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Mathematics Education in Field Education Contexts

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Abstract: *This article approaches the relationship between mathematics education and field education, based on the academic production of the research group on mathematics education in field education contexts (Gpemce) created in 2008 at the Federal University of Pernambuco. After presenting the repercussions and lines of research of the group, we reflect on the roots and principles of field education and some approximations of this domain with mathematics education. Then, we present a documentary study, whose corpus consists of 20 articles published in journals by researchers from Gpemce from 2009 to 2020. These articles are organised around four thematic categories that are associated with the research lines of the group: teaching and learning mathematics in field education contexts; relationships between curriculum contents, mathematical practices and productive field activities; resources in the teaching of mathematics in field schools and qualification of mathematics teachers of schools in field areas. The study highlights the diversity of educational subjects, themes, and sociocultural contexts contemplated in the research, and points out ways to conduct new investigations that contribute to deepen our understanding of the teaching and learning of mathematics in field schools and initial and continuing teacher education in field education contexts.*

Keywords: Mathematics education; Field education; Mathematics teaching and learning; Field teacher education.

Introduction

Field Education expresses an achievement of the peoples of the Brazilian field areas who, represented by the field social movements, claim the right to education and protagonism in the teaching and learning processes through the recognition of their histories, knowledge, cultures, ways of life, work, and production. As stated in Decree No. 7.352 (2010), which provides for field education policy, rural peoples are family farmers, extractives, artisanal fishermen, riverside dwellers, settlers, and campers of agrarian reform, rural workers, *quilombolas*, (traditional coastal-area peoples), forest people, caboclos and other

people and peoples who inhabit, work, and produce working and living conditions in the rural areas.

Caldart's (2012) definition of field education emphasises that:

Field education names a phenomenon of the current Brazilian reality, played by rural workers and their organisations, which aims to focus on education policy from the social interests of field communities. Objective and subject to refer to the issues of work, culture, knowledge and social struggles of field people and the clash (class) between field projects and between logics of agriculture that have implications for the project of country and society and the conceptions of public policy, education, and human formation. (p. 259)

Research on field education (Lima, 2014; Molina, 2017; Caldart, 2019) points out the challenges for its implementation in schools located in field areas and/or that serve the population who live in field areas. Another examples of the questions faced are the financial investments and the implementation of initial and continuing teacher education actions. However, the same research shows the strength of a movement that emerges from field communities, schools, and universities, among other educational spaces, to strengthen field education as a national public policy based on democratic principles, that defends free, secular, and socially referenced quality public education for field peoples.

The creation in 2010 of the *Fórum Nacional de Educação do Campo* (National Forum for Field Education - FONEC) as an important space that brings together teachers, researchers, and representatives of field social movements throughout Brazil; the nuclei, such as the *Núcleo de Pesquisa, Extensão e Formação em Educação do Campo* (Center for Research, Extension and Education in Field Education - NUPEFEC) UFPE created in 2012, observatories, committees, state and municipal forums, and research groups in universities are all among the initiatives to strengthen field education. These collectives reflect, discuss, follow, and seek to understand the implementation of public field education policies, as well as the teaching and learning processes of the various areas of knowledge in field schools.

Our article analyses a part of this history based on the publications of the researchers of the Gpemce - *Grupo de Pesquisa em Educação Matemática nos Contextos da Educação do Campo* (2020) (Research Group on Mathematics Education in the Contexts of Field Education) that was created in 2008 linked to the Postgraduate Program in Mathematics and Technological Education (EDUMATEC), implemented this same year at the UFPE Education Center. A pioneer in the development of research that relates mathematics education and field education, Gpemce is comprised of three lines of research:

- *Mathematics teaching in field education contexts*: investigates the teaching and learning processes of mathematics in field schools and the relationships between mathematical contents, mathematical practices, and productive field activities;
- *Resources in the teaching of mathematics in field education contexts*: investigates theoretical and methodological aspects associated with didactic and pedagogical processes in field realities, and seeks to develop didactic resources aimed at teaching mathematics in field schools;
- *Teacher education that teaches mathematics in field education contexts*: investigates the initial and continuing education processes of field teachers in mathematics, aiming to contribute, through research, to strengthen the relationship between university, school, and field.

The plurality of aspects of the relationship between mathematics education and field education provided by these lines bring together researchers from UFPE, other Brazilian universities and foreign institutions, strengthening academic exchange and deepening studies on the themes researched. The maturation of debates, reflections, and research development provides seminars and publications in book chapters, proceedings of scientific events, and journals. In 2014, Gpemce published a special edition of *Revista de Educação Matemática e Tecnológica - Em Teia*, aimed at contributing to the dissemination of national and international research and reflections with interfaces between field education and mathematics education.

The academic production of Gpemce motivated us to conduct a documentary study focusing on articles published in journals, taking as its starting point the year 2009, when the first article was published. With this study, we want to answer the following question: What aspects of the relationship between mathematics education and field education are evidenced by articles published by researchers from Gpemce in journals in the period 2009-2020?

With this study as the central theme of this article, we initially present a reflection on field education and then on mathematics education, highlighting some elements of approximation between these two domains of teaching and research.

Field education: roots and principles

Field Education brings together principles and fundamentals of popular education that, as Hage and Corrêa (2019) emphasise, are opposed to the model of field education established in Brazil in the 1930s, which is characterised by hegemony, hierarchy, fragmentation, prejudice, and exclusion for a long time imposed on fields. Teaching with these characteristics adopts among its assumptions that peasants must be “fixed” in the rural areas and, as teaching is “universal,” the specificities of the field must be ignored.

Contrary to this archaic and perverse model of education, field education is based on Paulo Freire's studies, mainly on his writings in the book *Pedagogy of the Oppressed* (Freire, 1987), and assumes that educational subjects are protagonists of their stories and lives. Thus, the acts of teaching and learning should be questioned, with the critical perspective as one of its primary foundations.

Caldart (2019) highlights the *struggle of the collective subjects, field agriculture, and the conception of education for emancipatory purposes* as the three supporting roots of field education. The collectives, which is the first root, bring together not only the field peoples and the representatives of their social movements, but also a diversity of subjects and organisations around the field people's struggles for the right to land and education.

The field education (EdoC, in Portuguese) is therefore not an association of people, but of collectives or organisations of workers of different types, formats. It is the organised and struggling field people who build the main identity of the EdoC. But their struggle dynamics, which became also educational practices in common, soon was configured to welcome other subjects, not always originally from the field: people, groups, collectives, institutions of higher education, who assume the cause of the EdoC and are part of its construction. (Caldart, 2019, p. 61).

Universities also integrate those collectives and seek to contribute to a better understanding of field people education as a phenomenon of the Brazilian reality. The second root highlighted by Caldart (2019) is field agriculture, which has as one of its foundations the production of food with respect to the ways of life, work, and production of the field population. The various collectives of field education, from agroecological bases, strive to ensure food sovereignty and quality of life of families, against the field model anchored in the conception of agribusiness. The third root is the conception of education for emancipatory purposes, a conception that permeates field education that goes beyond the ideas of access

and permanence in school, which have their relevance in themselves, to glimpse the experience of educational practices that oppose the mechanisms of oppression, exploitation and discrimination of field peoples. For collectives, the purpose of education based on this conception “is the fullest development of the human being and their critical, creative and transformative insertion in the society in which they live” (Caldart, 2019, p. 69).

The field school that adopts this conception of education observes the interests of field families from different territories¹ who use the resources of nature to practice agriculture and other modes of production in the field without, however, exploring the environment. As recommended in Decree-Law No. 7.352 (2010), which provides for field education policy and the Education Program in Agrarian Reform (PRONERA), one of the principles governing field schools is respect for the field diversity. Therefore, it is necessary that the specificities of each territory are recognised and valued in the teaching and learning processes in all areas of knowledge worked in school, including mathematics. This is the center of interest of Gpemce that studies and researches the relationships between mathematics education and field education.

Mathematics education and some approximations with field education

Mathematics education can be defined as an encounter between education and mathematics, in dialogue with other areas of knowledge such as anthropology, sociology, psychology, and philosophy. Mathematics in this domain does not have an end in itself and, thus, is not neutral, because it influences the lives of people and society. Indeed, international and national research have shown the diversity of aspects that highlight the political, social, and cultural dimensions related to the teaching and learning processes of mathematics. Among the research domains that have aroused the interest of researchers, we highlight ethnomathematics (D'Ambrosio, 1990; 2018; Knijnik, 2012, 2014) and critical mathematics education - CME (Skovsmose, 2001, 2008, 2014).

¹ The field peoples' territories have multidimensional specificities in the material and immaterial spheres. (Fernandes, 2013).

Ethnomathematics is dedicated to understanding the mathematics that permeate the realities of people and their cultures, seeking to relate them to school teaching, and its pedagogical implications. This way of thinking about mathematics, Knijnik (2012, 2014), influenced by Wittgenstein's (1991) philosophical basis, calls it an *ethnomathematical perspective* because it allows "analysing the mathematical language games of different forms of life and their family similarities, as well as the Eurocentric discourses of academic and school mathematics and their effects of truth" (Knijnik, 2012, p. 90).

Critical mathematics education is a field of research that originates in several concerns about the relationship between mathematics and its teaching. In other words, Skovsmose (2014) questions, on the one hand, the social purposes of mathematics and, on the other, seeks to understand the extent to which criticism guides the mathematics teaching and learning processes. To support his studies, he uses Freire's sense (Freire, 1987, 1996), with emphasis on problematisation and dialogue, as means of teaching and learning, as well as on the principles of the critical theory (Assoun, 1989), as a way of questioning the world. Thus, the CME aims to contribute to critical reflection on the teaching of mathematics, either in a more restricted scope, such as the use of digital information and communication technologies, or in a broader perspective, such as the concepts of democracy and social justice and their implications for teaching and learning mathematics.

The consolidation of the work in both domains, among others, is increasingly visible and point to the relevance of teaching the mathematical contents associated with the realities of students and the aspects that are relevant to economic, political, and sociocultural contexts. The possibility of relating school and academic mathematics to these dimensions is consistent with the principles of field education, which, as we said, adopts dialogue and criticism as fundamental elements for understanding the world and social transformation.

The breadth of possibilities that open up on this topic and the need to understand how mathematics has been taught and learned in field education contexts. Thus, at the heart of this article are the productions that represent the confluence of the interests of the group by the theme, materialised in their publications.

Organisation of the documentary study

The documentary study aimed to organise and analyse the research carried out in Gpemce that contemplated aspects inherent to the teaching and learning processes in field schools, including the resources used by teachers, the relationship between university, school and field communities and field school teacher education.

The *corpus* of the study consists of articles published in journals from January 2009 to July 2020. The first stage of the research consisted of identifying the articles from a search of the curricula of Gpemce researchers registered on the Lattes Platform of CNPq (National Council for Scientific and Technological Development). The search was guided by the analysis of titles, abstracts and keywords to identify whether the articles addressed the relationship between mathematics education and field education. This stage of analysis resulted in the selection of 20 articles.

In the second stage, we read the full articles, which allowed the construction of four categories linked to the relations between mathematics education and field education worked in Gpemce:

(1) *the teaching and learning of mathematics in field education contexts*: includes articles that address more generally the processes of teaching and learning in field schools;

(2) *relationships between mathematical contents, and productive field practices, and activities*: includes articles that more specifically address the principles and foundations of field education and its relationships between school contents and productive field activities;

(3) *resources in the teaching of mathematics in field schools*: includes articles that specifically problematise the concept of resource and its uses for teaching mathematics;

(4) *field school teacher education*: includes articles that present research on initial and continuing field teacher education.

It is important to note that while recognising that the research presented in the articles is linked to different theoretical and methodological frameworks, we did not consider this aspect in the categorisation.

In this study, we focus our interest on aspects of publications that explain the interfaces of mathematics education with the specificities of field education.

What did the documentary study reveal?

The 20 articles of selected journals were distributed in the four thematic categories as follows:

- *The teaching and learning of mathematics in field education contexts* – 3 articles: Lima and Lima (2013); Farias, Macêdo, and Monteiro (2014); Menezes (2014);
- *Relationships between mathematical contents, and productive field practices and activities* - 5 articles: Alves and Monteiro (2011); Silva and Fonseca (2014); Lima and Lima (2016a); Lima and Lima (2016b); Silva and Lima (2017);
- *Resources in the teaching of mathematics in field schools* - 5 articles: Monteiro, Leitão and Asseker (2009); Monteiro, Cruz, and Alves (2012); Monteiro, Carvalho, and François (2014); Macêdo, Monteiro, and Carvalho (2016); Monteiro, Martins, Carvalho, and Queiroz (2017);
- *Field school teacher education* – 7 articles: Alcântara, Monteiro, and Lima (2014); Lima and Lima (2017); Lima and Lima (2019); Lima and Lima (2020); Lima, Lima, and Oliveira (2020); Souza and Monteiro (2020); Fernandes and Sousa (2020).

Our views on those 20 articles make up the summaries that we bring below, organised around the themes already presented.

First Theme: Mathematics teaching and learning in field education contexts

Chart 1. Articles associated with the first theme

Author(s) / (year)	Title of the Article	Publication Data
Lima & Lima (2013)	Educação Matemática e Educação do Campo: desafios e possibilidades de uma articulação	EM TEIA, v. 4, n. 3, 2013. Available at: https://periodicos.ufpe.br/revistas/emteia/article/view/2218 . Accessed on: July 10, 2020.
Farias, Macêdo, & Monteiro (2014)	Ensinar e Aprender Matemática em uma escola do campo: o que	Contexto e Educação. Ano 29, n. 93, p. 72-107, mai/ago. 2014. Available at:

Author(s) / (year)	Title of the Article	Publication Data
	dizem alunos e professora	https://www.revistas.unijui.edu.br/index.php/contextoeducacao/article/view/3230 . Accessed on: July 10, 2020.
Menezes (2014)	Um olhar para a prática em sala de aula do professor de Matemática da escola do semiárido paraibano	EM TEIA, v. 5, n. 1, p.1-22, 2014. Available at: https://periodicos.ufpe.br/revistas/emteia/article/view/2217 . Access on: July 10, 2020.

Fonte: Plataforma Lattes do CNPq

Lima and Lima (2013) bring a theoretical essay that raises a reflection on the challenges and possibilities that permeate the relationships that can be established between mathematics education and field education. To this end, the authors seek to list some assumptions that can guide mathematics teaching anchored in the principles of field education. The essay brings historical elements of the *Movimento Nacional por uma Educação do Campo* (national movement for a field education), seeking to explain the contradiction between the foundations of field education, anchored in the perspective of human emancipation, and rural education that starts from a vertical conception that ignores the field peoples and as subjects of law, culture, and knowledge.

The first and last points of the essay are based on the field education principles (Caldart, Pereira, Alentejano & Frigotto, 2012) and critical mathematics education (Skovsmose, 2001), which allow the authors to point out some challenges that are imposed on the teacher who teaches mathematics in field schools, as well as some possibilities for the teaching of mathematics to be processed to overcome the challenges pointed out.

Farias, Monteiro, and Macêdo (2014) present an investigation carried out in 2009 with a teacher and her students of the 4th and 5th grades of elementary school, in a field school in a municipality of Agreste de Pernambuco, seeking to understand the conceptions of the participants about the field school and the mathematics teaching and learning processes. Data were produced through a semi-structured interview and class observation.

The authors emphasise that the conceptions of education of the teacher and her students, accessed through the interviews, do not include elements about the identity of the field school. The teacher's testimony expresses mainly her concern with the access and physical infrastructure of the school. The difference between the field and the urban schools highlighted by the students is restricted to the low rates of violence in field schools. Regarding the mathematics teaching and learning processes in the classes observed, the teacher did not establish relationships between the mathematical activities and the social context of the students, and the textbook she used did not bring activities that addressed the ways of life, cultures, and other specificities of the field. However, the answers in the interview reveal that the participants recognise the applicability of mathematical contents in their practices in the field.

Menezes (2014) describes in the article a research on the influence of the semiarid region in the practice of a teacher who teaches mathematics in the 8th grade of elementary school at an Agrotechnical School headquartered in the mesoregion of Borborema, in the Cariri Paraibano. The author emphasises that the school's characteristic is to meet the needs of the farmers' children, based on their realities, and the specificities of the community, guided by agroecological principles. With the development of the research, the author sought to "identify elements that characterise the teacher's intervention in this process of seeking a re-signification for mathematics contents that contemplate the specificities of field education" (Menezes, 2014, p.3). To this end, the research proposed a historical rescue of education from the colonisation period, when education was a privilege of the elite, to the regulatory framework of field education. As foundations, the research is based on studies on didactic transposition and the didactic contract (Chevallard, Bosch, & Gascón, 2001; Brousseau, 1986) to understand the didactic phenomena in the classroom observed.

The results of the research presented by Menezes (2014) show that the mathematical contents worked in those classes dialogued neither with the reality of the students, nor with the specificities of the place. Like Farias, Monteiro, and Macêdo (2014), the author also points out that textbooks, distributed nationally, do not meet the regional needs of field schools.

Those articles, whose interests are the teaching and learning processes of mathematics in field education contexts, show at least two aspects. The first corresponds to the recognition of possibilities of teaching mathematical contents, relating them to the specificities of the field. The second refers to the challenges faced for this relationship to take effect.

Second Theme: Relationships between mathematical contents, and productive field practices and activities

Chart 2. Articles associated with the second theme

Author(s) / (year)	Title of the Article	Publication Data
Alves & Monteiro (2011)	Escola Ativa: analisando os Guias de aprendizagem de matemática de 1 ^a a 4 ^a séries	TCC, Revista de Divulgação Científica do Curso de Pedagogia da UFPE, v. 2011.2, p. 1-24. Available at: https://www.researchgate.net/publication/278741556 . Access on: July 27, 2020.
Silva & Fonseca (2014)	Solidariedade no contexto laboral: práticas de numeramento como táticas de resistência de estudantes camponeses da EJA	EM TEIA, v. 5, n. 1, 2014. Available at: https://periodicos.ufpe.br/revistas/emteia/article/view/2216 . Accessed on: July 10, 2020.
Lima & Lima (2016a)	Os conteúdos matemáticos e as realidades dos alunos camponeses: que articulações são realizadas pelos professores que atuam em escolas do campo?	Revista Perspectivas da Educação Matemática, v. 9, n. 19, 2016. Available at: http://www.edumat.ufms.br/ . Accessed on: July 10, 2020.
Lima & Lima (2016b)	Elementos de uma relação entre o ensino de matemática e as atividades produtivas camponesas	Entrelaçando Revista Eletrônica de Culturas e Educação, Edição Especial, n. 10. Ano V, 2016. Available at: Access on: May 8, 2020.
Silva & Lima (2017)	Atividades matemáticas propostas por professores que ensinam na EJA campo - Ensino Médio	RPEM, v.6, n.12, jul./dez., 2017. Available at: http://www.fecilcam.br/revista/index.php/rpem/article/view/1605 . Accessed on: May 8, 2020.

Source: Plataforma Lattes do CNPq

Alves and Monteiro (2011) analyse how the *Guias de Aprendizagem de Matemática* (mathematics learning guidelines) of the early years of elementary school - published in 2005 as part of the collection of textbooks of the *Escola Ativa* (Active School) program of the Ministry of Education for multigrade schools. The books addressed sociocultural issues of the field starting from the organisation of the works by content axes. The authors emphasise the relevance of publishing a work aimed at field schools. However, one of the results of the analyses shows that the guidelines did not relate mathematical contents to themes existing in the field and that they could be treated in schools. The activities proposed that established some relationship with the ways of life of the field were restricted to agricultural plantation and animal breeding, disregarding the diversity of productive activities of the field. In addition, the authors identify images with negative stereotypes of peasants who contributed to emphasising a prejudiced view of field life.

Silva and Fonseca (2014) show in their article the numbering practices of Youth and Adult Education (EJA) field students who live in a rural community in the Agreste Pernambuco and workers in the production of clothes in jeans. Eight students aged from 16 to 55 who were assiduous both at work and in class participated in the study. To understand numbering practices, researchers are anchored in studies on ethnomathematics and adopt ethnography as a methodological approach. The authors consider numbering practices as discursive practices constituted from the different ways that young people and adults in the field deal with quantification, geometric shapes, and measurements at work and at school. In this sense, they highlight the solidarity behaviours of the participants in the development of school activities and in work activities, such as compassion when seeing tiredness and difficulties, sharing a feeling of collective indignation. This occurs in a framework of tense relationships that permeate the activity of producing clothes in those apparel manufacturers that does not meet the interests of the workers, but only the owners of the clothing industry. From the participants' narratives, the research also shows discursive practices

related to wage inequality and the collective struggle of workers for better working conditions in those apparel factories and in the field.

Lima and Lima (2016a) and Lima and Lima (2016b) present excerpts from a master's research that aimed to identify the articulation established by teachers between mathematical contents and productive field activities. The research is based on the principles of field education and the approach to critical mathematics education (Skovsmose, 2008, 2014), specially on the typology of learning environments that result from the characteristics of mathematical activities.

In Lima and Lima (2016a), the authors bring the research data produced through two instruments: (1) interviews with four mathematics teachers who taught the 8th and 9th grades of elementary school in two field schools, located in Agreste and Sertão Pernambucano and who had already participated in continuing education on field education; (2) analysis of mathematical activities students recorded in their notebooks during three of the four bimesters of the school year. In the interview, the four teachers emphasised the importance of teaching mathematics articulated with students' reality and presented possibilities of how to materialise this teaching in the classroom, although the proposed activities did not explicitly favour them to exercise criticism. The analysis of the notebooks revealed that the relationship between students' realities and mathematical contents is almost non-existent in the activities proposed. Of the 539 mathematical activities analysed, only 7 brought some aspect that could be associated with the contexts of the field.

In Lima and Lima (2016b), the authors present data from interviews with six field workers, selected from the 116 who had responded before a questionnaire aiming to identify the productive field activities they carried out in Agreste and Sertão de Pernambuco. Animal breeding, growing corn and beans, cultivating vegetables and fruits, and manufacturing clothing in factories are among the activities identified. The article brings excerpts from the interviews in which they point out situations of life and work in the field that can be used in mathematics classes, such as the costs of animal breeding and growing corn and beans.

Silva and Lima (2017) present a research that aimed to "analyse the relationships that the mathematics teachers of Youth and Adult Education- EJA Field High School establish between the concept of affine function and productive activities undertaken by field students" (Silva & Lima, 2017, p. 246). This objective was based on the hypothesis that teaching the affine function from the reality of the field people could contribute to a better understanding of facts of social practice. To this end, the authors make an approximation between field education and critical mathematics education, considering that the two approaches are anchored in the Freirean sense of education and teaching. The data presented in the article were produced from a questionnaire on the teachers' education and professional profile, semi-structured interviews, and 17 activities developed by the seven teachers who participated in the research, from a graph they were given that represented the affine function defined by $y = x - 2$. From the results, we highlight the relationship between the concept of affine function and situations that are relevant to the realities of field communities in which they operate, activities that were also the object of study of this research. Of the 17 activities the teachers developed, 12 are associated with what Skovsmose (2008, 2014) classifies as reference to a semi-reality, i.e., that work situations that do not correspond to the real life of those who solve it. Those results led the authors to consider that for the teachers investigated, teaching the affine function requires a contextualisation regardless of whether it is linked to the realities of students, in this case, field workers of the EJA school modality.

Four of the five articles associated with the relationship between mathematical contents, practices, and productive field activities bring results of research conducted in communities of Agreste and Sertão Pernambucano. The authors emphasise that the mathematical activities analysed rarely include the field workers' specificities. Those results are in line with those obtained by Alves and Monteiro (2011) when they analysed the Guias de Aprendizagem de Matemática (Mathematics Learning Guides) within the framework of the Active School Programme.

Third Theme: Resources in the teaching of mathematics in field schools

Chart 3. Articles associated with the third theme

Author(s) / (year)	Title of the Article	Publication Data
Monteiro, Leitão, & Asseker (2009)	Ensinando matemática em contextos sócio-culturais de educação	Horizontes, v. 27, n.1, p. 69-78, jan./jun. 2009. Available at: https://www.researchgate.net/publication/272788478 . Access on: 27 Jul. 2020.
Monteiro, Cruz, & Alves (2012)	O que dizem os pais sobre o ensino e a aprendizagem de Matemática em escolas rurais	Roteiro, v. 37, n. 1, jan./jun., 2012. Available at: https://portalperiodicos.unoesc.edu.br/roteiro/article/view/1060/pdf . Accessed on: July 10, 2020.
Monteiro, Carvalho, & François (2014)	What field school teachers say about the teaching of mathematics: A study in the Northeast of Brazil	Latinoamericana de Etnomatemática vol. 7 n. 1, fev./abr, 2014. Available at: http://www.redalyc.org/articulo.oa?id=274030901001 . Accessed on: July 10, 2020.
Macêdo, Monteiro, & Carvalho (2016)	Recursos para ensinar matemática em escolas do campo: perspectivas discentes	Tema, v. 16, n. 26/27, jan./dez., 2016. Available at: http://revistatema.facisa.edu.br/index.php/revistatema/article/view/789/pdf . Accessed on: May 8, 2020.
Monteiro et al. (2017)	Acesso e utilização de recursos no ensino de Matemática por professores de escolas do Campo	REMATEC, Ano 12, n. 25, mai./ago. 2017. Available at: https://www.researchgate.net/publication/320863467 Access on: May 8, 2020.

Source: CNPq Plataforma Lattes

Monteiro, Leitão, and Asseker (2009) present part of a study that aimed to identify teachers' conceptions about the use of resources in mathematics teaching in field education contexts. For this, the research is based on the conceptions of resources (Adler, 2000) and field education (Arroyo, Caldart, & Molina, 2004). Data presented in the article were produced through a semi-structured interview with three teachers who worked in two field schools in a municipality of Agreste of Pernambuco. For the authors, the teachers' answers gave few indications of their conceptions of resources and the possible relationships to be established between them and the specificities of field education and how they could favour the mathematics teaching and learning processes.

Monteiro, Cruz, and Alves (2012) present in the article the views of parents and/or guardians of students from two rural schools located in Agreste, Pernambuco, on the teaching and learning of mathematics in rural schools² and resources teachers used. The authors refer to the studies of the movement of national articulation for field education and the relationship with family and school. The research data were produced from an interview with 17 parents and/or guardians of students from both schools, who answered the following questions: How do parents understand the mathematics contents taught to their children in field schools? How do parents guide their children to study mathematics? What do parents understand as resources for teaching and learning mathematics? The authors' analyses reveal the interviewees' concern with their children's school education and their zeal for attendance and continuity in school. They also indicate material resources that can be used for teaching and learning mathematics, but go beyond their responses when pointing out cultural and human aspects. The interactive dimension, the relationship of affection, the dialogue between teacher and student, and the participation of parents in school routine are among the resources cited by the interviewees.

Monteiro, Carvalho, and François (2014) present a study that analysed the discourse of 12 teachers who taught in multigrade classes of 4 field schools based in Caruaru, Agreste de Pernambuco, about the practices adopted and the resources they used to teach mathematics and the relationship with field education. For this, the authors rely on studies that address mathematics education in field schools (Knijnik, 2004; Garnica & Martins, 2006) and the design of resources to teach mathematics, considering cultural diversity and its complexity (Adler, 2001, 2000, 1999). The researchers conducted a semi-structured interview whose script contained broad questions about education and specific questions inherent to teachers' understanding of field education, the concept of resources and use in mathematics teaching. The results presented in the article show that the teachers did not yet know the principles of field education and, consequently, did not differentiate the characteristics of one field school from another

² The authors use the expression "Rural School" instead of "Field School". However, we observe the relevance given in the text to the "rural" as a place of life and culture of field workers, a characteristic that is typical of field education.

in the town. Regarding resources, the teachers' answers point to the relevance of material resources as a means of facing the challenges of teaching mathematics.

Macêdo, Monteiro, and Carvalho (2016) present a study carried out with 23 students of the 4th and 5th grades of elementary school, aged 8 to 12 years, from two field schools located in Agreste de Pernambuco. The study sought to identify the characteristics of the two schools from the point of view of the students, and the resources they use in mathematics classes. The authors based the study on Adler's (2000) conception of resources and Caldart's (2012) conception of field education. For this, they conducted a semi-structured interview with questions about mathematics teaching, the resources used in mathematics classes and about the school identity. In the students' responses, the researchers did not identify aspects that allowed them to characterise the field schools. Regarding the resources they use in mathematics classes, the students pointed out the predominant use of chalk board. Based on those results, the researchers highlight the importance of continuing education actions for field teachers that address topics such as the use of resources to teach mathematics.

Monteiro, Martins, Carvalho, and Queiroz (2017) present results of a survey conducted in 2013 with 104 teachers, among the 115 who taught in the early years (1st to 5th grade) of Elementary School in 23 field schools of the Municipal Education Network of the Municipality of Igarassu in Pernambuco. The research analysed teachers' access to resources to teach mathematics and its use and was anchored in discussions about mathematics teaching in field schools and the conceptualisation of resources (Adler, 2000). The teachers answered a questionnaire composed of 25 items organised in seven parts: identification, training, professional performance, knowledge about the conception of field schools, relationship with the teaching of mathematics, use of resources for teaching mathematics, and use of textbooks. The results the authors presented in the article deal only with the use of resources for teaching mathematics at the level of education in focus. Teachers point to a variety of resources and recognise the importance of using them in the classroom. However, the emphasis given by most teachers is on material resources.

Articles about resources in mathematics teaching in field schools deal with various aspects of this theme, ranging from the teachers' and students' conception, access, and use to teachers' conceptions about resources and the relationship with field education. The results presented converge on the difficulties faced, especially by teachers, in understanding the concept of resources that tend to associate them only with the material ones. The challenges imposed on the teaching of mathematical contents based on the realities of educational subjects and the specificities inherent to the field population also converge.

Fourth Theme: Mathematics teacher training of field schools

Chart 3. Articles associated with Theme 4

Author(s) / (year)	Title of the Article	Publication Data
Alcântara, Monteiro, & Lima (2014)	The qualification of educators of ProJovem Campo – Saberes da Terra and the teaching of statistical content	Boletim GEPEN, n. 65, jul./dez., 2014 Available at: https://www.researchgate.net/publication/274250102 . Accessed on: July 10, 2020.
Lima & Lima (2017)	Formação de professores de Matemática na Licenciatura em Educação do Campo: um olhar sobre as pesquisas	REMATEC, Ano 12, n. 25, mai./ago. 2017. Available at: http://www.rematec.net.br/index.php/rematec/article/view/99 . Access on: May 8, 2020.
Lima & Lima (2019)	Diálogo, investigação e criticidade em um curso de Licenciatura em Educação do Campo	Revista de Matemática, Ensino e Cultura, 2019. http://www.rematec.net.br/index.php/rematec/article/view/204 . Access on: May 8, 2020.
Lima, Lima, & Oliveira (2020)	Diversidade, investigação e emancipação humana como princípios da formação de professores de matemática em cursos de Licenciatura em Educação do Campo	Revista Educação Matemática Pesquisa, v. 22, p. 731-752, 2020. Available at: https://revistas.pucsp.br/emp/article/view/45259 . Accessed on: July 10, 2020.
Lima & Lima (2020)	A Pedagogia de Alternância em Cursos de Licenciatura em Educação do Campo que formam Professores de Matemática	Revista UNIÓN (San Cristobal de la Laguna), v. 58, p. 11-24, 2020. Available at: https://union.fespm.es/index.php/UNION/article/view/150/22 . Accessed on: July 10, 2020

Author(s) / (year)	Title of the Article	Publication Data
Souza & Monteiro (2020)	Understanding about graphs by field school teachers	<u>Revista Zetetiké, Campinas, SP, v.28, 2020, p.1-19.</u> <u>https://doi.org/10.1590/s1517-97022015041858</u> . Acesso em: 10 July 2020
Fernandes & Sousa (2020)	Desenvolvimento curricular e a dimensão sociocultural em uma disciplina de funções na Licenciatura em Educação do Campo	Education In Re-Vista, v.27, n.2, p.500-518, 2020. http://www.seer.ufu.br/index.php/emrevista/article/view/54058 . Access on: July 10, 2020.

Source: CNPq Plataforma Lattes

Alcântara, Monteiro, and Lima (2014) discuss a research that investigated the formation of teachers who taught the areas of natural sciences and mathematics in the ProJovem Campo - Saberes da Terra programme in Pernambuco. The programme was an initiative of the Secretaria de Educação Continuada, Alfabetização, Diversidade e Inclusão (Secretariat of Continuing Education, Literacy, Diversity, and Inclusion - SECADI) of the Ministry of Education. The research was conducted with teachers of the Curso de Aperfeiçoamento em Educação do Campo (course of improvement in field education), held in the Pedagogy of Alternation offered by UFPE. The article focuses in particular on the training and professional profile of the 124 participating teachers and on some elements of initial and continuing education on the teaching of statistical content in the final years of elementary school that were collected through a questionnaire. The research was anchored in the principles of field education and teaching statistics. The authors emphasise that the initial education of 75% of the teachers included the teaching of statistical content, although only 35% remembered some of the content studied. Considering that 91% of the teachers had attended a degree in biology or mathematics, the researchers highlighted the relevance of initial and continuing education actions to address statistics, since the contents of this area have repercussions on the social practices of field school students.

Lima and Lima (2017) present a literature review on the education of mathematics teachers in field education teaching degree courses (LEdoC - *licenciatura*), delimiting the period from 2007 to 2016. The

research *corpus* consisted of six papers published in the proceedings of four editions of ENEM (National Meeting of Mathematics Education), two dissertations and one thesis published in the *Catálogo de Teses e Dissertações* (Catalog of Theses and Dissertations) of CAPES (Coordination for the Improvement of Higher Education Personnel). With the study, the researchers sought to understand the aspects of mathematics teacher education in LEdoC inserted in the research and what their findings evidenced. The article brings a reflection on the education of mathematics teachers in field education degree courses and addresses field education and rural education as projects in dispute in Brazilian education. The results of the analysis presented in the article show some challenges and potentialities inherent to the implementation of LEdoC courses in higher education institutions. Among the challenges are the guarantee of the functioning of the courses, especially regarding public investments and the implementation of curricular proposals that relate the mathematical and pedagogical knowledge of the fields, in order to favour an emancipatory formation.

Lima and Lima (2019) present a research whose objective was to understand the relationship established by LEdoC teacher educators between mathematical contents and the political, social, and cultural dimensions of the field people (Lima, 2018). The article addresses the concepts of dialogue, research, and criticism within the meaning of critical mathematics education (Skovsmose, 2001, 2014), seeking to relate them to field education in the context of mathematics teacher education in LEdoC. The authors present excerpts from an interview with three teacher educators of a LEdoC course, whose analysis indicates that the concepts of dialogue, research, and criticism are present in the formation of future mathematics teachers in that specific context. The results obtained in the research are pointed out by the authors as indicators of the "possibility of graduating mathematics teachers by establishing a close relationship between mathematics contents and the realities of educational subjects in field education contexts" (Lima & Lima, 2019, p. 77).

Lima, Lima, and Oliveira (2020) and Lima and Lima (2020) discuss mathematics teacher education in LEdoC and refer to field education and critical mathematics education studies. The focus of the first article is on identifying elements that are constituted as principles of mathematics teacher education at

LEdoC. Therefore, they rely on excerpts from the responses of five teacher educators who worked in two courses, obtained through semi-structured interviews. To analyse those responses, the authors considered the following thematic categories: *respect for diversity as a formative principle*, *investigation as a formative principle*, and *human emancipation as a formative principle*. For the authors, the teachers' answers bring elements that allow them to affirm that those principles are contemplated in the formation of teachers in the courses investigated and that this is provided, mainly, by the fact that they are organised and experienced from the perspective of the Pedagogy of Alternation that contemplates formative times in the university and in the communities where the undergraduates reside.

The central argument of the second article, developed by Lima and Lima (2020), is the role of the Pedagogy of Alternation in LEdoC Courses. To feed the reflection, the authors are anchored in the interviews given by three coordinators of the courses. The coordinators' responses were analysed in the light of three thematic categories: *the dialogical relationship between community time and university time*, *research as a training instrument*, and *criticism as a training instrument*. The authors emphasise that the results of this study confirm the materiality of alternation in the organisation of the courses and highlight the important role it plays in the realisation of the actions of time community, insofar as it favours the close relationship between the educational institutions, the teacher trainers, and in formation, and the field communities.

Souza and Monteiro (2020) present a research on the understanding of statistical graphs and the relationship between statistical literacy and field education by teachers who teach mathematics in the final years of elementary school in public schools in the field of a municipality of Zona da Mata Norte de Pernambuco. For this, the research adopts as theoretical framework the discussions of Caldart (2012) and Molina (2012) on field education, and Cazorla, Kataoka, and Silva (2010), and Gal (2002) on statistical literacy. The authors discuss the data produced through a semi-structured interview with three teachers from different schools on the relevance of working with statistical education, in particular the interpretation of graphs from the perspective of statistical literacy. They also present teachers' reflections in two workshops held in continuing education meetings. The results obtained from the research show

some gaps intrinsic to the relationship between theoretical and practical concepts on field education and difficulties that can be associated with the lack of knowledge necessary for the interpretation of data expressed in statistical graphs. The analysis of the teachers' reflections in the workshops reveals that the interpretation strategies they used were based on obtaining the average value referring to the data in the graph. The authors also emphasise that continuing education workshops provided an interactive environment of knowledge, exchanges of experiences, and opportunities for reflection on statistical literacy and the conception of field education.

Fernandes and Sousa (2020) present an excerpt from a doctoral thesis developed within the framework of a research-driven degree course in field education (*bacharelado*). In the article, they propose to “discuss and understand the curriculum development of a discipline on functions, in which sociocultural aspects related to the field population were mobilised and problematised” (Fernandes & Souza, 2020, p. 503). To achieve this goal, they refer to studies on the curriculum in higher education and mathematics teacher education in the context of field education. The research data were produced in the discipline *Funções e suas Aplicações no Campo Agrário* (Functions and their Applications in the Agrarian Field) taught by one of the authors to forty-five students of that course. Among the results obtained, the authors highlight that the teacher's intention to address functions relating them to the specificities of the field, an aspect that was not provided for in the syllabus, produced successful results insofar as it led students to become aware of the relationship of mathematics with their realities and to reflect on aspects beyond mathematics, such as the sociocultural dimension.

The research that gave rise to the articles presented in this theme highlights, on the one hand, the importance of the implementation of initial and continuing education actions aimed at field school teachers, insofar as they are designed and structured to contemplate the specificities of field territories in relation to mathematical knowledge. On the other hand, they confirm the challenges faced by teachers in the materialisation of such relationships in formative practices, while indicating that overcoming such challenges is a constant search by several teachers investigated.

Conclusion

The discussion of the 20 articles published in journals by researchers from Gpemce highlights the consolidation of the group as a research space on mathematics education and field education. These domains have been addressed in the group with a diversity of participants, such as fields from Agreste and Sertão de Pernambuco municipalities, teachers and students from elementary schools, teachers and students from youth and adult education in the final years of elementary school and high school, and teachers in initial and continuing education.

Diversity is also revealed in the themes that constitute the research lines that include the teaching and learning mathematics in field education contexts; relationships between mathematical contents, mathematical practices, and field productive activities; resources in mathematics teaching in field schools, and the qualification of field schools mathematics teachers.

Organising the documentary study on our own productions allows us to recognise the achievements in terms of our understanding of the relationships between mathematics education and field education and the contributions that the results of research point to the educational and academic communities that are dedicated to this study. The study also points out ways we can follow to answer questions that remain open, for example, about a better understanding of the territories that constitute the Brazilian field people, so as to subsidise the production of didactic resources for field schools and public policies for teacher education.

In the current Brazilian context, the crisis caused by the Covid-19 pandemic raises the need to develop new research that addresses, beyond the political and sociocultural aspects, the impacts of health issues on field populations. Field schools - that already face precariousness and slowness in the implementation of public policies provided for in the regulatory frameworks of field education - are challenged to also face the worsening resulting from the pandemic, such as the advent of remote education without the necessary minimum structural and formative conditions.

Therefore, Gpemce feels, too, challenged to contribute to addressing sanitary issues that affect Brazilian educational policies, from the discussions in the collectives that represent one of the roots of the Field Education Movement and the development of actions in dialogue with the Mathematics Education Movement.

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