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The approach Science, Technology, and Society (STS) Education in the training of Mathematics teachers: a focus of the proposed studies

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ABSTRACT

This article aims to analyze theses and dissertations related to Science, Technology, and Society (STS) Education in the initial and continuing education of mathematics teachers. The methodological approach adopted was a narrative literature review. Grounded in Pinheiro (2010; 2022), Ole Skovsmose (2013; 2014), and Brazilian Ministry of Education (1996; 2018), the study emphasizes the need to reflect on and rethink the educational processes of both pre-service and in-service mathematics teachers in order to establish connections between STS Education and the development of Critical Mathematics Education (CME). The findings reveal discrepancies between the principles outlined in educational legislation aimed at fostering “critical citizens” and the actual teaching of mathematics in basic education. It was found that, in the higher education programs analyzed, mathematics teaching still relies heavily on mechanical instruction, with little dialogue with other disciplines or with broader social and human contexts. STS Education is therefore presented as a relevant approach to complement curriculum content.

Keywords: STS Education. Critical Mathematics Education. Teacher Education.

INTRODUCTION

The content proposed in the mathematics curriculum of basic education, as outlined in the current Common National Curriculum Base (BNCC) (Brazil, 2018), should be structured around multiple relationships between the subject matter and other areas of knowledge, in line with an interdisciplinary approach. Furthermore, it should promote learning grounded in propositions and questioning that engage with social, political, economic, cultural, and environmental contexts, encouraging students to propose solutions to the problems they encounter.

In this teaching and learning process, the Mathematics teacher, in the context of this study, acts as a mediator. With regard to initial and continuing teacher education, it is essential to promote professional development that meets the demands placed on teachers in order to achieve the aims of basic education.

However, studies by Monteiro (2013), Almeida and Pimenta (2014), Richit and Colling (2019), and Sousa and Del Pino (2022) indicate that, in general, few Mathematics Teacher Education programs value a curriculum that highlights the importance of debate and reflection on this topic. For the most part, when establishing their curricula, these programs consider only the requirements imposed by educational legislation, offering generalist courses in pedagogical content, with little focus on Mathematics and its technologies as a specific field.

Pinheiro (2010; 2022) emphasizes the importance of aligning mathematical knowledge with the processes of science, technology, and society in order to support individuals in understanding the various forms of social, political, and economic interaction. In doing so, they can reflect beyond the formulas and models presented in the classroom. The author highlights '[…] the relevance of enabling teachers to incorporate into their pedagogical practice moments that promote a more critical and reflective perspective on mathematics […]' (Pinheiro, 2022, p. 2).

In terms of educational legislation, with the enactment of the Law of Guidelines and Bases of National Education (LDB) (Brazil, 1996), the importance of developing teaching practices that bring students closer to interactions with science and technology across different dimensions of society is established, enabling them to understand issues related to the scientific and technological context and, thus, fostering the development of critical thinking.

Authors such as Gatti and Barreto (2009) and Pinheiro (2010; 2022) point out that teachers are responsible for mobilizing and developing this knowledge in the classroom, articulating teaching and learning processes in ways that foster students' interest and encourage them to raise the questions necessary for the exercise of citizenship.

To this end, Gatti and Barreto (2009) emphasize the need to discuss the teacher education process, since the knowledge embedded in current teacher education curricula should address the demands of contemporary education. According to these authors, the social transformations that permeate various domains of human activity also enter the school context, requiring educational conceptions and practices capable of contributing to the construction of a more just society.

In this context, the aim of this article is to analyze theses and dissertations related to Science, Technology, and Society (STS) in the initial and continuing education of mathematics teachers, reflecting on the teacher education process in Mathematics Teacher Education programs and on the role of teacher educators in higher education. To this end, we seek to understand these teachers' perspectives on the concepts and knowledge associated with STS Education and Critical Mathematics Education (CME), considering current legislation and the research conducted in graduate programs across the country.

To achieve the aim of this study, we collected data from the databases of the CAPES Theses and Dissertations Catalog (Coordination for the Improvement of Higher Education Personnel) and the Brazilian Digital Library of Theses and Dissertations (BDTD), using the keywords 'STS' and 'Mathematics Education.

This study discusses the connections between STS Education and mathematics teacher education, highlighting the challenges and possibilities that shape the teacher education process in this field. It seeks to address the following question: what contributions and implications do studies relating STS and Mathematics Education offer for mathematics teacher education?

The study also highlights the importance of the relationship between mathematics teaching and the STS Education perspective. It then outlines the theoretical framework adopted to analyze the collected data, describing the methodological procedures, as well as the analysis and discussion of the investigation guided by the research question. Finally, it presents the study's concluding remarks.

SCIENCE, TECHNOLOGY, AND SOCIETY (STS) EDUCATION AND CRITICAL MATHEMATICS EDUCATION

STS Education originated in the so-called 'STS Movement,' which began in the 1960s, in different forms in Europe and the United States. The main objectives of these two strands were, in the first case, to foster an academic environment for analyzing the relationship between science, technology, and society, and, in the second, to promote a militant and grassroots movement opposing the advances and risks that science and technology posed to society at the time.

These two origins inspired other developments, such as Latin American Thought in Science-Technology-Society (PLACTS), which shared objectives similar to those of the original STS movement. According to Cerezo (1998), these distinct strands constitute a unified body of intentions with three fields of action. One of these fields was education, leading to the emergence of the STS Approach, based on Ziman (1980).

In his studies, that author argues that science teaching should emphasize the development of citizenship, ethics, and social responsibility through social, philosophical, and historical approaches; interdisciplinarity and contextualization; the valorization of problematization; and the inclusion of socioscientific issues. According to Santos and Mortimer (2002), the application of these approaches in teaching contributes to a more humanistic education that fosters critical thinking and promotes solutions to social problems.

In this context, and in parallel, mathematics teaching has also benefited over the years from a range of approaches, including the use of the history of mathematics, an emphasis on problematization and the modeling of phenomena, ethnomathematics, recreational mathematics, the use of computational resources in mathematics teaching, and Critical Mathematics Education (CME) (Silva, Couto, & Cunha Junior, 2020).

The aim of CME is to promote the development of a critical perspective on the role of mathematics in society and to question the notions of exactness and irrefutability often associated with the teaching of this subject. As stated by Passos (2008, p. 42), 'the development of new perspectives regarding the roles played by mathematical knowledge in society is one of the main objectives of Critical Mathematics Education.

The learning of mathematical content developed in basic education is often associated with the conception of mathematics as an exact science, free from error. For some, it is seen as a body of ready-made knowledge, whose established formulas cannot be questioned, but only applied across different fields of knowledge, supposedly guaranteeing correct answers. This perspective keeps mathematics detached from social, cultural, scientific, and technological issues (Pinheiro, 2005).

Therefore, it is important to understand and develop mathematics curriculum content from a social perspective. To this end, prevailing conceptions must be reconsidered, and efforts should be made to engage both teachers and students in contexts that problematize situations in multiple ways, enabling a critical reading of reality and the identification of possible solutions and concrete actions for intervention. According to Strieder *et al*. (2016), for this to occur, it is necessary

> […] to discuss the limitations of scientific knowledge in understanding and solving social problems; to emphasize the importance of society striving for an alternative model of development that seeks to meet the basic needs of a given population rather than merely generating economic profit; and to foster a culture of participation in the sphere of public policies, involving the definition of objectives, the means to achieve them, and ways to monitor their implementation (Strieder *et al*., 2016, p. 89).

In the effort to integrate social issues into the school context, STS Education promotes a shift in how the role of science and of individuals as social beings is understood. It seeks to articulate science, technology, and society, overcoming a fragmented view of these concepts and fostering a new understanding of their interrelationships. Thus, '[…] the STS movement is a process of rupture with traditional views of science and technology' (Cambi, 2015, p. 40).

Medeiros, Morais, and Nunes (2022), Strieder *et al*. (2016), and Pinheiro (2022) explain in their studies that the STS Education approach aims to explore individuals' engagement in participation and intervention in the dilemmas present in the situations discussed, both in the school context and in the broader social contexts in which they are embedded. According to these researchers, the STS approach promotes the experience of social processes grounded in reality, contributing to the development of more autonomous, active, and critical individuals within these contexts.

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Almeida and Pimenta (2014) argue that, for high-quality teaching, it is necessary to ensure that knowledge is understood systemically rather than as a mere accumulation of content and information. It is important that students are able to understand the reality in which they are situated, thereby aligning with the objectives proposed by STS Education.

By recognizing the relevance of teaching that seeks to engage students in the various social aspects linked to science and technology, we understand that mathematics teaching should be situated within the context of STS relations, contributing to the interpretation of problem situations and supporting decision-making for their resolution.

We also understand that the STS Education approach aligns with the perspective developed by Critical Mathematics Education (CME), particularly regarding the ideas of participation, engagement, and interaction between teacher educators and students in fostering reflective and critical attitudes toward the interrelationship between concepts and lived situations. According to the researcher Ole Skovsmose (2013), such moments provide a basis for a form of education oriented toward a critical perspective, in which the fundamental conditions for the production and development of knowledge can be discussed.
In articulating STS and CME concepts in mathematics classes, the aim is to work with questions that involve the use of mathematical concepts to interpret real-world contexts, while also exploring the emancipatory potential of the individuals involved. In this way, it supports students (citizens) who find themselves '[…] in comfortable positions to develop a critical awareness that enables them to deepen their knowledge and understanding of the sociopolitical contexts of their lives' (Skovsmose, 2017, p. 22).

As outlined in Brazil (1996, 2018), basic education should develop in students the capacity to make decisions guided by attitudes and values oriented toward social development. To this end, teachers should guide students along paths that support this understanding, particularly with regard to issues involving scientific and technological domains.

We argue that teaching grounded in STS Education and informed by the contributions of Critical Mathematics Education (CME), when incorporated from initial teacher education, could foster changes in mathematics teacher education by revaluing the social dimensions of science and technology. It would also enable

the incorporation of societal issues into debates, classroom practices, and the topics addressed in mathematics lessons.

METHODOLOGY

In recent scientific research in education, several methods are currently under development. Lüdke and André (2018) point out that studies in the field of education engage with multiple aspects that need to be investigated and examined, and it is within these aspects that the roots of different phenomena—requiring observation and detailed analysis within their specific social and human contexts—should be sought.

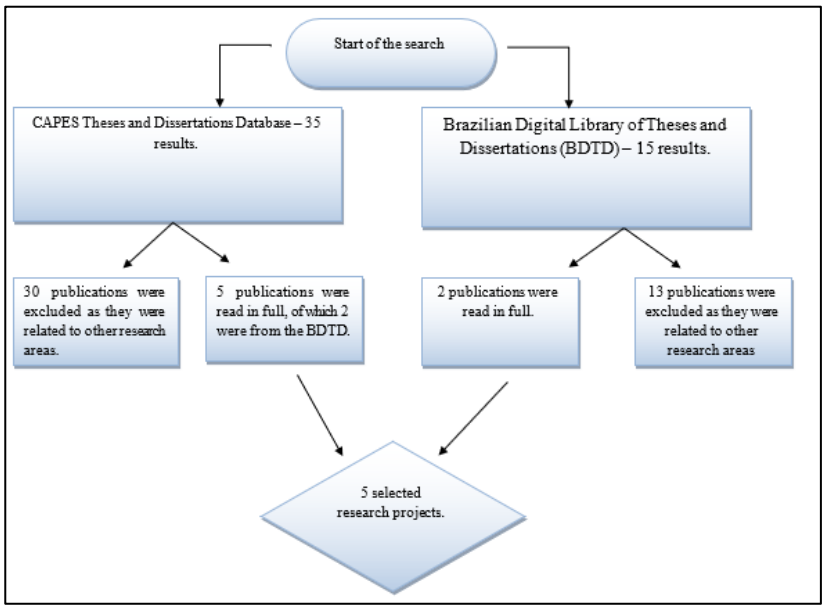
For this study, we adopted a Narrative Literature Review (NLR), with a qualitative approach and a descriptive nature. Narrative reviews aim to describe the current state of the topic under investigation, without requiring a highly detailed formulation of the research question, which may be outlined more broadly. In addition, methodological aspects can be organized and described by the researcher according to the adopted theoretical framework and the context of the topic addressed. Therefore, there is no strict requirement for rigorous detailing of procedures or criteria used for the selection and evaluation of the scientific works included in the analysis (Rother, 2007; Casarin *et al*., 2020).

We conducted the search for the scientific works included in this study in the CAPES Theses and Dissertations Database (Coordination for the Improvement of Higher Education Personnel) and the Brazilian Digital Library of Theses and Dissertations (BDTD). To access the studies in the Theses and Dissertations Database, we adopted the strategy of searching for the terms ‘STS’ and ‘Mathematics Education.’ We selected these keywords during the search process based on the main terms used in the research topic.

To select the studies, we established the following inclusion criteria: studies related to mathematics teacher education; research developed within the context of STS Education and mathematics teaching; and scientific works with free access and available in full text.

Figure 1 presents information on the application of the inclusion and exclusion criteria in the selection of scientific articles, aiming to facilitate the reader’s understanding of the specific characteristics of the publications. It illustrates the process from the initial search to the selection of the articles that composed the final sample of the analyzed studies.

Figure 1 – Flowchart of Study Selection Based on Inclusion and Exclusion Criteria



Source: The authors (2023).

As a result of this review, we selected five studies: two doctoral theses and three master's dissertations. We excluded studies that addressed topics related to STS Education in the field of Science (Physics, Chemistry, or Biology), as well as those focusing on specific teaching methodologies and their classroom applications, since they did not directly address mathematics teacher education. Although these topics relate to the STS field, in this study we chose to focus on teacher education in Mathematics Teacher Education programs or on teachers who teach mathematics in higher education.

After applying the selection criteria, we read the titles, full abstracts, and results of the theses and dissertations. Table 1 presents the authors and titles of these works in chronological order, their classification by type—master's dissertations (D) or doctoral theses (T)—as well as their research approaches and research participants.

Chart 1 – List of the studies reviewed.

Year	Authors and titles	Source	Type	Approach	Researcrh participantes
2012	SILVA, Débora Janaina Ribeiro e. The STS Approach and Critical Mathematics Education: A Perspective on the Initial Education of Pre-service Teachers.	Professional Master's Program in Science and Mathematics Education, UEPB - Campina Grande/PB	D1	Qualitative	Pre-service mathematics teachers in a Mathematics Teacher Education program.

2016	CIVIERO, Paula Andréa Grawieski. Critical Mathematics Education and the Social Implications of Science and Technology in the Contemporary Civilizational Process: Challenges for Mathematics Teacher Education.	PhD in Scientific and Technological Education, UFSC. Florianópolis/ SC	T1	Qualitative	Faculty members in Mathematics Teacher Education program.
2017	SBRANA, Maria de Fátima Costa. The Contextualization of Mathematics through the STS Approach from the Perspective of Critical Mathematics Education.	Master's Degree in Teaching and History of Science and Mathematics. UFABC. Santo André/SP. UFABC	D2	Qualitative	Pre-service teachers and Faculty members in a Mathematics Teacher Education program.
2021	GAFFURI, Stefane Layana. Mathematics Education and the Social Implications of Technoscience in Engineering.	PhD in Scientific and Technological Education, UFSC. Florianópolis/ SC	T2	Qualitative	Faculty members in Engineering programs teaching Mathematics-related courses.
2021	HENRIQUE, Loriete Marques. Mathematics Teacher Education Graduates and Their Knowledge and Understandings: A Discussion of	Master's Degree in Science, Technology, and Society. IFPR *campus* Paranaguá. Curitiba/PR.	D3	Qualitative	Faculty members in Mathematics Teacher Education programs.

	Teaching Knowledge and Practice in Teacher Education Programs Based on the Analysis of Recent Studies and the STS Approach.				

Source: The authors (2023, emphasis added).

We organized the studies selected for this research in a database and characterized them in detail to better explore the proposed objectives. We conducted the analysis of the results using a qualitative and descriptive approach, following the steps of the Narrative Literature Review (NLR) theoretical and methodological framework. As this is a literature review study, we based the discussion on relevant scientific works related to the topic.

To ensure the methodological rigor of the NLR, we followed the stages described by Gonçalves, Nascimento, and Nascimento (2015) as a guide for conducting the research, from identifying the theme to presenting the synthesis. The steps we followed were: describing the studies, highlighting their characteristics and specificities; grouping the works according to similarities and findings; and presenting the scope of the identified evidence.

RESULTS AND DISCUSSION

Silva (2012), in his master's research, sought to promote reflection and foster dialogue between the initial education of pre-service mathematics teachers and the STS approach, aiming to answer the following question: What is the impact of incorporating STS approaches aligned with Critical Mathematics Education (CME) in the education of future mathematics teachers?

The discussion of the STS approach and CME within the Teaching Practice course, in the context of initial mathematics teacher education, involved both theoretical and practical classes aimed at supporting students in developing a reflective understanding of mathematics.

Through activities developed in the course, and by addressing themes related to interdisciplinarity, it was possible to observe that pre-service teachers came to understand that mathematics teaching can be implemented through a teacher education process that involves educational practices connected to sociocultural relations. Such an approach considers aspects experienced by the school community and proposes solutions to the problems discussed in class.

It is important to note that, according to Silveira, Santos, and Chrispino (2019), scientific knowledge has a transdisciplinary nature; therefore, the connection between learners and knowledge should also be established in this way. According to these authors, STS Education values discussions that challenge the rigid structuring of disciplines, relating scientific theories and concepts to historical,

philosophical, and sociological contexts, while also highlighting regional issues involving scientific and technological developments within a given society.

Silva (2012, p. 101) emphasizes the importance of research on mathematics teaching practices in teacher education, as well as actions that help future teachers overcome a rigid view of the discipline, limited to fixed rules and definitions. In this context, STS Education themes may foster practices that stimulate '[…] the development of a critical stance among those involved in the teaching and learning process regarding the role of science and technology in the development of society.'

Thus, there is a clear need to rethink the structure of initial and continuing mathematics teacher education, as many pre-service teachers still perceive subjects outside the core of pure mathematics as simplistic or merely serving to fulfill curriculum requirements. According to Almeida and Pimenta (2014) and Sousa and Del Pino (2022), these research findings lead us to reflect on curricular changes that promote a different stance that supports the education of teaching professionals capable of fostering critical and reflective citizens who can engage with the challenges of the society in which they are embedded.

Gil Pérez and his collaborators (2001) also discuss the need to move beyond the conception of science as an inductivist process characterized by linear and exact development. According to these researchers, this reduced perspective stems from a positivist model of understanding and practicing science, which remains a predominant approach in academia.

Civiero (2016, p. 27), in her doctoral thesis, emphasizes the importance of recognizing that 'Mathematics is a science that must be reflected upon before considering its exactness, perfection, and applicability to all human activities,' which may lead to learning processes that contribute to the development of students' critical and reflective thinking.

These perspectives align with the proposal of Pinheiro (2005, p. 58), who states that '[…] it is urgent to reflect on the relationship conceived between mathematical knowledge, science, technology, and society, which is far broader than merely the use made of technological devices.

In her doctoral thesis, Civiero (2016) raises the following questions:

> How has the dissemination of Critical Mathematics Education (CME) been developing in Brazil? What contributions does CME offer toward transforming teacher education from a critical perspective—in contrast to the prevailing model structured according to the logic of technical rationality—within the context of the social relations of science and technology in the contemporary civilizational process? (Civiero, 2016, p. 35).

These propositions align with the principles of STS Education advocated in current educational legislation, namely the LDB (1996) and the BNCC (2018), which position themselves as guidelines for promoting education for citizenship.

Civiero (2016) observes that these currently in-force documents aim to promote a discourse centered on citizenship through social transformation; however, she also points out that individuals are considered fit to act as citizens only if they conform to societal rules, particularly when situated within conditions of submission to hegemonic power. This position contrasts with the perspective

proposed by Ole Skovsmose (2013), who argues that the critical-reflective approach of Critical Mathematics Education (CME) should be associated with teaching practices that lead students to questioning actions, as well as to making decisions, thereby establishing connections between mathematics and life in society.

Civiero (2016, p. 285) also warns that '[…] synergy between specific mathematical knowledge and social knowledge is essential to grasp the reality of a society structured by science and technology.' To achieve this, mathematics teacher education must incorporate STS Education in ways that integrate the principles of CME. In doing so, it becomes possible to educate reflective teachers—teachers who investigate their own practice, who teach mathematics through a critical and citizenship-oriented perspective, and who can pass on this understanding to future teachers in basic education.

Still with regard to teacher education, Ribeiro (1975) highlights the historical tendency of Brazilian universities to value the departmentalization of programs, the specificity of disciplines, and the positivist model in areas considered exact and technological, and suggests prioritizing dialogue among forms of knowledge originating from different fields. According to Freire (1997), this type of integration contributes to overcoming a view common among many educators, grounded in the idea that teaching consists merely of transmitting knowledge.

In the study conducted by Sbrana (2017), the author sought to discuss relevant aspects of a continuing education course for teachers who teach mathematics, based on the STS and CME approaches.

The researcher found that participating teachers believe that simply incorporating students' everyday experiences would be sufficient to develop classroom activities and foster competencies related to these contexts, thereby advancing critical development and citizenship formation. These arguments run counter to the propositions of Cambi (2015) and Strieder *et al*. (2016), who argue that it is also necessary to address social problems and their consequences for society, as well as political and economic interests and human values.

Sbrana (2017) points out that teachers' lack of knowledge about STS Education originates in their initial teacher education, as many report that they had no exposure to these approaches during their mathematics teacher education. Therefore, the author argues that incorporating STS-related knowledge into Mathematics Teacher Education programs can promote reflection and debate on the social role of science, as well as support the inclusion of these issues in the future classroom practices of pre-service teachers.

The researchers Silva (2012) and Civiero (2016) corroborate Sbrana's (2017) argument that the STS approach and Critical Mathematics Education (CME) share similarities that enable progress toward mathematics teaching that connects scientific and technological knowledge to social problems and fosters engagement with the communities surrounding schools.

Gaffuri (2021) aimed to explore pathways for discussing the social implications of technoscience in engineering programs, particularly within mathematics courses, emphasizing their importance. The study was conducted with mathematics teachers in higher education, and the researcher proposed the following guiding question: 'What is the relationship between mathematics

education and the social implications of technoscience in the education of engineers?

Gaffuri's (2021) thesis shows that the teaching practices developed by the investigated teachers implement approaches that fail to create meaningful learning experiences for students. Although the context is engineering programs, instruction relies primarily on mechanical calculations and formulas, aligned with a model of technical rationality and the application of content, as can be seen below:

> […] the teaching practice of mathematics teachers in engineering programs still centers on traditional methodology, with the resolution of exercises aimed at understanding concepts and the contextualization of knowledge serving mainly as a form of motivation or as a demonstration of utilitarian mathematics. It is noted that, for these teachers, the concept of technology is reduced to the use of software as teaching tools, that is, for methodological purposes (Gaffuri, 2021, p. 116).

We observe that, by proposing practices based on methods that isolate mathematical knowledge from other fields, teachers ultimately reinforce a form of teaching that presents it as unquestionable. This constitutes a conception that runs counter to the principles of Critical Mathematics Education (CME) and STS Education, which are essential for the development of critical thinking and for the education of citizens capable of making informed decisions based on their own questioning.

In this regard, Gaffuri (2021) highlights that, in order to break with this conception, mathematical knowledge—articulated with technoscientific knowledge—becomes a powerful means of fostering an education committed to social development.

According to Silva (2012), Civiero (2016), and Gaffuri (2021), mathematics is a socially constructed science whose investigation should be holistic and oriented toward its application in society and technological development. Going beyond ready-made formulas, '[…] modern mathematics education presents mathematics as an indispensable tool for understanding nature and for the realization of all technological projects, while also valuing it in its pure form' (Skovsmose, 2014, p. 75).

Gaffuri (2021) reflects on the need to implement teaching practices that go beyond technical dimensions and enable dialogue with social and human aspects. The author also emphasizes the urgency of incorporating interdisciplinary experiences across different course subjects and suggests the use of seminars that promote the articulation of the mathematical models employed. In doing so, a process of practical engagement with the principles of Critical Mathematics Education (CME) is initiated.

In turn, Henrique's (2021) study aimed to understand the multiple dimensions of teaching knowledge currently under discussion. It primarily addressed the initial education of mathematics teachers and the historical and social processes that have shaped the current configuration of this field, investigating how such knowledge relates to the STS field (CTSA). Through a bibliometric analysis, the author mapped the geographical and temporal profile of researchers and research lines, also providing an important theoretical and historical reference base.

The researcher also highlights the importance of ensuring that, in the initial education of pre-service mathematics teachers, the knowledge provided incorporates the STS (CTSA) approach. This is intended to promote the development of critical thinking, interdisciplinarity, and reflection. He further emphasizes that, in order to foster transformation in pre-service teachers, these forms of knowledge must be widely debated in their different conceptions and analyzed from multiple perspectives (Henrique, 2021).

Silva (2012) and Civiero (2016) corroborate Henrique's (2021) claims by pointing out that the concepts of STS and Critical Mathematics Education (CME) share very similar objectives in the educational field, as they seek to enable students to reflect, discuss, understand, and feel encouraged to participate and make decisions in the situations they encounter in the society in which they are embedded.

> Mathematics Education, in its reflective sense, seeks to contribute to preparing students for the exercise of citizenship by establishing mathematics as a science that analyzes socially relevant critical characteristics, thereby fostering an understanding of the world and the society in which students are situated, and equipping them with the means to reflect on and transform their reality (Henrique, 2021, pp. 114–115).

These concepts encourage students to become protagonists of their own learning, to conceive the process of dealing with everyday situations, and not merely to accept curricular content transmitted by teachers or to view teaching solely as a process of content transmission.

STS Education understands science as a movement socially constructed through human activities. This perspective converges with the ideas of Ole Skovsmose (2013, 2014), who recognizes that mathematical knowledge is neither neutral nor isolated, but rather constituted through the various social practices present in human activities and articulated with scientific and technological contexts.

With regard to teacher education, Henrique (2021, p. 130) argues that, although the concepts of STS and Critical Mathematics Education (CME) are closely related, '[…] in teacher education, from the perspective of current legislation, there is relative proximity in their guidelines, yet they still seem distant from the reality of classroom practice in many institutions […]'. In other words, it remains necessary to develop activities capable of modifying, expanding, and reconfiguring the curricula of Mathematics Teacher Education programs in order to bridge the gap between legislation and teaching practice in higher education institutions.

Based on the studies by Silva (2012), Civiero (2016), Sbrana (2017), Gaffuri (2021), and Henrique (2021), we observe that, although educational legislation outlines pathways for teacher education programs to prepare teachers capable of fostering critical and reflective citizens, a formative model still persists that conceives mathematics as static and consolidated knowledge, detached from other fields of knowledge. This reflects a teacher education process that remains deeply rooted in the assumptions of technical rationality.

CONCLUSIONS

Revisiting the objective outlined for this study—namely, to analyze theses and dissertations related to Science, Technology, and Society (STS) in the initial and continuing education of teachers who teach mathematics—reveals a limited number of studies addressing this theme in relation to mathematics teacher education.

Although there is a considerable body of research on STS Education, few studies explore its relationship with mathematics, with most research concentrated in the Natural Sciences (Chemistry, Physics, and Biology). Even among the studies identified in the field, there is a predominance of case studies focused solely on basic education, which highlight possibilities and applications of mathematics teaching linked to STS-related content.

The findings highlight the importance of conducting research and promoting reflection on the initial teacher education process in Mathematics Teacher Education programs, as these are the professionals who will teach mathematics in the final years of elementary education and in secondary education and, therefore, must be equipped with elements that enhance the quality of teaching.

It is thus reinforced that initial teacher education should incorporate elements that engage with STS Education, rather than focusing solely on pedagogical knowledge and/or pure mathematics. Accordingly, it is necessary to develop formative activities throughout teacher education programs that aim to promote changes in the professional practices of future teachers.

This discussion is justified in order to enable pre-service teachers to understand that advances in science and technology are inseparable from the human condition, that these activities carry sociocultural implications, and that such interrelationships must be addressed and contextualized in school settings.

Students' participation in the problems proposed in class represents an important step toward fostering a democratic and critically aware form of education, one that stimulates learning and, consequently, promotes improvements in mathematics teaching as well as in other related disciplines.
Therefore, it is expected that the principles of STS Education, integrated with mathematical knowledge through Critical Mathematics Education (CME), will be incorporated into the curricula of Mathematics Teacher Education programs, so that they can resonate in the classrooms of basic education.

A ABORDAGEM DA EDUCAÇÃO CIÊNCIA, TECNOLOGIA E SOCIEDADE (CTS) NA FORMAÇÃO DO PROFESSOR DE MATEMÁTICA: UM RECORTE SOBRE OS ESTUDOS PROPOSTOS

RESUMO

Neste artigo procuramos analisar teses e dissertações relacionadas à Educação Ciência, Tecnologia e Sociedade (CTS) na formação inicial e continuada do professor que ensina Matemática. O procedimento adotado foi a Revisão Narrativa de Literatura (RNL). Ancorados em Pinheiro (2010; 2022), Skovsmose (2013; 2014) e Brasil (1996; 2018), ficou reforçada a necessidade de repensar, assim como de refletir nos processos formativos dos licenciandos em Matemática e dos professores que ensinam Matemática relacionando-os com a Educação CTS e com o desenvolvimento da Educação Matemática Crítica (EMC). Nas pesquisas realizadas para este artigo, apontam-se discrepâncias entre os conceitos exigidos pela legislação educacional para "formar cidadãos críticos" e o ensino da disciplina de Matemática na educação básica. Foi verificado que nos cursos de ensino superior pesquisados, ainda persistem, no ensino de Matemática, aulas mecânicas e sem diálogo com as outras disciplinas do contexto humano e social. Aponta-se a Educação CTS como uma alternativa para complementar os conteúdos descritos no currículo.

PALAVRAS-CHAVE: Educação CTS. Educação Matemática Crítica. Formação de professores.

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