TEACHER RESEARCH BASED ON REFLECTION ON PRACTICE: A CASE IN THE INITIAL TRAINING OF MATHEMATICS TEACHERS FOR THE SECONDARY LEVEL

PESQUISA DOCENTE A PARTIR DA REFLEXÃO SOBRE A PRÁTICA: UM CASO NA FORMAÇÃO INICIAL DE PROFESSORES DE MATEMÁTICA PARA O NÍVEL MÉDIO

ENSEÑAR A INVESTIGAR DESDE LA REFLEXIÓN SOBRE LA PRÁCTICA: UN CASO EN LA FORMACIÓN INICIAL DE DOCENTES DE MATEMÁTICA PARA EL NIVEL SECUNDARIO

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ABSTRACT: We describe the conception and development of a teaching-learning project of the Educational Research Workshop of the last year of High School for Mathematics Teachers, in an Argentine higher institute of teacher training. An analysis of the dynamics of the work in the classroom is presented, which took as its starting point the writing of a narrative of experiences of teaching practice from students to teachers, and as the main activities of academic reading and writing in the field of training. In this sense, the research work focuses its attention on initial research training and its relationship with teaching practice from the professional problems of teachers in training, and from the perspective of formative research and the teacher as a reflective professional. We consider that the teaching-learning project has a number of powers, while highlighting certain emerging tensions.

KEYWORDS: Initial mathematics teacher education. Formative research. Reflection on practice. Teaching Educational Research

***RESUMO**: Descreve-se a concepção e o desenvolvimento de um projeto de ensino-aprendizagem da Oficina de Pesquisa Educacional do último ano do Ensino Médio de Professores de Matemática, em um instituto superior argentino de formação de professores. Apresenta-se uma análise da dinâmica do trabalho em sala de aula, que tomou como ponto de partida a escrita de uma narrativa de experiências de prática docente de alunos para professores, e como principais atividades de leitura e escrita acadêmica no campo da formação. Nesse sentido, o trabalho de pesquisa focaliza sua atenção na formação inicial em pesquisa e sua relação com a prática docente a partir dos problemas profissionais dos professores em formação, e na perspectiva da pesquisa formativa e do professor como profissional reflexivo. Consideramos que o projeto de ensino-aprendizagem tem uma série de poderes, ao mesmo tempo em que destacamos certas tensões emergentes.*

***PALAVRAS-CHAVE**: Formação inicial de professores de matemática. Pesquisa formativa. Reflexão sobre a prática. Ensino de Pesquisa Educacional*

***RESUMEN**: Se describe el diseño y desarrollo de un proyecto de enseñanza-aprendizaje del Taller Investigación Educativa del último año del Profesorado de Educación Secundaria en Matemática, en un instituto superior de formación docente argentino. Se presenta un análisis de la dinámica de trabajo en aula que tomó como punto de partida la escritura de una narrativa de experiencias de práctica docente de las y los estudiantes para docente, y como actividades principales la lectura y escritura académicas en el campo de formación. En ese sentido, el trabajo de investigación centra su atención en la formación inicial en investigación y su relación con la práctica docente a partir de los problemas profesionales de docentes en formación, y desde la perspectiva de la investigación formativa y el docente como un profesional reflexivo. Consideramos que el proyecto de enseñanza-aprendizaje tiene una serie de potencias, a la vez que evidenciamos ciertas tensiones emergentes.*

***PALABRAS CLAVE**: Formación inicial de docentes de matemática. Investigación formativa. Reflexión sobre la práctica. Enseñanza de investigación educativa.*

Introduction

A recent perspective on the initial training of mathematics teachers at secondary level is associated with the idea of professional skills or competencies (Font, 2013). From this perspective, teaching work is diverse, it is no longer limited to just the task of teaching content in the classroom, but includes, among others, carrying out educational research. In 1998, Kilpatrick (1998) stated that research in mathematics education shows the need for teachers to be researchers. In this sense, Conde *et al.* (2018, p. 157, our translation)

> the challenge of training young people who will be future researchers (Valbuena, Conde, & Ortíz, 2018), taking into account the different skills that a teacher must have today, which depend, to a certain extent, on the demands and constant changes that the academic field suffers.

Training future mathematics teachers in research involves establishing a relationship between research in mathematics education and teaching practice, from which training institutions become privileged places for problematizing and producing knowledge related to Education. In particular, the classroom, as a historical place where school educational action takes place, becomes an inexhaustible source of knowledge about teaching and learning based on the problems that emerge from teaching practice, understood as social practice.

Within the scope of the teaching approach to educational research, based on research praxis, we share the case, in this article, of the Educational Research Workshop of a teaching career in secondary education in mathematics at a Higher Institute for Teacher Training in the Argentine province of Tierra del Fuego, Antarctica and South Atlantic Islands (TDF AeIAS). In this sense, we do not seek to address the broad debate on the teaching didactics of Educational Research in the initial training of mathematics teachers at secondary level, but we describe the processes of construction, implementation and analysis of a specific teaching-learning project. In particular, we present an analysis of the dynamics of work in the classroom that took as its starting point the writing of a narrative of students' experiences of teaching practice for teachers, and as its main activities academic reading and writing in the field of training.

The notion of teaching-learning project is assumed in the sense of a grounded teaching proposal that conceives teaching through action research, therefore, rigorous, systematic and analytical, which feeds on the experience and reflection of its implementation, and the interaction of the proposal with the students and between them and the teacher.

Contextualization of the proposal

The "Paulo Freire" Provincial Institute of Higher Education (IPES), in the city of Río Grande, in the TDF AeIAS province, in southern Patagonia, Argentina, is dedicated to the initial training of teachers for compulsory education levels. One of his careers is High School Mathematics Teacher (PESM) (Terra do Fogo, 2013), whose graduate profile is framed in the initial training of high school teachers in mathematics, and is described in relation to the situations that the training proposal seeks to promote. These favor the professional development of their graduates in terms of traits and skills, among which,

> Predisposition to analyze and reflect on one's own professional practice, from the researcher's point of view, with the possibility of evaluating and modifying it, tending to improve the quality of student learning, recognizing the provisional nature of knowledge and developing an attitude of balance between the need to strengthen successful practices and permanently innovate (Terra do Fogo, 2013, p. 30, our translation).

The PESM course is organized over 4 years, of 2 semesters each, in person with the support of a virtual classroom on the IPES virtual campus, which is hosted on the Moodle platform. The curricular unit of the career for which the teaching-learning project was designed is Educational Research, which is located in the 4th year, is part of the general training area, is planned in a workshop format, with an annual duration and a weekly workload of 3 teaching hours, and its related subjects are Probability and Statistics and Practice III (therefore, also Practice I and Practice II).

The PESM Curricular Design (Terra do Fogo, 2013), conceives the workshop as one of the organizational and dynamic formats of the Faculty's curricular units, such as

> curricular units oriented towards the production and instrumentalization necessary for professional action. As such, they are units that promote the practical resolution of situations of high value for teacher training. The development of capabilities that involve practical action involves a diversity and complementarity of attributes, since practical situations are not reduced to doing, but are constituted as creative and reflective doing, in which both the available conceptual frameworks are put into question and the search for new ones that are necessary to guide and orient the environment. Solve or interpret production challenges. The workshop aims to develop capabilities for analyzing cases and action alternatives, making decisions and producing solutions and innovations to face them (Terra do Fogo, 2013, p. 38, our translation).

The Project also proposes that the Educational Research Office

> considers research as a process of knowledge and proposes at least three ways of achieving it: the objects of research, which in the educational field are subjects, the theoretical bodies, methodologies and instruments with which data are constructed, and the subjects who research (Terra do Fogo, 2013, p. 88, our translation).

Furthermore, it establishes 3 training purposes:

> - Promote the development of new forms of relationship with knowledge, enhancing the critical spirit, the permanent questioning of knowledge and processes in the school setting.
> - Promote the understanding of educational research as an intervention device, as it involves acts that modify, through certain theoretical-technical resources, the dynamics and meanings of relationships between subjects.
> - Provide theoretical and methodological tools for the analysis of educational research reports (Terra do Fogo, 2013, p. 88-89, our translation).

The Curricular Design organizes the minimum priority contents of the Educational Research Workshop into three sections: 1) The research process, to distinguish between process, design and research project, and between conceptual and empirical validation, and studying what the problem is, hypothesis and research framework; 2) Educational research as social research, which aims to study the design of educational research, current problems, paradigms, perspectives and theoretical-methodological approaches to educational research; and 3) Research at school, which addresses fieldwork, analysis, interpretation and systematization of information, research that is carried out in the classroom, the distinction between theory and practice, teaching practice as a source of research and approaches of educational research.

Conceptual framework

The theoretical references that served as a conceptual framework for the foundation of the Educational Research teaching-learning project take into account the fact that, in the field of initial training of mathematics teachers at secondary level, the proposal focuses its attention on research training and its relationship with teaching practice, based on the professional problems of teachers in training and within the scope of qualitative research perspectives.

For the conceptualization of qualitative research, we chose the way Anadón (2008) conceives it with reference to particular techniques, as the project aims to teach Educational Research. The author offers a definition of what the term qualitative research encompasses and states that

> in general, it refers to a whole set of theoretical currents (interpretive sociology, pragmatic philosophy, phenomenology, critical sociology, postmodern sociology), to ways of doing research (fieldwork, naturalism, ethnographic, phenomenological, hermeneutic, theoretical based on data) and a variety of data collection and analysis techniques (interviews, observations, document analysis, analytical induction) (Anadón, 2008, p. 199, our translation).

Of the three main guidelines that the author establishes as synthesizing qualitative research, the teaching-learning project is built from qualitative/interpretive research interested in understanding the meanings that individuals give to their own lives and experiences.

We alluded to the concept of formative research in terms of the work of Cabrales (2021), which consisted of documentary research on a sample of 82 articles published between 2016 and 2020 that mention studies on formative research in the initial training of teachers in pedagogical institutes and schools in the Peru. Based on this study, the author established the distinction between two models, research as a requirement of educational standards and policies, with special attention to institutional accreditation and research for the training of researchers. In the latter, the author finds two lines of work, that of the didactic strategy, which considers the objectives and contents of the subjects (Sánchez-Carlessi, 2017), and that of the learning process through the research method (López-Falcón; Ramos-Serpa; Gómez-Armijos, 2018). We accept both lines in the design of the teaching-learning project, because they prioritize training and use research as a tool.

Based on the second model, Cabrales (2021) elaborates the following definition agreed within the scope of the formative pedagogical approach. Formative research is assumed

> as a didactic, pedagogical and curricular strategy that favors the development of graduate profile competencies based on initial teacher training standards. This proposal has three important foundations: didactic, considering the scientific method in the teaching-learning process; the pedagogical, because it takes into account the specific actions provided for in the standards for initial teacher training; and the curricular because it vertically articulates the contents of the disciplines of the same academic cycle through integrative projects (Cabrales, 2021, p. 10, our translation).

The author highlights that this definition contributes to a comprehensive understanding of formative research by teacher educators, which has the consequence that "students will be able to develop research skills to reflect on their practice and make evidence-based pedagogical decisions, improving their educational work" (Cabrales, 2021, p. 10, our translation).

In the field of research on teacher training in mathematics, the line of research Professional Teacher Development allows the study of teaching practices in the classroom from

the perspective of teachers, considered teaching professionals. In this context, we think of a teacher as coordinator of a study group, who selects problems, promotes interactions between students and organizes ideas and orders them into a collective production, so that, in their actions, they show signs of professional private and personal knowledge (Villella *et al.,* 2018a). From this conception, the concept of the professional problem of mathematics teachers is assumed, as a scientific approach to the problems generated from the communication of mathematical knowledge in the task of teaching mathematics (Villella *et al.,* 2023).

From a broader perspective, Villella *et al.* (2018b) contextualize the concept of professional problem, alluding to the fact that

> Teaching practice is not an action derived from prior knowledge, but an activity that generates intellectual culture in parallel to its existence, which requires a trained professional with the ability to permanently read their daily work: reflect and rethink the meaning of their knowledge and the reconceptualization of their own practice based on choral sequences in which children's, young people's and adults' voices emerge in the school community who constantly question it. (...) This professional knowledge allows the teacher to look in a meaningful way, being able to identify practical problems (questions on which to construct provisional answers) related to teaching mathematics learning. These professional problems are recognized and analyzed based on the teacher's own experience and knowledge (Villella, 2018b, p. 78, our translation).

In relation to the notion of the mathematics teacher as a reflective professional, Flores (2009), following Schön (1992), makes a professional characterization of the mathematics teacher from the perspective of considering "that his task is specific, he has a body of knowledge that supports and helps him to rationalize his work" (np), and without falling into corporatism, he recognizes "that professional competence is centered on collective, critical and dialectical work" (sd). From this, the author assumes that the mathematics teacher has professional knowledge, and understands it to be composed of different types of knowledge, mathematical, general didactic, pedagogical and content didactic, and has a dynamic component developed in the performance of the professional task. It is in the latter that we place the mathematics teacher's reflection.

Design of the teaching-learning project

Considering that the teaching-learning project aims to teach educational research to future high school mathematics teachers, in methodological terms the chosen formative research approach is based on the multidimensional framework of three intersections between

formative research and didactic strategy, research training and pedagogical strategy (considering the specific actions provided for in the standards for initial teacher training) and training research and curricular strategy (considering the training purposes of the curricular unit provided for in the Faculty Curricular Design).

In accordance with the conceptual choice for qualitative research and formative research, research practice is the main axis of the conception of the teaching-learning project, thus, in coherence with the Workshop format of the curricular unit, we designed the classes assuming as a hypothesis of work that research is learned by investigating. Therefore, from a conception of research as an object of teaching, of a theoretical and practical type, it is taken as a principle that

> Learning practical knowledge requires different teaching methods than those that are sufficient for good learning of theoretical knowledge. The latter can be taught by instruction in its different forms; on the other hand, the former require for their teaching, mainly, a certain naturalness with the action that wants to be taught and learned, the shared performance of the action, between a specialist – the teacher – and an apprentice – the student – (Parra, 2004, p. 68, our translation).

As a result of the previous choices, the learning objectives sought for the Workshop were oriented towards (Pérez, 2023, sd, our translation) "Promoting a critical and reflective attitude towards educational facts, questioning the experiences of practice based on the knowledge and actions of educational research".

From the perspective of the mathematics teacher as a reflective professional, the Workshop proposes educational research as an articulating space between teaching and research to find possible answers to the professional problems of teaching practice, through a systematic look at the educational actions that occur in institutions. In this sense, the development of the Workshop is proposed in stages for an individual and progressive construction of a research project and its corresponding development. Each stage corresponds to the assembly of one of the sections of the research project, as well as the actions for its development, so that the Workshop's trajectory was structured according to the outline of a research project, taking into account the minimum priority contents established in the Curricular Design, framed in: Problem statement (including background, question and research objectives), theoretical framework, research methodology, fieldwork and data analysis. The proposal was prepared for the 2022 course.

Flores (2009) conceptualizes the dynamic component developed in the performance of the professional task, as the means by which the student can access the practical reference

necessary to extract their own professional problems. In this sense, we established that the students' professional problems experienced in their teaching practices constitute the seed for the research problem they will construct. Therefore, the practices considered above constitute a source of potential research problems, assumed as professional problems of practice and conceptualized in the workshop as situations to be studied that are situated, individual and particular to the subjects involved in them. Therefore, the attitude to be promoted is based on educational research based on reflection on action.

There are three activities transversal to all stages that make up the course. The first is a theoretical-practical approach that leads to the elaboration of the corresponding section of the research project; It begins with the teacher's explanation of what this section is in the qualitative research process in education, which includes guidance on meaning and writing, as well as examples. The second activity is the reading and discussion of certain excerpts from research texts in mathematics education in the format of master's dissertations and research articles, using a guide of questions to promote the discursive analysis of what was read and, in the following class, the discussion is generated based on the answers to the task questions. The objective of this activity is to explain the meanings and meanings that students attribute to this section of the research project, exemplified by the themes and situations chosen by the students. The third activity is shared reading in the classroom as an exercise in studying the structure of a research text and creating diagrams that illustrate it, or reviewing texts produced by students with the intention of constructive criticism of writing and rewriting.

Two strategies are applied when studying research articles. One of them is that at least one document is the same since the beginning of the course, so that the research study discussed in this text continues throughout all stages of construction of the research project. This makes this research the main reference in the course, so its choice is fundamental; in particular, two master's theses in mathematics teaching were chosen. One of the qualities of these texts is that they are investigations that do not have a rigid or typical structure. The second strategy is that the choice of sections of texts to be read is made according to the section of the research project that is being constructed.

Route path

Initially, it is proposed to recognize the professional problems of teachers in training, which have occurred in their teaching practice, whether when they took on the curricular units of PESM practices, or other teachers, if applicable, or teaching experiences external to he. The experiences lived in practice are referred to as everyday situations that generate interest in investigating and going deeper to understand them; You are asked to choose a specific one and determine a topic related to it. Once they have shared their responses orally, they are asked to narrate the situation in a text, so that the context (geographical and institutional) and the moment of occurrence can be identified, the actors and documents (if any) involved, the facts related, the concern (need, condition, contradiction, difficulty, etc.) that arises, what they want to understand expressed through questions, why it is important to research this research and what the associated themes and subtopics would be.

The next step is to discern the situation they are going to investigate and delve deeper. This starts with the shared reading of the answers to the questions they created and the discussion about whether these could be resolved without research or not. If the first case is determined, the student is invited to redirect their questions or choice of situation, and rewrite the narrative. In the second case, the student is invited to rewrite his narrative based on the observations and comments his text received. It is important to highlight that this stage encourages reflection on the recognition and characterization of some problems in teaching and/or learning Mathematics at secondary level. In the first class of the development stage, the first section of chapter 1 of one of the chosen master's theses is read, with the intention of illustrating the requested narrative text, clarifying that it is given as a reference and not as an example to be followed.

A third step consists of identifying, in the constructed narrative, what the themes and their associated subthemes of mathematical didactics would be, and from this starting a personal exercise of searching for bibliographic information about them. The objective is for students to have a first approach in searching for research texts on specific topics associated with the situation they chose to study, with which it will be possible to highlight search locations and types of texts they choose. With the information obtained by the students, the study of the texts found is carried out using an instrument called a reading card which consists of a format to complete the bibliographical data of the text, professional biographical data of the authors, structure and synthesis of the document, information to be used and references of the document to be consulted. The product of this stage is the choice of texts that will serve as research

background, for which a minimum of 5 texts are indicated as a requirement, of which 3 are national research and 2 foreign, and that all contain results of research that studied the same situation, one very close or similar to the one they chose.

Based on the completed reading sheets, the research history is written in the next step. The process begins with the teacher explaining what they are and how they are written, and the shared reading of the corresponding section of the first chapter of the master's thesis chosen in step 2. Next, students write their first version of the history of their project. It is then read collectively in the classroom and feedback is given, so it is a text that has been rewritten based on observations left by the teacher and colleagues. Feedback concerns whether the information given and how much of it is necessary to inform the authors' work, the order in which this information is written, formal aspects such as cohesion, coherence and punctuation, and whether it was well communicated.

In a subsequent stage, the necessary arguments are worked on to formulate the research question based on the connection between the situation described in the narrative and the research background, from which the formulation of the research objectives derives. The stage is introduced with the joint reading of the corresponding section of the chosen master's thesis and the collective elaboration of a sketch that illustrates the text. This diagram shows the issues involved by the research author and the relationships established between them, which allows the argumentation elaborated by the author to be identified more clearly. Once the argument, question and research objectives have been developed, students work on the cohesion between the three constructed texts that will make up the first section of their research project, which is the formulation of the research problem.

The next stage is the construction of the theoretical framework for the research based on the professor's explanation of what it is and the review of the relationships between the index of the corresponding chapter of the master's thesis and the research question of the latter. This construction is an activity developed mainly from the bibliographical consultation carried out by the students, which has a first approximation based on the references they found in the texts read for the background and which they left on the reading cards. The theoretical framework is requested as a statement of definitions of the research concepts involved in the research question.

In a subsequent stage, we work on the construction of the project's methodological sector based on the professor's explanation that distinguishes technique, instrument and means of collecting information, and presents six qualitative research techniques and their

corresponding instruments. Then, in class, students are asked to ask themselves which technique and instrument they find useful in obtaining the field information needed to answer the research question. Students share their answers after explaining the population and sample they will study in their research and discuss whether the chosen technique and instrument would be relevant. Based on what was discussed, students characterize the necessary instrument and communicate it through writing the corresponding section of their research project. This section includes the argument for the choice of technique and the characterization and design of the chosen instrument. The prepared instrument is presented in class and everyone contributes regarding its relevance and suitability, as well as ideas on the best way to enable its implementation.

The next stage consists of carrying out student research fieldwork. Initially, each student in the class presents their case, identifying the field, the sample, the instrument and the implementation needs, to which everyone tries to contribute ideas for the success of the fieldwork. The necessary institutional support was requested so that students can implement the instrument developed in the chosen institution(s). While the fieldwork is being carried out and until its completion, in classes the students share their experience by narrating what happened and presenting any inconvenience experienced, together we try to contribute to solving it.

When students collect information from fieldwork, they take it to class and socialize it, which is the next step. The teacher gives general guidance on what actions to take to analyze this information, and students contribute ideas. The student then carries out a brief analysis of what was achieved to obtain the results of their research and carry out the exercise of building conclusions.

The last stage consists of preparing the investigation report and its oral presentation. The first thing is to gather the documents that they created in the previous steps, which are the sections of the research project. The second consists of a presentation in the form of a brief communication, 15 minutes of presentation and 10 minutes for questions. For this example, it is proposed that students invite the IPES community to listen to their presentations.

Analysis and interim results

Classroom discussions about constructed research problems, written productions presented by students as works and oral presentations of their research projects constitute instruments for collecting information for the teaching-learning project. In this way, it was possible to triangulate sources, that is, to check whether the information provided by one source is confirmed by others.

The development of the three transversal activities proposed highlighted the students' resistance to changing their conception of educational research. This is mainly associated with two ideas, one in the quantitative sense, that research is carried out to quantify educational phenomena, and another in the sense of information accumulation, that research is knowing a lot of information about some topic. Carrying out the first transversal activity showed that the students acquired the information as a recipe that should be followed for writing, the purpose of using it as guidance for the meaning of the sections of the research project was not achieved. The second activity had the expected results, but the time it took was longer than expected, it cost the abstraction of the unpublished information that the text reported in order to measure the part of the research that was being studied.

As for the third activity, which provoked very productive and powerful instances of work, the students achieved a relevant textual and discursive construction to scale the research process. In relation to the shared reading of student texts, it is beneficial because it transforms the group into a learning community, whoever reads is motivated to intervene with recommendations, mainly, or observations for the student's text, everyone is involved to the point of giving Give them ideas to consider to improve your writing.

The two strategies applied to the study of research documents produced good results, as this research was always used as a reference and progressively better understood, since throughout the course the idea of research matured. The students' interventions in classes, as well as their written productions throughout the course, showed what they gained qualitatively in the conception of what educational research is from a qualitative perspective.

Regarding the progressive construction of the proposed research project in stages, not everyone is able to advance to reach each stage at the same time. Even though we try to ensure that the revisions of the texts produced by the students are carried out promptly and at the same time, and that the texts that had the greatest difficulties in their execution are read in the classroom, it was not possible to guarantee that everyone goes hand in hand. To this extent, it also happened that only those who arrive with everything necessary for this do the field work.

It is noteworthy that the reading worksheet used in the third stage for the research study was a relevant tool, as it allowed us to realize that students are progressively refining their reading level of this type of academic text.

The discussion about the techniques and characteristics of the instruments chosen for fieldwork was very rich, as students feel empowered to participate, as they know the institutions that are being discussed and contribute appropriately in terms of the relevance of the instrument and the feasibility of its implementation. In this sense, they contribute significantly to the development of their colleagues' instruments.

The successive versions that the students submitted of the different sections of their research project, according to the proposed stages, show the particularity that from the third or fourth stage onwards they showed a substantial qualitative improvement. The improvements in the texts produced were not only at the writing level, as it would be natural to think based on the revisions that were made to them, but also at the content level as there was an improvement in the processes of taking a position and its argumentation, dialogue with the cited authors and critical reading of their results and academic discussion of ideas. For this reason, it can be said that it was possible to promote the actions of a researcher.

The course of the Workshop for 2022 showed the need to make adjustments to the teaching-learning project for its implementation and development in 2023. For the first transversal activity, it was necessary to change the order at the beginning of the theoretical-practical approach, starting with the reading of research texts to start with the example and then move on to explaining what this section of a research project is. For the construction of the theoretical framework in the sixth stage, it was considered more appropriate to start with a collective analysis of the research question of the chosen master's thesis, identify the necessary research concepts according to it and then proceed with the chapter review of the theoretical framework to find the association.

Another of the improvements highlighted as necessary was to include in classes an explanation about the search for bibliographic information, citation and referencing for educational research. This would benefit from increasing the search strategies and tools that students have for their performance throughout the course. In line with this improvement, it is planned to include some classes in which the APA standards are studied in a concrete and detailed way, as it was seen that the manual that was delivered and the guidelines that were given when the texts produced by the students were read together.

Final remarks

The analysis presented, from a qualitative point of view and focusing on the description of the pedagogical and didactic dynamics that support the learning process of educational research from an active research practice, gave an account of the different tools, strategies, and teaching actions that supported the Workshop course. From this analysis, it would be plausible to think that the dynamics of classroom work proposed in the teaching-learning project for educational research, having as its starting point the writing of a narrative of teaching practice experiences and reading as its main activities and academic writing in the field, enables the development of actions typical of a researcher's work.

The results achieved in the implementation of the teaching-learning educational research project, based on the professional problems of teachers in training and within the scope of qualitative research, formative research and the teacher as a reflective professional, would lead us to think that this is a proposal for relevant teaching. In particular, it is clear that students conceive educational research as a qualitative tool to face the emergence of problematic situations, which provides critical and systematic views and interpretations and deep understandings about what happens in the institutional fabric of the school.

In line with the above, the evaluation of the experience of designing and implementing a teaching-learning project of educational research in the initial training of mathematics teachers at secondary level, is made based on reflection on what was achieved in relation to various aspects. As one of the strengths of the teaching-learning project, it can be said that the Educational Research Workshop offers a sphere of discussion around the experiences and problematic situations identified within the framework of practices developed by students, and provides tools that allow characterizing, address and understand such problems from various references for teaching and learning Mathematics. This encourages future teachers to conceive of the classroom as a research setting in which they can recognize and characterize problematic issues of interest related to the teaching and learning of Mathematics, document them and study them systematically to understand them, so that inputs are obtained to think about possible solutions.

Another strength of the project is that classroom discussions lead to the formation of a learning community in which students take on the role of researchers. In this sense, looking at the classroom they carry out transcends teaching work, as it leads them to consider the concepts of research and systematic analysis necessary to address educational situations that are recognized as professional problems, in light of the theoretical issues of Mathematics Education

and, in particular, from perspectives oriented towards the integration of widely used digital technology (Pérez, 2014).

Based on the experience in the course and the analysis carried out, we estimate the indirect consequences of the implementation of the project, which constitute its potential: the formation of an educational research learning community around reflection on teaching practice; the development of a professional culture that values research over practice is favored, evidenced, for example, by the fact that teachers become consumers of research products to combine with their teaching practice; the development of a professional practice is promoted that views educational research as a source of practical knowledge and reflection on practice as a relevant element for the professional performance of mathematics teachers. Based on them, we consider that we have managed to contribute to the initial training of teachers by investigating their own praxis, so that future teachers become graduates who take on the role of researcher in their pedagogical practice.

The tensions emerging during the Workshop are related to the students' preconception about research that consists of searching for information, that it is an innovation and that it is designed to find solutions to educational problems. This last notion is very persistent in students and influences resistance in putting together the argument and the research question; The concept of research problem is associated with a problematic situation in education, in the sense that it generates inconveniences and difficulties for the usual development of activities; The reading habit or practice that students have is in the style of passive consumers of the text, it is difficult to make them be critical and analytical consumers of the texts that are the product of research.

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