PROSPECTIVE PRIMARY TEACHERS' CONCEPTIONS ABOUT SCIENCE TEACHING: IDEAS RESISTANT TO CHANGE

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Abstract: Our interest in this work is to develop and implement a Likert-scale questionnaire on primary science teaching. We performed a study with a sample of 404 students in Preservice Primary Education enrolled in a Science Methods Course at the University of Seville. To this end, we designed and validated a 6-point Likert-scale questionnaire on which the individual prospective teachers expressed their degree of agreement or disagreement with a series of statements about science teaching and learning in Primary Education. In drafting the statements, we took into account two basic referents: (i) the usual level at which our students begin (starting level, as defined by previous studies with small samples), which coincides with a transmissive perspective on science education (Traditional Model); and (ii) the target levels that we consider desirable, consistent with inquiry based science education (Inquiry-Based Model). The results indicated that the prospective teachers were in agreement with inquiry-based science education, although there co-existed deeply rooted traditional ideas.

Keywords: Preservice Science Teacher Education; Primary Science Education; Methodological Instruments

INTRODUCTION AND RATIONALE

Several studies have suggested that prospective teachers begin their science education courses with ideas that coincide with the Traditional Model of teaching, and that they can evolve to a more pupil-centred than teacher-centred view, but without reaching an Inquiry-Based Model for science education (Porlán et al., 2010, 2011; Martín del Pozo, Porlán & Rivero, 2011; Rivero et al., 2011).

Table 1 summarizes the characteristics of these two models, which we used to serve as referents for the present work (García, 2000).

Table 1:

Current teaching models (García, 2000)

	Traditional Model (TM)	*Inquiry-Based Model (I-BM)*
Pupils' ideas, interests, and needs	Not considered	Considered
What to teach	A simplified form of the	Alternative (school-level)

	discipline's knowledge	knowledge which includes various referents (of the discipline itself, of everyday life, scientific)
How to teach	Methodology based purely on the transmission of information Activities confirming the transmitted information The pupil's role is to listen, memorize, and reproduce the transmitted content The teacher's role is to present the topics, and to keep order in the classroom	Methodology based on the idea of inquiry on the part of the pupils Problem-based activities The pupils' role is to be active participants in their learning process and responsible for the construction of their knowledge. The teacher's role is as facilitator or counselor in the process, and as a researcher in the classroom.
Assessment	Based on repetition of the set content Product-centred Done by means of tests and examinations	It is the instrument used to monitor the evolution of the pupils' knowledge, of the teacher's intervention, and of the use of inquiry in the classroom. Process-centred Done by means of multiple instruments.

Our intention is to develop a questionnaire that will allow one to discern the presence of these perspectives in prospective primary teachers when they are participating in a science method course.

To this end, in addition to the aforementioned models, we reviewed other instruments, such as the Inventory of Educational and Scientific Beliefs, INPECIP (Porlán, 1989; Porlán, R., da Silva, C., Mellado, V. & Ruiz, C., 2007), the Professional and Pedagogical Experience Repertoire (Loughran, Mulhall & Berry, 2004), and others (Martinez & al., 2001; Marin & Benarroch, 2010).

METHODS

We conducted a survey-type, descriptive, quantitative study relating to four key curricular categories (see Table 2). For each of these categories, we defined three subcategories. Four items were drafted for each subcategory, two corresponding to what we consider the starting level (coincident basically with the Traditional Model), and two with the reference level (Inquiry-Based Model). The questionnaire therefore comprised forty-eight items. The instrument was administered towards the end of the

science method course. The students (four hundred and four in total) were divided into eight groups, each of which was assigned to a different teacher.

Table 2

Curricular elements to investigate

Categories	*Subcategories*	*Referents*	
1. School content.	1.1.Formulation/presentation of the content	Starting Level (coincident with the Traditional Model, TM)	Reference Level (coincident with the Inquiry-Based Model, I-BM)
	1.2. Content selection		
	1.3. Type of content		
2. Pupils' ideas	2.1. Nature of the pupils' ideas		
	2.2. Changing the pupils' ideas		
	2.3. Using the pupils' ideas.		
3. Teaching methodology	3.1. Sense of the activity		
	3.2. Types of activities		
	3.3. Methodological sequence		
4. Assessment	4.1. Sense of the Assessment		
	4.2. Assessment criteria		
	4.3. Assessment instruments		

The methodological sequence followed for the acquisition and analysis of the information is shown in the following figure:

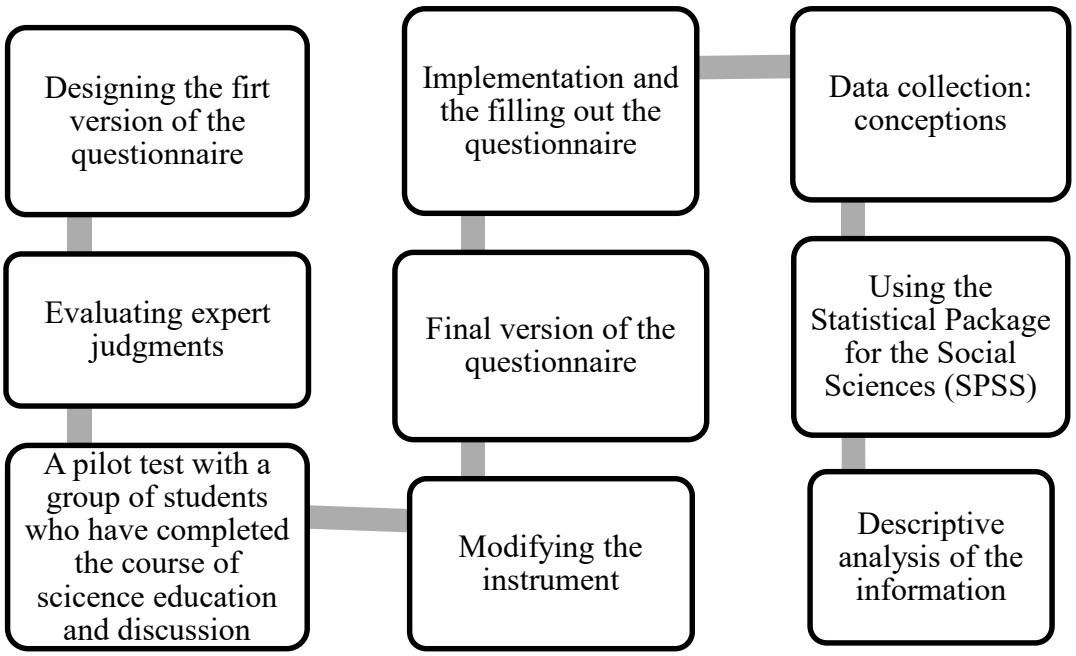

Figure 1. Methodological sequence followed in the study

The descriptive analysis of the data was done using SPSS vn 18.0, computing the percentages, averages, and standard deviations for each item. To verify that the differences found in the results were statistically significant, we subjected them to a *t*-test for related samples with an alpha level set at 0.01 and a confidence level at 0.99.

RESULTS

The results indicate that most of the prospective primary teachers are in agreement with an inquiry-based science education, with the differences of acceptance between the means of the scores of the items corresponding to the two models being statistically significant (*p*-value 0.00, < 0.01). In some cases however, there remained certain deeply rooted traditional conceptions. We shall describe each of them in what follows.

With respect to *changing and using the pupils' ideas*, nearly half were in agreement with the consideration that learning is a process of the pupils retaining scientific content in their minds (48%), or that it consists in replacing their "erroneous conceptions" by the scientific "right or appropriate conceptions" (60.7%). Most believe that one needs to pay particular attention to the pupils' initial ideas so as to determine their starting level (89.6%) (see Figure 2).

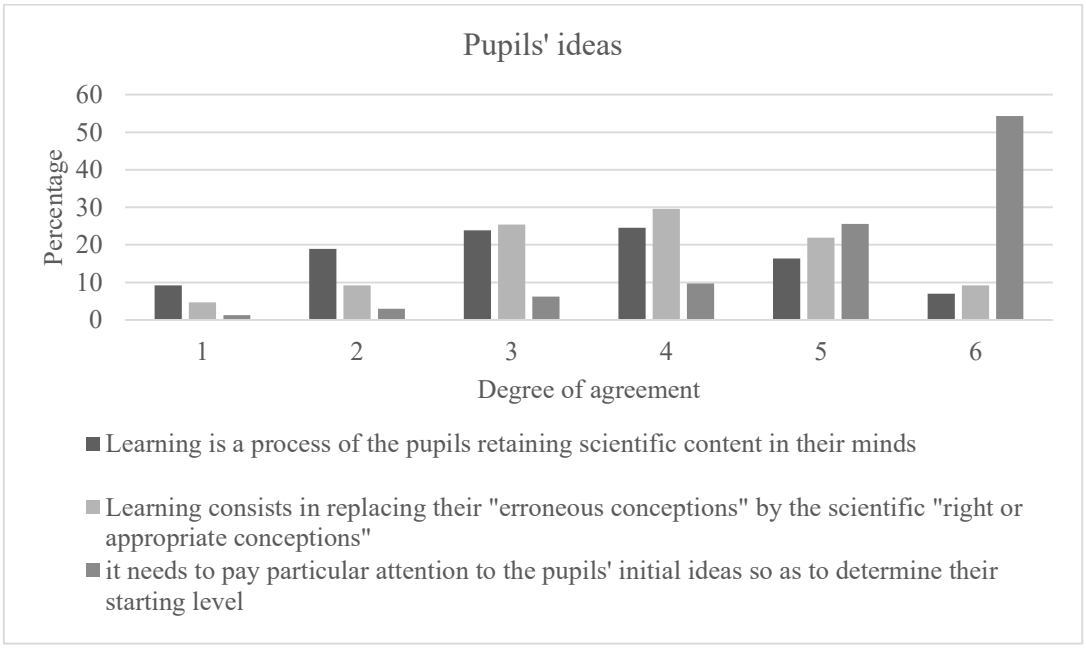

Figure 2. Percentage of participants' responses related to changing and using the pupils' ideas

With respect to *the selection content in science education*, scientific knowledge is the main and almost sole referent (55.8%) (see figure 3).

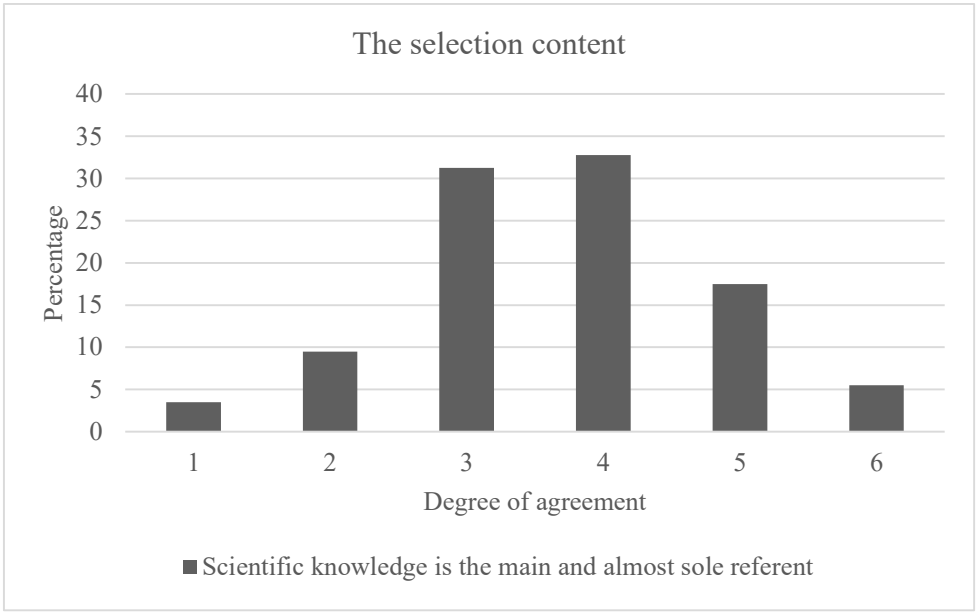

Figure 3. Percentage of participants' responses related to the selection content

With respect to *methodology*, most consider that activities involving situations of practical applications should come after the teacher's theoretical explanation (81.5%). Also, more than half believe the appropriate methodological sequence to be one that begins with theory and then continues with activities (54.1%) (see figure 4).

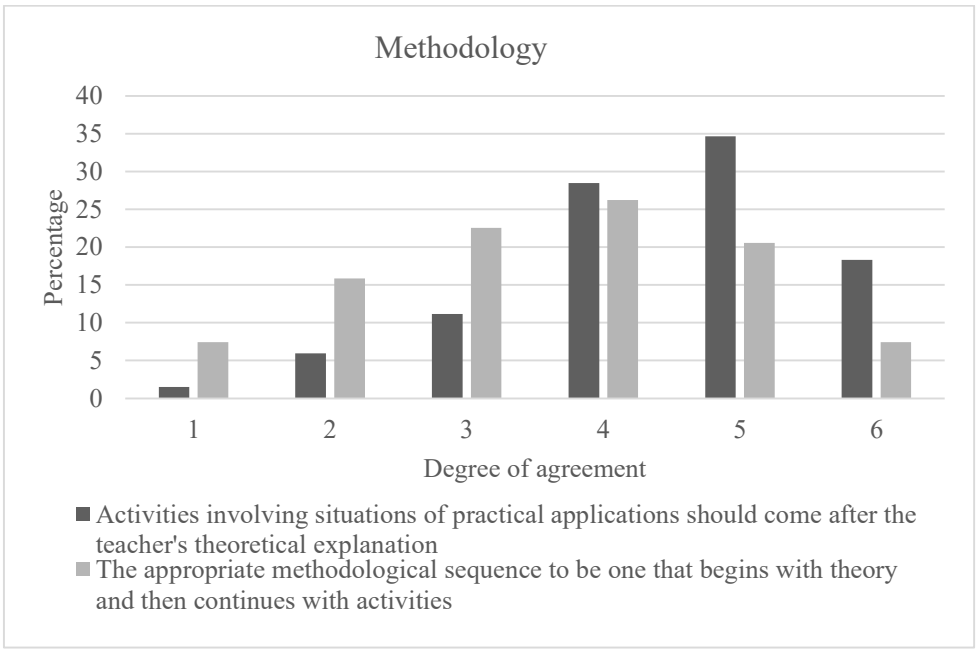

Figure 4. Percentage of participants' responses related to the methodology

Finally, with respect to *assessment*, more than half hold that the purpose is to discriminate among pupils so as to decide which should pass to the following courses (63%). They believe that pupils should be evaluated (70,5%), and that the tests should be kept anonymous and should be prepared in accordance with the pre-set level that the teacher has programmed (57,9%) (see figure 5).

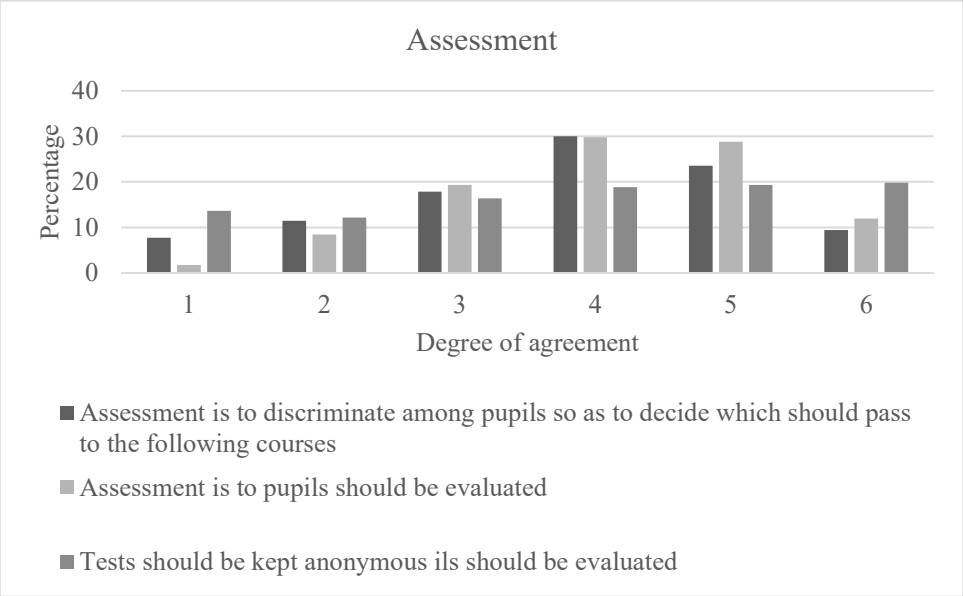

Figure 5. Percentage of participants' responses related to the assessment

CONCLUSIONS

The present results are consistent with those of other studies in that change in professional knowledge is slow and gradual, and one needs to temper one's expectations regarding preservice teacher education (Flores, López, Gallegos, and Barojas, 2000). They also support the findings of other studies in that there appear to exist deep-lying obstacles to change: the pupils' ideas have no epistemic value and scientific knowledge represents absolute truths (Porlán et al., 2010 & 2011; Martín del Pozo, Porlán & Rivero, 2011; Rivero et al., 2011).

In our research team, we intend to use the questionnaire with samples of prospective teachers participating in science methods courses with an orientation to addressing the major obstacles against change. In that study, we shall also apply other research instruments and techniques to investigate in depth the conceptions about teaching and learning science that prospective teachers hold at the time they are beginning their teacher education, and the changes that occur during their participation in the course.

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