

State of the art of research groups in Mathematics Education from the perspective of Historical-cultural theory in the Brazilian context

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Abstract: This article is part of a doctoral research that had as its central question: "What are the contributions of the Historical-Cultural Theory to Mathematics Education and what elements enhance it to configure it as a teaching trend in the Brazilian educational context? (Gomes Novaes, 2022). To this end, the objective was to identify and map the research groups registered in the Directory of Research Groups in Brazil (DGP) that have as objects of study the teaching and learning of mathematics based on the Historical-Cultural Theory. The study has a qualitative approach, historical-bibliographic and analytical-descriptive character, and a methodological design of the State of the Art type. The analysis of the 32 research groups, found in the investigation, are consolidated in terms of time of existence, lines of research and variety of themes researched, which is configured as a potentiating element for the existence of a Historical-cultural teaching Trend in the field of Mathematics Education in Brazil.

Palavras-chave: State of the art; Historical-cultural theory; Mathematics Education teaching tendency.

Estado da arte de grupos investigativos na Educação Matemática sob a perspectiva da Teoria Histórico-cultural

Resumo: Esse artigo é parte de uma pesquisa de doutorado que teve como indagação central "Quais as contribuições da Teoria Histórico-Cultural para a Educação Matemática e que elementos a potencializam para configurá-la como tendência de ensino no contexto educacional brasileiro? (Gomes Novaes, 2022). Para tanto, objetivou-se identificar e mapear os grupos de pesquisa cadastrados no Diretório dos Grupos de Pesquisa no Brasil (DGP) que tenham como objetos de estudo o ensino e a aprendizagem da matemática com fundamento na Teoria Histórico-cultural. O estudo tem abordagem qualitativa, caráter histórico-bibliográfico e analítico-descritivo, e delineamento metodológico do tipo Estado da arte. A análise dos 32 grupos de pesquisa, encontrados na investigação, se mostram consolidados quanto ao tempo de existência, linhas de pesquisa e variedade de temáticas pesquisadas, o que se configura como elemento potencializador para a existência de uma Tendência de ensino Histórico-cultural no campo da Educação Matemática no Brasil.

Palavras-chave: Estado da arte; Teoria Histórico-cultural; Tendência de ensino da Educação Matemática.

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1 Introduction

Mathematics Education defines areas of concentration, lines of research groups and specific graduate programs throughout the country. It promotes scientific associations, scientific events and scientific debate working groups (Damazio, 2008). In this way, it is possible to identify three possible ways of thinking about trends in Mathematics Education: 1. As a line of research; 2. How to direct the research, that is, where it points; and 3. As methodological, that is, those more linked to the teaching of Mathematics and, therefore, called Teaching Trends in Mathematics Education.

Such tendencies, which are concerned with the development of methodologies for the teaching and learning processes of mathematical knowledge, are based on various pedagogical and/or psychological theories and approaches. They are also classified based on different criteria. Researchers in the field of Mathematics Education show different classifications when dealing with teaching trends (D'ambrosio, B., 1989; Lopes and Borba, 1994; Fiorentini, 1994, 1995; Campos and Nunes, 1994; Petronzelli, 2002; Borba, 2001; Groenwald, Silva and Mora, 2004; Damazio, 2008).

However, none of the classifications presented by the aforementioned authors have the denomination "Historical-cultural" and its derivations "Activity Theory" and "Developmental Teaching". Damazio and Rosa (2013) had already pointed out the absence of the historical-cultural approach in the Teaching Trends in Mathematics Education and also highlighted that this approach was only indicated in Fiorentini's (1995) classification, since when discussing the semantic Socio-interactionist tendency, "[...] affirms that its basis is Vygotsky's theory, more specifically in its assumptions regarding language." (p. 34).

In this sense, this article is part of a doctoral research, carried out in the Graduate Program in Education of the Faculty of Science and Technology, UNESP/Campus Presidente Prudente, which had as its central question "What are the contributions of the Historical-Cultural Theory to Mathematics Education and what elements enhance it to configure it as a teaching trend in the Brazilian educational context? (Gomes Novaes, 2022).

The research aimed to understand the influence of the Historical-cultural Theory in Mathematics Education and the possibility of *the constitution of a historical-cultural teaching tendency, since it defended the thesis that the foundations of the Historical-Cultural Theory and the investigations and pedagogical proposals in the field of Mathematics Education, anchored in this theory, contribute to the reflection on the same objects and themes addressed in the various teaching trends of the referred field.* (Gomes Novaes, 2022).

The potentiality of the existence of a teaching trend in Mathematics Education with denomination and historical-cultural foundation or theories that derive from it, investigated in this thesis, was anchored in the following arguments:

1) Contributions of the Historical-Cultural Theory of Mathematics Education in Brazil, with emphasis on the investigations of Russian scholars related to the teaching and learning of mathematical concepts, including Vygotski, Luria, Leontiev, Davidov, Galperin, Krutestskii, Kalmykova and Talyzina;

2) The definition of teaching trend as a philosophical and pedagogical orientation, indicated in the literature in the area of Education (Luckesi, 1990; Lebanese, 1990; Ferreira, L., 2003) and Mathematics Education (Campos and Nunes, 1994; Fiorenttini, 1995; Cavalcanti, 2010).

3) The existence of research groups registered in the Directory of Research Groups in Brazil (DGP), whose objects of study are the processes of teaching and learning mathematics based on the Historical-Cultural Theory;

4) The characteristics of the Brazilian academic production related to Mathematics Education and Historical-Cultural Theory make it possible to reflect on the processes of teaching and learning mathematics;

In the design of the research, two lines of investigation were developed. The first refers to the study of the research groups and their organizational characteristics, in which it sought to identify who the members of the group are, time working in the area, lines of research development and themes addressed. The second research front consisted of the identification and analysis of the scientific production of these research groups.

The main purpose of this work, linked to the third argument of the thesis, is to discuss the relevance of the study and research groups and to present an overview of the research groups related to Mathematics Education and Historical-Cultural Theory, obtained in the current database of the directory during the investigation. The decision to present this 'State of the Art' study in English is a strategic choice aimed at the internationalization of Brazilian research in Mathematics Education. By mapping the consolidation and maturity of the 32 active research groups identified in this study, this article seeks to project the Brazilian scientific production to the global community. Furthermore, publishing in a global *lingua franca* facilitates the dialogue with international peers who utilize the same Historical-Cultural framework (such as Vygotsky, Leontiev, and Davydov), ensuring that the Brazilian 'Teaching Trend' achieves greater visibility and impact in international databases like the Web of Science. The work is organized in the following sections: relevance of study and research groups, research methodology and research

2 Relevance of study and research groups

The National Council for Scientific and Technological Development (CNPq) understands research groups as a group of subjects hierarchically organized around one or two leaders of notorious and recognized prominence in the scientific or technological field, in which they are permanently and professionally involved in research activity. The group's work is organized around common lines of research that are subordinate to the group and that, to some degree, share facilities and equipment (CNPq, 2020b). The line of research represents, therefore, unifying themes of scientific studies, from which originate the research projects whose results have reciprocal affinities.

Therefore, the researchers, registered in the Directory of Research Groups (DGP) and in the Lattes Platform, develop research teams, organized under the designation of research groups, in which knowledge is organized into areas of concentration and lines of research. The first refers to branches of knowledge, activities or skills in a thematic domain, while the lines of research discriminate the directions of scientific research in a given context, "[...] it limits the boundaries of a specific field of knowledge, offers theoretical guidance for the search, and establishes procedures appropriate to the process of knowledge construction." (Erdmann and Lanzoni, 2008, p. 317).

Beyond the administrative definition provided by CNPq, research groups must be understood as social contexts of activity. In this sense, the heterogeneity mentioned is an intrinsic characteristic: the diversity of backgrounds, experiences, and academic cultures within and between groups is what fuels the dialectical movement of knowledge production. Therefore, the 'characterization' of these 32 groups in this study does not imply a search for uniformity, but rather an identification of a common ground (the Historical-Cultural Theory) upon which diverse and distinct scientific identities are built.

The formation and consolidation of research groups have been one of the guidelines of the policies of research funding agencies in the country and of higher education institutions, since they constitute a space for training researchers and the production of knowledge. The role and importance of research groups in the training of researchers have been emphasized in several studies (Gatti, 2005; Hayashi, 2007; Sanchez Gamboa, 2011; Matos, 2016).

For Sanchez Gamboa (2011), research groups are the institutionalized way to enhance the production of scientific knowledge. The institutionalization of research groups contributes

to the consolidation of the fields of knowledge production, since, in the research groups, there is permanent involvement with scientific production activities.

The consolidation and development of scientific knowledge is largely dependent on the continuous dialogue between peers provided by research groups. Gatti (2005) points out that

The researcher does not work alone, nor does he produce alone. Intercommunication with peers, teamwork, networks for the exchange of ideas and dissemination of research proposals and findings, and thematic reference groups are now an essential condition for conducting scientific research and advancing knowledge. For the most experienced researchers, this permanent dialogue with thematic reference groups becomes fundamental to the critical and judicious advancement in theorizations, methodologies, and inferences. For the less experienced, or beginners, it is fundamental for their training, because you don't learn how to research, you don't develop investigator skills just by reading manuals. This learning is processed through interlocutions, interfaces, fruitful participation in working groups, in networks that are created, in the experience and coexistence with more mature researchers. (p. 124).

Research groups, according to Mainardes (2021b), are like epistemic communities, because "[...] they are spaces for the production of knowledge and lead to the growth of intellectual and methodological proficiency" (p. 6). Thus, the research group, as a representation of the epistemic community, is composed of individuals who, collectively, and as a social institution governed by values that guide scientific practice, are concerned with the development of science.

However, from a historical-cultural perspective, this collective involvement is not a homogeneous or static process. Although groups may share a common theoretical framework, they are not monolithic entities. Each research group is a product of unique historical trajectories and specific institutional cultures, which shape their internal dynamics and the 'values' that guide their scientific practice. These values are socially and historically constructed, meaning that the motives, goals, and ways of perceiving the object of study—mathematics teaching and learning—can differ significantly from one group to another. Thus, a research group is more than a hierarchical administrative unit; it is a dynamic and heterogeneous space of tension and synthesis, where different individual histories converge into a collective activity that is constantly being redefined.

For Guimarães, Lourenço and Cosac (2001), the research group is the fundamental unit of analysis of the Directory's database, because the organizing foundation of this group of hierarchically arranged individuals is experience, prominence and leadership in the scientific and technological field. The research group reflects the materialization of the *modus operandi*

of a domain of knowledge that, in turn, can be characterized as a community of thought or discourse, as it has a coherent ontology that shares the same epistemology (Smiraglia, 2015 apud Guimarães, 2021).

For Mainardes (2021a), investigations referring to research groups have been approached in several areas, in order to think about individual learning processes, as well as the development of the group's scientific production. The author points out that Education, even though it is the area with the largest number of research groups registered in the directory, is little dedicated to this theme, since its survey resulted in 55 works on research groups in the area of Education, between the years 2003 and 2021.

The knowledge produced by the scientific community over time can be found in several scientific databases, such as Web of Science (ISI) and Scielo. Such databases, despite recording and making available the scientists' productions, are called secondary databases, because they only indicate individual information from the articles. Still, they are thematic bases, which cover only one area of science, or generalist, several areas of science. However, Magalhães, Quoniam, Mena-Chalco and Santos (2014) assert that the Lattes database differs from the others because it has a curricular characteristic, that is, the compulsory registration of the curriculum and/or research group by all Brazilian scientists in its database. For the authors, the Lattes database

[...] has approached the concept of integrated database, bringing together researchers, activities, scientific production and institutions involved with science, in which a large database of curricula is configured and which, intrinsically, has an excellent reference to bibliographic production in each curriculum listed in the database. (p. 32).

In this sense, this investigation was carried out on the Lattes Platform, which integrates the curricular databases, Research Groups and Institutions in a single information system and was designed to facilitate the planning, management and Implementation of research funding. The Directory of Research Groups is an inventory of the groups active in the country. The information contained in the directory refers to the human resources that make up the groups (researchers, students and technicians), the lines of research in progress, the specialties of knowledge, the application sectors involved, the scientific and technological production and the patterns of interaction with the productive sector (CNPq, 2020b).

3 Research methodology

The study is characterized by a qualitative approach, historical-bibliographical and analytical-descriptive approach, and a methodological design of the State of the Art type.

The need to carry out state-of-the-art research has already been indicated by Lüdke (1984), who defends the idea that studies of this nature can constitute a historical milestone in an area of knowledge, making it possible to verify its evolution. It is a common research modality in several countries, and that has recently gained remarkable expression in the Brazilian scenario, in which works have been developed in the most diverse subareas of research in Education, such as, for example, to map studies on teacher training (André, 2002), or on literacy (Soares and Maciel, 2000).

In general, the methodological procedures of the State of the Art research are: definition of criteria for search and selection of material, location of databases, and organization and analysis of the material (Romanowski, 2002; Romanowski and Ens, 2006).

The search for research groups took place in the current database of the Directory of Research Groups in Brazil (DGP), through parameterized consultation. The survey was carried out during the period from March to July 2020, with the manual crossing between the keyword Mathematics and a group of terms that characterize the theme Historical-Cultural Theory, since the current base of the directory does not allow working with the Boolean search⁴.

A total of 24 descriptors was used for Historical-Cultural Theory, based on nomenclature, derived theories, authors and common educational terms of the theory. Chart 1 shows the breakdown of the search terms used in the parameterized query and the number of search groups obtained in each crossing.

It is essential to clarify that the 'Historical-Cultural Theory' (HCT) is not defined merely by the presence of specific keywords, but by a foundational core rooted in Soviet psychology and dialectical materialism. In this study, HCT is characterized as a framework that investigates the social and historical origins of higher mental functions, mediated by tools and signs within the context of human activity. This involves the specific contributions of Vygotski, Leontiev, and Davydov, focusing on the organization of Teaching Activity and Developmental Teaching. Therefore, a group was only included if its theoretical orientation aligned with this

⁴ Boolean search is the application of mathematician George Boole's theory of binary logic to a type of information retrieval system, in which two or more terms are combined, relating them by logical operators, which make the search more restricted or detailed. The Boolean operators represented by the linking terms AND (restrictive combination), OR (additive combination) and NOT (exclusionary combination) are used with the descriptors, with the function of informing the search system of certain combinations between the search terms.

psychological-pedagogical tradition, rather than a generic or sociological use of the terms 'historical' or 'cultural'.

Chart 1 - Number of research groups registered in the DGP by search term

SEARCH TERMS			Groups
Mathematics Education	Historical-Cultural Theory		
MATHEMATICS	Socio-historical/socio-historical	NOMENCLATURE	01
	Historical-cultural		21
	Soviet Psychology		-----
	Marxist Psychology		-----
	Materialistic Psychology		-----
	Activity Theory	THEORIES DERIVED	08
	Developmental Teaching		01
	Objectification Theory		01
	Guiding Activity		02
	Teaching Activity	EDUCATIONAL TERMS	45
	Teaching Concepts		09
	Concept learning		10
	Pedagogical activity		01
	Leontiev	AUTHORS SOVIET	02
	Davydov/Davidov		03
	Vygotsky/Vigotsky/Vygotski/Vigotski		01
	Galperin		01
	Ponds		-----
	Talyzina		-----
	Kalmykova		-----
	Krutetskii		-----
	Rubtsov		-----
	Zankov		-----
Psychology	GENERIC TERM	23	
TOTAL			129

Source: Prepared by the author.

Each crossing of words gave rise to a Microsoft Excel spreadsheet that, when unified and organized in alphabetical order, highlighted the duplicity of some groups, which is justified by the fact that the same group was searched for more than one crossing of words. Thus, of the 129 groups, 38 were excluded and, therefore, the universe of analysis of this research now has 91 research groups.

The exclusion of groups related to the History of Mathematics and Ethnomathematics was a necessary step to maintain the focus on HCT as a specific Teaching Trend. While the History of Mathematics investigates the chronological and epistemological development of

mathematical concepts as a pedagogical tool, it often lacks the specific focus on the subject's psychic development through mediated activity that characterizes HCT. Similarly, Ethnomathematics, as conceptualized by D'Ambrosio (1989), focuses on the mathematical practices of distinct cultural and social groups from an anthropological perspective. Although both trends value 'history' and 'culture,' they operate under different theoretical paradigms. HCT, as analyzed here, is specifically concerned with the dialectical relationship between teaching and learning in the constitution of scientific concepts, a distinction that justifies the exclusion of groups whose primary focus was not anchored in the Soviet Historical-Cultural tradition.

To certify that the object of study of the 91 research groups was, in fact, the process of teaching and learning mathematics based on the Historical-Cultural Theory, the mirror of each research group was accessed for the appreciation of more specific information, such as: identification and description of the group, titles and objectives of the lines of research, keywords, repercussion of the actions developed, human resources and research networks. The analysis criterion consisted of the location of the search terms used in the quantitative survey of the research groups to evaluate the context and meaning they presented. For example, the terms "teaching of concepts" and "learning of concepts", because they are comprehensive, have returned groups from other areas and/or other theoretical frameworks. In general, groups that are dedicated to the teaching of science from the cognitive perspective of learning. Two other terms, "socio-historical" and "historical-cultural", returned to groups in the area of Mathematics Education, but with the theoretical framework of the History of Mathematics and/or Ethnomathematics teaching tendencies.

This verification ensured the compatibility between the research group's object of study and the object of the investigation. Thus, at this stage, 59 research groups were excluded from the universe of analysis, which then became composed of 32 research groups. Consequently, the inclusion/exclusion criteria were based on a qualitative analysis of the groups' mirrors. This ensured that the 'historical-cultural' perspective identified was indeed the one derived from the authors listed in Chart 1 (such as Galperin and Talyzina) and directed toward the Historical-Cultural Teaching Trend, as proposed in the central thesis of this research. This distinction is vital to ensure that the 32 groups identified represent a cohesive theoretical-methodological field in Brazilian Mathematics Education."

4 Research findings

Of the 32 research groups identified in our survey, 26 are certified by the institutional research director, 04 groups are in the *situation* of not being updated and 02 are in the situation of being filled. Only groups with certified status are considered by CNPq for the Directory Censuses and for the unrestricted access queries of the Current Base. Groups that are not updated are certified, but have not been updated for more than 12 months. On the other hand, the status groups being filled in can be new groups not yet sent to CNPq by the leader or an existing group whose form has been edited by the leader for updates and has not yet been resent. (DGP, 2021). In this case, it is possible that such groups were being edited, since they were created in the years 2006 and 2014.

Regarding the *year of formation* of these research groups, all of them had their institutional birth between the years 1995 and 2018. Most of the groups are concentrated in the period between 2011 and 2017, as the 19 groups created in this time interval represent 59.4% of the total percentage of research groups. Thus, since 2011 there has been a significant growth in the number of groups dedicated to studying the process of teaching and learning mathematics based on the Historical-Cultural Theory. This seems to be related to the increase in master's and doctoral degrees, since, in the period between 2013 and 2019, the total number of degrees had increased by 312% (CAPES, 2021).

From the year of creation of the groups, it was possible to measure the *time of existence* of each one and identify that most of the groups have a time of existence that varies from 6 to 10 years. The time of existence of the research group, as well as its constancy over time, is an aspect that reveals the professional and permanent involvement of its members with the research activity. However, it is essential for the group to maintain a regularity of scientific production, as this is the greatest evidence that the group is active.

The *composition of the leadership* makes up a total of 56 researchers, since three researchers are repeated in different groups and functions. Still, regarding the composition of the leadership of the research groups, in 27 groups (84.4%) the work is articulated around the collaborative action between two leaders, while in the other five groups (15.6%), the exercise of leadership occurs by a single researcher.

Regarding the *researchers' degrees*, the survey points out that the percentage of PhDs (60.4%) is higher than the other degrees, indicating that all leaders are PhDs and only 3 vice-leaders have master's degrees. However, even if the percentage of PhDs is higher, the percentage of master's degrees (32.5%) is no less relevant, presenting itself as representative.

A more detailed analysis of the researchers who make up the research groups shows, with regard to gender, the predominance of women with 240 researchers (67.8%). Male researchers total 114 and represent 32.2%. Among the leaders of the research groups, 21 (65.6%) are women and 11 (34.4%) are men, and among the vice-leaders, 19 (70.4%) are women and 8 (29.6%) are men, which indicates the high female presence in these research groups, including in leadership and vice-leadership.

These findings are close to those mentioned by Hayashi M., Ferreira Jr, Bitar and Hayashi C. (2008), who indicated that 60.2% of the female presence in the distribution of researchers by sex in the broad area of Human Sciences is 60.2%. Similarly, the research conducted by Matos (2016) identified that, in the field of curriculum, women lead 59 (67%) of the groups registered in the CNPq group directory, while men lead 29 (33%). It can be seen here that there is a correspondence between these data and the theoretical approaches on the feminization of work in the area of Education and also in the area of Health, which are historically considered as a place of concentration of female workers, as argued by Yannoulas, Vallejos and Lenarduzzi (2000).

For the Coordination for the Improvement of Higher Education Personnel (CAPES, 2016), women are the majority in Brazilian graduate studies and there is no impact on the social reality of the country, it is necessary to consider, according to CAPES, the need for gender equality, reduction of violence and equalization of monetary income.

As for the *geographic regions*, the largest number of research groups is found in the Southeast region (14), followed by the South and Northeast regions with eight groups each. The North and Midwest regions are home to 01 group each. This configuration possibly occurs due to the distribution of universities and research centers and, consequently, of graduate programs, since research groups are primarily located in institutions of this nature. According to data from the 2010 IBGE Demographic Census, the North region has the lowest number of HEIs, with 6.4% of the total, followed by the Midwest region, which has a concentration of institutions of 9.9%.

The highest concentration of research groups is found in the states of São Paulo (6) and Minas Gerais (5), which also corresponds to the data presented by the Demographic Census, which points out that the highest concentration of HEIs is also found in the states of São Paulo (577) and Minas Gerais (355).

The research groups identified are distributed among 26 *higher education institutions* (HEIs) in all regions of the country, 24 public and 02 private institutions, which represent, respectively, 92.3% and 7.7%. Among the 24 public institutions of higher education, 17

(70.8%) are federal and 07 (29.2%) state. These data reveal that there is practically no scientific production in private administrative institutions in Brazil on Mathematics Education based on the Historical-Cultural Theory.

However, these results are not exclusive to the theme we are investigating, but a Brazilian reality on other research topics. According to the study, "Research in Brazil – A report for CAPES", carried out by the American company Clarivate Analytics, Brazilian scientific production is carried out almost exclusively within public educational institutions. In this study, it was observed that among the 20 institutions that produced the most papers and had the most impact are 15 federal universities and 5 state universities. Therefore, it can be affirmed that public institutions constitute the main support for research and for the training of researchers in our country.

Furthermore, it is essential to highlight the inherent political dimension of research groups grounded in Historical-Cultural Theory. This theoretical framework, rooted in dialectical and historical materialism, does not perceive scientific activity as a neutral or isolated process, but as a socially committed practice aimed at human transformation. In the current neoliberal context, marked by the systematic dismantling of public universities and the precariousness of research funding, these groups serve as vital spaces of resistance. Given that 92.3% of the identified groups are hosted in public institutions, their existence and scientific production represent a political stance in defense of public education as a primary locus for the construction of critical knowledge. Thus, the Historical-Cultural Teaching Trend in Brazil transcends academic boundaries, positioning itself as a collective effort to safeguard the social role of science and its potential to transform the Brazilian educational reality.

Considering that Mathematics Education is a multidisciplinary area, it is interesting to verify the areas of knowledge in which the Research Groups are inserted.

There is a prevalence of the large area of Human Sciences, with 28 groups distributed among the basic areas of Education (26) and Psychology (2). The remainder, 04 groups, are in the large area of Exact Sciences, basic mathematical area. The greater number of research groups concentrating on the broad area of the Human Sciences is interesting, in the sense that it serves as subsidies for the elaboration of educational public policies, curricular proposals, as well as being of fundamental importance in the development of pedagogical practices. However, the non-representativeness of the basic area of psychology is noteworthy, since its object of study is the human being.

In order to identify the central themes of the research groups, the names and text

"Special Education" - or even to theoretical foundations - such as "Activity Theory", "Objectification Theory" and "Historical-Cultural Theory".

For Borges-Andrade (2003, p. 160) there is, in the concept of line of research, "[...] serious problems of definition (or lack of definition)." For Sanchez Gamboa (2011, p. 273) the "[...] Groups and lines of research refer fundamentally to fields of in-depth study around problems that bring together common interests of researchers from different fields of knowledge and different scientific traditions." Thus, the lines of research presuppose a differentiation of the group's sub-themes, and it is necessary that these subthemes articulate and dialogue with each other, otherwise there will be, in practice, distinct research groups in a single registered group.

Borges Andrade (2003, p. 164) points out that the concept of line of research has four essential elements: objective, scope delimitation, reference to work activities and theoretical orientation. The author defines line of research as an imaginary trait that:

- . determines the *direction*, or what will be investigated in a given context or reality;
 - . limits the boundaries of the *specific field of knowledge* in which it should be included in the study;
 - . offers *theoretical guidance* to those who will do the searching; and
 - . *sets out the procedures* that will be considered appropriate in this process.
- (Borges Andrade, 2003, p. 164, emphasis added).

It is important to emphasize that the high number of research lines (129) and the thematic diversity identified in this study should not be interpreted solely as a technical problem of 'lack of definition' or a failure in administrative standardization. Instead, from the Historical-Cultural perspective assumed in this research, this dispersion is a direct reflection of the cultural heterogeneity of the research groups. As previously discussed, these groups function as epistemic communities governed by values that are socially and historically constructed. Therefore, the variety of themes - encompassing areas such as Special Education, Teacher Training, and diverse theoretical derivations like the Theory of Objectification - reveals how each group, as a unique social context of activity, appropriates the common theoretical framework according to its own historical trajectory and institutional reality. This diversity reflects the different ways in which groups think and act, even when sharing the same foundational principles, proving that the Historical-Cultural Teaching Trend in Brazil is a plural and dynamic movement rather than a monolithic one.

For Mainardes (2021a), Research Groups take on distinct characteristics in each area of knowledge and, in the area of Human and Social Sciences, "[...] There is a predominance of

individual research. In this case, the Research Group functions as an aggregating element of researchers who have in common certain research interests and common (or similar) theoretical-methodological foundations." (p.3).

For Sanchez Gamboa (2011, p. 270), the organic articulation of research groups has been one of the greatest challenges, since the organizational structure in lines of research requires "[...] a new perspective of science that develops new possibilities for interdisciplinary research centered on the problems of Brazilian education, overcoming the division of knowledge into disciplines or areas of concentration." (p. 270).

Regarding the theoretical-methodological foundations of the 32 research groups identified, 21 groups (65.6%) are namely dedicated to the studies of Mathematics Education based on the Historical-Cultural Theory, since they expressly announce, in the mirror of the group, that their theoretical-methodological principles are based on this approach. These groups were considered, in the investigation, as *totally historical-cultural groups*.

The texts presented in the mirrors of the research groups considered totally historical-cultural present as theoretical perspectives, the Historical-Cultural Theory, Activity Theory and/or Objectification Theory, or even mention that they are based on the authors of these theories, such as Vygotsky, Leontiev, Davidov, among others.

The other 11 groups (34.4%) present the Historical-Cultural Theory dispersed in the lines of research and, therefore, which is considered as *partially historical-cultural*.

Of the 11 partially historical-cultural groups, 8 groups make this approach explicit in the description of a line of research, while in the other three groups, the Historical-Cultural Theory appears only in keywords of one of the group's lines of research.

Regarding *collaboration networks* between research groups, it is possible to say that 15 groups (46.88%) are interrelated. Of these, six groups (40%) have a declared and formal link on the DGP website with the "Study and Research Group on Pedagogical Activity (GEPAPe)", led by Manoel Oriosvaldo de Moura, at the University of São Paulo.

From the search for information on the GEPAPe⁶ website, such as the group's productions and activities developed, it is possible to affirm that seven other research groups (46.67%) are also directly related to GEPAPe, since they have in common a considerable number of researchers and academic production. The remaining two research groups (13.33%) declare that they have a collaborative network, one of which is related to the GT/ANPEPP Psychology and Educational Policies and the other to the Academic Cooperation Program.

⁶ Disponível em: <http://www2.fe.usp.br/~gepape/> e consultadas em março de 2021.

The collaboration network with the GEPAPe group is, in fact, a research network. The information available on the GEPAPe website explains that "[...] due to the changes of its participants who, when they were allocated to other higher education institutions, formed new groups with their advisees. Due to the wide range of groups, GEPAPe is organized into nuclei, made up of groups with geographical proximity or interests."

Thus, it is possible to affirm that the GEPAPe collaboration network occurs at the interinstitutional and intergroup levels, that is, between institutions and research groups. However, this relationship also occurs at the intragroup level, since the researchers of the research groups that relate to GEPAPe are also its members. Certainly, the Graduate Program in Education at the University of São Paulo is one of the main responsible for this network of collaboration, since it trains doctors in the area of Education who, in turn, carry out their activities as researchers in other institutions and thus more and more research groups are emerging.

The production of knowledge is a complex process that involves different subjects and institutions. Intellectual collaboration makes it possible to bring together the different researchers and institutions that carry out research with common points and the creation of research groups and consolidation of research lines is a fundamental condition for the exchange of ideas, since it is through the group and in the group that the researcher builds collaboration networks with other researchers, groups and institutions. For Mainardes (2021b), it is important to investigate the reasons why many research groups are endogenous and not very interactive, and also to what extent collaboration between groups is effective and what are the patterns of cooperation.

5 Final thoughts

Research that investigates mathematics teaching and learning processes has sought theoretical and methodological sources for work and didactic proposals that break with the problems arising from outdated and precarious learning.

The insertion of the Teaching Trends in Mathematics Education in the pedagogical practice of teachers of different levels of education has driven several researchers to discuss its scope and limits, in order to seek to qualify the teaching of mathematics from a perspective of problematizing and transforming education. Therefore, the importance of teaching trends from this perspective lies precisely in the definitive break with the purely algorithmic, teacher-centered, and decontextualized didactic view.

The purpose of this work is to contribute to such research, based on the analysis of indicators of research groups, an important activity for in the evaluation of scientific development in the country. In this sense, the work, the result of a doctoral thesis, intended to inventory and analyze the research groups that are dedicated to studying the process of teaching and learning mathematics with a historical-cultural theoretical contribution.

The analysis of the 32 research groups, found in the investigation, which are based on the Historical-Cultural Theory to study issues related to Mathematics Education are consolidated. The aspects presented about the research groups - time of existence, numerous lines of research, variety of themes researched, among others - show the diversity of ways of forming the research groups and the different dynamics that are constituted in the groups, and also suggest the need for discussion and standardization of the lines of research among the researchers of the group. as well as the definition of strategies for the delimitation of the themes in relation to the researched axes.

Thus, the existence of consolidated research groups, mainly the GEPAPe network, and the academic production of these groups are the potentiating elements that allow us to affirm the possibility of the existence of a Historical-cultural teaching Trend in the field of Mathematics Education in Brazil.

Finally, the choice of the English language for this publication serves as a bridge to overcome linguistic barriers, projecting the robustness of the Historical-Cultural Teaching Trend in Brazil to the international stage. As the findings reveal a highly organized and interconnected network of researchers—most notably the GEPAPe network—its dissemination in English is essential to establish Brazil as a primary reference point in the global debate on the applications of Historical-Cultural Theory to Mathematics Education. This effort aligns with the goal of increasing the impact and indexing of national production, showcasing the potential of Brazilian public universities as centers of excellence in scientific research.

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