PRESERVICE SCIENCE TEACHER EDUCATION: INQUIRY INTO PROFESSIONAL PRACTICAL PROBLEMS

Ana Rivero[1], *Rafael Porlán*[1], *Soraya Hamed*[1], *Ángel Ezquerra*[2], *Fátima Rodríguez*[1], *Jorge Fernández*[1] *and Carmen Solís*[1]

[1] University of Seville, Spain

[2] Complutense University of Madrid, Spain

Abstract: We present a proposal for preservice science teacher education entitled "Aprendiendo a Enseñar Ciencias en Primaria -*Learning to Teach Primary Science- (APENCIP Workbook)*" (Rivero et al., 2012). We take as referents for this workbook: inquiry-based science education; teacher education by inquiry into professional practical problems; the interaction with innovative teaching practices through audiovisuals. In the first part, the students prepare a plan to teach some specific content. The discussion and analysis of their proposals will serve as an initial contrast between the different teams, and an introduction to the professional problems they will have to address during the course (the intention being to clearly relate these problems with elements of the curriculum). In the second part, each curricular element and the problems it raises will be worked on sequentially. We shall begin by analysing the first version, and then compare and contrast it with various documents. The process culminates with work on a script for reflection aimed at setting out each team's position relative to the curricular element being analysed, and the team members' responses to the problems addressed. After analysing all the curricular elements selected, a second version of the teaching plan will be elaborated. In the third part, how inquiry-based science education is actually put into practice in the classroom will be visualized from video material and analysed, and a third version of the plan will be elaborated. The final activity is to compare the three versions, and to evaluate the entire process. Our intention is to investigate the prospective teachers' progression of knowledge in this process, and the possible influence that the course, especially the use of videos, may have had on that progression. Currently the workbook is being used in five classes at the University of Seville.

Keywords: Preservice Science Teacher Education, Science Methods Courses, Professional Practical Problems, Inquiry-Based Science Education, Theory-Practice Relationship

INTRODUCTION

We present a proposal for preservice science teacher education entitled "Aprendiendo a Enseñar Ciencias en Primaria -*Learning to Teach Elementary Science- (APENCIP Workbook)*" (Rivero et al., 2012). We take as referents for this workbook: inquiry-based science education; teacher education by inquiry into professional practical problems; the interaction with innovative teaching practices through audiovisuals.

The aim of our team is to investigate the progression of prospective teachers' knowledge about inquiry-based science education when they are participating in a course which uses the APENCIP workbook, and the influence the course has on that progression. Currently, the workbook is being used in five classes at the University of Seville, and although we have no results yet, we hope to be able to present them at the Conference. In this present communication, we describe the features of the workbook in some detail.

THEORETICAL FRAMEWORK

Previous studies with small samples, in which we adopted some of the formative principles underpinning the APENCIP workbook, identified a certain progression in prospective teachers' knowledge – from a teacher-centred to a more pupil-centred approach to teaching, although without actually reaching a true inquiry-based focus (Porlán et al., 2011; Martín del Pozo, Porlán & Rivero, 2011; Rivero et al., 2011).

To try to facilitate our students' better learning, we assume various principles in the APENCIP workbook:

Inquiry into practice, consistent with what we propose for teaching Primary pupils. Inquiry in this context implies creating with some rigour an interaction between meanings originating from the inquirer, from other persons, and from phenomena of reality, with the aim of addressing necessary or interesting problems, and thereby contributing to professional change (Crawford, 1999).

Organizing our teacher education around professional practical problems. There is broad consensus among researchers on the need for prospective teachers to learn to question their approaches to fundamental curricular problems of teaching practice (what to teach and why, which tasks to set in class, how to monitor the evolution of the class and their pupils' learning, etc.), and to initiate robust change towards knowledge that is more consistent with the contributions of educational research and innovation (Watters, J. & Ginns, I., 2000; Zembal-Saul, Krajcik & Blumenfeld, 2002; Russell & Martin, 2007).

Interaction with innovative teaching practices rather than just with theoretical information. For several authors, direct exchanges with innovative practices constitute the most promising way to provoke genuine professional development (Tillema, 2000). In Preservice Education (at least at the University of Seville), direct contact with practice is completely detached in time and space from the rest of the courses the students have to take. In science methods courses there is therefore no possibility of analysing either the practices undertaken by the students or the professional practice of other teachers. Included in the proposal set out in the APENCIP workbook are audiovisual materials specifically created to offer students the opportunity to see and discuss innovative practices. Various authors have examined the importance of using videos in education (Santagana, 2009; Ezquerra, 2010; Richoux y Tiberghien, 2012). We realize that even in a single image, and more so in a sequence, there is so much information that students may be distracted away from the relevant points. But we believe that viewing and analysing images that reflect a classroom that is both current and in a context that is close to them will allow them to meaningfully access the information, lend credibility to the innovative proposals being presented (about which

they usually have very little personal experience), and help construct richer and more detailed models of science teaching.

ACTIVITIES FOR LEARNING TO TEACH INQUIRY- BASED SCIENCE

The APENCIP workbook is organized in a sequence of teacher education activities, beginning with work on the prospective teachers' ideas and experiences. Through a process of comparing and contrasting with support documents, and statements and actual practices of in-service primary teachers implementing inquiry-based teaching in their classes, we seek to improve these initial ideas about teaching (see Table 1).

Table 1:

Proposed teacher education activities

	Initial activity - Presentation and negotiation of the proposed course work - Formation of 3 to 4 person teams - Questionnaire with statements about science teaching and learning
First Part	*Activity* 1. Elaboration of the first version of the Plan Teaching a specific content of the science curriculum. *Activity* 2. Analysis by the teams of the first version of the Plan. Analysis by another team - Annotate possible improvements to the first plan
Second Part	*Activity* 3. What to teach? - Analysis of the content in the first version - Working with documents of different types (the official curriculum, exemplifications, theoretical reflections) - Script of reflection on classroom content - Reworking the classroom content *Activity* 4. Do you have to take into account the pupils' ideas in order to teach? - Analysis of the pupils' ideas in the first version - Working with documents of different types (the official curriculum, exemplifications, theoretical reflections) - Script for discussing pupils' ideas - Reworking the treatment of pupils' ideas *Activity* 5. How to teach? - Analysis of the teaching methodology in the first version - Working with documents of different types (the official curriculum, exemplifications, theoretical reflections) - Script of reflection on the teaching methodology - Reworking of the teaching methodology

	Activity 6. Why, what, and how to evaluate pupils? - Analysis of the evaluation in the first version - Working with documents of different types (the official curriculum, exemplifications, theoretical reflections) - Script of reflection on the evaluation - Reworking of the evaluation *Activity* 7. Second version of the Teaching Plan
Third Part	*Activity* 8. The practice of inquiry-based science education. - Watching the video - Script of reflection on practice *Activity* 9. Third version of the Teaching Plan.
	Final Activity - Valuation of the course and of your own learning - Questionnaire with statements about science teaching and learning

As one observes in Table 1, in the second part each curricular element is analysed, starting with the characterization of the first version. Table 2 presents the first activity in the case of the teaching methodology.

Table 2:

First analysis of the methodology in the first version of the Teaching Plan

Methodology	*First Version*
What types of activities have been proposed? Why did you choose those?	
What characterizes the proposed activities? What is the point behind them?	a) The activities are practical situations with the pupils as protagonists that seek to motivate them, involve them in the process, etc. b) The activities are each of the situations that constitute the teaching and learning process, and seek to promote the pupils' own construction of knowledge. c) The activities are practical situations in which pupils apply the theory in order to enhance their learning. d) If you do not identify with these options, what is your initial proposal like?
What determines the order of activities that have been proposed?	Explain why you chose that option a) There is nothing to explain the order – the sequence came out randomly, without any criterion.

b) The pupils' ideas, in the sense that one follows a sequence of the type: finding out what their ideas are, providing information to correct any errors and gaps found, and seeing if their ideas have changed.

c) The conceptual content, in the sense that the first thing you do is connected with the first concept, the following with the second concept, and so on.

d) If you do not identify with these options, what is your initial proposal like?

Explain why you chose that option

To help the students structure the new ideas that are developed during the process of comparison and contrast with the various documents, it is proposed that they respond to a script of reflection. See the example presented in Table 3 for the case of the methodology of teaching.

Table 3.

Script of reflection on the methodology

Script of reflection on the Methodology of Teaching
1. Enumerate the different types of activities that seem to you best suited for teaching and learning science. Try to classify them by selecting the criteria yourselves. 2. Some authors define an activity as a programming unit. Accordingly, a teaching plan will consist of a set of temporally ordered activities, regardless of whether it is the pupil or the teacher who has the more prominent role, or neither. I.e., an activity can refer to a teacher's explanation, a small-group work session, a debate, an experiment, etc. What is your opinion on this? Reason your response. 3. So what is the purpose of activities? I.e., what do you think their role is in science teaching and learning?
4. Some authors argue that behind every activity plan there lies a methodological model. These models are characterized by a series of ordered phases. For example, the following phrases reflect different models in which there is a change in the phases or their order:
a) Explain the theory first and do practical work to apply it.
b) The ideal is to start with activities of observation, then to present the theory, and finally to check what has been learnt by means of an examination.
c) First you have to find out what the pupils' ideas are, then explain the errors that you found, and finally give a verification test.
d) You have to start by posing a problem, then the pupils should reflect on their ideas, later activities should be done for these ideas to evolve, and finally a synthesis has to be made of what they have learnt.

e) You must begin with motivational activities, then experimental activities, followed by activities with the teacher's explanation, and finally activities of application.

f) Etc.

In connection with the foregoing, describe and justify the methodological model that you would now follow.

5. Indicate three key ideas on the methodology of teaching.

6. Given what you have answered so far, do you want to make any changes to your initial methodological proposal? What kind of changes? Explain why you want introduce these changes.

In short, our intention with this teacher education proposal is to overcome the idea that "in order to teach, what is needed is to know the content because the rest is learnt by teaching" by fostering the evolution of our prospective teachers' curriculum designs towards a more inquiry-based approach. We try to bring in-service teachers' innovative practices into initial teacher education, promoting a positive and professionalized image of teaching and teachers which should help develop interest in the career and foster its deserved social appreciation (Rivero et al., 2012).

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