

Mathematics in the foreground and teacher knowledge

Rolando Torres Castillo¹  

¹ Escuela Superior Politécnica de Chimborazo, El Coca EC220001, Ecuador

 Correspondence: rolando.torres@esPOCH.edu.ec  + 593 99 163 7771

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Abstract: Mathematics is an extremely necessary skill for everyone, as it is the main tool with which human beings have been able to understand the world around them. When we are students, it is common for us to ask ourselves, why should I study mathematics? We could start by saying that there are many activities of daily life that are related to this science, for example, managing money, preparing a recipe, calculating the distance we have to travel to get somewhere, among other things, but the answer goes further. It is difficult to find a completely comprehensive definition of the mathematical concept. Currently, it is classified as one of the formal sciences (along with logic), since, using logical reasoning as a tool, it focuses on the analysis of relationships and properties between numbers and geometric figures. Thus, the objective of this study was to analyze the trends and challenges in mathematics teacher education and to establish their challenges. The main results indicate that there is a bias to think that it is difficult to study mathematics.

Keywords: Knowledge, mathematics, education, fear.

1. Introduction

For several decades now, the teaching of mathematics has been opening up a range of possibilities to achieve not only a better understanding of mathematics and the development of logical mathematical thinking, but also to be a factor in changing realities, having a useful and pertinent meaning in the development of everyday life [1–5].

In support of this effort to give greater meaning to the learning of mathematics, the National Council of Teachers of Mathematics proposes six basic principles for its teaching [6,7]. These principles are Equity, understood as providing high expectations and strong support for all students; Coherent curriculum, focused on important and well-articulated mathematics across levels; Effective mathematics teaching, which requires understanding what students know and need to learn, and therefore challenging and supporting them to



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Prof. Carlos Mestanza-Ramón, PhD.
Editor-in-Chief / CaMeRa Editorial
editor@greenworldjournal.com

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learn it well [8–13]; Learning mathematics by understanding it, actively constructing new knowledge from experience and prior knowledge; Assessment, which should support the learning of important mathematics and provide useful information to both teachers and students; and Technology, as essential in the teaching and learning of mathematics as it influences the mathematics being taught and stimulates student learning [7, 10, 14].

On the other hand, authors propose to bring mathematics closer to everyday life, generating a mathematical culture. Taking into account that one of the aims of education is to form educated citizens, mathematics contributes to this end [8, 15, 16]. The authors state that the main objective is not to turn future citizens into "amateur mathematicians", nor is it to train them in complex calculations, since, nowadays, computers solve this problem, but rather to provide a culture with several interrelated components: ability to interpret and critically evaluate mathematical information and arguments supported by data that people encounter in various contexts, ability to discuss or communicate mathematical information, when relevant, and competence to solve mathematical problems encountered in daily life [7, 10, 17, 18].

These theoretical contributions to the state of the art challenge teachers and experts in didactics to develop mathematics teaching based on principles such as activity, to learn by doing and participating, creativity, stimulating thinking and research, interdisciplinarity, connecting mathematics with other areas of the curriculum and cross-cutting objectives, and socialization, connecting mathematics with cultural reality and developing it through collaborative work [18–21]. Thus, the objective of this study was to analyze the trends and challenges in mathematics teacher education and to establish their challenges.

2. Trends and Challenges in Teacher Education

Approaching the issue of trends and challenges in mathematics teacher education in both research and practice requires us to look at different educational levels and different contexts where this issue is being addressed.

In this section, priority will be given to highlight, in the European socio-cultural and political context, what policies and practices are being developed and how these can be a starting point to point out some lines of international cooperation [1, 9, 22]. In particular, we will focus on the training of secondary and higher education teachers.

What counts in teacher education studies and how to identify it?

In the face of collaborative projects, it is necessary to identify the lines of research and practice that are being developed [17, 23]. Teacher education is an extensive and multifaceted area that has become increasingly systematized in recent years [24, 25].

In 1999, Krainer and Goffree (1999) published a literature review of mathematics teacher education research in Europe [26]. This work is part of a broader synthesis of research in mathematics education. In this review, Krainer and Goffree distinguish four typologies of research conducted under the umbrella: research on teacher education, mathematics education and teacher training [25, 26].

The first category is called research in the perspective of teacher education. This group includes research that focuses on teachers' mathematical beliefs, teachers' knowledge and aspects of classroom teaching. The authors make it clear that these studies are not research on teacher training. However, they consider that the results of the research can be used as a basis for designing learning conditions for teacher training [27, 28].

This category contrasts with the second category they propose in their classification: research in the context of teacher training [18, 28]. This category includes aspects such as: learning through

professional development, the discontinuity between initial teacher training and the professional activity to be developed at school, and the changes that teachers experience in their beliefs and practices. In this category, the use of research for teacher training directly affects the teacher [25,29]. However, in the works developed, practice is not yet considered as an object of research.

As a third category, the authors point to research on teacher education, in which teacher education is the object of research, and the processes of interaction in teacher education are the main focus of study. Finally, the fourth category is research as teacher education. Here, research activity is foregrounded as a means for professional development and teacher education. Various forms of action research and reflective practice are included, through which teachers reflect on and investigate their own practice as a means of improving their learning and action [6,30].

Through this category system, Krainer and Goffree articulate their review of research being conducted on mathematics teacher education in Europe, revealing that most of these studies fall under the first two categories [31–34]: research on knowledge, beliefs, and practice change predominantly. We note that there is a concern to integrate theory and practice, and to advance in a deeper understanding of the elements that favor professional development as a teacher [24,35,36].

3. Challenges

In response to this challenge, methods have emerged in recent decades that seek to renew the teaching and learning of mathematics, giving a new meaning to its development [26]. An increasingly well-known example is the Singapore method, used for more than 50 years and named after the country from which it originates, which seeks to develop mathematics beyond the traditional. This method proposes the teaching of mathematics, no longer from numbers or the blackboard, but from the introduction of mathematical concepts based on the students' own experiences. This experience is graphed with a pictorial representation, to be later taken to an abstract concept. Its main objective is that students are able to relate mathematics to their own lives. This method proposes five keys to learning mathematics, emphasizing understanding in order to learn, developing multiple intelligences in an equitable manner, providing students with learning from the concrete and promoting learning through cooperative work.

With these advances in the teaching of mathematics at our disposal, the challenge is now personal for each mathematics teacher, not only to become an expert in various methodologies, but also to assume a vision of the teaching and learning of mathematics based on principles that will contribute to the integral development of our students and of a culture where mathematics is a contribution to the improvement and development of society.

4. Conclusions

Thus, mathematics is fundamental for the intellectual development of children, it helps them to be logical, to reason in an orderly manner and to have a mind prepared for thinking, criticism and abstraction. Mathematics is considered as a fundamental basis in every person, mathematics is also considered as the queen of sciences, since to perform different activities or action we are always using a mathematical function, either adding, subtracting, dividing or multiplying.

However, the majority opinion is that mathematics plays an important role in society. Indeed, mathematics is present in every facet of our daily lives: the use of bank ATMs, cell phone communications, weather forecasting, new technologies, architecture, and even, although it is not so well known, in a work of art, in music, in advertising, in the cinema or in the reading of a book. In the educational field, mathematics shapes attitudes and values in students, since it guarantees a solid foundation, security in the procedures and confidence in the results obtained. All this creates in children a conscious and favorable disposition to undertake actions that lead to the solution of the problems they face every day.

In turn, mathematics contributes to the formation of values in children, determining their attitudes and behavior, and serving as patterns to guide their lives, such as a logical and coherent way of facing reality, the search for accuracy in the results, a clear understanding and expression through the use of symbols, the ability to understand and express themselves clearly through the use of symbols, and the ability to understand the results obtained.

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Rolando Torres Castillo, research professor at the Higher Polytechnic School of Chimborazo in the branch of mathematics. His latest research has been carried out in the northern part of the Amazon region in the province of Orellana, Ecuador..