

## **Teacher education: from education to teacher substance and practice**

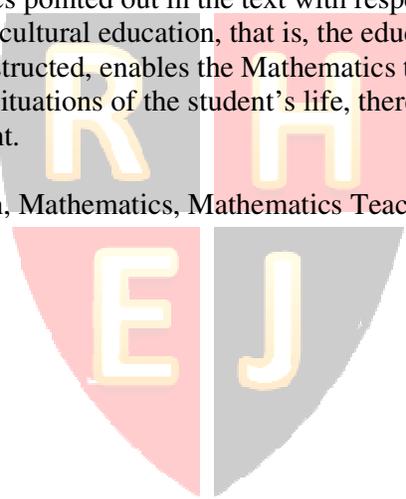
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### **Abstracts**

This article aims to reflect the trajectory of the teacher from the perspective of building and rebuilding the knowledge of the professional in education; it shows the teacher constituting the development of his knowledge-substance and knowledge-practice over the course of teacher performance, which makes each professional unique, though they consist of the same feelings and the same needs. These perspectives are made salient in the view of authors such as Tardif, Maués, and others. The methodological proposal used is naturalistic-constructive. This article deals with the difference between a mathematician and a Mathematics teacher, and highlights the aspects relevant to classroom practices in this discipline. The importance of practices that are reflective, critical and allied to theory is also highlighted. The characteristics pointed out in the text with respect to teacher education evidence the need for general cultural education, that is, the education of a “civilized man”. This characteristic, when constructed, enables the Mathematics teacher to relate the content of this discipline to the daily situations of the student’s life, thereby establishing the meaning of the discipline for the student.

Keywords: Teacher Education, Mathematics, Mathematics Teacher



## INTRODUCTION

Every teacher, before becoming one, has been a student, and certainly innumerable experiences, as a student, have an impact on the learning process and, by extension, the teaching process, since teaching and learning are interwoven.

The teacher's first contact with the teaching career is like an object of study for other teachers. This means to say that teachers, apart from aiming to achieve determined objectives in education, also work on an 'object', which is the student (Tardif, 2002). Tardif, upon identifying students as objects, sees them as human beings who, while socialized, are individualized, unique, and each one has particular characteristics, differences, a particular way of learning, comprehending and understanding, not only the content inherent to the academic context, but also to society as a whole.

This way, the academic, the future teacher, builds his conceptions with respect to teaching and learning, according to the experiences had through different pedagogical conceptions, once each teacher assumes a theory of teaching and learning.

In the perspective considered, the student, upon entering teacher education courses, comes rooted in 'conceptions', 'ways' or 'models' that were experienced as a student. These experiences are capable of aiding in his own education as well as complicating or inhibiting the development of proper teaching practices, since they imply the consideration of a style of 'teaching' related to the way in which he had learned.

One study presented by Raymond et al. (1993) points out these conceptions regarding teaching, as implicit and established as certainties, since this is how they learned and how they intend to 'teach'.

This position appears to imply that being a teacher means taking a ready and complete pedagogical model, and simply repeat it (as if that were possible) like an unchanging technique that can be applied without adaptations or changes necessary for each context.

However, the teacher is directly connected to objects of knowledge, and they are built and rebuilt constantly. Thus, taking a teacher as a model cannot mean adopting a way of being or doing, since we cannot, given that we are unique, but he should be reflected in it like a stimulating model to achieve his own objectives which enable the development of one's own autonomy, personally as well as professionally.

This autonomy enables the teacher to not only perceive or understand the academic and social context, but mainly, to perform in a way that improves them, contributing towards the enhancement of one's own knowledge as well as those involved in such contexts.

Only by understanding the circumstances of each context and the consequences of the processes under way can the teacher build and rebuild his autonomous performance, that which reflects his understanding of the situation and the possibilities of defending, improving and even changing them (Contreras, 1997). This represents a pursuit, a learning process and the construction of a reflective and critical teacher.

Teacher education refers to a series of factors, among them practice, the aspect which contributes to the construction of knowledge. Certainly, practice in itself is not only about knowing, but when it provokes a critical effect in knowledge it can be understood as a learning process, where teachers rebuild their education.

Practice allied with theoretical conceptions structures the identity and the know-how of the teacher. Maués (2007) reinforces this idea saying that teacher education must be based on a solid theoretical background. The teacher builds his own knowledge, complete with sets of knowledge, those currently as well as previously acquired, which contribute to the creation of a unique professional identity.

The identity and the know-how of the teacher are related to the way in which he develops his classroom activities, in other words, through the different ways in which he can

contribute to the development of the teaching and learning process. But, for this he needs to have a quality academic education. An education capable of building and rebuilding practices and/or experiences acquired and developed by the academic over the course of his life, or, the education of a “civilized man” (Carr, 1995; Kant, 1958; Ortega and Gasset, 1999). The ideas of Carr, Kant and Ortega and Gasset on the education of a “civilized man” implies thinking about civilized not in the ornamental sense, but as a system of ideas about situations, the world and humanity in each era, and being able to reflect and conjecture about them.

The perspectives mentioned above can improve the quality of academic development, and by extension, the quality of teaching, since teaching is a cyclic process, and since working teachers at the teaching levels prior to Higher Education have, for the most part, come from these levels.

### **QUALITY IN TEACHER EDUCATION: mathematician or Mathematics teacher**

Quality university education has lately been an object of concern and international level studies. And one of the indicators pointed out by the World Bank (1995, 2000) regarding a qualification that tends to the demands of the market is a greater adaptability of Higher Education to the demands of the job market. This demand of the academic, apart from competence in a specific area of knowledge, flexibility and awareness of knowledge that, upon graduating from a Higher Education institution, his education is not ready and complete, but demands constant renewal and improvements, in order to keep up with the scientific and technological advancements of the globalized world.

This means to say that there is a need for continuous study, which makes the professional more and more qualified in his profession, being able to contribute with greater success to his area of performance. In this context, the graduate programs, with their relevant research, respond to educational needs, improving teaching in the institution itself and by extension the educational quality of the previous levels.

A quality teacher education, whether from an undergraduate or graduate program, or a continued education course, is a relevant aspect in the teaching and learning process for all levels of education. The teacher is a fundamental part of this process.

Teacher competence is not summed up in a technique composed only of skills specific to his discipline; in other words, “the teacher is not a technician or an improviser, but a professional who can use his knowledge and his experience to develop himself in preexisting practical pedagogical contexts.” (Sacristán, 1995, p. 74). Understanding teacher professionalism goes beyond knowledge and skills: it includes attitudes, behaviors and values that form the particularities of the teacher. Being a teacher means being capable of programming one’s own program of professional development. It means being open to learning as a whole, being an investigator in the whole of the teaching profession, to know how to adapt the content of the discipline to the needs of the job market.

The needs of the area of teaching Mathematics go far beyond knowledge of Mathematics. They mainly require knowledge of how to teach it. In this sense, teacher education in this area requires a set of strategies that contribute to better teaching, and consequently better learning. This set of strategies refers to differentiated learning activities, such as using games, mathematical modeling, expository classroom dialogues, and tutorial services, among others. This diversified set of methodological practices will be understood here as “good practices” for teaching Mathematics.

When “good practices”, mainly in Mathematics, are experienced by academics, they can be learned, and then applied to their own teaching practice. However, it is known that for a differentiated teaching practice, there are various factors that are involved, like for example, the organizational structure of the teaching institution where they will be taught.

Nevertheless, the use of good practices for teaching Mathematics in academic development enables the students to learn, to compare and contrast new information from known information. This means to say that one is collaborating towards the education of a critical and attentive teacher, in other words, enabling the construction of teacher autonomy.

This suggests, then, that the teacher who only ‘professes or teaches’ should start to rethink his role as an educator. The teacher who is aware of his teaching role needs to answer to the demands of the job market, which means to say that teaching Mathematics needs to be aimed at applicability; that is, the student needs to learn how to use and perceive where to use Mathematics from school in his daily life. Learning needs to be meaningful for the student (Ausubel, 2000). Studies in the area of Mathematics emphasize the importance of teaching aimed at meaningful learning for the student (Nuthall, 1997; Good, Grouws and Ebmeier, 1983).

The National Council of Teachers of Mathematics (NCTM, 1989, 1991, 2000) emphasizes teaching Mathematics aimed at understanding and applications. Exercises aimed at the capacity to explore, conjecture and reason logically, as well as use a variety of mathematical models effectively to solve non-routine problems. The idea of developing Mathematics this way is based on the reasoning that this discipline is more than a set of concepts and skills to be dominated, it includes methods of investigation and reasoning, means of communication and notions of context. But for this fact to occur in the classroom, the teacher needs to be capable of using a variety of practices in the classroom that contemplate such needs.

Good teaching practices in Mathematics contribute to learning being able to keep up with scientific and technological progress. Teaching this discipline cannot be limited to reproductions or labeling and identifying things, it needs to be aimed at production; in other words, the student must know how to solve problem situations present in his day to day life, to apply Mathematics to their social context, and not only in situations presented in the classroom, since Mathematics is one of the strongest factors of social progress, due to its absolute universal dominance over all other disciplines, even the native language.

However, in classroom practice, what we see are practices contrary to teaching which enables the student to build his mathematical thinking. Most students do not use Mathematics from the classroom in real life, they learn how to do mathematics exercises, but they do not learn why or what to do them for; that is, they cannot see where to apply Mathematics in real contexts (Zaslavsky, 1994; Whitney, 1987).

This can be related to the resistance and/or the difficulty of many students in learning Mathematics, since it is being worked on in a very decontextualized way, disconnected from thought, from action and from understanding; in other words, mathematical content is approached in an instructional way, and mainly, algebraic. This denomination is used in a pejorative sense, to designate that which is complicated, attributing meaningless memorizations and repetitions to Mathematics, and not to the algebraist mathematician himself.

Algebraist teachers, according to teacher José Ferraz de Campos, waste time “[...] by proposing and cramming the students with abstract, uninteresting and fastidious difficulties, instead of searching within the endless wealth of facts and circumstances from ordinary life, the necessary data for organizing useful problems.” (apud Tahan, 1961, p. 62).

Perhaps this algebraist influence is due to teacher education itself, which often falls short of the necessary minimum. Whether it is easier to be algebraist with the students, instead of thinking with them, discussing and/or providing them with discussion and/or understanding, since, providing an opportunity for understanding requires courage and mainly a holistic command of the discipline, which is sometimes difficult for a teacher from

this area, and certainly much more difficult for those with only a general education and those prepared to teach in the initial grades.

There is also a certain discrepancy between what is understood as a teacher of Mathematics and a mathematician. There is, according to Fiorentini and Lorenzato (2006), a relative difference between the two: the mathematician is directed towards Mathematics in itself, while the teacher/educator mathematician conceives it as a means, a tool for student development, trying to promote education through Mathematics.

One attributes the algebraist nature of the students to the algebraist teacher; that is, he is not a Math teacher and not a mathematician, seeing that the latter aims to produce new knowledge and mathematical tools that enable the development of the Science, while the former has his teaching practices focused on the student. If this teacher is not a mathematician and not a teacher of Mathematics, what is left for him to be is an algebraist.

According to Fragoso (2001), routine is parallel to algebraism. The algebraist practice is a symptom of routine, provided by improvisation, that is, there is no class preparation. Even if one has broad experience (or repetition), planning is still necessary, in order to avoid the lack of variety and to make the classes more dynamic. But, for this, it is necessary to have a teacher who craves for improvement, who is concerned with the evolution of knowledge, who has a quality education and uses it in his teaching practice. According to the National Curricular Parameters, “part of the problems referring to teaching Mathematics is related to the teaching education process, with respect to initial education as well as to continuing education.” (Brazil, 1997, p. 24).

Through the whole attributed to the Math teacher, one can say that it is not interesting for him to know ‘a lot of Math’; what matters, is knowing how to teach it well, since, in the teaching and learning process, he is a guide, an advisor, the one who organizes and creates learning conditions which are able to spark the interest of the student and encourage him to act, to think mathematically and to learn. However, knowing how to teach Math is not an easy task; this requires constant study. This enables the Math teacher to better combine theory and practice, to diversify his teaching strategies (good teaching practices), to discuss and share experiences or knowledge, in other words, to improve his methodology.

Martinez and Cervone (2008) claim that research has proven that an improvement in the results of student learning is directly connected to improvements in teaching practices. Stein (2001) argues that better teaching practices in Math include activities centered on important mathematical ideas, the use of multiple representations of concepts as well as of the procedures involved, which can be solved through innumerable strategies.

Some authors present the dissemination of good teaching practices, such as aspects relevant to quality higher education (Chickering and Gamson, 1987). Carrol and McConchie (1998) analyze the advancement of the quality of Higher Education based on the conception of learning organization; in other words, learning at this level of teaching needs to be connected to good practices, since they contribute to a quality university education, as well as to the quality of the teaching institution.

It is thus necessary to have a quality university education, which enables the future teacher to develop good teaching practices, that is, an education that enables the construction of a methodology capable of improving the teaching and learning process of Mathematics, through multiple teaching strategies, and not simply with the use of “spit and chalk”.

### **THE TEACHER OF MATHEMATICS: good practices permeating his work**

Every teacher, inevitably, adopts a pedagogical perspective; that is, they use teaching and learning theories, since pedagogy is nothing more than the teacher’s practice, in which he is constantly exposed to situations that only he can solve, without recipes or models, but

within his capacities and limitations. In this sense, the condition that there is no such thing as work without technique extends to the issue that there is no teaching and learning process without pedagogy. This means that pedagogy is aimed at all of the aspects that can influence this process, seeing that the content to be taught requires necessary transformations and adaptations in order to be understood by the group that is being 'taught', making the management of the subject matter a pedagogical challenge. To overcome this challenge, the teacher needs to have total command of the content, which facilitates and enables the development of unique techniques and/or those adapted to the situation, in other words, the good use of a set of good classroom practices.

One cannot say that a methodology or practice is better than another, but that a set of them can contribute to the better learning of Mathematics. The conception of good teaching practices, especially in teaching Mathematics is pointed out as a good path that provides different forms of teaching, hence different forms of learning. This is essential to the teaching and learning process, since this way each teacher is unique, the students are as well, and the different forms, practices, or paths used for learning enable the contemplation of different learning styles, that is, they increase the chances of a greater number of students learning better.

There certainly is not one teaching practice better than another, which is why the use of a varied set of them can provide a better teaching and learning process. This refers to a methodological practice aimed at understanding and not memorization, to applicability and not to repetition, in connection to reality and not dissociated from it, since diversity broadens the possibilities of learning. If this practice is used and developed for teaching Mathematics, this discipline can become easy, feasible and interesting for the student, since he begins to understand it and apply it to his daily life.

The methodological suggestions or diversity of teaching strategies are formed by a vast spectrum of practices, which can be adapted, improved or rejected by the teacher, depending on the situation where they are given applicability. Within this set of practices, the use of analogies and metaphors is mentioned; problem-solving; mathematical modeling; the formation of study groups and monitoring; classroom research; the use of para-educational as well as educational books; practicing Mathematics in teaching workshops; the use of mathematical games; interdisciplinarity; transversal topics; the use of new technologies and other situations that contribute to non-routines in the classroom.

However, a list of diversified activities and/or practices can become valid only when enriched by the creativity and dynamism of the teacher, but this follows from a quality teacher education, from a continuous process of continued education.

## **FINAL CONSIDERATIONS**

When the teacher builds his practice over the years, transforming his knowledge into an identity and know-how, he is investing in his own teaching methodology, providing quality teaching, hence a good learning process. When the teacher thinks about his work in a critical and reflective manner, reinforcing his ideas and consolidating them with relevant theories, he is being a true teacher, since he is pursuing ways to improve his work, that is, to improve the teaching and learning process.

Observe that teacher education does not take place in a decontextualized manner or from one day to the next, it happens, it is built and rebuilt in time and with time. It is never ready and complete, it is under constant development. But, for this, the teacher needs to be present and be different over time and not just go through the motions.

Teacher education, with an emphasis in this article on teachers of Mathematics, brings attention to an education aimed at the capacity to use different teaching and learning

strategies, that is, the relevance in adjusting the guidelines of good practices. They can provide a continuous improvement in the quality of learning, increasing, this way, the academic success of the students and answering the scientific and technological demands of the 21<sup>st</sup> century.

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