2023 • Ano X • v. 13 • n. 1 • ISSN 1983-7399

EDITORIAL

CURRENT TRENDS IN MATHEMATICS EDUCATION: CENTERING THEORY AND PRACTICES

In this special issue of the Brazilian journal, *Caminhos da Educação Matemática em Revista* (CEMeR), which in English translates as "Mathematics Education Paths in Review," we are concerned with highlighting contemporary trends in the theory and practice of mathematics education. However, what do we mean by trends in mathematics education?

The term 'trends' has many meanings. In our view, one meaning corresponds to how Brazilian mathematics education researchers use the term to indicate orientation. As such, a trend in mathematics education orients mathematics teaching and learning and reflections about what they involve. From this perspective, among other topics, mathematical modeling, information and communication technologies, the history of mathematics, ethnomathematics, classroom-based research, teacher professional learning, and numerical cognition are examples of current trends in mathematics education. Nevertheless, philosophy, psychology, and studies related to social justice and inclusion, for instance, are concerns that currently guide mathematics education research and practice and can also be considered trends. Thus, are all things related to mathematics learning and teaching trends?

We do not believe so. Research and practice trends result from reflecting on teaching and learning mathematics at a given historical moment and are validated by the mathematics education scientific community. What is trending today may not have been before and may not be later. Trends are dynamic and reflect the contemporary demands and needs of the mathematics education community. Nevertheless, speaking about the nature of his course, "Tendencias da Educação Matemática," D'Ambrósio (1996) notes the following: "Talking about trends in mathematics education is very subjective. It reflects my interpretation of how I see the mathematics education movement around the world and how it affects [mathematics education] in Brazil" (D'Ambrosio, 1996, p. 7).

Accordingly, trends are subjective and depend on an individual's perspective and involvement in the worldwide community of mathematics practitioners and researchers. Currently, several trends guide mathematics education research. Some emerged earlier, such as modeling, ethnomathematics, and the history of mathematics. Others are more contemporary such as numerical cognition and social inclusion. Although a plurality of

perspectives exists about what are trends in mathematics education, we adopt the framework proposed by Cavancanti (2010), composed of three macro-trends, namely, didactic-pragmatic, epistemological, and political-socio-cultural, to group the trends that, in our view, predominate in the 12 articles that are part of this special issue. However, we do not claim to exhaust discussions on trends. Instead, we present only part of what mathematics education has explored concerning trends.

Didactic-Pragmatic

The didactic-pragmatic macro-trend concerns those trends that underline the teaching of Mathematics, with emphasis on new methodologies aimed at teaching contents of this discipline (CAVALCANTI, 2010) and that contribute to the training of teachers to work in the classroom. Inserted in this trend, we can consider some articles.

In their article, **"*Kyozaikenkyu*: Essential lesson planning in Japanese Lesson Study,"** Souza and Powell present research with 11 Brazilian teachers involved in a 12-week Lesson Study project centered on the theme of fractions. In Lesson Study, *kyozaikenkyu* is an essential initial engagement in which teachers enhance their knowledge of specific mathematical content. Moreover, teachers explore new possibilities for teaching this content in the classroom. The research results revealed that the participating teachers not only appropriated new content knowledge about fractions from the measuring perspective but also learned to teach the content by paying attention to social aspects and recognizing the role of resources and manipulative materials.

Based on didactics and shifting from a pedagogical to a cognitive focus, in their contribution, **"Measuring fences and sharing pizzas: Current advances in nonsymbolic fraction interventions,"** Abreu-Mendoza and Rosenberg-Lee also focus on fractional number cognition but present a systematic review of 22 intervention and training studies that leveraged nonsymbolic skills, primarily via number lines, to improve students' symbolic fraction understanding. Their study found that placing symbolic and nonsymbolic representations of fractions on number lines improves the fraction skills of low-achieving students. These results suggest that promoting nonsymbolic skills may be essential to enhance fraction knowledge.

In the article **"Modeling in mathematics education: Different ways to practice and understand,"** Araújo contributes a theoretical essay to introduce mathematical modeling to teachers unfamiliar with it and summarize its characteristics for those who already know it. For this, the author uses examples to illustrate different ways of putting modeling into practice, which she considers relatively flexible. This approach allows those who want to use it greater freedom to practice or adapt it according to their conceptions and conditions of their schools. Based on the literature, Araújo also presents a typology of modeling activities that accounts for the complexity of the task, how the task is proposed, and the teacher's and students' roles.

Continuing with this trend in their article, **"Perspectives for mathematics education in higher education from research on modeling in differential equations**

teaching," Reis and Araújo further explore modeling. However, unlike the previous theoretical article, this empirical study involves students from a degree program at a private university in Minas Gerais, Brazil. According to the authors, the study presents perspectives for investigating mathematics education in higher education. Its objective was to identify and analyze possible contributions of mathematical modeling for learning differential equations in a mathematics degree program. The modeling perspective adopted is socio-critical, and owing to the COVID-19 pandemic, the context of the classes was remote. Nevertheless, their results demonstrate that the modeling tasks contributed to re-signifying concepts and applications of ordinary differential equations. Moreover, the socio-critical perspective enhanced future mathematics teachers' critical thinking, especially concerning issues such as citizenship, social inequality, and even the social role of mathematics itself.

Epistemology

The epistemology macro-trend in mathematics education encompasses trends referring to theories of mathematics education and its own identity as a research field. Examples include theories of psychology, philosophy, sociology, and education. Furthermore, Campos and Nunes (1994) consider that epistemological trends also involve teachers' knowledge.

In his article "**Two perspectives of fraction knowledge: characterization, origins and implications,"** Powell advances a perspective that awareness of fractional numbers results from sensing a quantitative relation between the magnitude of two quantities, using the psychological mechanisms of stressing and ignoring. Afterward, focused on the quantitative relations, he presents a mathematical analysis of the magnitude of two quantities. Next, building on the theoretical views of fractions, he outlines the mathematical and cognitive attributes of two models of fraction knowledge—partitioning and measuring—describing their historical and philosophical-technological origins. Finally, the author describes the cognitive consequences of the partitioning perspective and suggests areas for future research to investigate further the measuring perspective.

Exploring teacher knowledge, Toledo, Abreu-Mendoza, and Rosenberg-Lee present in their article, **"Math teachers' implicit and explicit fraction knowledge: a mixed-methods approach,"** Brazilian mathematics teachers' knowledge of fraction magnitude and strategies for comparing fractions. Supported by neuroscience and cognitive psychology studies, they employed a convergent parallel mixed methods design to investigate how practicing teachers process and understand faction magnitude. The results showed that educators used a non-generalizable procedure—the gap strategy, calculating the difference between the numerator and denominator and selecting the fraction with the smallest gap as the larger fraction. Since this strategy does not work in all cases, its use points to teachers' problematic mathematical reasoning. Given the documented relationship between teachers' knowledge of mathematical concepts and

connections and students' learning (Tchoshanov, 2011), these results have important implications for students learning about fractional numbers and their operations.

In their article, **"Trends in mathematics' education degree: from theory to practice, what are the outstanding reflections?"** Deodato and Santos present a study whose objective was to describe and analyze the insertion of discussions about trends in mathematics education in a supervised internship course and the consequent actions and reflections of the interns. To this end, the course's tasks sought to articulate theoretical aspects of some trends chosen by the interns, promoting thoughts about the practice of remote mathematics teaching they carried out in schools. Through the analysis of synchronous meetings, anchored by the theoretical framework of the Cultural-Historical Theory of Activity, they produce understandings along two axes: methodologies and teaching practices. Based on these understandings, they highlighted the trainees' movement to reframe their own 'theoretical' insights about trends and analyze possibilities of articulating them with their pedagogical practices.

The theoretical epistemological article by Bittar and Bellemain, **"Reflections on the development of mathematics teaching in France and Brazil: Brief history, characteristics and contributions,"** has three objectives: (1) to reflect on the emergence and development of mathematics didactics (DDM) in France and Brazil; (2) highlight characteristics of this trend, and (3) discuss some of its contributions to mathematics education and, generally, educational sciences. The text presents DDM since its emergence as a scientific field in the 1970s, encompassing the theory of conceptual fields (TCF) and the theory of didactic situations (TDS). However, the text shows the historical evolution of DDM in terms of theories and methodologies of the research developed.

In their contribution, **"Mapping research on the multiplicative structures field based on the conceptual field theory,"** Moreira and Tinti chart studies concerning multiplicative structures from the perspective of Vergnaud's (1994) theory of Conceptual Fields. This theory constitutes what has been called the Didactics of Mathematics, a subject discussed in the previous article. However, unlike Bittar and Bellemain's review, Moreira and Tinti emphasize research only on the Theory of Conceptual Fields related to combinatorial reasoning. The data corpus analyzed consists of related research from 1997-2018 found in CAPES's[1] database of dissertations and theses, using search descriptors "multiplicative structures" and "multiplicative field." Their mapping revealed few studies investigated combinatorial reasoning despite students' many difficulties understanding and applying combinatorial concepts.

From a social psychological perspective, **"Reflections on the use of self-handicapping strategies in Mathematics: Literature review"** is the article's title by Torisu and Viana. The authors review the literature on self-harming strategies in

[1] Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Improvement of Higher Education Personnel) or CAPES is a foundation within the Brazilian Ministry of Education whose central purpose is to coordinate efforts to improve the quality of the country's higher education faculty and staff through grant programs. It is particularly focuses on the training of doctoral candidates, pre-doctoral short-term researchers, and post-doctoral scholars.

mathematics learning. Such strategies are performance configuration actions or choices that increase the opportunity to externalize (or excuse) failure and to internalize (or accept credit for) success. Those strategies involve creating or declaring real or fictitious obstacles before attempting a task to justify a possible poor performance, decreasing the individual's sense of responsibility for the failure. The article's main objective was to present an analysis of ten studies focusing on using self-harmful strategies concerning mathematics learning, retrieved from the databases of the SciELO, PsycINFO, and ERIC platforms. The results revealed that several factors contribute to the adoption, or not, of self-harming strategies by mathematics learners, such as the classroom environment and the teacher's support. Moreover, other characteristics like self-esteem and self-efficacy affect learners' choice to use self-harming strategies. Finally, the authors note that further research is needed to understand critical variables in adopting those strategies.

We emphasize that the studies selected in the epistemological macro-trend have a less pragmatic and more reflective character for mathematical learning.

Political-Socio-Culture

The Political-Socio-Culture macro-trend relates to meta-objectives, issues beyond both the pedagogical and epistemological such as inclusion, critical mathematics education, the social role of mathematics education, and respect and appreciation of cultures. In this trend category, we have inserted three articles. Albeit in different ways, the authors provide a political discussion by problematizing the students' context as something that may interfere with their perspectives for their future. They underscore the importance of respect for different cultures and emphasize that teachers should value students' knowledge to augment students' self-respect.

This trend encompasses Ferreira and Corrêa's article, **"The mathematical teacher education of indigenous teachers in Brazil, in the last decades of the 20th century: Memoirs of a teacher educator,"** presents a historical investigation using oral history and the theory of situated learning based on the memories and writings of Professor Roseli Corrêa. The authors inquire into her conception of mathematics and teaching and learning. The results indicate that her proposals promoted an intense dialogue between the knowledge of indigenous and non-indigenous peoples cohesively and organically. It was also found that, in the highlighted decades, Mathematics Education in the training of indigenous teachers in Brazil already considered ethnic diversity in its proposals, based on understanding the existence of different mathematics typical of different cultures and social groups.

Finally, Marilyn Frankenstein contributes a challenging article, **"Respecting learner's knowledge: Evaluation through self-assessment."** In the text, she highlights the importance of formal and non-formal knowledge as understandings that individuals continually create and recreate as they reflect and act on the world. Further, she argues that involving students in assessing their knowledge, dialoguing with teachers, and studying together with others can increase students' self-respect and deepen their

understanding of mathematics. Furthermore, she reviews the skills and assessment methodologies underlying a course in quantitative reasoning at the College of Public and Community Service of the University of Massachusetts in Boston. She then focuses on the details of the mathematical literacy self-assessment.

This special issue presents studies—theoretical, theoretical-practical, and practical inserted in a framework of trends in Mathematics Education, which we judged as appropriate. However, since classifications are subjective, other than the one we presented in this issue, other possibilities exist, such as Katibe's (2022). Importantly, unlike Katibe's, our classification of trends looks forward to mathematics education topics needing further investigation.

References

Campos, T. M. M.; Nunes, T. (1994). Tendências atuais do ensino e aprendizagem da matemática. *Aberto*, Brasília, *14*(62), 3-7.

Cavalcanti, J. D. B. (2010). As tendências contemporâneas no ensino de Matemática e na pesquisa em Educação Matemática: questões para o debate. *Mesa Redonda: A Matemática e as Tendências Contemporâneas no Ensino e na Pesquisa* UNICAMP.

D'Ambrosio, U. (1996). *Educação Matemática: da teoria à prática*. Papirus Editora.

Katibe, G. Y. (2022). Research trends in mathematics education: A quantitative content analysis of major journals 2017-2021. *Journal of Pedagogical Research, 6*(3) https://doi.org/10.33902/JPR.202215529

Tchoshanov, M. A. (2011). Relationship between teacher knowledge of concepts and connections, teaching practice, and student achievement in middle grades mathematics. *Educational Studies in Mathematics, 76*(2), 141-164.

Vergnaud, G. (1994). Multiplicative conceptual field: what and why? In H. Gershon & J. Confrey (Eds.), *The development of multiplicative reasoning in the learning of mathematics* (pp. 41-60). New York, NY: State University of New York Press.

Arthur Belford Powell - Editor Convidado[2]
Edmilson Minoru Torisu - Editor Convidado[3]
Laerte Fonseca – Editor Chefe [4]
Estaner Claro Romão – Vice-Editor Adjunto[5]
Paulo Rogério Miranda Correia – Vice-Editor Assistente[6]

[2] Doctor in Mathematics Education. Professor, Department of Urban Education, Affiliated Faculty of Africana Studies and Global Urban Studies, Rutgers University-Newark, and Affiliated Faculty of the Department of Learning and Teaching, Rutgers University-New Brunswick. E-mail: powellab@newark.rutgers.edu

[3] Doctor in Education. Professor at the Department of Mathematics Education and the Graduate Program in Mathematics Education at the Federal University of Ouro Preto. E-mail: edmilson@ufop.edu.br

[4] Associate Professor at Emil Brunner World University – Florida/USA. Full Professor of Education Mathematics of the Federal Institute of Sergipe. Professor of the Graduate Program in Science Teaching and Mathematics at the Federal University of Sergipe. E-mail: laerte.fonseca@uol.com.br

[5] Associate professsor at the University of São Paulo. Professor at the School of Engineering of Lorena. E-mail: estaner23@usp.br

[6] Associate professsor at the University of São Paulo. Professor at the School of Arts, Sciences and Humanities at University of Sao Paulo. E-mail: prmc@usp.br