Acta Scientiarum

http://periodicos.uem.br/ojs/acta
ISSN online: 2178-5201
https://doi.org/10.4025/actascieduc.v47i1.72082

Synergy between theoretical knowledge and practices associated with ethnomathematics and creative learning

Carla Vanesa Ramos da Silva and André Raabe*

Programa de Pós-graduação em Educação, Universidade do Vale do Itajaí, Rua Uruguai, 458, bloco F4, 88302-901, Itajaí, Santa Catarina, Brasil. *Autor for correspondence. E-mail: raabe@univali.br

ABSTRACT. This paper promotes a discussion of the voices that guide the conceptual understanding of the theoretical constructs of Ethnomathematics and Creative Learning. Ethnomathematics seeks to understand mathematical knowledge and practice throughout history, contextualized across different interest groups, communities, peoples, and nations, in agreement with the mathematical knowledge systematized by humanity to meet its need for counting. Creative Learning is an educational approach that encourages the creation of more exploratory, investigative, and playful learning experiences, fostering the development of creative thinking, curiosity, and an inventive spirit in students. The study sought to answer the following question: based on literature, what similarities can be identified between the theoretical knowledge and practices of Creative Learning and Ethnomathematics? To discuss the synergy between theoretical knowledge and practices associated with Ethnomathematics and Creative Learning, a bibliographical study was conducted to support pedagogical practices in teaching mathematics in the early years of elementary school. The methodology was based on a systematic literature review to identify studies that favored both theoretical constructs in the Ethnomathematics and Creative Learning approaches, related to teachers' classroom practices, with the aim of ensuring and promoting teaching and learning. The main findings/foundations of both approaches were organized, and discussions of existing synergies were outlined. The results indicate that both approaches can be used concurrently, fostering a more contextualized and meaningful pedagogical practice.

Keywords: ethnomathematics; creative learning; pedagogical practice.

Sinergia entre conhecimentos teóricos e práticas associadas a etnomatemática e aprendizagem criativa

RESUMO. Este artigo promove uma discussão de vozes que norteiam o entendimento conceitual sobre os constructos teóricos da Etnomatemática e da Aprendizagem Criativa. A Etnomatemática procura entender o saber/fazer matemático ao longo da história, contextualizado em diferentes grupos de interesse, comunidades, povos e nações em comum acordo com o saber matemático sistematizado pela humanidade para suprir sua necessidade de contar; a Aprendizagem Criativa é uma abordagem educacional que estimula a criação de experiências de aprendizagem mais exploratórias, investigativas e lúdicas, que incentivam o desenvolvimento do pensamento criativo, da curiosidade e do espírito inventivo nos estudantes. O estudo buscou responder à seguinte questão: com base na literatura, que semelhanças podem ser evidenciadas entre os conhecimentos teóricos e práticas da Aprendizagem Criativa e da Etnomatemática? Com o objetivo de discutir a sinergia entre os conhecimentos teóricos e as práticas associadas a Etnomatemática e Aprendizagem Criativa, desenvolveu-se uma pesquisa bibliográfica, a fim de referendar práticas pedagógicas no ensino de Matemática nos anos iniciais do Ensino Fundamental. A metodologia ancorou-se na Revisão Sistemática da Literatura, para verificar estudos que favoreceram os dois construtos teóricos nas abordagens da Etnomatemática e da Aprendizagem Criativa, relacionadas à atuação dos professores em sala de aula, na intenção de assegurar e promover o ensino e a aprendizagem. Foram organizados os principais achados/fundamentos de ambas as abordagens e traçadas as discussões das sinergias existentes. Os resultados apontam que que ambas as abordagens podem ser utilizadas de forma concomitante, favorecendo uma prática pedagógica mais contextualizada e significativa.

Palavras-chave: etnomatemática; aprendizagem criativa; prática pedagógica.

Sinergia entre conocimientos teóricos y prácticas asociadas a la etnomatemática y el aprendizaje creativo

RESUMEN. Este artículo promueve una discusión de las voces que orientan la comprensión conceptual de los constructos teóricos de Etnomatemática y Aprendizaje Creativo. La Etnomatemática busca comprender el saber/hacer matemático a lo largo de la historia, contextualizado en diferentes grupos de interés, comunidades, pueblos y naciones, en concordancia con el conocimiento matemático sistematizado por la humanidad para satisfacer su necesidad de contar; el Aprendizaje Creativo es un enfoque educativo que incentiva la creación de experiencias de aprendizaje más exploratorias, investigativas y lúdicas, que fomentan el desarrollo del pensamiento creativo, la curiosidad y el espíritu inventivo en los estudiantes. El estudio pretendía responder a la siguiente pregunta: ¿a partir de la bibliografía, qué semejanzas pueden observarse entre los conocimientos teóricos y las prácticas del Aprendizaje Creativo y la Etnomatemática? Para discutir la sinergia entre los conocimientos teóricos y las prácticas asociadas a estos enfoques, se realizó un estudio documental con el fin de referenciar las prácticas pedagógicas en la enseñanza de las matemáticas en los primeros años de la escuela primaria. La metodología se basó en una Revisión Sistemática de la Literatura para verificar los estudios que favorecían los dos constructos teóricos en los enfoques en cuestión, relacionados con las acciones de los profesores en el aula, con la intención de asegurar y promover la enseñanza y el aprendizaje. Se organizaron los principales hallazgos/fundamentos de ambos enfoques y se rastrearon las sinergias existentes. Los resultados muestran que ambos enfoques pueden utilizarse de forma concurrente, favoreciendo una práctica docente más contextualizada y significativa.

Palavras clave: etnomatemáticas; aprendizaje creativo; práctica pedagógica.

Received on April 30, 2024.
Accepted on November 9, 2024.
Published in October 08, 2025.

Introduction

This study examines two approaches, originating from different communities and cultures and introduced into the educational process at different times: Creative Learning (CL) and Ethnomathematics, both related to teachers' classroom practices, with the aim of ensuring and promoting teaching and learning. To discuss these approaches, Carnielli (2022) states that it is crucial to understand that mathematical learning still represents a significant challenge. The author emphasizes that mathematics, considered difficult and feared by most students, leads educators to constantly seek new strategies to aid the teaching-learning process, making it more understandable, as mathematical knowledge is extremely relevant to everyday practices.

In the educational context, mathematical knowledge still constitutes a paradigm shift, requiring creative stimuli to shift students' disinterest in the classroom due to the difficulties they face in mathematics. It is important for teachers to seek new teaching strategies to help them overcome their fears and obstacles (Souza, 2013). In this sense, the approaches discussed here offer a new perspective on the mathematics curriculum by envisioning opportunities for teachers to motivate learning.

CA stands out as an approach in which learning experiences are grounded in principles that stimulate students; its use expands possibilities, generates complex, subjective learning, and depends on the individual's actions and their historical context (Muniz & Martinez, 2015). In CA, the practice focuses on teaching strategies that meet the interests of students, placing their desires and needs at the center of the process, valuing youth leadership and fostering creativity and creative thinking.

When discussing CA, Resnick (2020) prefers to call creativity 'creative thinking,' emphasizing the notion that creativity can be developed through technique and practice. Thus, the entire scope of a teacher's work is based on the principle that one learns best when one has the opportunity to construct something meaningful — that is, when the processes of the cognitive and intellectual fields, with CA, are supported by competencies and skills.

In this context, educational innovation is being implemented to ensure the premises of quality teaching, fostering a more active and practical (maker) culture. This is interconnected by the Brazilian Creative Learning Network (RBAC), which motivates existing initiatives to promote student learning. This Network aims to support Education Departments in transforming public schools into increasingly engaging, hands-on places by focusing on student interests as the center of the process, where education becomes a social space for developing citizenship, social participation, and personalized learning, according to the needs of the school and students (Brazilian Creative Learning Network, 2023).

New initiatives that incorporate motivational processes, such as project-based approaches, problem-based learning, and practices aligned with *design thinking, are becoming increasingly essential. Recently, the maker* movement, which values the "do-it-yourself" culture, has expanded. This perspective on innovative initiatives reveals an educational wave that impacts teaching practices by ensuring students' knowledge through diverse pedagogical possibilities, engaging with the current educational landscape through the theoretical interfaces of constructionism.

Constructionism, proposed and developed by Papert (1994), understands that the use of technology can enhance learning, especially if it is used as a building material. In a way, CA is a continuation of Papert's (1994) constructionism, a way of making the theoretical pillars adopted by this author and his collaborators more accessible and practical.

In the same vein, Raabe et al. (2016) emphasize that, to more actively work with constructionist concepts, pedagogical planning should focus on the use of more active verbs, such as: create, build, conceive, develop, assemble, combine, design, test, evaluate, and review. In turn, Valente (2005, p. 55) defends the idea of "[...] contextualized constructionism [...]," in which students use technology to build a meaningful product that is contextualized and related to their reality. Thus, constructionism interacts with CA when teaching stimulates the assimilation of knowledge for various formative constructions, encouraging students' creativity, autonomy, and critical thinking.

The other construct of this study is Ethnomathematics, which aims to work within the school environment to help new generations of individuals understand and recognize a much more cultural mathematics, connected to the daily lives of diverse ethnic groups. Therefore, adopting Ethnomathematics as a pedagogical approach means moving away from the idea of studying solely for passing grades and instead creating pedagogical methodologies in this field of knowledge, going beyond the classroom (Pinheiro & Costa, 2016).

To understand the term, discussions begin with the Ethnomathematics program, conceptualized as "[...] seeking to understand mathematical knowledge/doing throughout history, contextualized in different interest groups, communities, peoples, and nations [...]" (D'Ambrosio, 2006, p. 27), in common agreement, for example, with that mathematical knowledge systematized by humanity to meet its need to count. Furthermore, the insertion of Ethnomathematics brought a diversity of problem-solving with mathematical learning, since it seeks to value sociocultural plurality, creating conditions for the student to become active in the organization and transformation of their environment through knowledge for the exercise of citizenship.

In view of the above, this article seeks to discuss the synergy between CA and Ethnomathematics and how these approaches can mutually boost each other in the teaching of Mathematics.

Ethnomathematics

In the search for definitions of Ethnomathematics, theoretical support comes from D'Ambrosio (2006), who highlights an important reflection: the greater the supply of intellectual instruments and techniques, the greater the ability to solve problems and face diverse situations. The author emphasizes that the use of these instruments and resources and the definition of a real situation is what can lead to a possible solution, reaffirming that "[...] this is learning par excellence, that is, the ability to explain, to learn and understand, and critically face new situations" (D'Ambrosio, 2006, p. 119).

To understand the voices that guide the conceptual understanding of the Ethnomathematics approach, it is beneficial to begin with the contribution made by Heringer (2018), when emphasizing that it is a search for innovative proposals in the field of Mathematics, which take into account the articulation of this area of knowledge with sociocultural aspects, which has been occurring in Brazil since the 1990s.

Historically, in the 1970s, multiple conceptions of ethnomathematics emerged, among which Araújo (2018) states that, although it might suggest an emphasis on mathematics, it has a broad meaning and a profound relationship with the study of humanity's cultural evolution. For the author, ethnomathematics emerged from questions intrinsic to mathematics, since, in 1970, the discussion involved themes related to mathematics and society. However, one of the culminating points of this field of study occurred at the 5th International Congress on Education, in Adelaide, Australia, in 1984.

One of the precursors in the negotiations to define Ethnomathematics is the mathematics educator Ubiratan D'Ambrosio, considered the most important theorist in this field of study and "[...] the main leader and disseminator of the assumptions of the Ethnomathematics Program in the international community" (Bandeira & Gonçalves, 2016, p. 16).

When speaking of Mathematics associated with distinct cultural forms, D'Ambrosio (2008) arrived at the concept of Ethnomathematics:

> Ethnomathematics implies a very broad conceptualization of *ethnos* and mathematics. Much more than simply an association with ethnicities, *ethnos* refers to identifiable cultural groups, such as national-tribal societies, trade

> union and professional groups, children of a certain age group, etc., and include cultural memory, codes, symbols, myths, and even specific ways of reasoning and inferring (D'Ambrosio, 2008, p. 17).

In the precepts of Ethnomathematics, the aforementioned author emphasizes that:

> Knowledge does not occur in isolation, but is inserted in a context and, being part of it, modifies it and is also modified by it, in which it undergoes diverse influences in its structuring process from generation and systematization, as well as in the social organization and sharing of new knowledge with cognitive, epistemological, historical and political approaches (D´Ambrosio, 1993, p. 75-76).

D'Ambrosio (2006) argues that knowledge, as a generator of knowledge, is decisive for action and, consequently, for the production of behaviors "[...] in practice, in doing, knowledge is evaluated, redefines and reconstructed [...]" (D`Ambrosio, 2006, p. 21), based on a dialectical relationship between knowing/doing. Action generates knowledge, generates the ability to explain, to deal with, to manage, to understand reality, generates the *matheme*, that is, explaining, understanding, knowing, learning to know and do, and ethics, observation, material and intellectual instruments (D`Ambrosio, 2006).

Thus, it can be said that everything that happens in the classroom—as well as the knowledge of the students and the teacher—serves as an opportunity and can be treated as a mathematical tool, in which the teacher assumes the role of partner with the students in the different tasks proposed and, consequently, in the production of new knowledge. From this perspective, both grow socially and intellectually (D'ambrosio, 2006).

The aforementioned author mentions that Ethnomathematics is the way in which individuals have developed techniques to explain, know and learn to respond to survival needs; therefore, "[...] it is the art or technique of explaining, knowing, understanding in different cultural contexts" (D'ambrosio, 2015, p. 5). Furthermore, it is not limited to the search for Mathematics of different ethnicities but involves the cultural dynamics of mathematical knowledge related to social, political and cultural contexts. Thus, "[...] it is an approach that seeks different ways of knowing" (D'Ambrosio, 2015, p. 47).

To broaden the understandings that define Ethnomathematics, Ferreira's (2003) conception is inserted into the epistemological dialogue, in which Ethnomathematics is the most complete pedagogical paradigm in existence. Barton (2006, p. 55, author's emphasis) sees Ethnomathematics as "[...] an attempt to describe and understand the ways in which ideas, called mathematics by ethnomathematicians, are understood, articulated and used by others who do not share the same conception of 'mathematics'". Santos (2006), in turn, when reflecting on the functions of teaching Mathematics from an Ethnomathematical perspective, argues that:

> This should not be seen by educators as a teaching method in itself, but rather as a potentializer of inclusive relationships between teachers and students to understand the different ways of knowing present in different cultural/sociocultural contexts, which are capable of producing 'dialogue', 'contextualization' and 'comparison', as pillars that underpin Ethnomathematics and can also be understood as necessary postures for the teacher within this proposal (Santos, 2006, p. 18, author's emphasis).

Thus, Ethnomathematics is the art or technique of explaining, knowing, and understanding how different social groups go about their daily lives, how they distribute their time, how they organize their living space, situations that make them mathematical in their own reality.

Over time, ethnomathematical studies have been constantly evolving in various fields of Mathematics Education; in this context, Scandiuzzi (2002) stands out within the scope of the school curriculum, and Bello (2004) in teacher training. Currently, Ethnomathematics is also being problematized from a postmodern perspective (Bampi, 2003).

Another point to reflect on is mentioned by Santos and Lara (2013), when highlighting that, compared to others, Ethnomathematics is a recent field of study and its research is in constant movement, intertwined in diverse themes that derive from the concerns of researchers, as well as social groups.

As a pedagogical strategy, according to Pinheiro and Costa (2016), the principles of Ethnomathematics reaffirm that, upon arriving at school, individuals are eager to learn and possess a very attractive quality: their ability to adapt to contexts. However, in school settings, students often encounter stagnant content, which hinders their understanding. The authors highlight the different ways teachers can use Ethnomathematics in the school environment, enabling individuals to produce distinct knowledge and make a difference in their communities, which are rich in diverse knowledge. Teachers need to understand the social context of Ethnomathematics so they can recognize the diverse groups that make up their classrooms (Pinheiro & Costa, 2016).

However, the construction of knowledge occurs with the support of the school and teachers, ensuring that the premises of quality are established in the curriculum, providing students with a sense of belonging to the environment developed by teaching. It is in this sense that, in his considerations on the pedagogy of Ethnomathematics, D'Ambrosio (2008) highlights the extensive use of observation, literature, reading periodicals and diaries, games, cinema, etc. According to the author, these aspects, which are part of everyday life, have important mathematical components. Therefore, the entire pedagogical apparatus of Ethnomathematics encourages individuals to share their knowledge in the school environment, as everyone brings prior knowledge, lived experiences, and how to deal with and apply them in their daily lives.

It is important to emphasize that Ethnomathematics must be observed and discussed by the individual, so that he can recognize it as an ally in the learning process, so that the student is a transforming agent of this pedagogical instrument, not only in the school environment, but mainly in his own community.

Creative learning

CA is characterized by being an educational approach that encourages the creation of more exploratory, investigative, and playful learning experiences, which encourage the development of creative thinking, curiosity, and an inventive spirit in students.

Some authors, such as Morais and Santos (2016), argue that teachers are responsible for modeling students' language and mediating between students and knowledge, making the class dynamic and encouraging active participation. Thus, teachers, as the driving force behind teaching, are responsible for reaching students and stimulating creative thinking through teaching methods.

According to Tussi et al. (2022, p. 740), "[...] creativity is inherent to human beings, because through it, individuals are able to make discoveries and reinvent themselves in the different spaces they occupy." Creativity is present in society through inventions and the various scientific, cultural, political, economic, and educational advances achieved over time.

Specifically in teaching, the first CA statements were proposed by Mitchel Resnick, coordinator of *Lifelong Kindergarten* at the *Massachusetts Institute of Technology* (MIT) *Media Lab* . CA is primarily based on constructionism, developed by Seymour Papert, also of MIT, who was inspired by the ideas of Piaget, Paulo Freire, Montessori, and other great thinkers.

AC is an approach centered on four pillars that guide the creation of learning experiences, also called the 4 Ps: Projects, Passion, Peers, and Thinking through Play. The principle is that individuals learn best when they have the opportunity to build something meaningful to them, whether it's a toy car, a poem, or a computer program.

Furthermore, in the CA approach, pedagogical practice occurs when the student is placed at the center of the process, placing them at the center of the process. This provides opportunities for the development of students' interests, providing them with a social space for training in the exercise of citizenship, social participation, and personalization according to their needs.

Implementing CA-aligned pedagogical practices involves intentional changes, which may include classroom layout, creative use of materials, grouping certain curricular components in the schedule, more participatory decision-making processes, varied types of assessments, experimentation, and reflection on new, less instructional pedagogical practices, placing students' interests at the center of the process. The process of changing pedagogical practices within the CA approach becomes even richer when students are encouraged to exchange ideas with others and explore the materials and concepts involved in the project in a free and relaxed manner.

Resnick (2020) systematizes the precepts of constructionism into a spiral he calls the Creative Learning (CL) spiral. Later, in his book *Kindergarten for Life* (Resnick, 2020), the author deepens and consolidates the term "creative learning," exemplifying each stage so the reader understands the systematization of the spiral. This spiral recalls the author's defenses of the ideas of creativity, the use of technology, and learning processes, characterizing learning as a spiral cycle—imagining, creating, playing, sharing, reflecting, and back to imagining—that helps students develop creative thinking skills fundamental to success and satisfaction in today's society. The author adds that the CL spiral is the engine of creative thinking; as children move through the spiral, they develop and refine their skills as creative thinkers, learn to develop their own ideas, test them, and arrive at creative problem-solving alternatives.

From this perspective, the expected impact of intentional changes in pedagogical practice through CA occurs through the spiral of creative learning (imagining, creating, playing, sharing, reflecting, and back to imagining). The CA spiral gains strength in moments of reflection. Assessment is not punishment, but an opportunity to understand the current state of affairs and calibrate inventions. To inform decision-making, it is essential that all stakeholders—managers, school administrators, teachers, and students—document their process, define their goals, record achievements and challenges, and create strategies, thus engaging in the production of knowledge based on teaching practice.

Considering the thinking of the authors mentioned here, it is understood that, in this approach, the teacher needs to recognize that students are the protagonists of their knowledge construction process, to validate the knowledge that is being constructed in their formative identity.

Synergies

To support discussions of the synergies between CA and Ethnomathematics, a search for these approaches in pedagogical practices in mathematics teaching was conducted, focusing on the early years of elementary school. The search was based on the Systematic Literature Review (SLR) methodology, a type of secondary study that, through a well-defined procedure, seeks to identify, analyze, and interpret evidence regarding a specific research question (Kitchenham & Charters, 2007).

To develop the SLR, a search was conducted using the *strings 'ethnomathematics' AND 'pedagogical practice' AND 'elementary education' AND 'initial years' in the Google Scholar* database, yielding approximately 1,170 results. Given this significant number, two search engines were applied, yielding 665 results related to 'creative learning' AND 'mathematics' AND 'pedagogical practice'; for the descriptors 'creative learning' AND 'mathematics' AND 'pedagogical practice' AND 'elementary education' AND 'initial years', a total of 264 results were obtained.

This large number of results highlighted the need for a thorough RSL on the Education Resources Information Center (ERIC) and *Google platforms. Scholar* [1], for which the research questions presented below were formulated.

Research questions

The RSL implemented sought to answer the following Research Questions (RQ):

QP1) Which pedagogical practices developed by teachers in Basic Education, in Elementary Education - initial years, in the selected studies, highlight the student as a protagonist in the teaching of Mathematics?

QP2) Which studies signal/point out the synergy of the theoretical constructs of CA and Ethnomathematics?

Inclusion and exclusion criteria

The advanced search organization arguments occurred, firstly, to select the contributions, inserting the period from 2019 to 2024, in pairs, in the sequence of the descriptors, which were translated into English, becoming specific keywords of the productions that presented the terms about the thematic object. Following the protocol, at the bases of National and international searches selected productions (in English and Portuguese) related to CA, Ethnomathematics, and pedagogical practices developed by teachers in Basic Education, Elementary School - early years, in the mathematics curriculum component. The inclusion and exclusion criteria adopted are described in Table 1.

Table 1. Criteria of inclusion and exclusion.

Inclusion	Exclusion
- Studies of theses, dissertations and articles on the themes: Creative Learning, Ethnomathematics, Pedagogical Practice in Teaching Mathematics with a focus on the initial years of Elementary School. - Studies published between 2019 and 2024 (last five years). - National and international studies - Studies accessible via web, in a free manner.	- Studies published before 2019. - Studies duplicated or redundant. - Secondary or tertiary studies. - Studies redundant of same author. - Studies outside the topic covered. - Studies outside the target audience (Elementary School - initial years). - Studies without a focus on teaching Mathematics. - Studies published in books and *Ebooks*.

Source: Prepared by the authors (2024).

[1] https://eric.ed.gov/ and https://scholar.google.com .

Search Bases and arguments

The databases selected for the search were *Google Scholar* and ERIC, with the filter defined for the last five years (2019-2024). Figure 1 illustrates the search arguments used, the number of articles returned, and the number of articles selected after reading the abstracts and applying the exclusion criteria.

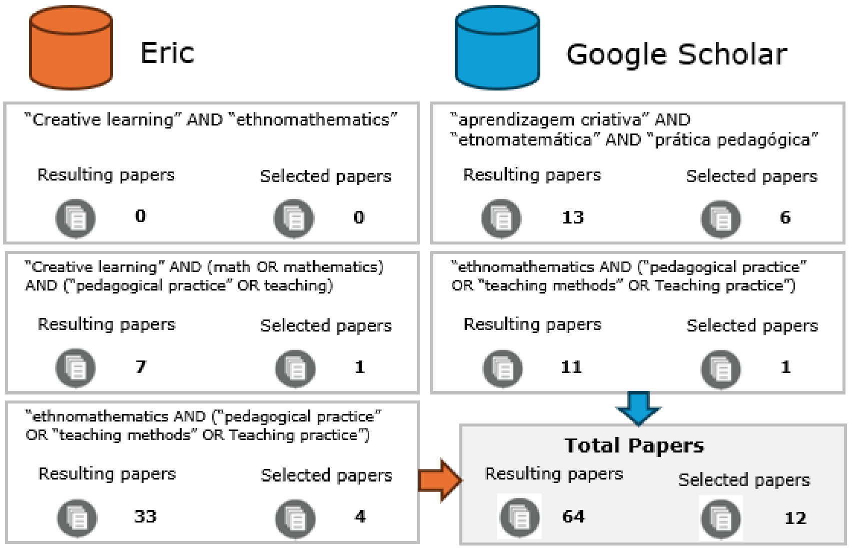

Figure 1. Job search process.

Source: Prepared by the authors (2024).

Figure 1 illustrates the findings of publications in the ERIC and *Google Scholar* databases. Sixty- *four* studies were retrieved, including articles, dissertations, and theses.

After reading the abstracts and applying the exclusion criteria, 12 studies were selected, as listed in Table 2. Following the inclusion and exclusion criteria, the selected texts were read, with a view to supporting the QP responses.

Table 2. Selected studies.

Id (Base)	Reference	Target audience	Objective
E01 (ERIC)	Kartikarari et al. (2022)	4th grade elementary school students	Test the effectiveness of open learning and creative problem-solving models for teaching students creative thinking skills in elementary school mathematics learning
E02 (ERIC)	Supriadi (2022)	56 students from 2nd to 6th grade of Elementary School	Use the *Rasch Winstep model* in designing the didactic learning stage with the *Endog-Endogan game* in learning Mathematics.
E03 (ERIC)	Payadnya et al. (2021)	46 students from SMP Widiatmika, academic year 2020/2021.	Analyze students' abilities in solving realistic mathematical problems using *What-If ethnomathematical tools* with content focused on flat and spatial materials.
E04 (ERIC)	Nugraha et al. (2020)	4th grade of Elementary School	To determine the increase in students' mathematical understanding ability in experimental classes (using the CTL model, based on Sudanese Ethnomathematics).
E05 (ERIC)	Nur et al. (2020)	60 students from a secondary school in Gowa Regency, South Sulawesi province	Examine contextual learning with Ethnomathematics to improve problem-solving skills based on levels of thinking.
E06 (*Google Scholar*)	Antunes (2023)	Classes of 3rd, 4th and 5th grades of the initial years, deaf students.	To analyze the pedagogical contributions of the Classroom Studies methodology in its intersections with the field of Ethnomathematics and the use of GeoGebra as an assistive technology for deaf students.
E07 (*Google Scholar*)	Kawalek (2023)	Multi-year classes, Rural Education	Analyze the potential of creative computing in teaching Mathematics in multi-year classes.
E8 (*Google Scholar*)	Gehrke (2020)	Students from 1st to 5th grade, rural area	To problematize the contributions of Pomeranian culture to the process of knowledge acquisition, especially in Mathematics.
E9 (*Google Scholar*)	Silva (2023)	Elementary School	Build a teaching sequence (workshop), from the perspective of critical and creative thinking, to explore the Pythagorean theorem, in order to make teaching more interesting and conducive to the development of students.
E10 (*Google Scholar*	Santos (2021)	Early Years of Elementary School	Describe possibilities of using *Ludobot* in educational robotics, as a resource for teaching Mathematics.

E11 (*Google Scholar*)	Silva (2020)	5th year of Elementary School	Conduct a study on the teaching of Mathematics (Thematic Units: Geometry and Quantities and Measurements); Digital Communication and Information Technologies, *Scratch* and Problem-Solving Methodology.
E12 (*Google Scholar*)	Owusu and Addo (2023)	Students in grades 4-6 in Ghana	To argue that mathematical concepts found in cultural games can teach mathematics to children in grades 4-6 in Ghana.

Source: Prepared by the authors (2024).

Data extraction

For the data extraction process of each selected article, dissertation and/or thesis , with a view to responding to the RQs proposed in this study, the following points were read/analyzed: abstracts; research question/problem or hypotheses; general and specific objectives; methodology: target audience, type of research, research object, method used; analysis of the data used; conclusion and findings of the main evidence.

Answering the research questions

To answer RQ1 of this study (Which pedagogical practices developed by elementary school teachers in the selected studies highlight the student as the protagonist in mathematics teaching?), the following data were extracted from the selected studies: target audience, focusing on the early years of elementary school, and mathematics activities. Three studies (E05, E07, and E09) presented a target audience outside the scope of the research question's analysis and, therefore, were not feasible. Study E01 did not present pedagogical practices, only the use of standardized tests, which distances itself from the aspects analyzed in this question.

Among the other studies, eight aspects were identified that favored youth protagonism in the proposed activities, such as: didactic sequence; pedagogical intervention; use of traditional/cultural games; educational games; educational trail game; robotics *kit* /Ludobot; GeoGebra/Assisted Technology (AT); and regional/traditional culinary recipes, practices developed by teachers in the eight studies analyzed (E02, E03, E04, E06, E08, E10, E11, E12). Figure 2 illustrates how often these aspects appeared in the selected studies.

N a Table 3 shows which selected studies most frequently showed the aspects that highlighted the student as the protagonist in the pedagogical practice developed by teachers in Mathematics teaching.

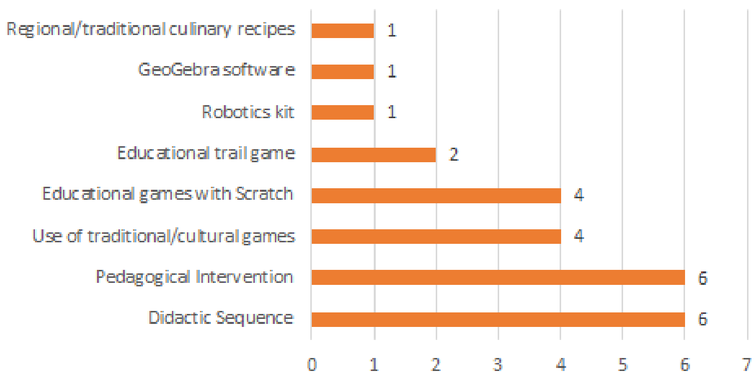

Figure 2. Practices that favor student protagonism.

Source: Prepared by the authors (2024).

Table 3. Pedagogical practices that highlight the student as the protagonist.

Aspects	Studies
Regional/traditional culinary recipes	E08
GeoGebra software	E06
Robotics Kit	E10
Educational trail game	E11, E12
Educational games with Scratch	E06, E10 and E11
Use of traditional/cultural games	E02, E03, E04, E12
Pedagogical Intervention	E02, E03, E04, E06, E08, E12
Didactic sequence	E02, E03, E04, E06, E08, E12

Source: Prepared by the authors (2024).

Anchored in the methodological assumptions of CA, proposed by Resnick (2020), and in the foundations of Ethnomathematics, proposed by D'Ambrosio (2015), works E02, E03, E04, E08, E12 pointed out a didactic sequence that provides an opportunity for a pedagogical intervention using traditional games, exploring local culture and traditional regional recipes for teaching Mathematics, through projects that involve everyday situations.

Projects E06, E10, and E11, in turn, provided the immersion of digital technologies in mathematics teaching. In E06, in activities developed in inclusive classrooms, deaf students used elements of their culture to think, teach, discuss, and respond to spatial geometry tasks.

Based on this pedagogical proposal, which encompasses the socio-historical-cultural context, mathematical learning provided interdisciplinary work (Ministry of Education, 2017), carried out with dialogue and articulation between all curricular components, a fact evidenced in E10, which developed activities in the school's computer lab, with educational games in literacy and basic computing, using the *Oudobot kit* as an educational robotics resource for teaching Mathematics.

E11 developed projects with a learning path sequence focused on creating microworlds programmed in *Scratch* for problem-solving. The diverse possibilities for creating virtual objects using the *Scratch platform* enable students to develop projects. These actions emphasized the student as the protagonist in the construction of their learning, highlighting the teacher as a mediator of knowledge, researcher, and designer.

To address RQ2 (Which studies signal/point out the synergy of the theoretical constructs of CA and Ethnomathematics?), the aspects that characterize the synergy between the two theoretical constructs made by the CA and Ethnomathematics approaches were extracted from the selected studies. Four studies (E01, E05, E07, and E09) were unable to be analyzed: E01, which presented a proposal far from the approaches under analysis; E05, E07, and E09, were outside the target audience of the research.

Among the other studies (E02, E03, E04, E06, E08, E10, E11, E12), nine aspects were identified that point to synergy, resulting from evidence of practices developed by teachers in the studies analyzed, as illustrated in Figure 3.

Dialoguing with the aspects that characterize the synergy under analysis, E08, through the didactic sequence, explored Mathematics in the fields of family tradition, culinary recipes and visits to tourist attractions in the municipality of São Lourenço do Sul-RS, Brazil.

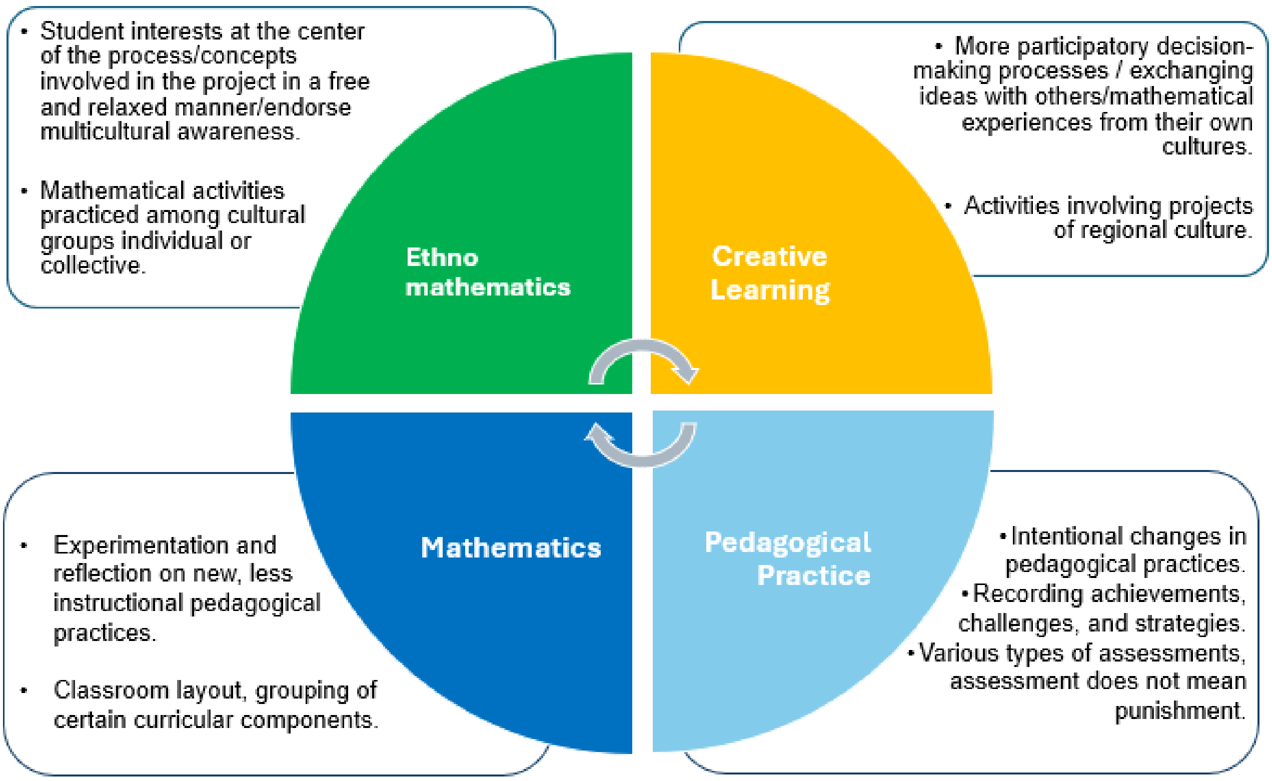

Figure 3. Aspects that demonstrate the synergy between theoretical constructs.

Source: Prepared by the authors (2024).

Resnick (2020) and D'Ambrosio (2015) trace a path of immersion in a learning process in which exchange, sharing, and peer interaction enable the development of mathematical concepts and knowledge produced by social interaction. In line with this, the following studies are highlighted: E02, which valued Sudanese culture through *Endog-Endogan games* in mathematics learning, to work on didactic *design projects* with whole numbers and fractions; E03 used the didactic sequence for pedagogical projects involving mathematical problems, focusing on Balinese culture, with a religious and cultural focus. Gede (person) will make a *klakat* (a geometrically shaped object for building a bench) for a religious ceremony; and Sintia wants to make *ituk-ituk (an electric car with leaves) and build the facade of a pelinggih* house. Each format explores the centimeters of each angle.

In E04, through the teaching sequence, the projects involved indigenous Sudanese games to develop mathematics in two-dimensional geometry, using traditional Sudanese games, such as local wisdom in West Java, namely *bebentengan, galah asin/gobak sodor, bakiak, and batik*. These games, through mathematics, teach cooperation and thinking in developing strategies to achieve common goals, the cultural value of mutual cooperation, and the historical, cultural, and geographic description of the area, so that ancestral heritage is not lost.

E06, E10, and E11 provided an immersion of digital technologies in mathematics teaching. In Brazil, mathematics teaching predominantly follows the banking model, based on lectures, primarily theoretical. However, given the social, economic, political, and cultural transformations of the modern world, mathematics education is being questioned regarding its role in society, which demands a new type of professional and more creative citizen.

D'Ambrosio (2015) defined Ethnomathematics as mathematics practiced among individual cultural groups, in the sense that it deals with mathematical concepts and techniques urbanized in different cultures, to solve real-life problems. This premise is evidenced, with more focus, in study E06, which brought the contribution of deaf students, inserted in regular classes, in the use of the GeoGebra/Assisted Technology system in the teaching of spatial geometry, for social interaction in the development of classes.

Through this experience, students were able to acquire knowledge about culture and relate it to teaching mathematics, activating the CA spiral (Resnick, 2020), building a learning process through social interaction, and developing the 4Ps of CA. This is evidenced in E03, where the *What-If* - Ethnomathematics tools allowed students to analyze their mistakes and obstacles, reflect together, and propose strategies for solving realistic problems in the proposed activities, prioritizing applied and cultural mathematics and questions that tested students' mathematical thinking skills.

Considering the QP proposed by this work, the studies analyzed here indicate that CA and Ethnomathematics approaches contribute to the teaching of Mathematics.

Final remarks

The findings of this study allowed us to illustrate the synergies between the constructs of Creative Learning and Ethnomathematics, answering the research question based on scientific productions from the last five years. Both constructs promote the development of creativity, place the student at the center of the process, provide individuals with the opportunity to become protagonists through self-responsibility in acquiring knowledge, and value a more exploratory knowledge acquisition connected to students' interests and desires, leading to more meaningful learning. They allow for the appreciation of local culture, the inclusion of elements of everyday life, playfulness, and collaborative work. Ultimately, they appear to be promising alternatives for fostering a passion for discovery and learning itself, fostering more positive and enjoyable experiences during mathematical learning.

We emphasize this new perspective of the teacher, who speaks to the new student profile, which has been altered by the rise of technology; therefore, it is beneficial that the school and the educational curriculum follow pedagogical strategies to promote and stimulate creativity focused on knowledge in these areas of knowledge.

In this sense, it is necessary for teachers to value both CA and Ethnomathematics, since there is a synergy in the insertion of these approaches in the pedagogical organization, with a view to ensuring the construction of students' social identity for the social exercise of citizenship.

The readings carried out, and the studies analyzed here support the discussion of this synergy, highlighting the importance of understanding the teaching of Mathematics when both approaches are considered as complementary and foundational, allowing new ways of teaching and promoting development through learning.

Finally, it can be stated that CA and Ethnomathematics expand competencies and skills, strengthening the ability to argue, reformulate, listen, and encourage students to solve problems, so that they are discussed with reflection, creativity, and critical thinking based on the knowledge endorsed in the educational process.

References

Antunes, M. F. N. (2023). *Surdos, tecnologias assistivas e estudos de aula: uma perspectiva Etnomatemática em foco* [Tese de Doutorado em Ensino das Ciências Exatas, Universidade do Vale do Taquari].

Araújo, H. M. (2018). *Etnomatemática e educação: contexto interdisciplinar da dinâmica da fronteira amazônica em uma comunidade do município Benjamin Constant na região do Alto Solimões* [Dissertação de Mestrado em Sociedade e Cultura na Amazônia, Universidade Federal do Amazonas].

Bampi, L. R. (2003). *Governo etnomatemático: tecnologias do multiculturalismo* [Tese de Doutorado em Educação, Universidade Federal do Rio Grande do Sul]. https://lume.ufrgs.br/handle/10183/2672

Bandeira, F. A., & Gonçalves, P. G. F. (Orgs.), (2016). *Etnomatemáticas pelo Brasil: aspectos teóricos, ticas de matema e práticas escolares*. CRV.

Barton, B. (2006). Dando sentido à etnomatemática: Etnomatemática fazendo sentido. In J. P. M. Ribeiro, M. C. S. Domite, & R. Ferreira (Orgs.), *Etnomatemática: papel, valor e significado* (2a ed., pp. 39-74). Zouk.

Bello, S. E. L. (2004). Etnomatemática e sua relação com a formação de professores: alguns elementos para a discussão. In G. Knijnik, F. Wanderer, & C. Oliveira (Orgs.), *Etnomatemática: currículo e formação de professores* (pp. 377-395). Edunisc.

Carnielli, A. F. (2022). *O jogo como um recurso didático: uma perspectiva inclusiva para o ensino de números complexos* [Dissertação de Mestrado Profissional em Matemática, Universidade Tecnológica Federal do Paraná].

D'Ambrosio, U. (1993) A transdisciplinaridade como acesso a uma história holística. In P. Weil, U. D'Ambrosio, & R. Crema. *Rumo à nova transdisciplinaridade: sistemas abertos de conhecimento* (pp. 26-39). Summus.

D'Ambrosio, U. (2006). *Educação matemática: da teoria à prática* (13a ed.). Papirus.

D'Ambrosio, U. (2008). O programa etnomatemático: uma síntese. *Acta Scientia, 10*(1), 7-16.

D'Ambrosio, U. (2015). *Etnomatemática - elo entre as tradições e a modernidade* (5a ed., Coleção Tendências em Educação Matemática). Autêntica.

Gehrke, T. H. (2020). *Receitas culinárias pomeranas: integrando saberes e sabores em uma escola multisseriada do município de São Lourenço do Sul* [Dissertação de Mestrado em Ensino de Ciências e Matemática, Universidade Federal de Pelotas].

Ferreira, E. S. (2003). *O que é etnomatemática*. http://www.ufrrj.br/leptrans/arquivos/etno.pdf

Heringer, C. (2018). *O saber/fazer na pedagogia da alternância numa escola do campo de Nova Friburgo na perspectiva da Etnomatemática* [Dissertação de Mestrado em Educação Agrícola, Universidade Federal Rural do Rio de Janeiro].

Kartikarari, S., Usodo, A., & Riyadi, B. (2022). *The effectiveness open-ended learning and creative problem solving models to improve creative thinking skills*. Pegem Journal of Education & Instruction, 12(4), 29-38. https://doi.org/10.47750/pegegog.12.04.04

Kawalek, V. M. (2023). *Computação criativa no ensino de Matemática em classes multianos* [Dissertação de Mestrado em Ensino de Ciência e Tecnologia, Universidade Tecnológica Federal do Paraná].

Kitchenham, B., & Charters, S. (2007). *Guidelines for performing systematic literature reviews in software engineering*. Keele University; Durham University.

Ministério da Educação. (2017). *Base Nacional Comum Curricular*. http://basenacionalcomum.mec.gov.br/images/BNCC_EI_EF_110518_versaofinal_site.pdf

Morais, V. C. S., & Santos, A. B. (2016). Implicações do uso deatividades experimentais no ensino de biologia na escola pública. *Investigações em Ensino de Ciências, 21*(1), 166-181. https://doi.org/10.22600/1518-8795.ienci2016v21n1p166

Muniz, L. S., & Martinez, A. M. (2015). A expressão da criatividade na aprendizagem da leitura e da escrita: um estudo de caso. *Educação e Pesquisa, 41*(4), 1039-1054. https://doi.org/10.1590/s1517-97022015041888

Nugraha, T., Maulana, M., & Mutiasih, P. (2020). Sundanese ethnomathematics context in primary school learning. *Mimbar Sekolah Dasar, 7*(1), 93-105. https://doi.org/10.17509/mimbar-sd.v7i1.22452

Nur, A. S., Waluya, S. B., Rochmad, R., & Wardono, R. (2020). Contextual learning with Ethnomathematics in enhancing the problem solving based on thinking levels. *Jornal of Research and Advances in Mathematics Education, 5*(3). https://doi:10.23917/jramathedu.v5i3.11679

Owusu, P., & Addo, A. O. (2023) Alikoto: Mathematics instruction and cultural games in Ghana. *Cogent Education, 10*(1). https://doi.org/10.1080/2331186X.2023.2207045.

Papert, S. (1994). *A máquina das crianças: repensando a escola na era da informática*. Artes Médicas.

Payadnya, A. A., Suwija, I. K., & Wibawa, K. A. (2021). Analysis of Students' Abilities in Solving Realistic Mathematics Problems Using "What-If"-Ethnomathematics Instruments. Mathematics Teaching Research Journal, 13(4), 131-149. https://files.eric.ed.gov/fulltext/EJ1332339.pdf

Pinheiro, D. R., & Costa, W. C. L. (2016). A etnomatemática como ferramenta pedagógica no contexto escolar. In *Anais da 2ª Jornada de Estudos em Matemática da Faculdade de Matemática do Instituto de Ciências Exatas da Universidade Federal do Sul e Sudeste do Pará* (pp. 16-27), Marabá, PA.

Raabe, A. L. A., Gomes, A. S., Bittencourt, I. I., & Pontual, T. (Orgs.), (2016). *Educação criativa: multiplicando experiências para a aprendizagem* (1a ed., Série Professor Criativo, Vol. IV) Pipa Comunicação.

Rede Brasileira de Aprendizagem Criativa. (2023). *Programa Escolas Criativas. Dimensões de uma escola criativa*. https://aprendizagemcriativa.org/sites/default/files/2023-02/dimensoes_escola_criativa_2023.pdf

Resnick, M. (2020). *Jardim de infância para a vida toda: por uma aprendizagem criativa, mão na massa e relevante para todos* (M. C. Cruz & L. R. Sobral, Trad.). Penso.

Santos, B. P. (2006). Etnomatemática e suas possibilidades pedagógicas: algumas indicações. In J. P. M. Ribeiro, M. C. S. Domite, & R. Ferreira (Orgs.), *Etnomatemática: papel, valor e significado* (2a ed., pp. 203-218). Zouk.

Santos, É. O. (2021). *Robótica educacional nas escolas de Curitiba: possibilidades pedagógicas para o ensino de Matemática com o Ludobot* [Dissertação de Mestrado em Formação Científica, Educacional e Tecnológica, Universidade Tecnológica Federal do Paraná].

Santos, J. D., & Lara, I. C. M. (2013). *Diferentes modos de olhar a etnomatemática: uma análise dos estudos brasileiros*. Anais do 6º Congresso Internacional de Ensino de Matemática da Universidade Luterana do Brasil, Canoas-RS.

Scandiuzzi, P. P. (2002). Água e óleo: modelagem e etnomatemática? *BOLEMA, 15*(17), 52-58. https://www.periodicos.rc.biblioteca.unesp.br/index.php/bolema/article/view/10604

Silva, F. S. (2023). *Explorando o teorema de Pitágoras na perspectiva do pensamento crítico e criativo em Matemática* [Dissertação de Mestrado Profissional em Matemática, Rede Nacional-ProfMat), Universidade de Brasília]. http://repositorio2.unb.br/handle/10482/47455?mode=full

Silva, L. A. (2020). *O Scratch e a metodologia de resolução de problemas: uma proposta para o ensino de Matemática no 5º ano do Ensino Fundamental* [Dissertação de Mestrado Profissional em Educação Básica, Formação Docente para Educação Básica, Universidade de Uberaba]. Repositório Uniube. https://repositorio.uniube.br/bitstream/123456789/1412/1/Lucimar%20Araujo%20da%20Silva.pdf

Souza, A. C. (2013). *A experimentação no ensino de ciências: importância das aulas práticas no processo de ensino aprendizagem*. UFPR.

Supriadi, S. (2022). Elementary school students reflection: Didactical design analysis on integer and fraction operations on mathematical concepts with Sundanese ethnomathematics learning. Pegem Journal of Education & Instruction*, 12*(4), 192-199. https://doi.org/10.47750/pegegog.12.04.19

Tussi, G. B., Neves, E. A., & Fávero, A. A. (2022). Aprendizagem criativa e formação docente no Ensino Superior. *Revista Educar Mais, 6*, 737-747. https://doi:10.15536/reducarmais.6.2022.2859

Valente, J. A. (2005). *A espiral da espiral de aprendizagem: o processo de compreensão do papel das tecnologias de informação e comunicação na educação* [Tese de Doutorado em Livre Docência, Universidade Estadual de Campinas].

INFORMATION ABOUT THE AUTHORS

Carla Vanesa Ramos da Silva: Master's in education from Univali (2024). MBA in Financial Management: Controllership and Auditing from FGV (2014). Specialist in Literacy from UNIR (2008). Specialization in Psychopedagogy from UNIR (2005). She has a full degree in Pedagogy-Educational Guidance from UNIPEC (2001). She has worked in the educational field for over 25 years with experience in Literacy and School Management. She worked as a trainer for PNAIC (2018) and a trainer for MATHEMA (2017-2018). She is a Teacher Trainer/Articulator of the Municipal Education Plan of the Porto Velho City Hall and a Teacher Trainer for the State Department of Education of Rondônia.
ORCID: https://orcid.org/0009-0001-1638-7487
Email: carlavrs2016@gmail.com

André Raabe: PhD in Computer Science in Education from UFRGS (2005) with a postdoctoral degree from Stanford University (2016). He is a Productivity Scholar in Technological Development and Innovative Extension (DT). He holds a master's degree on Computer Science from PUCRS (2000) and a bachelor's degree in computer science from PUCRS (1996). He is a professor and researcher at UNIVALI (University of Vale do Itajaí), where he works in the Graduate Program in Computer Science and in the Master's and Doctorate programs in Education. He coordinates the Laboratory of Technological Innovation in Education (LITE). He provides teacher training and research on Computer Education, Maker Education, and Computer Science in Education.
ORCID: https://orcid.org/0000-0002-8093-2507
Email: raabe@univali.br

NOTICE:
Carla Vanesa Ramos da Silva: Research, Data Curation, Writing of the Original Article. **André Raabe:** Supervision, Validation, Review, and Final Editing of the Article.

Associate Editor in Charge:
Maria Terezinha Bellanda Galuch (UEM)
ORCID: https://orcid.org/0000-0001-5154-9819
Email: mtbgaluch@uem.br

Evaluation rounds:
R1: Eight invitations; two opinions received

Standardization reviewer:
Adriana Curti Cantador de Camargo

Data availability:
Not applicable.