

The perspective of teacher trainees about the mathematics teacher's profession

Le point de vue des enseignants stagiaires sur le métier de professeur de mathématiques

Ana Rosa Corica¹

CONICET, NIECyT, UNCPBA, Argentina

María Rita Otero²

<https://orcid.org/0000-0002-3583-6081>

CONICET, NIECyT, UNCPBA, Argentina

<https://orcid.org/0000-0002-1682-9142>

Abstract

We present some results of the design and implementation of a research and study course for the Mathematics teacher trainees. The research is based on the Anthropological Theory of the Didactic. We analyze which gestures of the paradigm of the questioning and the research are identified in teacher trainees that study the question: how to teach mathematical knowledge.

Keywords: Teacher Training, Mathematics, Anthropological Theory of the Didactical.

Résumé

Nous présentons quelques résultats de la conception et de la mise en œuvre d'un programme d'étude et recherche pour la formation des enseignants en mathématiques, basé sur la Théorie Anthropologique du Didactique. On analyse les gestes du paradigme de la recherche et du questionnement du monde identifiés chez les étudiants quand ils étudient la question: comment enseigner des mathématiques ?

Mots-clés: Formation des enseignants, Mathématiques, Théorie anthropologique de la didactique.

¹ arcorica@gmail.com

² masamotero@gmail.com

The perspective of teacher trainees about the mathematics teacher's profession

This work is set in the problematic of the mathematics trainees. Bosch & Gascón (2009) consider that this problematic is not solved with the necessary skills for the practice of the teaching profession. Our results show that the theoretical training does not guarantee that teacher trainees (TT) acquire didactic praxeological equipment (Corica and Otero, 2014). In this paper, we present partial results of the design and implementation of a study program for TT in Mathematics. The principal aim is that these TT adopt a non-traditional pedagogy model, based on research and on linking mathematics with other disciplines. We analyze which elements of the paradigm of the questioning and the research are identified in TT, who study the essential issue to the mathematics teacher profession: *how to teach mathematical knowledge?*

Theoretical framework

We adopt as theoretical framework the Anthropological Theory of the Didactic (Chevallard, 1999, 2007, 2013a; 2013b). Following the lines suggested in the theory, it is necessary to introduce functional study processes into education systems. The Study and Research Path (SRP) are devices that would allow facing the monumentalization process of knowing and giving life to research pedagogy in the math class. The management of teaching by means of an RSP requires executing didactic gestures typical of the study and research, called dialectics (Chevallard, 2007, 2013b). The *Study and Research dialectic* is the engine of a teaching by SRP. It is not possible to investigate without studying.

Methodology

The methodology proposed is exploratory and descriptive (Hernández, Fernández and Baptista, 2010).

We designed and implemented a study program concerned with notions of mathematics didactic aimed at TT in Mathematics.

In the first situation, we want the TT to experience by themselves the study of ATD involved in a teaching based on the principles of the paradigm of the questioning and the research. We develop an activity in which not foreseen questions arose at the outset, causing the study to occur in different directions. This paper presents an analysis of the first session of this situation. The second situation aimed at TT living a co-discipline SRP (Parra, Otero and Fanaro, 2015) since all along their academic training they have never been involved in a teaching governed by the research pedagogy. When circumstances allowed it, we sought to study both situations in a complementary way.

Description of the TT group

The research took place in a third-year course corresponding to Teacher Training in Mathematics in a National University in Argentina. The study program proposes to focus on the training of TT in the ATD. In previous courses, the TT studied: Didactical Situations Theory (Brousseau, 1986), Instrument - Object Dialectic and frame playing (Douady, 1988) and the fundamental principles of the Anthropological Theory of Didactics (Chevallard, 1985, 1999).

The course lasted 4 months with two weekly meetings of 4 and 3 hours. During the 4-hour meetings TT studied the first situation where Research Teacher (RT) was the study director. During the meetings of 3 hours, the TT experienced as students a codisciplinary SRP. These classes were conducted by the researcher who developed the didactic device. The course was composed of 12 students. In all class sessions the TT formed the same workgroup: 5 groups of 2 or 3 members each.

Data collection

In the first session, the RT proposed a generating initial question and during the subsequent lessons, when circumstances required, he provided material for study. So questions and answers developed by each group were withdrawn at the end of each

session and were scanned and given back to students in the immediate following session. All students' written protocols of students of each implementation were obtained.

In the first session, as a synthesis of the contributions of the various working groups, the community developed a study package proposal of the means to study throughout the course. In the subsequent sessions, the different groups contributed questions (Q_i) and answers (A_i) pairs according to their interests and needs.

Data analysis

The data analyzed are the product of the protocols that we collected from students and general audio transcription of the first session. For data analysis, the transcription of the general audio was segmented into episodes and its study was supplemented from the study protocols. The criteria adopted for the segmentation in episode was when the community study speech raised a new question. This allowed to sort questions and answers pairs provided by the study community and identify the actors who the producers were. We formulated categories inductively, that permitted to make inferences about the types of questions that constitute the primary means of study.

Result analysis

In the first session we presented a video about different possible classroom situations to provoke TT to reflect and place themselves in understanding and designing teaching practices. Then, we proposed them to work in groups and carry out the following task:

Q₀: How to design and implement didactics devices for the mathematics study?

The study of Q_0 led to the formulation of questions and answers pairs (Q_i , A_i), which we detailed below. The RT had to intervene several times so that students did not give immediate and finished answers.

Following, we indicated the set of questions and answers (Q_i, A_i) that emerged from the Q0 study in the first session (Figure 1):

Figure 1

The set of questions and answers (Q_i, A_i) that emerged from the Q_0 study in the first session

- Q1: What are the didactics devices?*
- Q2: What kind of tools provides the mathematics?*
- Q3: What is a dynamic sequence?*
- Q4: How should the teacher - student interaction be?*
- Q5: What kind of tools should the teacher provide?*
- Q6: How can the teacher show students that mathematics is useful for their future?*
- Q7: How can he raise interest in students?*
- Q8: How to show students that mathematics is for the future?*
- Q9: What do the teachers do when a student brings a problem?*
- Q10: How do we choose an activity?*
- Q11: How to determine the background knowledge of the students?*
- Q12: How to strike a balance between the students who are interested in passing and those who are interested in learning?*
- Q13: What should be the role of the teacher towards different proposals?*
- Q14: How do we look for information?*
- Q15: How to implement a didactic device at university?*
- Q16: What is an introductory problem?*
- Q17: What features should the problem have?*
- Q18: What if a part of the class has no interest in participating?*
- Q19: What is the difference between a professor and a teacher at high school?*
- Q20: How does the number of students influence?*
- Q21: What to do when the teacher worries about the students' behavior?*

From the analysis of the questions and answers pairs that emerged from the study community, we formulated categories inductively, which allowed to synthesize and characterize the primary study medium. The categories and subcategories are described below:

Questions type. This refers to the style of questions proposed by the study community. We distinguish two types of questions:

Interrogative What. These questions admit an immediate and finished response.

Interrogative How. Such issues go beyond the demands of mere information. They outsource an issue in which their research generates questions and answers.

Types of responses. It refers to the type of response that brings the TT to the issues raised. We distinguish three kinds of responses:

Questions in weak sense (QWS). These answers provide a closed and completed response.

Questions in half sense (QHS). These responses are formulated as a finished and closed answer, and derivate in new questions.

Questions in strong sense (QSS). These answers generate several questions that the TT cannot provide an answer for, and requires restart their study.

Main actor. This category includes the actor of the study process that makes each question. Each actor is identified as follows:

Teacher Trainees (TT)

Research Teacher (RT).

On Table 1 we show the analysis results of the questions and answers pairs formulated:

Table 1

Analysis results of the questions and answers pairs formulated by the study

Interrogative What...	Interrogative How...	Types of responses	Main actor
	Q ₀	QSS	RT
Q ₁		QHS	TT
Q ₂		Unanswered	TT
Q ₃		QWS	TT
	Q ₄	QWS	TT
Q ₅		Unanswered	RT
	Q ₆	Unanswered	RT
	Q ₇	QSS	RT
	Q ₈	QWS	RT
Q ₉		Unanswered	RT
	Q ₁₀	QHS	TT
	Q ₁₁	QHS	RT
	Q ₁₂	Unanswered	TT
	Q ₁₃	QHS	RT
	Q ₁₄	Unanswered	RT
	Q ₁₅	QWS	TT
¹⁶		QWS	TT
Q ₁₇		QWS	TT
Q ₁₈		QWS	TT
Q ₁₉		QWS	TT
	Q ₂₀	Unanswered	TT
Q ₂₁		Unanswered	TT

We highlight that only 2 out of the 22 questions, were formulated in a strong sense. Both were provided by the RT, one of them is the initial generator question Q_0 , and the other is questions Q_7 that refers to how the teacher manages the students' interest in the mathematics study.

The TT tend to propose questions that begin with the interrogative what (8/10). They made only 5 out of 12 questions that begin with interrogative how. This highlights the need of the TT to formulate questions that can provide immediate and finished answers. On the other hand, we emphasize that 12 questions support answers in weak and half sense. There is a high number of questions ($n = 8$) that the TT did not provide an answer, which makes that the means require to continue their study in the following sessions.

Conclusions

The analysis results of the first class indicate that the Q0 study of TT is reduced to propose questions, and possible immediate answers, as if there was no more to study. This required that the RT should intervene on several occasions to problematize the questions that TT made. We consider that the questions and answers pairs proposed by TT do not invite to reflection. The largest proportion of these questions aim at establishing what to do so that the students will have interest in the mathematics study.

This interest seems to be more linked to the fact that students like mathematics rather than they are interested in the mathematics as a knowledge field. In the TT manifestations, the issue on mathematics teaching is absent since their interventions stay at the pedagogic and society levels. This characterization of the teacher's profession emphasizes that the teacher is responsible for the students' like the mathematics.

In the subsequent sessions, we continued studying and modifying the study means conceived in the first session. We get greater evidence of the development in the TT attitudes compatible to enter the research pedagogy.

References

- Brousseau, G. Fondements et méthodes de la didactique des mathématiques. *Recherches en Didactique des mathématiques*, 7(2), p. 33-115, 1986.
- Bosch, M., Gascón, J. Fundamentación antropológica de las organizaciones didácticas: de los “talleres de prácticas matemáticas” a los “recorridos de estudio e investigación”. In: *Diffuser les mathématiques (et les autres savoirs) comme outils de connaissance et d'action*, Montpellier: IUFM de l'Académie de Montpellier, p.49-85, 2010.
- Bosch, M. & Gascón, J. Aportaciones de la Teoría Antropológica de lo Didáctico a la formación del profesorado de matemáticas de secundaria. In: *Investigación en Educación Matemática XIII*, Santander: SEIEM, p.89-113, 2009.
- Chevallard, Y. *La transposition didactique*. Grenoble: La Pensée Sauvage, 1985.
- Chevallard, Y. L'analyse des pratiques enseignantes en théorie anthropologique du didactique. *Recherches en Didactique des Mathématiques*, 19/2, p. 221-266., 1999
- Chevallard, Y. *Passé et présent de la théorie anthropologique du didactique*, 2007. <http://yves.chevallard.free.fr>
- Chevallard, Y. Enseñar Matemáticas en la Sociedad de Mañana: Alegato a Favor de un Contraparadigma Emergente. *Journal of Research in Mathematics Education*, 2 (2), p. 161-182, 2013a..
- Chevallard, Y. *Éléments de didactique du développement durable. Leçon3*. 2013b. <http://yves.chevallard.free.fr/spip/spip/IMG/pdf/Didactiquedu-DD-2012-2013-3.pdf>
- Corica, A. & Otero, M. La formación de profesores de Matemática desde la Teoría Antropológica de lo Didáctico: un estudio de caso. *Perspectiva Educacional*. 53(2), p. 20–44, 2014.
- Douady, R Dialectique outil-objet et jeux de cadres. *Recherches en Didactique des Mathématiques*, 7.2, p. 5-31, 1988.
- Hernández, R., Fernández, C. & Baptista, M. *Metodología de la investigación*. México D.F.: Mc Graw Hill, 2010.
- Parra, V., Otero, M. R. & Fanaro, M. Recorrido de Estudio e Investigación codisciplinar a la microeconomía en el último año del nivel secundario. Preguntas generatrices y derivadas. Uno. *Revista de Didáctica de las Matemáticas*, 69, p. 1-10, 2015.