written work of basic education students regarding the content of some comic strips that addressed mathematical concepts. According to Nunes (2024), comic strips constitute a synthetic text genre, characterized by the ability to condense information and transmit simple or complex messages in a brief narrative. Figure 2 shows one of the comic strips featured in the work by Menezes (2021), authored by the American cartoonist Ryan Kramer.

Figure 2: When the second one is not a big deal

Source: Menezes (2021).

[4] T.N.: This is the original French title. In English, the series is called "The adventures of Archibald Higgins"; in Portuguese, "As aventuras de Anselmo Curioso".

Given the comic strip depicted in Figure 2, the participants in the research by Menezes (2021) were asked to describe, in writing, the story, the meaning of the title, and the mathematical problem it presents. The narrative features a young man who intends to renew his driver's license and, for this purpose, goes to the State Department of Transportation or the competent authority. Upon receiving ticket number "two", he is happy, believing he will be served shortly. However, he is surprised to see the current password number on the screen. Students' records reveal an adequate understanding of the context in which the numbering of the passwords belongs to the set of rational numbers and not only to the set of natural numbers.

Mathematical communication is one of the skills that make up mathematical literacy, as explained in the previous section. The research by Menezes (2021) reveals a way to mobilize it through comic strips. For Assis (2017), it is also possible, through comic books, to stimulate students' mathematical reasoning. In his doctoral research, the author sought to identify contributions and limitations of presenting content from plane Euclidean geometry through comic books. Data showed that the use of comic book literature in the classroom has the potential to promote the development of students' logical and deductive reasoning. However, "the presence of deductive thinking is not always converted into the appropriate use of language" (Assis, 2017, p. 422). In other words, reasoning precedes language, and therefore mathematical communication needs more time to develop.

In both research by Assis (2017) and Menezes (2021), complete comic strips or graphic novels were presented to students. It was up to them to analyze them based on their cognitive repertoire. This critical reading of comic book literature is one of the skills proposed by BNCC. However, this document also proposes that students be encouraged to construct their own narratives. This perspective aligns with the ideas by Assis (2021). This author, as a professor-researcher, proposed to the participants of his research, students of the mathematics degree course at a public university in Bahia, that they create comic strips depicting some content of plane Euclidean geometry covered by him in the classroom. Productions allowed him to identify conceptual errors made by the participants and, more than that, they revealed the varied meanings attributed by the subjects to the objects studied. According to the author, "students have a lot to say, and comics can represent another channel of communication between them and the teacher" (Assis, 2021, p. 38).

This section presented different ways to incorporate comic books into math classes. They can be brought into the classroom by the teacher, as Assis (2017) and Menezes (2021) point out, or even produced by the students, according to proposed by Assis (2021). In any of these approaches, it is essential that there be a didactic intention that guides the pedagogical practice. Rosa *et al.* (2012) also suggest another possibility: removing excerpts from the comics for students complete, a strategy that seeks to encourage the construction of meaning. This proposal, in a way, dialogues with Assis (2021), who defends the development of conceptual understanding through the production of comics. Another alternative is to invite students to select comic books that address mathematical content studied in class, with the teacher's encouraging critical thinking so that this reading is permeated with critical awareness. It is from this perspective that the research presented in this article is developed, as will be detailed in the next section.

4 Methodological procedures

As previously mentioned, this research aims to identify and analyze the mathematical literacy skills mobilized by future mathematics teachers during the reading and interpretation of comic books that address mathematical content. Regarding the approach, this is qualitative research since it seeks to understand, in depth, the meanings, interpretations, and relationships

constructed by the participants based on their speech or written records (Coutinho, 2011). For Goldenberg (2004, p. 14), in this type of research, the emphasis is on "deepening the understanding of a social group, an organization, an institution, a trajectory, etc."

Regarding technical procedures, this research consists of a case study conducted in a third-semester class of a mathematics degree program at a public university in Bahia, with the participation of 25 students. According to Ponte (1994), this type of procedure is indicated when seeking a detailed understanding of actions, justifications, and motivations that guide the behavior of a particular subject or group in relation to the phenomenon under investigation. There is also field research, through the researcher's presence at the location where the phenomena being investigated occur, in direct contact with the participants (Fonseca, 2002).

Participants were chosen based on ease access for the researcher, who was working as a teacher on the *Euclidean Plane Geometry* course with the class involved. As a teacher, he taught the classes for the curricular component under his responsibility, conducting activities through theoretical discussions and problem-solving. After completing approximately 40% of the course's required hours, the researcher began the work. In the classroom, he discussed the educational contributions of comic books, illustrating with examples and data from previous research. Next, he asked students to organize themselves into groups of five. Each group was responsible for locating and selecting a comic strip that addressed some aspects of plane geometry, and could use sources such as newspapers, books, magazines, the internet, among others. After making their selection, the groups read the comic, interpreted the message conveyed, and then answered a questionnaire prepared by the researcher. Finally, the comic strips and questionnaire responses were presented and shared with the researcher and the whole class in an environment open to interaction.

According to Goldenberg (2004), using questionnaires as a data collection instrument is justifiable because they offer participants a certain degree of freedom, allowing them to express their opinions in writing with more time to respond and without the need for direct interaction with the researcher. In qualitative research, they are generally composed of open-ended questions whose answers require some level of detail from the participants. Since the participants were organized into groups, which are denoted as G1, G2, G3, G4, and G5, the researcher instructed that each item of the questionnaire be discussed collectively, so that the answers would be written based on consensus established within each group.

In his investigation of mathematical communication based on the interpretation of comics, Menezes (2021) also used questionnaires as instruments for data production. In addition to asking students to describe the comic strips, this author posed questions about the content of the narratives to understand if the students had grasped the "mathematics" present in the comic strips.

The questionnaire given to participants in this research also asked them to describe the story, in a manner like what was proposed by Menezes (2021). A full description of the questions appears in Table 2.

Table 2: Items from the questionnaire

Number	Question
01	Where did you find the comic strip?
02	What title would you give the story? Explain.
03	What mathematical concepts are covered?
04	What is the comic strip about?

05	What reflections can be provoked by the comic strip?
06	What would you change about the story? Explain.
07	How can comic strips be used in math classes? Comment below.

Source: Research data.

The questions presented in Table 2 were designed to encourage participants to engage in a critical and reflective reading of the comics. As cited by Assis (2017), for educational potential of comics to be effectively explored, it is essential that these productions are accompanied by didactic intent. Then, a reading approach guided by questions that encourage the reader to interact with the narrative, interpret it critically, and even propose modifications constitutes a methodological alternative capable of stimulating mathematical thinking, creativity, and student engagement with the content covered.

Data produced from observation, the presentations made by participants in the classroom, and the responses to the questionnaire were analyzed based on three categories defined a priori. According to Moraes (1999), the prior selection of analytical categories is justified when anchored in the research theoretical foundation. In that regard, we chose to categorize each type of mathematical literacy mentioned in this article: Conceptual-ML, Contextual-ML and Critical-ML. Classification was based on the predominant mathematical literacy level identified in the participants' responses. This categorization does not exclude the presence of other dimensions of literacy in the discourses and productions analyzed. It aims to highlight the emphasis observed in each group, recognizing the complexity and overlap between the types of literacy that can emerge in reading, interpretation, and production practices involving comics.

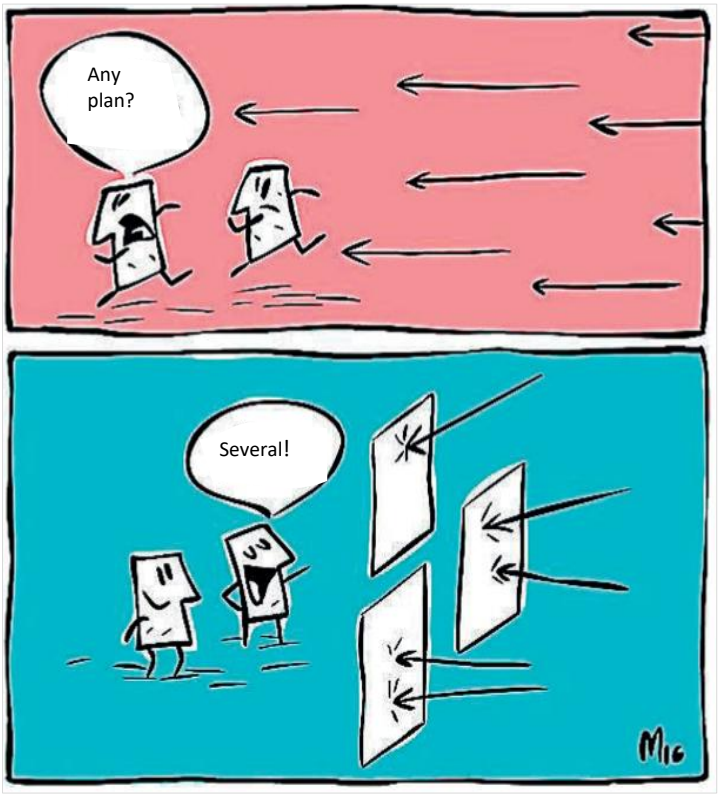
5 Results and Discussion

Having established the mathematical literacy classifications suggested in this text, we move on to the analysis of the comic strips selected by the participants in this investigation, as well as the mathematical meanings attributed to them. The use of comics to identify the meanings constructed by students is advocated by Assis (2021), who analyzed productions created by the own students. In this study, we turned to comic strips chosen (but not created) by the participants, analyzing them from the perspective of mathematical literacy.

5.1 Conceptual Mathematical Literacy

Group 1 (G1) selected a comic strip that relates plane and spatial geometry. As we can see in Figure 3, the narrative presents a dialogue between two friends who are being attacked by a common (and unidentified) enemy. While one of them uses the word "plan" in the sense of "strategy", the other adopts the term thinking of it as a mathematical concept.

Figure 3: Our plans



Source: Menezes *et al.* (2017)

As can be seen in Figure 3, the existence, in three-dimensional space, of several parallel planes (in fact, there are an infinite number of them) is what guarantees the survival of characters visible in the story. While parallelograms are used to represent planes, vectors are also used to illustrate the arrows launched by the enemy. Iconic representations, in the sense indicated by Duval (1993), stand out by complementing the mother language, associating representations of mathematical concepts with everyday vocabulary. As pointed out by Vergueiro (2006), the bridge created in comics between multiple languages, through their representations, makes the message more intelligible.

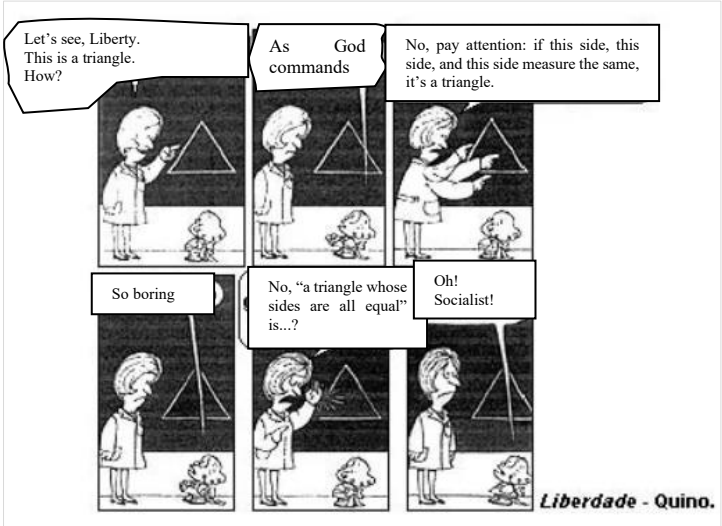
Regarding ways to use comic strips in the classroom, G1 suggests that students:

Identify the problems to be solved and/or define the elements present in the comic strips.

From the perspective of mathematical literacy, G1 proposal encourages mathematical reasoning, representation, and communication - essential skills for a mathematically literate individual (MEC, 2018). In that regard, Menezes (2021) recommends that responses be submitted in writing so that students realize the need to revise and, in some cases, reformulate their own ideas. Representation through the mother language is naturally evoked, but iconic and symbolic representations should also be present.

Group 2 (G2) selected a comic strip that deals with the classification of triangles according to the length of their sides, as shown in Figure 4.

Figure 4: Perfect for some, imperfect for others



Source: Professor.bio/Portuguese (n.d.)[5]

In describing the narrative presented in Figure 4, G2 reported:

> *The comic strip depicts a dialogue between a teacher and a student, where the teacher becomes irritated with the student's answers about equilateral triangles.*

The answer reveals adequate mathematical reasoning, a characteristic of mathematical literacy according to the BNCC (MEC, 2018). However, the presentation is noticeably very brief. Assis (2017) mentions that, in fact, mathematical communication develops in layers after reasoning. Menezes (2021) argues that it is not uncommon to find inaccuracies in students' written records. Therefore, it is necessary to encourage them to describe problem situations and images and thus develop their mathematical communication skills.

Another fact not mentioned by G2 refers to the message present in the last comic strips. Student's response [in the comic strip] establishes a dialogue with the field of social sciences, by making a pun between the concept of "equality" in an equilateral triangle and the political meaning of the term.

Regarding the title of the comic strip ("Chosen by some, imperfect for others"), G2 justified his choice by stating:

> *The equilateral triangle is, didactically speaking, one of the students' favorite triangles because, in addition to all its angles and sides being equal, several of its properties coincide. However, it was a source of boredom for the comic strip character.*

As can be seen, G2 possesses conceptual mathematical literacy. He demonstrates a certain mastery of the properties of equilateral triangles. Furthermore, the activity involving comics stimulated his textual interpretation skills, a contribution of comic book literature highlighted by Upson and Hall (2013).

Responses from the other groups also reveal an understanding of their respective

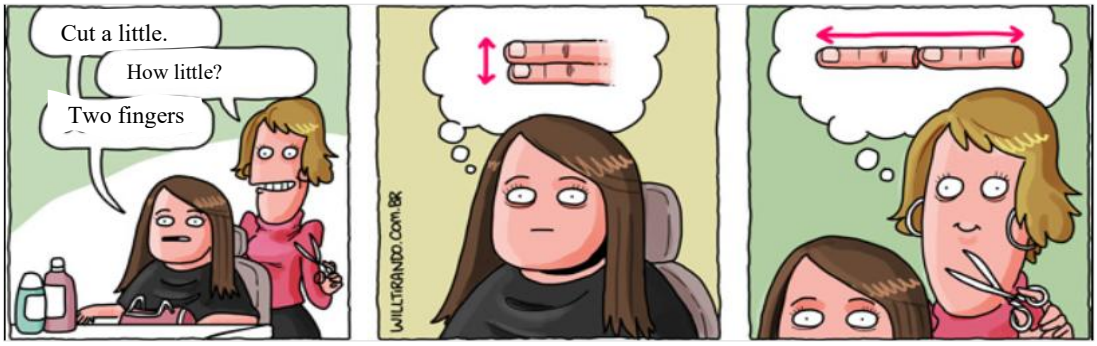
[5] Retrieved from: https://professor.bio.br/lista.php?tabela=portugu%C3%AAs&topico=0&origem=Ufsm&p=160. May 3rd, 2025.

contexts. In certain cases, it was possible to identify manifestations of contextual mathematical literacy, not limited only to conceptual literacy, which predominated in group G2. Regarding mathematical communication, like G2, the other groups opted for a synthetic and direct way of communicating.

5.2 Contextual Mathematical Literacy

Group 3 (G3) chose a comic strip that addresses the theme of "Quantities and Measurements", authored by the Brazilian cartoonist Will Leite. As we can see in Figure 5, the story takes place in a beauty salon and involves two characters: a hairdresser and her client. The second woman tells the first how much of her hair needs to be cut, but they are both thinking in different units of measurement.

Figure 5: Viewpoint



Source: Willtirando[6]

According to G3, the comic strip depicted in Figure 5 addresses *the ambiguity of the unit of measurement used to measure the cut length.*

Participants selected a story that aims to alert the reader to the importance of choosing a specific unit of measurement. As highlighted by G3, depending on the unit used, the same request can be interpreted in different ways ("ambiguity"), which can lead to confusion or unexpected results. Lima *et al*. (2016) also emphasized the importance of carefully choosing units of measurement, which must be consistent, universal, and reproducible.

When asked about possible changes they would make to the story depicted in Figure 5, G3 presented the following suggestions:

> *Other speech bubbles could be added to the last panel showing other ways to interpret "two fingers", such as different fingers on the same hand, hands of different people (differentiating them by size), or even hands of different cultures (differentiating them by color in the comic strip).*

G3's response reveals a comprehensive understanding of the situation depicted in the comic strip: by choosing "the finger" as the unit of measurement, it becomes impossible to guarantee the uniformity of sizes, making it an unreliable measure. The reflections suggested by Will Leite were further developed by G3, who attributed new meanings to the comic strip, in line with the ideas defended by Assis (2021). Considering the perspectives of conceptual, contextual, and critical literacy, G3 demonstrates potential for articulation with any of the approaches indicated by Skovsmose (2021): Structuralism, pragmatism, or process-orientation.

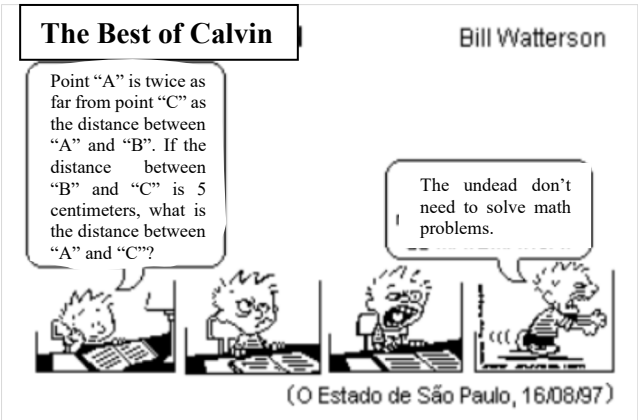
[6] Retrieved from: http://www.willtirando.com.br/dois-dedos/ . May 3rd, 2025.

All groups added possibilities to the narratives they chose, revealing ability to make new choices and decisions. According to Ponte, Brocardo and Oliveira (2021), this type of attitude reveals a non-mechanized mathematical approach, based on argumentation and logical reasoning.

5.3 Critical Mathematical Literacy

Group 4 (G4) selected a Calvin and Hobbes comic strip, characters by the cartoonist Bill Watterson. Originally titled "The Best of Calvin", Watterson's work received a new title, given by G4, as we can see in Figure 6.

Figure 6: Calvin and the "Terror" of Mathematics



Source: Tutorbrasil[7]

According to G4,

> *The story deals with the dramatic and exaggerated way Calvin reacts to a math problem. By simply reading the question without even trying, and just panicking, he reveals a situation that is very common in math education in elementary and high school.*

In the description given by G4, mathematical literacy proves to be more critical than conceptual. The group presents arguments justifying their choice for the comic strip's title. They establish connections between the dialogue presented in the comic book ("the undead don't need to learn math") and elements observed in Basic Education ("situation [...] visualized in math learning").

Regarding conceptual mathematical literacy, it is possible to identify it, to some extent, when the group members mention the mathematical content present in Figure 6:

> *Distance between points, Simple equations, Proportionality, Interpretation of mathematical texts.*

The mention of "interpretation of mathematical text" in G4's response deserves some attention. As previously mentioned, looking beyond the comic strip is an educational element that can be mobilized by this type of literature (MEC, 2018; Upson & Hall, 2013). Thus, it is noteworthy that the participants identified this topic as mathematical content. From a mathematical literacy perspective, we understand G4's answer as valid.

[7] Retrieved from: https://www.tutorbrasil.com.br/forum/viewtopic.php?t=36119. May 3rd, 2025.

Based on the comic strip shown in Figure 6, G4 formulated the following question:

> *In the state of Pierre there are three cities, A, B, and C, with B 30km from A, and C three times that distance. José intends to leave city A for city B, bring his brother from there to their place of origin, and then proceed to city C. If every 5 km traveled by car consumes 2.3 liters of gasoline*[8]*, how many liters of gasoline were used in total to complete the trip?*

Although inspired by the problem presented in Figure 6, the question formulated by the participants presents new hypotheses, making it more interesting and complex. However, there are elements in the writing that need improvement, especially when referring to "triple that distance". It is unclear whether the hypothesis refers to the distance between B and C, or between A and C. Once again, we see that communication is a skill that needs improvement. The response presented by G4 appears in Figure 7.

Figure 7: Response submitted by G4

Step 1: Calculate routes
Route 1: A => B = 30km
Route 2: B => A = 30km
Route 3 = A => C = 3.AB = 90km

Step 2: Add up routes:
Route 1 = Route 2 + Route 3 ⇔ 30km + 30km + 90km ⇔ 150km

Step 3: Calculate gasoline used per km
Liters/distance traveled ⇔ 2,3/5 ⇔ 0,46L/km

Step 3: Calculate liters of gasoline used:
Total distance traveled . Liters traveled ⇔ 150 . 0,46 ⇔ 69L

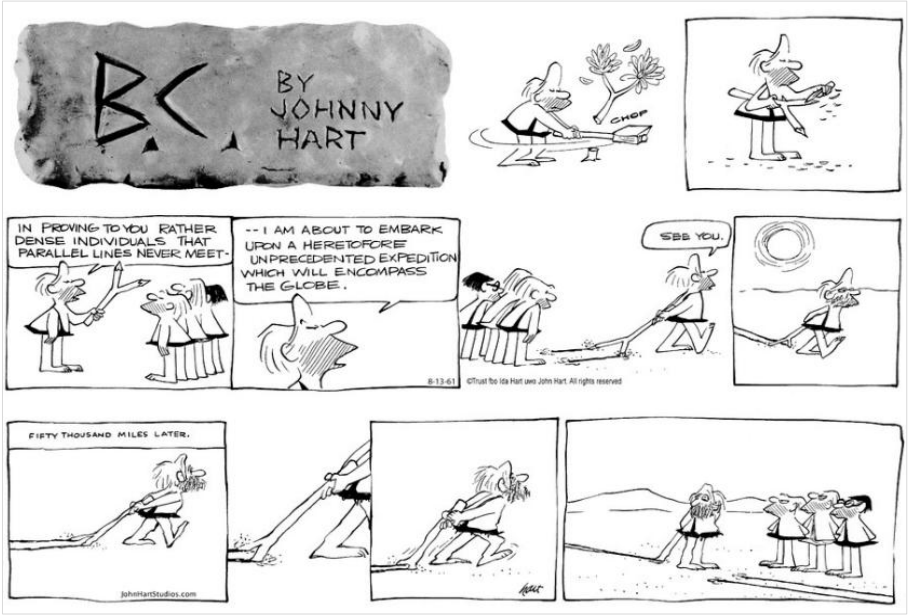
Source: Research data.

As shown in Figure 7, G4 divided the resolution into four stages, which they called "steps" (the term "step 3" was used twice). Initially, participants calculated the distance between the cities. Next, they found the total distance traveled by Pierre by adding the values obtained in the previous step. Then, G4 determined the amount of gasoline consumed per kilometer[9]. Finally, the group found the total fuel consumption by multiplying the distance traveled by the amount of gasoline used per kilometer. This type of resolution, based on calculations and expressed in sums or products performed considering the problem's hypotheses, constitutes, according to Balacheff (1999), a type of mathematical argumentation.

Let us now move on to the analysis of the comic strip presented by group 5 (G5). Although the participants were instructed to select a comic strip that addressed a concept related to plane Euclidean geometry, this recommendation was not followed by the group. They chose a comic strip that aims to introduce spherical geometry, as we can see in Figure 8.

[8] T. N.: In the United States of America (USA), the unit used to measure gasoline is the gallon, but in Brazil the unit used is liter, as in the United Kingdom (UK).
[9] T. N.: In the USA and UK, the unit used to measure distance is the mile, but in Brazil the unit used is kilometer.

Figure 8: The parallel journey



Source: Cartoonstock (n.d.)[10]

As also occurs in Petit (1982), the comic strip presented in Figure 8 shows that straight lines on the Earth's surface are great circles and therefore always intersect (Assis, 2021). According to G5, among the reflections prompted by the comic strip, the following stands out:

> *The importance of understanding the limits and applications of mathematics in the real world, given the difference between theoretical models and physical reality.*

The answer given by G5 expresses characteristics of conceptual, contextual, and critical mathematical literacy, with emphasis on the third one. In fact, for small distances, Euclidean geometry can be applied satisfactorily (Santos & Assis, 2024). However, in other situations, such as those involving large distances and surfaces with non-zero curvature (such as the Earth's surface), Euclidean geometry ceases to be the most appropriate approach.

When asked about possible changes they would make to the story, G5 gave the following response:

> *One possible modification would be to remove the physical element that interferes with the path - such as the friction of the branch with the ground - and allow the character to maintain the two parallel lines until the end of the path. However, this change would compromise the humor of the comic strip, which relies precisely on the irony between the ideal mathematical concept and the limitations of the real world.*

The argument presented by G5 prioritizes the mathematical concept to the detriment of the actions of physics. Participants reveal a conceptual understanding of the parallelism between lines and, at the same time, highlight that breaking with parallelism implies removing the playfulness from the story. On the other hand, when considering the movement of the characters on a spherical surface, parallelism defended by G5 ceases to exist, as Santos and

[10] Retrieved from: https://www.cartoonstock.com/ . May 3rd, 2025.

Assis point out (2024).

Table 3 summarizes the results presented in this section.

Table 3: Group activities and skills mobilized

Group	Comic strip (theme)	Skills mobilized	Types of Mathematical Literacy
G1	Plane vs. spatial geometry	Reasoning, representation	Conceptual, contextual
G2	Equilateral triangle	Reasoning, communication	Conceptual
G3	Magnitudes and Measurements	Reasoning, communication, argumentation	Conceptual, contextual and critical
G4	Calvin and the "terror" of mathematics	Reasoning, argumentation	Contextual, critical
G5	Spherical geometry	Reasoning, communication, argumentation	Conceptual, contextual and critical

Source: the authors.

Findings show that comic books present themselves as potential strategies for teaching mathematics, since they enable the development of several skills foreseen in BNCC. Its hybrid language, which combines verbal and visual elements, promotes *mathematical communication* by encouraging students to interpret, represent, and express ideas. Contextualized situations in narratives allow for the mobilization of mathematical reasoning, encouraging identification of patterns, formulation of conjectures, and problem resolution in contexts close to the students' reality. Furthermore, comics expand the possibilities of mathematical representation by moving between different registers - iconic, symbolic, and linguistic (mother language) - and promoting connections between them. When used critically and intentionally, they also foster *mathematical argumentation* by prompting questioning, justifications, and positions regarding problem situations. In that regard, using comic books transcends the playful aspect and reveals itself as a didactic strategy capable of articulating the objectives of mathematics education with the formation of more critical, creative individuals prepared to act in different social and cultural contexts.

6 Conclusion

This research aimed to identify and analyze the mathematical literacy skills mobilized by future mathematics teachers during the reading and interpretation of comic books that address mathematical content. Thereunto, 25 undergraduate students from a public university in the state of Bahia, divided into five groups, selected, interpreted, and analyzed comic strips that addressed mathematical concepts, specifically plane Euclidean geometry. With a view to creating an environment for reflection on the content of the narratives, the researcher gave the participants a questionnaire which also served as a data collection instrument.

For data analysis, we introduce in this article a classification of mathematical literacy inspired by didactic-pedagogical perspectives: conceptual mathematical literacy (Conceptual-ML), contextual mathematical literacy (Contextual-ML), and critical mathematical literacy (Critical-ML). Each of these dimensions of literacy presents, respectively, traits of structuralism, pragmatism, and process-orientation.

Conceptual-ML was the most frequently repeated response from participants, indicating a mastery of the mathematical properties present in the concepts discussed in the comic strips. On the other hand, the way these concepts were employed in concrete situations, related to the narratives and characters, highlighted elements of Contextual-ML. In all groups, it was possible

to identify appropriate interpretations of the comic strips, which expresses characteristics associated with this second type of mathematical literacy.

The suggestions for changes to be made to the comics constituted a promising ground for mobilization of critical-ML, as well as the description of reflections proposed by each narrative. Examples include understanding that "the/a finger" should not be used as a unit of measurement; and the perception that the same term can have one meaning within mathematics and another outside of it (such as "plane"); understanding that the notion of parallelism has a meaning in Euclidean geometry and another outside of it, etc. Ultimately, each comic strip helped to promote a deeper reflection that goes beyond the layer of entertainment that it often helps to foster.

Regarding the mathematical literacy skills mentioned by BNCC, it was possible to perceive the presence of all of them, some more frequently than others. *Mathematical reasoning* was the central axis that allowed participants to understand how mathematics present in each comic strip interacted with the context of the narratives. It was enhanced by the suggestions for changes proposed by the research participants in each story. To understand each group's reasoning process, we rely on the mathematical communication skills of its members. In the oral communication field, they tend to express their ideas more freely and in greater detail. However, when asked for written records, the participants presented a more concise style of language, leaving out elements that could be explored in comics.

The very association between verbal and iconic language in comics facilitated *mathematical visualization*. These forms of representation were present in all the comic strips and were easily understood by participants. Regarding *mathematical argumentation*, we perceived its presence more explicitly when participants had to present solutions to the questions they created at the researcher's request, since solving a problem already constitutes a type of mathematical argumentation, and in this sense, it is possible to affirm that there were indeed demonstrations of this competence by participants. Although they did not take the form of formal demonstrations, these arguments reveal efforts at validation and explanation, characterizing themselves as fundamental discursive practices in the context of mathematical literacy.

We concluded that the use of comic books that address mathematical content, through their interpretation, modification, and the formulation of questions, constitutes a promising approach for mobilizing and improving mathematical literacy. By delegating the choice of comic strips to future mathematics teachers, we give them the autonomy to select the narratives they find most interesting. In this selection process, participants are encouraged to adopt a critical stance, evaluating which comics have the greatest educational potential.

Once the narratives have been chosen, the student teachers should be encouraged to engage in a reading that goes beyond the textual and iconic surface, identifying the mathematics present in the narratives and reflecting on its application. It is up to the teacher to assume the role of mediator in this process, encouraging more in-depth analysis and recognizing comic books as a valuable educational tool.

Among the limitations of the research, we highlight the use of the questionnaire as the main data collection instrument, which resulted in shorter responses, especially regarding written mathematical communication. Furthermore, since the selected comic strips predominantly addressed plane geometry content, it was not possible to assess the potential of the comics to mobilize mathematical literacy skills in other areas of mathematics. Then, as a follow-up to this investigation, we propose analyzing the contributions of the comic book creation process by future mathematics teachers to the development of their mathematical

literacy, not only in geometry, but also in different fields of mathematics.

Acknowledgment

To the Universidade Federal do Recôncavo da Bahia (UFRB) for funding through Public Notice 05/2024 – PPGCI – Programa Mulheres na Ciência UFRB: 23007.00015034/2025-80.

References

Afrilyasanti, R. & Basthomi, Y. (2011). Adapting comics and cartoons to develop 21st century learners. *Language in India*, *11*(11), 552–568.

Arruda, F. S. de, Ferreira, R. dos S. & Lacerda, A. G. (2020). Letramento matemático: Um olhar a partir das competências matemáticas propostas na Base Nacional Comum Curricular do Ensino Fundamental. *Ensino da Matemática em Debate*, *7*(2), 181–207.

Assis, E. S. (2017). *Exposição axiomática da geometria euclidiana plana por meio de histórias em quadrinhos: possibilidades, limitações e desafios*. Tese (Doutorado). Universidade do Minho, Instituto de Educação. Braga.

Assis, E. S. (2021). As histórias em quadrinhos nas aulas de geometria. In Z. E. F. Madruga & E. S. Assis (Orgs.), *Vivências e experiências em matemática* (pp. 23–42). Cruz das Almas, BA: EDUFRB.

Balacheff, N. (1999). Is argumentation an obstacle? Invitation to debate. *International Newsletter on the Teaching and Learning of Mathematical Proof*. Grenoble: IMAG.

Bennemann, M. & Allevato, N. S. G. (2012). Educação Matemática Crítica. *Revista de Produção Discente em Educação Matemática*, *1*(1), 103–112.

Coutinho, C. (2011). *Metodologia de investigação em ciências sociais e humanas: teoria e prática*. Coimbra: Almedina.

D'Ambrosio, U. (2004). A relevância do projeto Indicador Nacional de Alfabetismo Funcional – INAF como critério de avaliação da qualidade do ensino de matemática. In M. C. F. R. Fonseca (Org.), *Letramento no Brasil: habilidades matemáticas: reflexões a partir do INAF 2002* (pp. 31–46). São Paulo, SP: Global; Ação Educativa Assessoria, Pesquisa e Informação; Instituto Paulo Montenegro.

Douek, N. (1999). Argumentation and conceptualization in context: A case study on sunshadows in primary school. *Educational Studies in Mathematics*, *39*(1), 89–110.

Doxiadis, A. & Papadimitriou, C. H. (2013). *Logicomix: uma jornada épica em busca da verdade* (A. B. Santos, Trad.). São Paulo, SP: WMF Martins Fontes.

Duval, R. (1993). Registres de représentation sémiotique et fonctionnement cognitive de la pensée. *Annales de Didactique et de Sciences Cognitives*, *5*, 37–64.

Duval, R. (1998). Geometry from a cognitive point of view. In C. Mammana & V. Villani (Eds.), *Perspectives on the teaching of geometry for the 21st century* (pp. 37–52). London: Kluwer Academic Publishers.

Fonseca, J. J. S. (2002). *Metodologia da pesquisa científica*. Fortaleza, CE: UEC.

Francis Pelton, L. & Pelton, T. (2009). The learner as teacher: Using student authored comics to "teach" mathematics concepts. In G. Siemens & C. Fulford (Eds.), *Proceedings of EdMedia: World Conference on Educational Media and Technology 2009* (pp. 1591–1599). Association for the Advancement of Computing in Education.

Gal, I. (2002). Adults statistical literacy: Meanings, components, responsibilities. *International Statistical Review*, *70*(1), 1–25.

Goldenberg, M. (2004). *A arte de pesquisar: como fazer pesquisa qualitativa em ciências sociais* (8. ed.). Rio de Janeiro, RJ: Record.

Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira. (2020). *Relatório Brasil no PISA 2018: versão preliminar*. Brasília, DF: Inep.

Jolandek, E. G. & Kato, L. A. (2021). Vertentes sobre a modelagem matemática e o letramento matemático a partir de uma revisão bibliográfica. *Educação Matemática em Pesquisa*, *23*(2), 218–244.

Lima, E. L., Carvalho, P. C. P., Wagner, E. & Morgado, A. C. (2016). *A matemática do ensino médio* (Vol. *3*). Rio de Janeiro, RJ: SBM.

Lima, P. V. P. & Moreira, G. E. (2024). Avaliação do desempenho matemático no PISA: foco nos países latino-americanos. *Educação Matemática em Revista*, *29*(84), 1–23.

Lima, P. V. P. & Moreira, G. E. (2022). O programa internacional de avaliação de estudantes: a avaliação de matemática e o cenário brasileiro. *Revista Gestão e Avaliação Educacional*, *11*(20), 1–22.

Luyten, S. M. B. (2011). *Quadrinhos na sala de aula* (Série História em Quadrinhos: um recurso de aprendizagem). TV Escola – Salto para o Futuro.

Martinho, M. H. & Rocha, H. (2018). A escrita matemática e a intuição em geometria. *Educação e Matemática*, *(149)*, 34–38.

Menezes, L. *et al*. (2017). *Humor no ensino da matemática: tarefas para a sala de aula*. Viseu: Escola Superior de Educação, Instituto Politécnico de Viseu.

Menezes, L. (2021). Oportunidades para a comunicação escrita na aprendizagem da matemática. *Educação e Matemática*, *(160)*, 13–16.

Ministério da Educação. (2018). *Base Nacional Comum Curricular: educação é a base*. Brasília, DF: MEC.

Ministério da Educação. (2019). *Política Nacional de Alfabetização*. Brasília, DF: MEC; SEALF.

Moraes, R. (1999). Análise de conteúdo. *Revista Educação*, *22*(37), 7–32.

Nunes, C. C. (2024). Multimodalidade e construção de sentidos no gênero textual tira. *Verbum*, *13*(2), 113–125.

Petit, J. P. (1982). *As aventuras de Anselmo Curioso: os mistérios da geometria*. Lisboa: Publicações Dom Quixote.

Ponte, J. P., Brocardo, J. & Oliveira, H. (2021). *Investigação matemática na sala de aula: caminhos para aprender e ensinar matemática* (3. ed.). Belo Horizonte, MG: Autêntica.

Ponte, J. P. da. (1994). O estudo de caso na investigação em educação matemática. *Quadrante*, *3*(1), 3–18.

Prado, S. T. G. do, Ruppenthal, R. & Spohr, C. B. (2024). Os níveis de letramento matemático nos documentos orientadores: resultados de uma matriz de análise. *Revista de Matemática, Ensino e Cultura – REMATEC*, *(47)*.

Quadros, V. C. de. (2017). Reflexões sobre letramento em matemática e formação inicial de

professor. *Revista de Educação do Vale do Arinos – RELVA*, *3*(2).

Queiroz, C. A. B., Nunes, J. M. V. & Pereira, J. C. S. (2024). História em quadrinhos como dispositivo didático para ensinar média aritmética no contexto do letramento estatístico. *Revista Internacional de Pesquisa em Educação Matemática*, *14*(13), 1–14.

Reid, D. A. & Knipping, C. (2010). *Proof in mathematics education: research, learning and teaching*. Rotterdam: Sense Publishers.

Rosa, M., Pazuch, V. & Silva, S. T. (2012). O feedback de professores de matemática sobre a vivência com histórias em quadrinhos: reflexões para o processo de ensinar matemática. *Educação Matemática em Revista – RS*, *13*(2), 71–80.

Santos, G. A. & Assis, E. S. (2024). A utilização de história em quadrinhos no processo de ensino e aprendizagem da geometria esférica. *Revista Internacional de Pesquisa em Educação Matemática*, *14*(2), 1–16.

Skovsmose, O. (2001). *Educação matemática crítica: a questão da democracia*. Campinas, SP: Papirus.

Soares, M. (2004). *Letramento: um tema em três gêneros*. Belo Horizonte, MG: Autêntica.

Sostisso, A. F. (2014). *Modelação matemática: competência científica de uma licenciatura em matemática*. Dissertação (Mestrado). Pontifícia Universidade Católica do Rio Grande do Sul. Porto Alegre, RS.

Sousa, M. (2011). *Turma da Mônica em saiba mais sobre a história da matemática*. Barueri, SP: Panini.

Souza, E. S. R. (2018). *Modelagem matemática gerando ambiente de alfabetização científica: discussões no ensino de física*. Tese (Doutorado). Universidade Federal de Mato Grosso; Universidade Federal do Pará.

Upson, M. & Hall, C. M. (2013). Comic book guy in the classroom: The educational power and potential of graphic storytelling in library education. *Kansas Library Association College and University Libraries Section Proceedings*, *3*(1), 28–38.

Vergueiro, W. (2006). Uso das HQs no ensino. In A. Rama & W. Vergueiro (Orgs.), *Como usar as histórias em quadrinhos na sala de aula* (pp. 77–130). São Paulo, SP: Contexto.