



## Effects of Implementing a Model-Based Inquiry Sequence on In-Service Primary School Teachers' Perceptions

Ana Amat González<sup>1</sup>, María Martínez-Chico<sup>2</sup>, María Rut Jiménez Liso<sup>3</sup>

### Abstract

*Science educators and policy makers intent to widespread implementation of inquiry in science education due to its advantages to promote not only conceptual learning but also scientific practices achieving students' motivation the development of scientific competency. The growing concern about the existent distance between the advances of educational research and the instruction usually developed in classrooms, leads us to focus on in-service teachers' perceptions, by reducing such distance from the implementation of inquiry-based teaching proposals in Primary classrooms and the analysis of teachers' perceptions when their students experience them.*

*The present study shows the analysis of interviews with three in-service teachers, before and after the implementation of a sequence through a Model-Based Inquiry (MBI) approach focused on constructing the model of living being, in their classrooms, with their own students. Our purpose is knowing the teachers' perceptions about this approach, analyzing both, the collected information about how they usually teach science (before the implementation), and the declared perceptions after witnessing the implementation of the sequence.*

*Results show that all the in-service teachers who recognized in the initial interview that they did not know anything about the features of the inquiry-based approaches neither have never experienced it, after the implementation of sequence, they are able to recognize, its own characteristics (such as students are involved in solving scientific questions, construct explanations or models, look for evidence, analyze the obtained information, communicate and discuss ideas, and revise and use their explanations or models in other situations). The analysis of teachers' perceptions when witnessing how their students experience an inquiry-based sequence allow us to know the advantages and disadvantages they perceive, as well as to identify the obstacles that emerge when we try to transfer this kind of sequences, to other in-service teachers interested in incorporating scientific practices in their classrooms.*

**Keywords:** *Scientific Practices, Model-Based Inquiry, in-service primary school teachers' perceptions;*

### 1. Introduction

Numerous research projects and national and international reports [3, 9, 11] highlight the worrying gap between the results of research in science education and what really takes place in teaching in primary classrooms. One of the authors has personally experienced this gap from her experience along the initial teacher training provided by the Department of Education (with some educators who were researchers in science education), finding that this is really far from the science teaching we observe in Primary School classrooms when doing the practical period at schools.

In this sense, different studies [2, 6, 8, 10] show the high valuation that in-service teachers give to previously experience the approaches of teaching that they will have to implement in the classrooms. The justification is that this previous experience reduces the degree of anxiety and insecurity that any innovative proposal generates in the teacher, especially if their habitual lack of mastery of scientific content is considered. On the other hand, it is essential the relationship of science with what is close and daily for learners, hence, the activities and materials that are presented should highlight the functionality of knowledge as a feature that permeates the entire proposal from its beginning.

### 2. Purpose of the study

Taking into consideration the demands made by in-service teachers, and in order to reduce the distance between the innovation-research in science education and the instruction that takes place in primary classrooms, we decided to investigate the opinion of three in-service teachers about the initial training they consider necessary to teach science "properly", as well as the usual development of their teaching practice in science classes. In addition, we have asked them about the realization of scientific

---

<sup>1</sup> Universidad de Almería, (Spain)

<sup>2</sup> Universidad de Almería, (Spain)

<sup>3</sup> Universidad de Almería, (Spain)



practices characteristic of inquiry-based approaches. Our purpose is, on the one hand, to investigate the demands of in-service teachers to teach science, and on the other hand, to approach how the teaching practice is usually addressed in Primary Education.

Furthermore, in order to reduce the distance between research and actual instruction in primary classrooms, as well as to make both students and teachers aware of the many advantages offered by scientific practices, they have had the opportunity to experience a model-based inquiry teaching sequence, called "Sensopill" (in advance *SP*) that starts from the initial question: Is a chickpea a living being?, which lasted 1.5 hours approximately [7] With all this, it is intended that students know science in an authentic way that reflects the epistemic characteristics of scientific practices [1].

### **3. Method**

The *SP* has been implemented in three different classrooms and schools by two teachers in postgraduate training, in the presence of the in-service teachers, in their own classrooms, with their students, with the intention of contrasting and knowing the perception of the teaching staff on said proposal.

As the main objective of this work is to analyse the perception of in-service teachers about the effect of a Model-Based Inquiry teaching sequence, and knowing their usual teaching practices, we interviewed three teachers before and after implementing the *SP* with their students. Both the information collected in the previous interview regarding how they teach, and the reflections declared after the implementation, has been analysed.

All data were open-coded, looking for aspects that permit to identify the initial profiles of the in-service teachers as well as the changes on their perception after observing the implementation of the sequence with their students.

### **4. Findings and discussion**

The analysis performed has allowed us to appreciate whether there is an evolution in their ideas, perceptions, attitudes... and whether they recognize or not the advantages of the teaching sequence model-based inquiry and identify the scientific practices developed.

The results show that, focusing on the cognitive aspect, the three participating in-service teachers mainly identify the communication of hypotheses or explanations of the students, the detection of previous ideas, the argumentation and discussion of ideas, the construction of scientific knowledge based on evidence, and the role of students as protagonists of their own learning. This confers, according to them, utility to this approach for teaching all scientific contents.

Regarding the procedural aspects, the characteristics of the Model-Based Inquiry approach (raise scientific questions that involve students, develop explanations or models based on tests, analyze the information obtained, communicate and exchange ideas and use and review explanations or models) described by Martínez-Chico, Jiménez-Liso & López-Gay (2014) have been detected by all of the participating in-service teachers, which indicates that the implementation of the teaching sequence has not only been useful for the students, but it also allows the scientific practices developed along inquiry-based sequences are recognizable to teachers in active.

In addition, the responses of the interviewees seem to show that the visualization of the sequence has promoted an evolution in their ideas and has led them to recognize the effectiveness of a teaching that involves students, which highlights as a starting point the posing of meaningful questions for the apprentices, which starts from what is close and daily for them, and which overcomes the transmissive teaching centered on the repetition of contents. Then, we can affirm then that from their positive reflections, this implemented sequence (*SP*) that focuses on inquiry responds to the interests that society demands for the teaching of science [4].

Likewise, all the teachers interviewed stated that they had witnessed the experimentation, on the part of their students, of an innovative approach and stated that they had identified the activities inherent to teaching by inquiry. Moreover, a generally positive and satisfactory vision of the proposal is denoted, and they recognize that it fully involves the students, which entails significant learning.

Based on these results, we found that thanks to the experience developed, we were able to approach the goal of the Sensociencia project, to motivate the in-service teachers to develop innovative science teaching approaches, providing them as evidence of its effectiveness, the satisfactory results in their class, with their own students.

Finally, the analysis confirms the existing gap between school and university identified by numerous works and key reports in science education [3, 9, 11] since the in-service teachers are the ones who



continue to emphasize the long distance between what they are taught at the university and what really happens in Primary School classrooms.

### References

- [1] Bevins, S., y Price, G. "Reconceptualising inquiry in science education. International Journal of Science Education", 38 (1), 2016, 17-29.
- [2] Bhattacharyya, S., Volk, T., Lumpe, A. "The Influence of an Extensive Inquiry-Based Field Experience on Pre-Service Elementary Student Teachers' Science Teaching Beliefs". Journal of Science Teacher Education, 20 (3), 2009, 199-218.
- [3] Confederación de Sociedades Científicas de España. "Informe ENCIENDE: Enseñanza de las Ciencias en la Didáctica Escolar para edades tempranas en España". 2011. Disponible en línea: [http://www.cosce.org/pdf/Informe\\_ENCIENDE.pdf](http://www.cosce.org/pdf/Informe_ENCIENDE.pdf)
- [4] Forbes, C. T., y David, E. A. "Curriculum design for inquiry: Preservice elementary teachers' mobilization and adaptation of science curriculum materials". Journal of Research in Science Teaching, 4, 2010, 820-839.
- [5] Martínez-Chico, M., Jiménez Liso, M. R. y López-Gay, R. "La indagación en las propuestas de formación inicial de maestros: análisis de entrevistas a los formadores de Didáctica de las Ciencias **Experimentales**". **Enseñanza de las ciencias**, 32.3, 2014, 591-608.
- [6] Martínez-Chico, M., Jiménez Liso, M. R., López-Gay, R. y Acher, A. "Demandas de maestros en activo y materiales curriculares para la enseñanza de las ciencias. Investigación en la escuela" (80), 2013, 35-48.
- [7] Martínez-Chico, M., Jiménez Liso, M. R., Evagorou. "Pre-service teachers reflecting on knowledge, skills and emotions experienced when engaging in scientific practices". International Journal of Designs for Learning.
- [8] National Research Council. "Inquiry and the national science education standards". Washington, DC: National Academy Press. 2000.
- [9] Osborne, J. y Dillon, J. "Science Education in Europe: Critical Reflections". Nuffield Foundation: UK, 2008.
- [10] Windschitl, M. "Inquiry Projects in Science Teacher Education: What Can Investigative Experiences Reveal About Teacher Thinking and Eventual Classroom Practice?" Science Teacher Education, 2002, 112-143.
- [11] Worth, K., Duque, M. y Saltiel, E. "Designing and implementing inquiry-based science units for primary education". París: The Pollen FP 6 project. 2009.