

Teachers' perceptions of mathematics teaching in multicultural classrooms: A study of challenges and practices in primary and secondary education

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Abstract

This study explores in-service primary and secondary school teachers' perceptions of teaching mathematics in multicultural classroom contexts. This study employed a survey-based descriptive research design, based on the administration of the survey-MARIAN instrument to 50 Spanish teachers working in public multicultural schools. The findings indicate that: (a) algebra is perceived as one of the most challenging topics to teach at both primary and secondary levels, while computational thinking emerges as one of the most complex areas to teach; (b) active methodologies and digital technologies are moderately integrated across both educational stages, whereas familiarity with the Montessori approach differs substantially between primary and secondary teachers; and (c) language barriers are identified as the main challenge in teaching mathematics in multicultural settings. Overall, the results suggest that teachers demonstrate a positive orientation toward active, inclusive, and contextualized approaches to mathematics teaching; however, their implementation remains limited and uneven. These findings highlight the need for targeted professional development and pedagogical frameworks that support inclusive mathematics education in culturally diverse classrooms.

Keywords: mathematics education, multicultural classrooms, inclusive education, in-service teachers, primary education, secondary education

INTRODUCTION

Contemporary migration flows, driven by the interplay of social, economic, and environmental factors, are having a significant impact on the educational systems of receiving countries. As a result, classrooms are becoming increasingly diverse, while also facing new structural and pedagogical challenges. In Spain, for example, during the 2023-2024 academic year, non-university students of foreign origin accounted for 12.9% of total enrolment, reaching 15.5% in primary education and 13.9% in secondary education (Ministerio de Educación y Formación Profesional [MEFP], 2024). In response to this growing diversity, several institutions and scholars (Comisión Española de Ayuda al Refugiado [CEAR], 2020; Consejo Económico & Social España, 2019;

García & González, 2022) have emphasized the need to design educational interventions grounded in intercultural education, particularly to support students from refugee, migrant, and minority (RMM) backgrounds. Within this context, mathematics teaching in multicultural school settings has become an area of growing interest in educational research.

Why mathematics? Although the answer is multidimensional, two key arguments are particularly relevant. First, mathematics is currently considered a fundamental competence for both personal development and the transformation of society in social, economic, and environmental terms (Rychen & Salganik, 2001, 2003). Second, mathematics often functions as an academic gatekeeper, significantly influencing students' educational success and their future professional

Contribution to the literature

- This study contributes empirical evidence on the challenges perceived by in-service primary and secondary school teachers when teaching mathematics in multicultural classroom contexts, identifying algebra and computational thinking as particularly challenging areas.
- The findings contribute to the understanding of the relationship between teachers' orientations and their reported instructional practices in multicultural settings, revealing a positive orientation towards active, inclusive, and contextualized approaches, alongside limited and uneven implementation in mathematics classrooms.
- This study highlights language barriers as a key challenge for mathematics teaching in multicultural classrooms and underscores the need for targeted professional development and pedagogical frameworks that support inclusive and context-responsive mathematics education.

opportunities (Alro et al., 2010). Consequently, promoting high-quality and inclusive mathematics education has become a key priority in school contexts characterized by increasing cultural diversity.

From this perspective, teachers in multicultural schools who teach mathematics require well-established and effective pedagogical approaches that can be adapted to the specific needs of these contexts, such as the Montessori method. Although this method is currently often associated with private education for children from more affluent families, its origins lie in supporting disadvantaged children in marginalized areas of Rome (Italy). These origins highlight the considerable potential of the Montessori method to address the challenges faced by contemporary multicultural schools.

In the present study, the Montessori method is not conceptualized as a school model or as an intervention limited to Montessori schools. Rather, it is regarded as a pedagogical framework whose principles can enrich mathematics teaching. These principles include the use of manipulative materials, self-correcting tasks, opportunities for students to make decisions about their own learning, practical and hands-on mathematical activities, peer learning, and structured opportunities for reflection. Collectively, these elements encourage students to move beyond the mechanical execution of procedures towards a deeper understanding of mathematical concepts, while fostering autonomy, collaboration, reflection, and active participation in more inclusive mathematics learning environments.

However, addressing the educational demands of the 21st century requires these principles to be integrated with other emerging pedagogical perspectives. In this regard, combining the Montessori method with creative technologies offers a promising opportunity to design learning experiences that are more active, flexible, and inclusive, particularly in multicultural educational settings (MonTech, 2023). Nevertheless, the successful implementation of such an approach depends largely on teachers' perceptions of its value and their willingness to incorporate it into their classroom practice. Therefore, understanding how teachers perceive these pedagogical

approaches is an essential step towards informing future teacher education initiatives and supporting the development of inclusive mathematics education.

Against this backdrop, there is a need to gain a deeper understanding of the main challenges and opportunities associated with this approach in multicultural educational settings. The distinctive contribution of the study lies in using the survey-MARIAN to examine, within Spanish public primary and secondary schools, the relationships among perceived mathematical challenges, reported teaching practices, digital technology integration, Montessori-inspired principles, and inclusion in culturally and linguistically diverse classrooms. Accordingly, the following research question is posed: *How do in-service primary and secondary mathematics teachers perceive the teaching of mathematics in multicultural school settings?* Specifically, we aim to answer the following sub-questions: what difficulties do they perceive? What teaching strategies and resources do they use? and What obstacles do they associate with inclusion? To address these questions, the objective of the study is to explore teachers' perceptions of the teaching methods used in these contexts, as well as the integration of creative technologies and the Montessori approach into mathematics teaching. Examining these perceptions will help identify opportunities to integrate different pedagogical approaches with the principles of creative technologies and the Montessori approach, thereby supporting the development of more inclusive mathematics education.

THEORETICAL FRAMEWORK

Contemporary schools are increasingly characterized by multicultural contexts, in which multiple cultural, linguistic, and social backgrounds coexist and interact. In this regard, research in mathematics education over recent decades has sought to understand how students' cultural differences influence their learning of mathematics. These studies have concluded that cultural values shape not only how mathematics is taught and learned, but also the nature of the mathematics curriculum itself (D'Ambrosio, 1985; López-Serentill,

2010). In multicultural classrooms, conceptions of mathematical knowledge and learning are not necessarily shared between students and teachers, which may create cultural mismatch and lead to misunderstandings within the classroom (Bishop, 1994).

From a sociocultural perspective, Vygotsky (1978) highlights that knowledge is constructed through social interaction and language, which is particularly relevant in culturally heterogeneous classrooms. In this context, linguistic and cultural differences should not be considered deficits, but rather resources for learning (Moschkovich, 2002). Consistent with this perspective, research in mathematics education underscores the central role of language in the construction of mathematical meaning in multicultural settings, showing that bilingual students employ complex strategies to participate in mathematical practices. This requires teachers to recognize and value the use of multiple linguistic registers in the classroom (Halai & Barwell, 2015; Moschkovich, 2002).

With regard to teaching practice, several studies highlight the importance of developing teachers' intercultural competence (Gay, 2020; Ladson-Billings, 1995). Culturally relevant pedagogy (CRP) is an approach that focuses on understanding students' cultural backgrounds and using this knowledge to design more meaningful and effective learning experiences. Its main goal is to establish authentic connections between what is taught and students' identities, thereby fostering meaningful engagement in learning (Fanoga, 2025). In this regard, research also emphasizes that the effective implementation of this approach requires not only cultural awareness, but also specific teacher education and a critical revision of traditional practices that tend to present mathematics as neutral and universal knowledge (Halai & Clarkson, 2016).

Research on how to facilitate access to mathematical knowledge has been highly productive, giving rise to a wide range of approaches. Bearing in mind the aims of this article, we wish to explore in greater depth the contributions of the Montessori method to promoting inclusive math education in multicultural schools. Contemporary research on the Montessori method in mathematics education highlights that its effectiveness lies in the interconnection between thinking and doing. According to Lillard (2017), the use of manipulative materials is not merely a visual support but is based on the premise that "movement and cognition are closely intertwined, and movement can enhance thinking and learning" (p. 192). From the perspective of mathematical achievement, Basargekar and Lillard (2021) provide evidence linking Montessori education to improved mathematics outcomes, as it enables students to approach complex problems with greater cognitive flexibility. In addition, Faryadi (2017) notes that the method contributes to reducing mathematics anxiety.

His study shows that students in Montessori environments display more positive and proactive attitudes, concluding that materials function as tools for "self-discovery" that transform the role of error: students do not fear making mistakes because the materials are self-correcting, allowing learning to occur without constant external judgment.

On the one hand, then, the mathematics education in multicultural classrooms through creative technologies and Montessori approach (MARIAN) project aims to encourage teachers to make use of manipulatives to foster mathematical understanding; the difference between 'performing arithmetic operations' and 'knowing how to calculate effectively' – that is, the difference between rote learning, mindless algorithms and mathematical thinking; the opportunity for students to work more independently, using materials that present them with challenges and incorporate what Montessori calls 'error control'; the opportunity for students to choose challenges, activities or topics linked to their interests; the aim to involve students in practical activities, where they do not merely listen to or repeat procedures, but carry out tasks with mathematical meaning; the design of tasks that connect with students' interests, cultures and backgrounds and invite them to explore, construct, experiment, make mistakes and revise; the organization of work in small groups, where students can help one another (peer learning); the importance of exploration, repetition and the pace of learning; the use of a journal or notebook to help pupils reflect on what they have done and become aware of what they have learnt; and, in general, the idea of creating learning environments that are more active, visual, hands-on, self-directed and accessible for students from diverse linguistic and cultural backgrounds.

On the other hand, we recognize that it is necessary for them to incorporate these ideas whilst considering the key principles of inclusive mathematics education, which aimed at ensuring access, participation, and meaningful learning for all students, regardless of their characteristics, abilities, or sociocultural backgrounds (Alsina & Planas, 2008). This approach is grounded in the principles of inclusive education promoted by international organizations such as UNESCO (2017), which define inclusion as a process of transforming educational systems to respond to student diversity from a perspective of equity and educational justice.

In mathematics education, inclusion involves challenging the assumption that mathematical learning is accessible only to certain types of students. Historically, mathematics has often been perceived as a selective discipline, contributing to processes of exclusion, particularly among students with disabilities, learning difficulties, or diverse sociocultural backgrounds (Boaler, 2008).

Table 1. Beliefs related to access and equity in mathematics (National Council of Teachers of Mathematics, 2014, p. 63-64)

Unproductive beliefs	Productive beliefs
Students possess different innate levels of ability in mathematics, and these cannot be changed.	Mathematics ability is a function of opportunity, experience, and effort-not of innate intelligence.
Equity is the same as equality.	Equity is attained when students receive the differentiated supports.
Equity is only an issue for schools with racial and ethnic diversity or significant numbers of low-income students.	Equity applies to all settings.
Mathematics learning is independent of students' culture, conditions, and language.	Effective mathematics instruction leverages students' culture, conditions, and language to support and enhance mathematics learning.
Students living in poverty lack the cognitive, emotional, and behavioral characteristics to participate and achieve in mathematics.	Effective teaching practices have the potential to open up greater opportunities for higher-order thinking and for raising the mathematics achievement of all students, including poor and low-income students.
Tracking promotes students' achievement by allowing students to be placed in "homogeneous" classes and groups where they can make the greatest learning gains.	The practice of isolating low-achieving students in low-level or slower-paced mathematics groups should be eliminated.
Only high-achieving or gifted students can reason about, make sense of, and persevere in solving challenging mathematics problems.	All students are capable of making sense of and persevering in solving challenging mathematics problems and should be expected to do so.

In response, contemporary approaches advocate teaching practices that recognize diversity as a resource rather than an obstacle. Thus, inclusion in mathematics is not limited to ensuring access; it also requires creating genuine conditions for participation and the construction of mathematical meaning for all students.

In this regard, the National Council of Teachers of Mathematics (2014) states that:

An excellent mathematics program requires that all students have access to a high-quality mathematics curriculum, effective teaching and learning, high expectations, and the support and resources needed to maximize their learning potential (p. 59).

From this perspective, several authors argue that the key issue is whether the professionals responsible for organizing mathematics teaching and learning are able to transform traditional beliefs and practices in order to promote success for all students (Boaler & Staples, 2008; Kisker et al., 2012). This transformation is especially relevant in multicultural contexts, where implicit conceptions of ability, language, or culture may shape students' opportunities to learn mathematics. From this standpoint, the National Council of Teachers of Mathematics (2014) presents a synthesis of unproductive and productive beliefs related to access and equity in mathematics, summarized in **Table 1**.

From this perspective, Lambert and Tan (2020) propose rethinking conceptions of mathematical ability by questioning deficit-oriented views and promoting environments in which all students are recognized as mathematically competent learners. This view connects with sociocultural perspectives that emphasize that mathematical competence is not a fixed individual trait,

but rather is constructed through interaction with learning opportunities, classroom practices, and the social contexts in which it develops (Moschkovich, 2002; Vygotsky, 1978).

METHODOLOGY

This study employed a survey-based descriptive research design (Cohen et al., 2017) to explore in-service teachers' perceptions of teaching methods, the integration of creative technologies, and the Montessori approach in mathematics education within multicultural contexts. This approach emphasizes the social construction of knowledge and individuals' lived experiences (Creswell & Creswell, 2018), focusing on participants' perspectives to provide a nuanced understanding of their views on teaching mathematics in diverse settings. Within this framework, data collection was conducted as part of the European project MARIAN, funded by the Erasmus+ program. The project aims to develop and validate an innovative approach to mathematics teaching in multicultural school contexts by integrating the principles of Montessori pedagogy with creative technologies.

In addition, MARIAN promotes collaboration among European schools and organizations to design inclusive educational resources that support student participation and learning, particularly for those from vulnerable groups. Within this broader project, the present study constitutes an initial needs analysis intended to identify teachers perceived challenges, reported practices, and support needs, thereby informing the design of the subsequent intervention and professional development phases of MARIAN.

Table 2. Structure and organization of the survey

Dimension	Approach	Items
1	Challenges in teaching mathematics in multicultural school contexts	1-4
2	Planning and management of mathematics teaching in multicultural school contexts	5-11
3	Inclusion in mathematics education	12-14

Participants and Context

The study involved 50 in-service mathematics teachers from the autonomous community of Catalonia, Spain, who teach in public multicultural schools. The participating schools enrolled a high proportion of RMM students, resulting in educational settings characterized by substantial cultural and linguistic diversity, in which the present study was conducted. Of these, 80% were primary school teachers and 20% were secondary school teachers. Most participants had substantial teaching experience: 26% reported more than 20 years of experience, and 44% between 11 and 20 years. Additionally, 22% had between 6 and 10 years of experience, while only 8% had fewer than 5 years. Regarding the educational levels taught, primary school teachers were relatively evenly distributed across grades. The largest group (38%) taught students aged 10-11 years, followed by those teaching students aged 8-9 years (24%). Additionally, 18% of participants taught across a broader age range (8-11 years). Secondary school teachers (20% of the sample) taught students aged 12-13 years.

Instrument

A survey was designed to explore in-service teachers' perceptions of teaching mathematics in multicultural school contexts. The instrument development process was carried out in four stages: defining the construct; developing the questionnaire items; establishing content validity; and evaluating the instrument's psychometric properties.

In the first stage, a literature review was conducted on mathematics education in multicultural classrooms, the integration of creative technologies, and the Montessori approach. This review informed the definition of the study's conceptual dimensions and the identification of the key indicators to be included in the questionnaire. Based on these findings, a preliminary version of the instrument was developed.

Subsequently, the initial version of the instrument underwent a content validation process through expert review. The expert panel consisted of five specialists in mathematics education, intercultural education, and educational technology, who evaluated the clarity, relevance, and appropriateness of each item in relation to its corresponding theoretical dimension. Their feedback led to revisions in the wording of several items, the removal of redundant questions, and adjustments to the response categories, resulting in the final version of the questionnaire.

To assess the instrument's functionality prior to its implementation, a pilot study was conducted with ten in-service teachers. The pilot results helped identify minor comprehension issues and estimate the average completion time, which was approximately 15 minutes. The feedback obtained led only to minor wording modifications, while the conceptual structure of the instrument remained unchanged.

The final version of the instrument, referred to as survey-MARIAN, consisted of 14 items organized into three dimensions, as shown in **Table 2**. These dimensions were used as a conceptual framework for organizing the instrument and the analysis.

- Dimension 1. Challenges in teaching mathematics in multicultural school contexts:** This dimension aims to gather data on which mathematical topics are most difficult to learn and teach among RMM students backgrounds, as well as factors contributing to learning difficulties and the strategies used by teachers to address them.
- Dimension 2. Planning and management of mathematics teaching in multicultural school contexts:** This dimension focuses on methodological aspects, including the contexts and resources used in teaching mathematics (e.g., real-world contexts, manipulatives, games, and digital technologies), as well as teaching approaches such as competence-based instruction and the Montessori method.
- Dimension 3. Inclusion in mathematics education:** This dimension explores how equity is addressed in mathematics teaching and the challenges associated with its implementation.

Regarding the response format, the instrument comprised eight closed-ended questions, two open-ended questions, and four items rated on a five-point Likert scale. **Table 3** presents the survey items analyzed in this study.

The closed-ended questions provided structured information about the participants' perceptions, whereas the open-ended questions were included to expand and contextualize these responses by providing examples, nuances, and explanations that enriched the interpretation of the findings.

Because the questionnaire comprised multiple response formats, only the four Likert-scale items were subjected to reliability analysis using Cronbach's alpha. The analysis yielded a Cronbach's alpha coefficient of 0.81, indicating satisfactory internal consistency.

Table 3. Survey items

No	Items	Choice
1	In your experience, which mathematics topics are most challenging for students? (choose 2)	Numerical understanding and operations, measurement, geometry, algebra, statistics and probability, computational thinking
2	Which mathematics topics do you personally find most difficult to teach? (choose 2)	Numerical understanding and operations, measurement, geometry, algebra, statistics and probability, computational thinking
3	What are the main factors contributing to students' difficulties in mathematics?	Lack of foundational skills, difficulty in understanding abstract concepts, low engagement/motivation, language barriers, insufficient resources/materials, others
4	What strategies do you use to help students overcome these difficulties?	
5	How frequently do you use the following supports in your mathematics lessons? Assign a value: 1 (never), 2 (rarely), 3 (sometimes), 4 (often), 5 (very often)	Real-world contexts, manipulative materials, games, narratives and storytelling, technological resources, graphical resources
6	How frequently do you use the following approaches in your mathematics teaching? Assign a value: 1 (never), 2 (rarely), 3 (sometimes), 4 (often), 5 (very often)	Problem-solving, reasoning and proof, representation, communication, connections, computational thinking, mathematical modelling
7	Which digital technological tools do you use in mathematics instruction?	Interactive whiteboards, educational mathematics software, online learning platforms, coding and robotics tools, virtual simulations, I do not use digital tools in mathematics instruction, others
8	How effective are digital technologies in improving student understanding of mathematics? Assign a value: 1 (not effective at all), 2 (slightly effective), 3 (moderately effective), 4 (effective), 5 (very effective)	
9	What are the main barriers to using digital technologies in your mathematics classes?	Lack of access to digital devices, insufficient training or technical support, time constraints, student difficulties with technology, school policy restrictions, teacher's attitudes towards the use of digital technologies, others
10	Are you familiar with the principles of Montessori education? Assign a value: 1 (not familiar at all), 2 (slightly familiar), 3 (moderately familiar), 4 (familiar), 5 (very familiar)	
11	If you are familiar, which aspects of the Montessori methodology do you think could improve students' understanding and interest in mathematics?	The use of manipulative materials to facilitate the understanding of abstract concepts, self-directed learning and personalized pacing for each student, emphasis on problem-solving through exploration and discovery, connection to real-life situations to give meaning to mathematics, a structured yet flexible learning environment, others
12	How does your school accommodate RMM students in mathematics education?	Use of multilingual support/materials, culturally relevant examples in lessons, additional tutoring/support sessions, peer mentoring programs, others
13	What are the biggest challenges in teaching mathematics to RMM students?	Language barriers, different prior educational experiences, lack of engagement or motivation, limited parental support, others
14	What additional support or resources would help you in teaching mathematics more inclusively?	

Data Collection and Analysis

Data were collected through the online administration of the survey-MARIAN instrument. A web link to the questionnaire was distributed via email to teachers who voluntarily agreed to participate in the study. Before completing the survey, participants were informed about the purpose of the study, the voluntary nature of their participation, and the confidential and

anonymous treatment of the data. The questionnaire was administered in Catalan and required approximately 15 minutes to complete.

Data analysis combined descriptive and exploratory procedures. Responses to closed-ended questions were analyzed using descriptive statistics. In contrast, responses to open-ended questions were subjected to thematic analysis following content analysis procedures

(Krippendorff, 2019), through which categories were inductively derived from the different types of responses obtained.

The coding process was conducted using an MS Excel® spreadsheet. To ensure the reliability of the coding process, joint coding sessions were carried out among members of the research team. During these sessions, discrepancies were reviewed and discussed until consensus was reached. This procedure ensured consistency in category assignment and strengthened the internal coherence of the qualitative analysis.

To complement the descriptive findings and identify broader response patterns, exploratory cross-item analyses were also performed. Associations between ordinal Likert-type items were examined using Spearman's rank correlations, whereas relationships between categorical variables were explored through cross-tabulations and paired comparisons where appropriate. These analyses were intended to identify patterns across teachers' perceptions, reported practices, and perceived support needs. Given the exploratory nature of the study and the relatively small number of secondary school teachers in the sample, the results of these analyses should be interpreted with caution.

RESULTS

The following section presents the results of the survey organized according to the three dimensions addressed in the study. First, the findings for each survey item are reported within their corresponding dimension. This is followed by an exploratory cross-item analysis, which examines patterns across teachers' perceptions, reported practices, and perceived support needs to provide a more integrated interpretation of the findings.

Given the substantially larger proportion of primary than secondary teachers in the sample, comparisons between educational stages are presented for descriptive purposes only and should be interpreted with caution as exploratory.

Challenges in Teaching Mathematics in Multicultural School Contexts

Challenging mathematics topics for students in multicultural contexts

Responses to item 1 indicate that teachers perceive algebra as the most challenging topic for students in multicultural primary and secondary school contexts, as shown in **Figure 1**.

In primary education, algebra is identified as the most difficult topic (47.5%), followed by number and operations (42.5%) and data analysis and probability (40%), while measurement is considered the least challenging (15%).

Among the secondary teachers who participated in the study, algebra was selected by all respondents (100%, $n = 10$) as the most challenging topic, followed by geometry (50%, $n = 5$). Given the small number of secondary teachers, these percentages should be interpreted with caution. In this subgroup, number and operations and measurement are perceived as the least difficult topics, both at 10% ($n = 1$).

Mathematics topics difficult to teach in multicultural contexts

With regard to item 2, **Figure 2** shows that, in primary education, algebra is perceived by teachers as the most difficult topic to teach (52.5%), followed by computational thinking (47.5%). The secondary school teachers who participated in the study say that the most difficult subject to teach is computational thinking (70%, $n = 7$), while the remaining mathematical topics show considerably lower percentages, ranging from 10% ($n = 1$) to 30% ($n = 3$).

Factors contributing to students' difficulties in mathematics

Regarding the factors contributing to students' difficulties in mathematics (item 3), **Figure 3** shows that primary school teachers mainly attribute these difficulties to a lack of foundational skills (63%) and

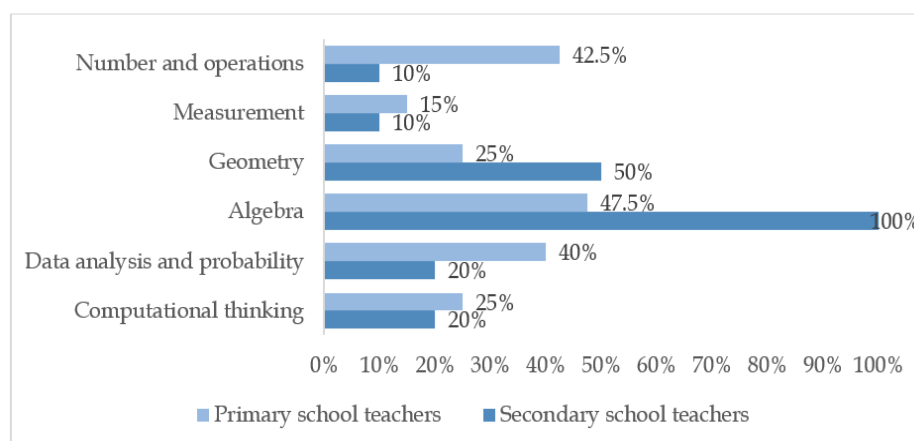


Figure 1. Challenging mathematics topics for students in multicultural contexts (the authors' own elaboration)

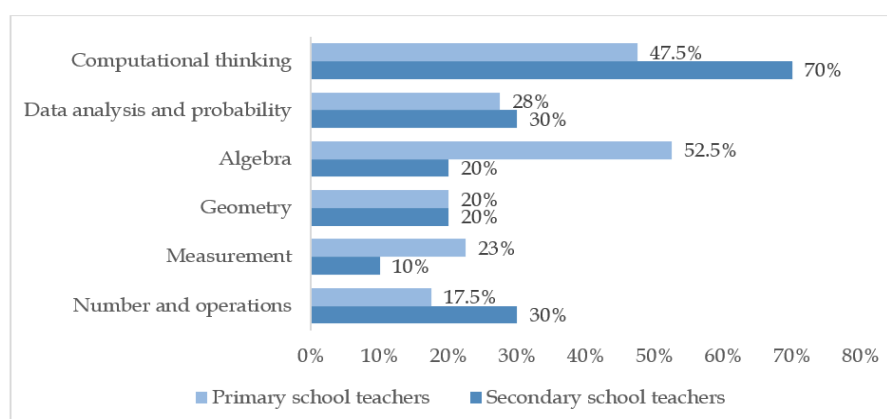


Figure 2. Mathematics topics are difficult to teach in multicultural contexts (the authors' own elaboration)

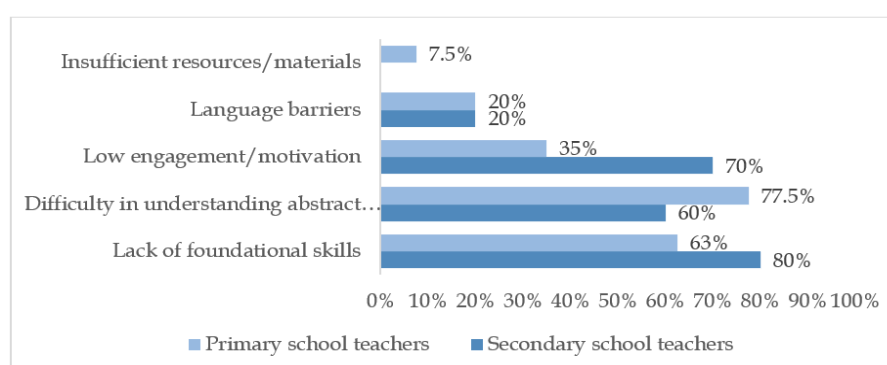


Figure 3. Factors contributing to students' difficulties in mathematics in multicultural contexts (the authors' own elaboration)

difficulties in understanding abstract concepts (67.5%). As in primary education, secondary school teachers suggest a lack of foundational skills as the most relevant factor (80%, $n = 8$), followed by low levels of student engagement and motivation (70%, $n = 7$).

It is important to note that, at both educational levels, language barriers and insufficient resources or materials are perceived as having a comparatively lower impact on students' difficulties in mathematics.

Strategies used to address students' difficulties in mathematics

Item 4 focuses on the strategies used by teachers in multicultural contexts to support students in overcoming difficulties in mathematics. Based on the content analysis, responses were categorized into four main groups: use of teaching materials, adaptation of activities, diversification of teaching methods, and use of real-life examples.

The results show that, in primary education, the most frequently reported strategy is the use of teaching materials (55%), reflecting a more concrete and manipulative approach to teaching. For example, participants mentioned, "Working with a variety of manipulative materials"; "Using manipulative materials that support the transition to abstract thinking"; "Providing support through the use of manipulative

materials". This is followed by the diversification of teaching methods (30%), including practices such as small-group work and the use of simplified language. In their responses, teachers stated, for example, "I use simpler language when necessary"; "I combine individual and cooperative activities"; "I organize heterogeneous groups to promote peer learning". In contrast, the adaptation of activities (12.5%) and the use of real-life examples (10%) are less frequently reported, for example, they stated, "I provide alternative activities when necessary"; "I adapt activities to students' level of understanding"; "I use examples that are closely related to students' everyday reality."

In secondary education, teachers more commonly rely on the diversification of teaching methods (50%, $n = 5$) and the use of real-life examples (40%, $n = 4$), for example, they stated, "I use a variety of activities and assessment methods"; "I contextualize mathematical problems"; "I explain concepts using everyday examples", suggesting a greater emphasis on varied and contextualized approaches. The use of teaching materials is less frequent at this level (30%, $n = 3$), followed by the adaptation of activities (20%, $n = 2$), for example, they stated, "I adapt activities by considering different levels of difficulty"; "I use concrete materials, such as tangrams or 3D shapes, to help students understand more abstract concepts."

Overall, the responses suggest some differences in the strategies reported by teachers from the two educational stages. Within this sample, primary teachers more frequently referred to manipulative materials, whereas secondary teachers more often mentioned diversified teaching methods and the use of real-life examples. However, given the limited number of secondary teachers, these patterns should be regarded as exploratory and should not be interpreted as evidence of systematic differences between educational stages.

Planning and Management of Mathematics Teaching in Multicultural Contexts

Resources used in mathematics lessons

Item 5 examines the frequency with which teachers in multicultural contexts use different supports in mathematics lessons, measured using a five-point Likert-type scale: 1 (never), 2 (rarely), 3 (sometimes), 4 (often), and 5 (very often). These supports include real-world contexts, manipulative materials, games, narratives and storytelling, technological resources, and graphical resources.

As shown in **Figure 4**, responses were concentrated mainly at intermediate levels (2 and 3), indicating occasional to moderate use of these resources. Real-world contexts, such as budgeting activities, cooking

measurements, or distances on maps, and manipulative materials (e.g., fraction tiles and abacuses) are among the most frequently used supports, particularly at level 3 (44% and 34%, respectively). Manipulative materials also show the highest percentage at level 5 (26%).

In contrast, technological resources, such as robotics kits, programming platforms, or dynamic geometry software (e.g., GeoGebra), and narrative approaches are predominantly concentrated at lower frequency levels (1 and 2), with minimal presence at level 5, indicating limited integration into teaching practice. Graphical resources (e.g., textbooks and worksheets) and games show a more balanced distribution across levels, reflecting variability in their reported use among participants.

Approaches used in mathematics teaching in multicultural contexts

Item 6 examines the frequency with which teachers in multicultural contexts incorporate specific mathematical competencies into their teaching practices, measured using a five-point Likert-type scale ranging from 1 (never) to 5 (very often), where 2 (rarely), 3 (sometimes), and 4 (often).

As shown in **Figure 5**, responses were concentrated mainly at intermediate frequency levels (2 and 3). Communication and connections show the highest

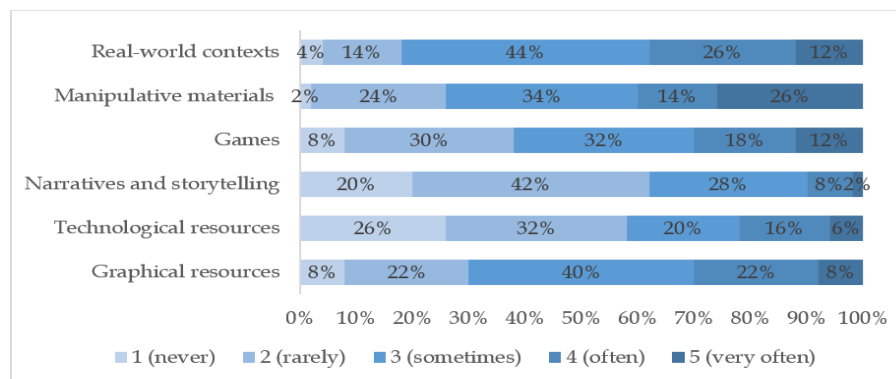


Figure 4. Resources used in mathematics lessons in multicultural contexts (the authors' own elaboration)

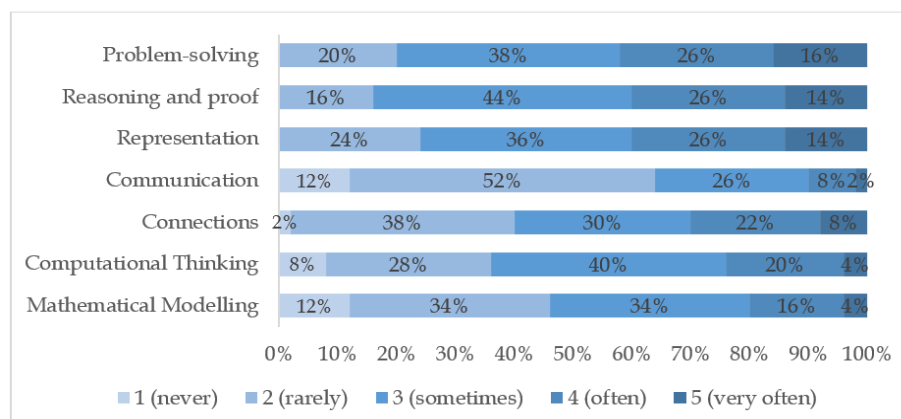


Figure 5. Approaches used in mathematics teaching in multicultural contexts (the authors' own elaboration)

percentages at level 2 (52% and 38%, respectively), whereas reasoning and proof, computational thinking, and problem solving are more prominent at level 3 (44%, 40%, and 38%, respectively), suggesting a more regular, although not systematic, presence in teaching practice.

Higher frequency levels (4 and 5) show relatively low percentages across all competencies, not exceeding 16%. This indicates that these competencies are still integrated to a limited extent. Similarly, level 1 (never) shows generally low percentages, particularly for connections (2%), suggesting that these practices are not absent, but their implementation remains limited.

Digital technological tools used in mathematics teaching

With regard to the use of digital technological tools in mathematics teaching (item 7), the results show that only a small proportion of teachers in multicultural primary and secondary contexts report not using digital resources ($\leq 10\%$), indicating a generally widespread integration of these tools (Figure 6).

However, notable differences emerge across educational levels. In primary education, the most commonly used tools are interactive whiteboards (72.5%) and coding and robotics tools (52.5%). In contrast, in secondary education, the use of educational mathematics software, such as GeoGebra or Desmos, predominates (70%, $n = 7$). Online learning platforms show similar levels of use across both educational stages,

while virtual simulations are used less frequently. Overall, the findings reveal distinct patterns in the integration of digital tools depending on the educational level.

Perceived effectiveness of digital technologies in mathematics learning

Item 8 explores teachers' perceptions of the effectiveness of digital technologies in improving RMM students' understanding of mathematics, measured using a five-point Likert-type scale ranging from 1 (not effective at all) to 5 (very effective), where 2 (slightly effective), 3 (moderately effective), and 4 (effective). The results reveal differences between educational levels (Figure 7).

In primary education, teachers' responses are concentrated at higher levels of perceived effectiveness, with 45% at level 4 and 40% at level 3, while lower levels (1 and 2) show minimal percentages. Among the secondary teachers, the largest proportion of responses was recorded at level 3 (60%, $n = 6$), followed by level 5 (30%, $n = 3$).

Overall, the findings suggest a more positive perception of the effectiveness of digital technologies among primary school teachers, compared to a more moderate evaluation among secondary school teachers. But given the limited number of secondary teachers included in the sample, these patterns should be interpreted as exploratory and should not be considered

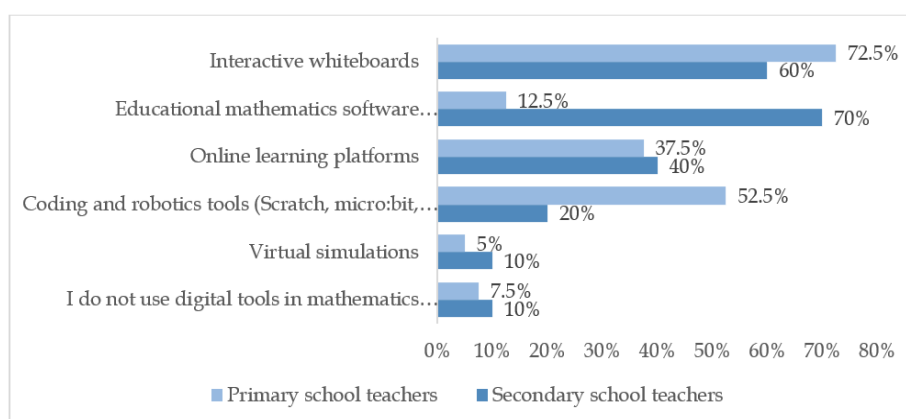


Figure 6. Digital technological tools used in mathematics teaching (the authors' own elaboration)

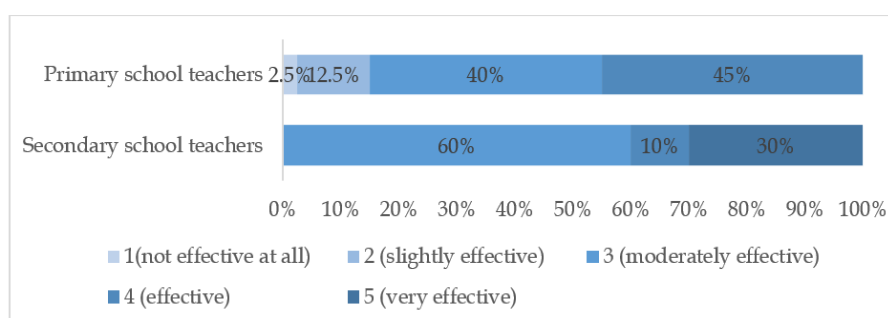


Figure 7. Perceived effectiveness of digital technologies in mathematics learning (the authors' own elaboration)

evidence of systematic differences between primary and secondary teachers.

Barriers to the use of digital technologies in mathematics teaching

Item 9 examines teachers' perceptions of the barriers they encounter when using digital technologies in mathematics lessons. **Figure 8** presents the distribution of responses by educational stage.

In primary education, the main barriers identified are insufficient training or technical support (52.5%) and time constraints (45%). Additionally, student difficulties with technology are reported as a barrier by 22.5% of teachers. Among the secondary teachers, responses to the predefined categories did not exceed 10% ($n = 1$). However, 30% ($n = 3$) of teachers indicate other factors, such as the need for greater confidence in using technology or issues related to the malfunctioning of digital devices.

It is noteworthy that school policy restrictions are not perceived as a significant barrier at either educational level. Overall, the responses suggest that barriers to the use of digital technologies are more pronounced and varied in primary education than in secondary education.

Familiarity with the Montessori approach

Item 10 examines teachers' familiarity with the principles of the Montessori approach. The results reveal significant differences between educational levels (**Figure 9**).

In primary education, teachers report a relatively high and balanced level of familiarity. Most participants (72.5%) indicate a medium to high level of familiarity, suggesting a greater presence and influence of Montessori principles in both teacher training and classroom practice at this stage. Secondary school teachers report low levels of familiarity, with 80% ($n = 8$) of respondents selecting level 1 or level 2 on the scale, corresponding to little or no familiarity. Only 20% ($n = 2$) indicate a moderate level of familiarity (level 3).

Overall, the findings highlight a clear gap between primary and secondary education in terms of familiarity with the Montessori approach.

Aspects of the Montessori approach relevant to mathematics learning

Item 11 examines teachers' perceptions of the aspects of the Montessori methodology that may enhance RMM students' understanding of and interest in mathematics. As shown in **Figure 10**, the results reveal differences between educational levels.

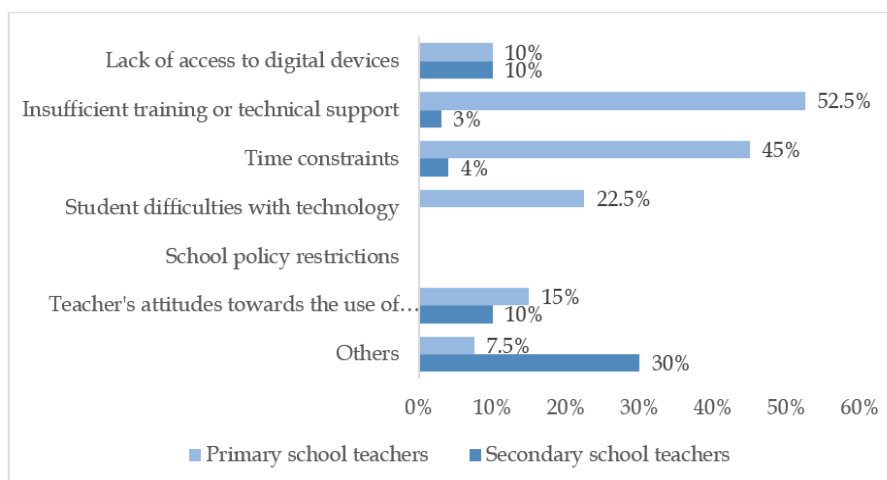


Figure 8. Barriers to the use of digital technologies in mathematics teaching (the authors' own elaboration)

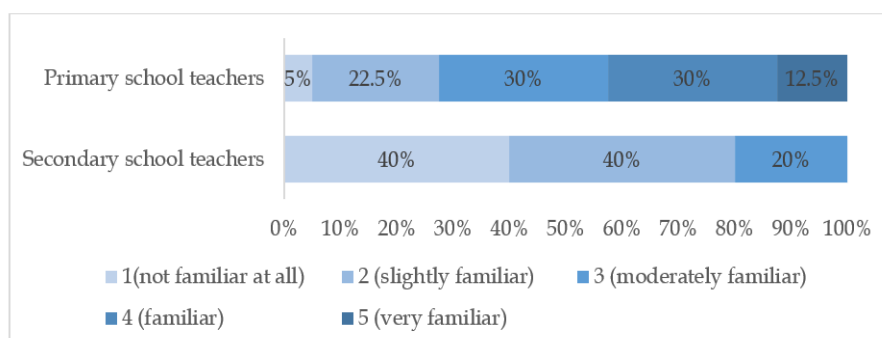


Figure 9. Familiarity with the Montessori approach (the authors' own elaboration)

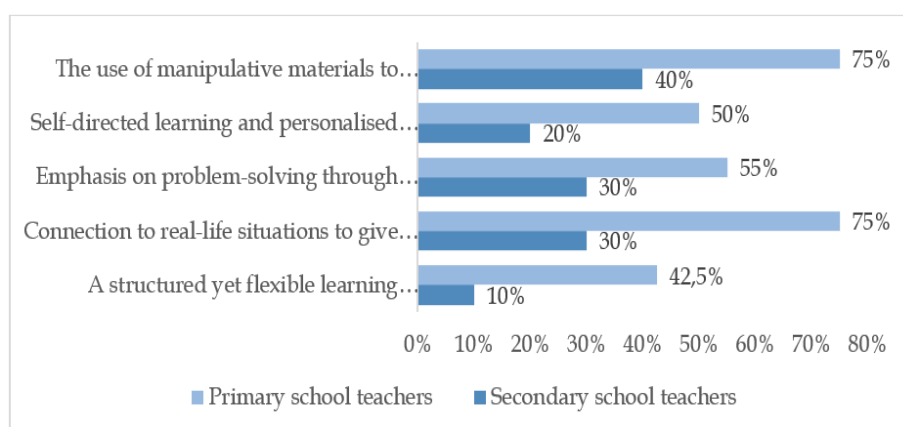


Figure 10. Aspects of the Montessori approach relevant to mathematics learning (the authors' own elaboration)

In primary education, the most highly valued aspects are the use of manipulative materials to support the understanding of abstract concepts and the connection to real-life situations to give meaning to mathematics, both reported by 75% of teachers. These are followed by an emphasis on problem solving through exploration and discovery (55%), and self-directed learning with personalized pacing (50%). A smaller, yet still notable proportion of teachers highlight the importance of a structured but flexible learning environment (42.5%).

In contrast, in secondary education, and overall responses show considerably lower percentages across all categories. Nevertheless, as in primary education, the use of manipulative materials to support the understanding of abstract concepts is the most frequently mentioned aspect (40%, $n = 4$). This is followed by problem solving through exploration and discovery and connections to real-life situations, both reported by 30% ($n = 3$) of teachers.

Overall, the results indicate that Montessori principles are more strongly recognized and valued in primary education, while their presence in secondary education is more limited.

Inclusion in Mathematics Education in Multicultural Contexts

Measures for teaching mathematics to RMM students

Item 12 examines the measures implemented by schools to support the teaching of mathematics to RMM students backgrounds. As shown in **Figure 11**, the results reveal similar patterns across primary and secondary education.

The most frequently implemented measures are additional tutoring or support sessions (67.5% in primary education and 80% ($n = 8$) in secondary education) and the use of multilingual materials (55% and 40% ($n = 4$), respectively). In contrast, peer mentoring programs and the use of culturally relevant examples in mathematics lessons are less commonly implemented at both educational levels.

Challenges in teaching mathematics to RMM students

Item 13 gathers teachers' perceptions of the challenges they face when teaching mathematics to RMM students. As shown in **Figure 12**, similar patterns emerge across both educational levels.

In both primary and secondary education, language barriers are identified as the main challenge, reported by

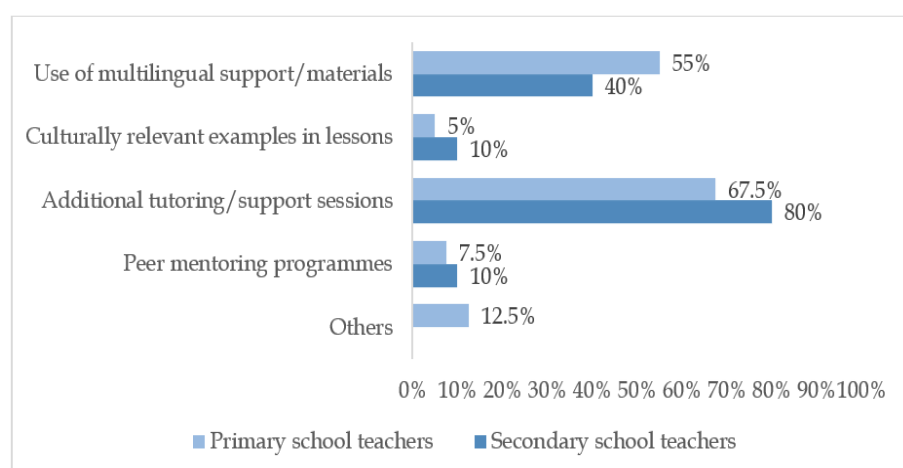


Figure 11. Measures for teaching mathematics to RMM students (the authors' own elaboration)

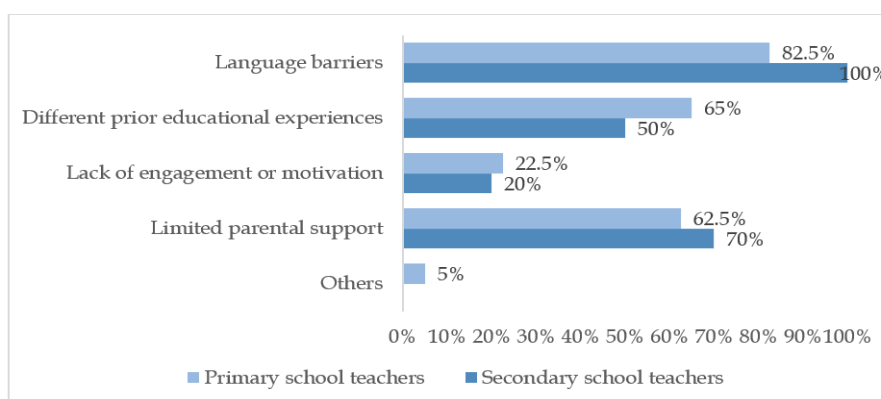


Figure 12. Challenges in teaching mathematics to RMM students (the authors' own elaboration)

82.5% and 100% ($n = 10$) of teachers, respectively. In primary education, differences in prior educational experiences are also highlighted (65%), followed by limited parental support (62.5%), while lack of student engagement or motivation is perceived as a less significant challenge (22.5%). In secondary education, limited parental support is identified as the second most significant challenge (70%, $n = 7$), followed by differences in prior educational experiences (50%, $n = 5$). As in primary education, lack of motivation is considered a less prominent challenge (20%, $n = 2$).

Finally, a small proportion of primary school teachers (5%) mention other challenges, such as the diversity of educational systems, lack of prior schooling, and difficulties in adapting to a new cultural context.

Supports and resources for inclusive mathematics teaching

Item 14 examines teachers' perceptions of the supports and resources needed to teach mathematics more inclusively. Based on the content analysis, responses were grouped into four categories: the need for increased classroom staffing (e.g., additional teachers or support staff); improved availability and quality of manipulative and visual materials; the implementation of more inclusive and differentiated teaching strategies; and access to multilingual tools and translated materials to support students' understanding of mathematical language.

In primary education, the most frequently identified need is the increase in human resources (27.5%), including additional support teachers, teaching assistants, and reduced class sizes to enable more personalized instruction. For example, teachers stated, "More staff in schools to better support students"; "Having more support available in the classroom to adequately address all students' needs"; "Smaller class sizes to ensure that all students receive the attention they need". This is followed by the need for higher-quality manipulative and visual materials (20%). For example, they stated, "Printed materials tailored to each child's level, along with manipulative resources (e.g., base-ten

blocks and number lines) and visual materials (e.g., hundred charts and multiplication tables)"; "Having more manipulative materials in the classroom. Much of what I use is either homemade or purchased with my own money".

To a lesser extent, teachers highlight the importance of more inclusive and differentiated teaching strategies (10%), for example, they stated, "I incorporate a greater variety of mathematical contexts and situations so that students understand the usefulness and relevance of what they are learning". Finally, multilingual tools and translated materials (5%), were also mentioned. For example, teachers stated, "Having translated versions of the teaching materials available"; "Providing students with access to multilingual digital tools".

In secondary education, 40% of teachers did not respond to this item. Among those who did, the demand for increased human resources is even more prominent (50%, $n = 3$), highlighting the need for additional support to address student diversity at this level. For example, they stated, "Fewer students per class should be the first measure implemented"; "More teaching staff and lower student-teacher ratios". In contrast, inclusive and differentiated teaching strategies (16.6%, $n = 1$) and multilingual tools and translated materials (16.6%, $n = 1$) are mentioned less frequently, for example, they stated, "More teaching resources specifically designed for newly arrived students". Overall, the results indicate that teachers perceive structural and material support, particularly increased human resources, as essential for advancing inclusive mathematics teaching in multicultural contexts.

Cross-Item Patterns in Teachers' Perceptions and Reported Practices

To complement the descriptive analysis, an exploratory cross-item analysis was conducted in order to identify broader patterns across teachers' responses. Given the exploratory nature of the study and the small size of the secondary teacher subgroup, these analyses are interpreted as indicative patterns rather than as generalizable statistical evidence. Spearman's rank

correlations were used for ordinal Likert-type items, while categorical responses were compared through cross-tabulations.

A first relevant pattern concerns the role of language in teachers' perceptions of mathematical difficulty. When teachers were asked about the main factors contributing to students' difficulties in mathematics in general, language barriers were selected by 11 teachers (11/50; 22%). However, when the question focused specifically on the challenges of teaching mathematics to RMM students, language barriers were selected by 43 teachers (43/50; 86%). More specifically, among the 39 teachers who did not identify language as a general factor contributing to mathematical difficulties, 33 nevertheless identified it as a challenge when referring to RMM students. This paired contrast was substantial (McNemar exact test, $n = 50$, $p < .001$). This suggests that teachers may not initially conceptualize language as an inherent dimension of mathematical learning, but rather as a difficulty that becomes visible when attention shifts specifically to students from RMM backgrounds.

This pattern is also visible when comparing the challenges identified for RMM students with the accommodations reported at the school level. Although language barriers were the most frequently reported challenge for RMM students, multilingual support or materials were reported by 25 teachers (25/50; 50%). By contrast, additional tutoring or support sessions were reported by 37 teachers (37/50; 74%), whereas culturally relevant examples in lessons were reported by only 3 teachers (3/50; 6%) and peer mentoring programs by 4 teachers (4/50; 8%). This contrast suggests that school responses to diversity are perceived mainly in terms of additional or compensatory support, while more culturally responsive or participatory forms of mathematical inclusion appear less frequently in teachers' reports.

A second pattern concerns the relationship between active teaching supports and mathematical teaching approaches. An active support index was calculated from teachers' reported use of real-world contexts, manipulative materials, games, narratives, and graphical resources. This index was strongly and positively associated with a mathematical practices index that included problem-solving, reasoning and proof, representation, communication, connections, and mathematical modelling (Spearman's $\rho = .73$, $n = 50$, $p < .001$). This indicates that these practices do not appear as isolated strategies, but rather as part of a broader pedagogical profile oriented toward active mathematics learning. The open-ended responses reinforce this interpretation: many teachers referred to "manipulative materials," "visual supports," "learning situations," "challenges," and "connections with everyday life" as strategies for helping students overcome mathematical difficulties.

A third pattern relates to digital technologies and computational thinking. Teachers' reported use of technological resources was positively associated with their reported use of computational thinking approaches in mathematics teaching (Spearman's $\rho = .51$, $n = 50$, $p < .001$). However, the association between the frequency of technology use and teachers' perceived effectiveness of digital technologies was weaker and did not reach conventional levels of statistical significance (Spearman's $\rho = .24$, $n = 50$, $p = .092$). This suggests that integration of technology is more closely connected to specific pedagogical practices, such as computational thinking, than to a general positive perception of digital technologies. At the same time, the barriers reported by teachers point to important implementation constraints: 25 teachers (25/50; 50%) identified insufficient training or technical support, and 26 teachers (26/50; 52%) identified time constraints as obstacles to using digital technologies in mathematics classes.

Finally, the analysis provides a more nuanced interpretation of the role of Montessori pedagogy in the study. Teachers' familiarity with Montessori education was moderately associated with their reported use of manipulative materials (Spearman's $\rho = .32$, $n = 50$, $p = .024$) and with the active support index (Spearman's $\rho = .31$, $n = 50$, $p = .026$), but only weakly associated with the broader mathematical practices index (Spearman's $\rho = .25$, $n = 50$, $p = .074$). In addition, among teachers who answered the item on potentially relevant aspects of the Montessori approach ($n = 41$), the most frequently selected aspects were the use of manipulative materials to facilitate the understanding of abstract concepts (34/41), connections to real-life situations to give meaning to mathematics (34/41), exploration and discovery through problem solving (25/41), and self-directed learning with personalized pacing (22/41). These results suggest that Montessori should not be interpreted in this study as a school model or as a distinct intervention, but rather as a pedagogical reference associated with concrete, active, exploratory, and student-centered mathematics learning.

Taken together, these cross-item patterns help move beyond an item-by-item description of the survey results. They suggest three broader interpretations. First, language becomes a central issue when mathematics teaching is considered in relation to RMM students. Second, active supports and mathematical practices tend to form a coherent pedagogical orientation. Third, technology and Montessori-inspired elements are relevant insofar as they are connected to concrete teaching practices, rather than as isolated methodological labels. As noted above, these patterns refer to the full sample and should be interpreted as exploratory associations rather than as evidence of stage-specific differences.

DISCUSSION AND CONCLUSIONS

This study explores Spanish in-service teachers' perceptions of the professional practice of teaching mathematics in multicultural school contexts, providing a context-specific diagnosis that is particularly relevant for guiding the development of the MARIAN project. In line with the research question, the findings suggest that teaching mathematics in these contexts is not perceived as a simple methodological adaptation, but rather as a complex practice that requires a comprehensive reconsideration of content, teaching practices, and the conditions that enable student participation. Beyond documenting teachers' perceptions, the study identifies three interrelated patterns that contribute to understanding inclusive mathematics teaching in multicultural classrooms: the contextual role of language when teaching RMM students, the coherence between active supports and reported mathematical practices, and the educational relevance of digital technologies and Montessori-inspired principles when they are connected to concrete mathematical practices.

First, the prominence of algebra as the most challenging content, particularly in secondary education, together with the difficulty attributed to understanding abstract concepts in primary education, suggests that the participating teachers perceive challenges associated with the progression towards increasingly symbolic forms of mathematical reasoning. This perception is consistent with research describing this transition as a significant stage in mathematical learning, particularly when students have had limited prior opportunities to engage in generalization and representation (Blanton et al., 2018; Kieran, 2004; Sun et al., 2023). Within the scope of the present study, these findings should be interpreted as reflecting teachers' reported perceptions rather than direct evidence of curriculum progression or classroom practice. From a sociocultural perspective (Vygotsky, 1980), the findings highlight the relevance of considering how the forms of mathematical representation used in schools relate to students' linguistic, cultural, and educational repertoires (Moschkovich, 2002).

Second, computational thinking emerges as one of the most complex areas to teach, particularly in secondary education. Rather than reflecting only a technical difficulty, this finding may indicate, from the perspective of the participating teachers, a perceived gap between the availability of digital technologies and teachers' preparedness to integrate them pedagogically. In this regard, previous research indicates that the incorporation of digital technologies, including artificial intelligence, does not in itself guarantee improvements in learning outcomes; instead, its effectiveness depends on teachers' ability to integrate these tools in ways that are coherent with mathematical objectives and classroom practices (Mohamed et al., 2022; Porter, 2022).

Consistent with these studies, teachers' responses suggest that, although digital tools are available in the participating schools, their use is perceived as moderate and not systematic. Within the scope of the present study, these findings should be interpreted as reflecting teachers' reported perceptions rather than direct evidence of how digital technologies are enacted in classroom practice. Taken together, the results highlight the importance of supporting teachers in the pedagogically meaningful integration of digital technologies into mathematics teaching.

With regard to teaching strategies, the results show a predominance of manipulative and concrete approaches in primary education, compared to a greater diversification of teaching methods in secondary education. This difference suggests that teachers perceive practices associated with exploration, manipulation, and contextualization as being more characteristic of primary education than of secondary education, despite their potential to support understanding at more advanced levels (Lillard, 2017).

A particularly significant finding is the gap in familiarity with the Montessori approach between primary and secondary education. While primary teachers report a relatively high level of familiarity, its presence in secondary education is notably limited. This pattern suggests that teachers tend to associate active pedagogical approaches primarily with early educational stages, despite the evidence highlighting their potential to support mathematical thinking across all levels of schooling (Basargekar & Lillard, 2021; Lillard, 2017). However, the findings also suggest that, from teachers' perspectives, the effective integration of such approaches cannot be reduced to the occasional use of materials or activities; rather, it requires a deeper understanding of their underlying principles, and a coherent implementation aligned with mathematical learning objectives.

In the area of inclusion, the findings reveal a particularly relevant tension. On the one hand, language barriers are perceived as having a relatively low impact when teachers consider general factors contributing to students' difficulties in mathematics. On the other hand, they emerge as the main challenge when the focus shifts specifically to RMM students. Rather than representing a contradiction, this pattern suggests that teachers appear to distinguish between language as a general factor influencing mathematics learning and language as a challenge that becomes particularly visible in multicultural teaching contexts. This interpretation is consistent with the exploratory analyses, which showed that most teachers who did not identify language as a general factor contributing to mathematical difficulties nevertheless recognized it as the main challenge when referring specifically to RMM students. From a sociocultural perspective, this finding reinforces the view that mathematical understanding is inseparable

from the linguistic practices through which meaning is constructed, particularly in multilingual learning environments (Halai & Clarkson, 2016; Moschkovich, 2002). In this sense, recognizing students' linguistic repertoires as resources for participation and mathematical meaning-making becomes especially relevant in culturally diverse classrooms.

Furthermore, the findings indicate that institutional responses to student diversity tend to focus primarily on compensatory support measures, such as additional tutoring or the provision of multilingual materials, whereas strategies aimed at incorporating culturally relevant mathematical content into classroom practice are less frequently implemented. From the perspective of CRP, this imbalance is significant, since inclusive mathematics learning environments require the meaningful integration of students' experiences, identities, and knowledge into classroom practices (Helsel, 2020; Ladson-Billings, 1995).

Finally, the demand for increased human resources, improved materials, and more specialized training highlights that the implementation of inclusive practices cannot rely solely on individual teachers' initiative. As emphasized by UNESCO (2017), inclusive education requires a systemic transformation that encompasses educational policies, institutional cultures, and classroom practices. In this regard, recent evidence on teacher professional development suggests that teachers' beliefs and self-efficacy can be strengthened through targeted training programs, which is essential for sustaining high-quality practices over time (Jerrim et al., 2025). The strong emphasis on increased staffing suggests that teachers perceive inclusion as a structural challenge that cannot be addressed through individual effort alone but requires systemic support at the institutional and policy levels. In addition, the findings point to the need for professional development focused on designing progressions that connect manipulative, visual, contextualized, and symbolic representations, particularly for algebra and abstract mathematical concepts; integrating digital technologies and computational thinking into specific mathematical practices; and using multilingual and culturally relevant resources to support mathematical communication and participation. Such programs could be developed through practice-based approaches involving the collaborative design, implementation, and reflection on mathematics learning activities adapted to culturally and linguistically diverse classrooms.

From this perspective, the findings suggest that teachers demonstrate a generally positive orientation toward active, inclusive, and context-based approaches to mathematics teaching; however, the reported frequency with which these approaches are used suggests that their incorporation into mathematics teaching remains moderate and uneven across the different dimensions explored in the study. Rather than

evidencing a discrepancy between teachers' beliefs and their classroom practice, these findings indicate that the pedagogical orientations expressed by participants are not always accompanied by an equally frequent reported use of the corresponding teaching approaches.

Within this context, the findings of this initial needs analysis can inform the subsequent phases of the MARIAN project, particularly the development of coherent proposals that integrate the principles of inclusive mathematics education, the Montessori approach, and creative technologies. In this way, the project aims to expand opportunities for access, participation, and representation in mathematics, particularly in classrooms where linguistic and cultural diversity constitutes a defining feature of the learning environment.

This study provides valuable evidence on teachers' perceptions of mathematics teaching in multicultural school settings. However, the findings should be interpreted in light of several methodological limitations. First, the greater representation of primary school teachers compared with secondary school teachers may have influenced the overall patterns observed. In particular, the small number of secondary school teachers limits the robustness of comparisons between educational stages, and therefore these findings should be interpreted with caution. In addition, as the study relied on a self-report questionnaire, the findings reflect participants' stated perceptions and evaluations, which may not necessarily correspond to their actual classroom practices. In this regard, the inclusion of complementary data collection methods, such as classroom observations or semi-structured interviews, would provide a deeper understanding of the relationship between teachers' beliefs and their instructional practices. Finally, because the study was conducted with a sample of teachers from Spain, caution should be exercised when interpreting and transferring the findings to other educational and cultural contexts.

Future research should focus on the analysis of classroom practices in order to better understand how teachers' perceptions are enacted in practice, as well as to evaluate the impact of specific interventions in terms of participation, understanding, and equity. In addition, further research is needed to explore the role of language, culture, and technology in the construction of mathematical meaning, with the aim of contributing to the development of sustainable and transferable pedagogical models across diverse educational contexts.

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Ethical statement: This study was approved by the Committee for Ethics and Biosecurity in Research at the University of Girona on 5 December 2025 with approval number CEBRU0092-25. All participants were adult in-service teachers. Before completing the online survey, they were informed about the purpose of the study, namely that their insights would help the research team understand challenges and opportunities in mathematics education and support the development of innovative methodologies. They were also informed about the voluntary nature of participation and the anonymous and confidential treatment of their responses. Completion of the survey after reading this information was considered informed consent to participate. The survey did not collect direct personal identifiers, and no sensitive personal data were requested. Data were stored in password-protected files accessible only to the research team and were reported in aggregated form. Any potentially identifying contextual information, such as school name, was removed or anonymized before data sharing.

AI statement: Generative AI tools, specifically ChatGPT by OpenAI, were used to support language editing, translation, and wording refinement. All AI-assisted content was reviewed and revised by the authors, who take full responsibility for the final content of the manuscript. AI tools were not used to collect data, generate responses, or make independent analytical decisions.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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