La trayectoria escolar en la formación inicial de profesores de matemáticas

The educational career in the initial training of mathematics teachers

A carreira escolar na formação inicial de professores de matemática

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Resumen

El presente trabajo documenta avances de una investigación en proceso, relacionada con la trayectoria escolar y el proceso de enseñanza aprendizaje de los futuros profesores de matemáticas de la Universidad Autónoma de Baja California.

La implicación del análisis de trayectoria escolar consiste en identificar los conocimientos y habilidades que el estudiante de docencia de la matemática posee y qué es lo que necesita mejorar para llegar a ser un profesor competente, que forme a estudiantes capaces de resolver problemas y tomar decisiones con base en el pensamiento matemático.

Palabras clave: formación inicial, profesor de matemáticas, trasposición didáctica, trayectoria escolar.

Abstract

The present work documents progress of a research in the making, related with the educational career and the process of teaching learning of the future teachers of mathematics of the Autonomous University of Baja California.

The implication of the analysis of educational career is to identify the knowledge and skills that the student of Mathematics Teaching possesses and what is needed to improve to get to be a competent teacher, to form students capable of solving problems and making decisions based on mathematical thinking.

Key words: initial training, Professor of Mathematics, Teaching transposition, educational career, Math Teacher.

Resumo

Este artigo documenta o progresso de uma investigação em curso relacionados com a carreira escolar eo processo de aprendizagem dos futuros professores de matemática na Universidade Autónoma de Baja California.

A implicação da análise da carreira escolar é identificar os conhecimentos e habilidades que o ensino do estudante de matemática tem eo que precisa melhorar para se tornar um professor competente, que treina os estudantes capazes de resolver problemas e tomar decisões com base no pensamento matemático.

Palavras-chave: formação inicial, professor de matemática, transposição didática, carreira escolar.

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Introduction

The importance of the mathematics in the educational curriculum lies in their benefits for a society aimed to knowledge, since promotes the development of critical and scientific thinking in the training of citizens capable of making decisions from the mathematical thinking, which awards great responsibility to the education system, schools and teachers (Terigi and Wolman, 2007; Cardoso and Cerecedo, 2008; Qualding, 1982). in accordance with this, the formation of these last is of great relevance to the Teachers Forming Institutions (IFD by its name in Spanish).

Is then prudent fix the attention in the teaching of the mathematics, in other words, observe how the teaching is carried out, characteristics of training and follow up, and the form of verify if this process enhances the students learning.

This requires a competent professional in the process of teaching and learning of mathematics, Therefore, the initial training is committed to reviewing the learning process of the students who will be professors of mathematics, so it is necessary to analyze their educational career to focus on potential areas of opportunity.

In response to this duty, the School of Pedagogy and Educational Innovatio (FPIE by its name in Spanish), institution forming of teachers of mathematics for secondary and college education, attached to the Autonomous University of Baja California (UABC), has taken up the task of undertaking a research project that contributes to this analysis.

Specifically, this paper focuses on the first results of the project analysis, corresponding to the review of a training career of the Future Teachers of Mathematics (FPM by its name in Spanish), supported by an instrument of self-assessment of knowledge and skills, which aims to identify what needs to be strengthened to be able to generate strategies for monitoring and follow-up in order to enhance the teaching and math skills. Starting with hypothesis that the process of Teaching Transposition that leads to out the teacher trainer is one of the main elements that significantly influences the learning development of the students.

The presence of school mathematics is in the learning objectives ranging from early childhood education to higher education; certainly, the amount intended to meet the needs that society demands (Goñi, 2008), and which are present in the curriculum means a great

responsibility for the education system, institutions and teachers, for this reason training the latter is very important for teacher training institutions.

Teaching math is not an easy task, as it requires more than knowing math: it is essential to know how to teach and specifically consider that mathematical knowledge must be contextualized in the classroom to prevent meaningless (SEP, 2001). To teach mathematics these must be transformed in the teaching-learning process, thus preventing their teaching is simplified, so the teaching work is of great importance to the teaching of mathematics is not something that does not apply in life everyday. It is important that teachers restructure their teaching, to make the necessary adjustments to bring the student to the construction of knowledge and forms it as someone able to apply mathematics in their environment.
To do this, the teacher must master various knowledge, skills and attitudes; precisely its development is linked to many aspects of epistemological, social and educational nature, that is, is not enough to possess mathematical knowledge, but also know what to teach mathematics, how to do and when.

Based on the above, the initial training of mathematics teachers should be maintained and monitored by the IFD. This work is an initiative of the FPIE to contribute to the responsibility of training professionals responsible for developing the scientific thinking of students of secondary and higher education media. In his care, this study aims to encourage trainers teachers to diversify their teaching from the identification of best educational practices that promote meaningful mathematical learning strategies. With this, students can develop and empower their thinking and math skills throughout their education.

It has been shown that mathematics is applicable in the next context of every person, as it is a science that develops thinking and deductive reasoning speeds. This is the structural foundation upon which the rest of the sciences (Tapia and Cofré, 1995) are supported. Similarly, this science is regarded as "a branch of scientific knowledge established, with solid criteria of truth and internationally robust communities" (Cantoral, Reyes-Gasperini and Montiel, 2014, p.103). Therein lies the complexity of learning, so there is school mathematics, considered a "derivative processes transposition into the school environment

product" (Cantoral et al., 2014, p.103). And to undertake studies, especially those teaching and learning, there mathematics education, which is the "scientific discipline that studies educational phenomena related to mathematical knowledge" (Cantoral et al., 2014, p.103).

Before mentioned that one of the main purposes of teaching mathematics in the curriculum is to apply the thinking and mathematical reasoning, the latter considered as the ability to present individuals to solve problems, make inferences and base solutions with solid arguments (Ferrandiz, Bermejo, Sainz, Ferrando and Prieto, 2008). In addition to this, students develop mathematical thinking are "inquisitive, curious and tireless researchers. They feel great attraction for strategy games that require large doses of planning and anticipation of the plays "(Ferrandiz et al., 2008). To develop it taken into account that includes "advanced thought processes, such as abstraction, justification, visualization, estimate or reasoning hypothesis" (Cantortal, 2012, p. 20).

Therefore, success in teaching mathematics is obtained when the teacher is adept consider learning processes presenting their students, ie, the teacher rather than fulfill their role of transmitter of knowledge, it must be the one who motivates the thought process on the student, so that it can cope with new situations and propose solutions. Accordingly, Cantoral (2012) points out that to potentiate mathematical thinking and learning students achieve significantly, learning must be based on creative activity; and the student discovers and proposes ways to build their own knowledge.

However, currently teaching mathematics are still used heavily supported teaching methods in memory, particularly in algorithmic, which only causes the student can not discover the relationship between mathematical methods and their applications in life as well that after school will not forget and apply them in real situations (Cantoral, 2012). Therefore, one of the purposes of teacher trainers is to reflect the future teachers about the importance of designing strategies to potentiate math skills.

Initial training of mathematics teachers

One of the main purposes of initial training lies in preparing the teacher who begins his work in education, to identify, discuss, consider and reflect on the many tasks required teaching practice (Rico, 2004).

With this in mind, one of the characteristics of a math teacher is that their training balance disciplinary knowledge math (arithmetic, algebra, geometry, trigonometry, probability, statistics, calculus, etc.) and knowledge of the teaching of mathematics, which it has been defined as the discipline that studies and investigates problems in mathematics education and proposes actions founded for processing (Godino, 2000).

To achieve this it is vital to consider that students in training (FPM) must understand and reflect mathematics, understanding them as an object must have certain transformations to be taught (Moreno, 2007). Here the initial training of mathematics teachers plays a key role, because through this may acquire the abilities and skills that are expected to develop at the end of their professional studies. During this process they have to train to be responsible, autonomous, innovative, thoughtful with their teaching, with the aim of training professionals able to argue and justify their teaching and effective exercise to lead the process of learning of mathematics (Moreno , 2007). Therefore, this step is considered crucial for students in training as they learn the practical and applicable knowledge to teaching practice.

Lupiáñez and Rico (2008) mention that it is important that a subject who intends to develop in them the ability to plan their teaching performance in the classroom is determined in the curriculum of initial training of mathematics teachers. Furthermore it addressed in depth the topic of curriculum adaptation for the FPM can respond adequately to face situations in the classroom (Maroto, 2010). This is necessary because one of the main features of the FPM is the ability to develop and strengthen math skills of their students.

Competition is a complex system of action that encompasses intellectual skills, attitudes and other non-cognitive elements (such as motivation and values), acquired and developed by individuals throughout their lives and are essential for effective participation in various contexts social (INEE, 2005). As for mathematical competence, "is the ability of an individual to identify and understand the role of mathematics in today's world, issue well-founded judgments, use and engage with them so that they can meet the needs of the subject as constructive citizen , committed and thoughtful "(INEE, 2008, p.30), while teaching competence involves knowing how and when to use disciplinary knowledge and learning in a learning environment (Planas, 2012).

The didactic transposition and its relationship with the initial training of teachers

A math teacher is a professional with mathematical and didactic knowledge, whose main function is to teach to use and build math skills in students (D'Amore, 2007). To achieve this, the mathematical content "knowledge wise" (expert knowledge) requires adaptations so that it can be learned by non-expert subjects (Sepúlveda, 2015). Such adaptations are possible through the didactic transposition process, defined as the work done by the teacher where it performs a set of transformations that adapt the wise know (scholarly knowledge) in a taught knowledge (Chevallard, 2002); in other words, it is the ability to transform scientific knowledge into one that can be taught, so you need to make adjustments in order to turn it into a digestible, dynamic and feasible mathematical object to learn. Therefore, the transposition "is considered as a creative process where the teacher must be insightful to determine how much can transpose a mathematical object" (Sepulveda, 2015, p.19).

In this process of change involving the triad teacher, student and know, called training system (Bertoni, 2009). This has made new contributions to the medium (D'Amore and Fandiño, 2015); hence the responsibility of the former teacher, who should lead the insatiable need to learn and develop knowledge (Goñi, 2008). Thus, a new question arises: what is its importance in teacher training? Meanwhile, Chevallard (2002) points out that since a FPM begins its formative process must acquire the competence to effectively manage the didactic transposition, as this will allow redesign, reflect, question their proposals and strategies and shake the traditional teaching of mathematical objects.

According to the above, it is essential that the process of didactic transposition develop in teachers during their initial training, to ensure their reflection and commitment to design educational activities suitable for students and from that adapt their teaching instrumentation to foster mathematical learning (Godino, Rivas, Castro, and Konic, 2012). This gives prominence to the teacher, and it is he who has the responsibility of managing the didactic transposition, adapt objects to teach their knowledge, incorporating them into school knowledge and organize (Vidal, 2011).

This didactic perspective means giving meaning to mathematical knowledge, contextualize them and place them in meaningful situations for the student; teach through the design of educational situations that generate cognitive conflict, as the approach of a problematic situation which seeks to promote meaningful learning.

School history

Since and the importance of the formation of the FPM described, as well as the didactic transposition in the process of teaching and learning, it is now necessary to talk about the school career, essential axis of this research proposal, which can be defined as means by which the school behavior of a student or group of students throughout their stay in an educational institution is expressed, from admission to the completion of their studies (Romo, 2005).

Usually the term school career is conceived as academic behavior of an individual throughout the school years and considers the average school performance obtained, approval, disapproval, among other indicators (Garcia and Barron, 2011). Similarly, it is related to factors that make up a set of problems affecting the regularity of the student, such as academic behavior: lag, desertion, performance and dropout (Gonzalez, Castro and Bañuelos, 2011). The focus of this research is parallel to these factors and is interested in developing the skills of FPM throughout their formative process, seeking to establish the knowledge and skills that are deficient to propose measures that would enrich their professional performance.

It is important to analyze the school career of students to know how these transit in each formative stage, locate critical points along the route and thoroughly analyze the situation. All this allows us to understand the complications that may arise and act accordingly with

preventive or corrective measures (Rembado Ramirez, Viera, Ros and Waimer, 2009); ie, identify problems, overcome and, therefore improve the processes of student training (Amaro, 2011). To examine the behavior of the FPM learning throughout their school career, an instrument that identifies the relevant information to improve their weaknesses and ensure that their potential to develop optimally during its formative process (L'Ecuyer, 2001) is needed . This means that the student can know at what stage of their learning is, where has to come and what to do to reach that potential (Stobart, 2010).

Analyze a training course helps verify if the FPM have the knowledge and skills necessary to function as teachers of mathematics, also it offers clues to how the didactic transposition of their learning is done and sets conjectures about possible mistakes in educational practices trainers and in the design of the curriculum (Ponce, Mendivil, Alcántar, Serna and Hernandez, 2005) teachers.

Methodology

This work shows the progress of quantitative research, as the data statistically (Bone and Cascant, 2012) analyzes and descriptive and exploratory. The study population are assigned to the Bachelor educational program in Teaching of Mathematics (LDM) students.

One of the main features of this program is its curriculum-based approach professional skills, noted for its curricular flexibility and focuses on the student during the teaching-learning process (UABC, 2013). Particularly its structure is organized in three stages of training: basic, disciplinary and professional; in the first the basic and generic skills that you must have a professional of the higher education level and discipline of study are developed; The following students have the opportunity to meet, discuss and strengthen their theoretical, methodological and technical aspects of their profession knowledge, which represents more complexity in student training, plus it takes place mainly in the middle part of the curriculum structure ; and the last stage is intended to reinforce the various specific theoretical and instrumental knowledge, so that practical work increase and professional skills through student participation in the workforce, who consolidates his academic project are consolidated (UABC , 2013).

The first phase of data analysis involved a review of the training course of the disciplinary stage of the LDM educational program through a self-assessment tool. Hence an

assessment of the powers that the FPM has developed throughout his academic career, considered essential in the process of lifelong learning and making it a self-reflexive act (D'Amore and Fandiño, 2015) is made. The analysis consists of 340 reagents and considered 17 subjects, which appraises the level of mastery of knowledge, procedures and attitudes acquired at the end of the stage of disciplinary formation (sixth through eighth cycle). Levels of development are considered excellent-good-enough and elemental.

It was designed from the curriculum for each subject, one that underwent a psychometric validation and content. It was applied in order to promote self-reflection and control over their own learning, for information to support the teaching-learning students and also contribute elements to improve teaching practice (Lopez, 2009).

Among its purposes the identify opportunities to strengthen the professional profile of the FPM, since in this way is evaluated whether they possess the necessary skills to practice is distinguished. It determines what aspects need improvement. It acts immediately so that, upon graduating from educational program to ensure the institution have formed completely full and math teacher.

The second phase of the analysis is to investigate how the teaching-learning process, through a questionnaire which is currently in the process of content validation. It is composed of 56 questions, of which nine are open and 47 are multiple choice with the following Likert scale: a) Strongly agree b) Agree c) Neither agree nor disagree d) Disagree e) Totally disagree. The questions were grouped into three dimensions: 1) Forecast teaching-learning process, 2) Driving teaching-learning process and 3) Assessment of the impact on the teaching-learning process, that the model Competency Evaluation Teachers (MECD) adhere proposed Garcia-Cabrero, Loredo, Moon and Rueda (2014).

The next step of this phase is to apply a questionnaire for teacher trainers; its intention is to understand the teaching strategies used and highlight those that promoted the development of teaching and math skills, in order to contrast mentioned by the FPM; subsequently indicators of school career as approval ratings and reprobation, which compares the revised path on self-assessment will be reviewed. The third phase is to correlate the results obtained to establish the implications of didactic transposition in the process of formation of those who will become mathematics teachers.

The study population are assigned to the program LDM students and participated four generations 2012-1, 2012-2 and 2013-1 in the analysis of self-assessment tool of the disciplinary stage; specific 75 students participated through a deliberate non-probability sampling, as students of those generations who attended the day on which the application was convened.

Results

In this section the results of the first phase concerning the interpretation of the self-assessment tool of the disciplinary stage are described. The most important of these is that it was identified that showed FPM have an excellent-good level in almost all subjects of the didactic-pedagogical area; for example, the subject "workshop educational activities" averaged 94.73% in the three generations, that is, eight of the nine subjects of this guidance range between 90% and 95% of excellent-good level, however, the subjects had the highest percentages in the elementary-level underperformance were three: "educational planning" with average of 19.75%, the only detected the didactic-pedagogical area; on the other hand, the area of mathematics were located two eight, which are "probability and statistics" with average 26.14% and "trigonometry" with average of 29.39%, the latter identified as the most deficient subject content.

Accordingly the subject of trigonometry, where five items were identified with higher levels of failure in three generations were promptly analyzed. In the generation 2012-2, the reagent number nine related to problem solving that involves the transformation of a sum of circular functions in product and vice versa, 13 (59%) of 22 students are at the elementary-inadequate. The reagent No. 12 refers to the resolution of equations by applying the logarithm to clear a variable, so that 16 (72.7%) of 22 students are at the same level.

In generating 2013-1, in the reagent number 11, which is to explain the basic properties of the logarithmic function, 14 (40%) of 35 students are at the elementary-inadequate. And reagent 16 associated with the operation of the law of cosines for the elements of a triangle, 12 (34.3%) of 35 students are at the same level.

As for the generation 2013-2, number 19 in the reagent referring to the application of circular functions in triangles, 9 (50%) of 18 students are at the elementary-inadequate.

As there was no coincidence in the generation reagents it means that deficiencies of students were outside the design of the program, ie required question and analyze what is the specific reason for this phenomenon. However, the didactic transposition by the teacher is of great importance because it determines the sufficiency and insufficiency of knowledge and skills necessary to develop the skills of the subject.

Conclusions

The need for highly trained teachers in educational reforms, demand a thorough review of the initial training of mathematics teachers. In support of this request, this paper provides some elements to consider in the formative process of future professionals.

Mainly it was identified that the powers of the didactic-pedagogical area are dominated more by the FPM, compared with the area of mathematics; In short, the differences between generations possible to ensure that the level of elementary-insufficient skills such development is not linked with the curriculum of subjects, but is a shared responsibility between the educational former and future teacher. In the first case, the didactic transposition teacher was crucial to the achievement of learning, although it should review how its implementation conducted to determine those elements that cause developmental level. Moreover, it should examine the process of study and student learning to verify which part of his career were located and thus determine strategies to develop their potential.

Examine the knowledge and skills of the FPM and the work of the former teacher is a mechanism to take relevant decisions in an educational institution that feeds both actors and actions are implemented throughout the school career of students. Thus the development of mathematics and teaching skills of future teachers is guaranteed, and improving practice teacher trainer.

In short, the initial training programs must balance in their curriculum and teaching skills of mathematical character; It is not enough to master an area of knowledge, for multiple knowledge, skills and attitudes to make successful, able to form critical and analytical citizens applying mathematical and scientific thinking in context educational interventions are required.

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