

What factors have an influence on a quality teaching practice in Sciences?

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Abstract

This paper aims to know to what extent in-service teachers who have not participated in science teaching training courses neither have performed any research in this field develop a quality teaching practice and what factors have influenced to achieve it. Questionnaires and non-participating observation protocols about the classroom work have been used as well as semi-structured interviews with a sample of teachers to obtain data. These instruments try to characterize the teaching action and determine what factors and in which degrees have influenced the performance of a quality science teaching activity.

Keywords: Research in education; Factors of a quality teaching practice; relationship between research in science and science teaching;

1. Introduction

This work offers an initial step of a larger research project whose main objective is to analyse in which way, if any, research in science education influences teaching practice and, in case of a positive answer we want to establish if it provides a teaching improvement or not. At the same time we are dealing with the study of the facts that may influence the improvement of teaching quality in depth. We think this is an important issue nowadays considering the data provided by the Rocard Report (2008). On it the reduction of young people studying sciences is considered a "capital danger for the future of Europe" pointing that "the origins of this situation can be found in the way science is taught". This problem represents an obstacle to one of the main objectives of the Lisbon Strategy, adopted by the EU in 2000 and aimed to achieve in the future a real knowledge economy.

In our country that dropping of students in sciences has also taken place, having found that one of its grounds is the way that science is taught (Solbes et al, 2007), a way mostly derived from a lack of teacher training (Solbes et al, 2004; Furio et al, 2008).

The first phase of the research project which is part of the aim of this study has been the development of quality criteria to assess the teaching task quality. We wanted to know, in particular, to what extent this task is associated with educational research or innovation. To do this we rest on previous studies referent to what must know and "know how" a science teacher (Gil, 1991), what it is supposed to be known (Tuning, 2003) and in which way it is possible to influence the development of skills relating to training teachers (Barojas, 2010). Moreover, we have

considered the existing studies referred to the relationship between educational research and educational practice (Briscoe, 1991; Pekarek et al, 1996; Sanmartí & Azcárate, 1997, Solbes et al, 2004). All of them highlight that such research has very little impact on classroom practice. That is to say, at the bottom of the hypothesis that guides this paper underlies the lack of relationship between educational theory and classroom practice and therefore also in the practice of science education.

That is why we have considered making an ethnographic study of teachers by means of a multiple and convergent study, researching about different issues related to their teaching.

2. Experimental design

The study group consists of 28 Physics and Chemistry teachers of Secondary Education involved as tutors in the practicum of the Master in Secondary Education Teaching in this speciality in the land of Valencia. This is an absolutely random group since for being tutors every school (nor every teacher) must prepare a project for hosting practicum students. Then the school offers the possibility of participating to all the teachers who wish to do it being the only requirement to have an antiquity of one year at last in the school. Finally, the students choose one school or another to do their practice period basing primarily in proximity factors to their home town and without knowing who their tutor school will be.

To obtain data questionnaires, observation and interview templates have been used. From them it is intended to characterize the performance of teachers and find out which factors have had greater influence in the performance of their work.

The written questionnaire is shown in table 1. It is brief and it serves as a base for exploring the teaching experience and research made by teachers:

Table 1. Written questionnaire

Subject teacher _____	Years of teaching experience: _____
Graduate in _____	Year of graduation: _____
PhD in: _____	Year: _____
1. What initial training in science education have you done?	
<ul style="list-style-type: none"> • CAP (initial teacher's training required in Spain until 2009) • A course in science education in one science faculty • Other (specify) 	
2. What in-service teachers' training courses have you attended?	
3. Have you participated in some innovation or research groups in science education? Which ones?	
4. Quote some magazines about science teaching you know	
5. Have you published any paper in one of those journals? Tell us the title	
6. Have you taught any lecture in science and/or its didactic in a Teacher Centre, University, etc.? Which ones?	
7. Do you regularly use ICT in your classes? Which ones?	

The observation chart applied to the same sample of teachers is far more complex than the previous questionnaire and it is based on an instrument previously used in research (Carrascosa et al., 1991). This chart has been suitably updated by deleting some items and adding others, so as finally it is formed by 44 items grouped into the following sections: knowledge of the subject to teach, knowledge of research in science education, content and epistemological teaching strategies and management strategies for classroom, climate of the classroom during lessons, assessment, curriculum materials used and, finally, use of ICT both during the classes or as auxiliary

material. For its evaluation a Likert scale has been used. It demands to value from 1 to 4 in which extent the listed items are a part of the teacher behaving (where 1 is nothing, 2 a little, 3 means enough and 4 quite a lot), avoiding the indifferent, so the central value corresponds to 2.5.

The control group interview consists on the following items.

1. How do you think was your practice when you started teaching?
(If the answer is that the practice was innovative, we must ask: Had any specific didactic training influenced your conceptions and teaching practice? Which one?)
2. In which way your conceptions about science, science teaching and learning of science have changed over time?
3. Have you changed your attitudes and estimation of teaching? How?
4. Have you changed your teaching practice? In what sense?
5. Which facts have contributed to the change? (training, experience, a partner ...)
6. What materials and/or strategies did you use in your classes when you started teaching? (...)
7. Do you continue using them today? Why?
8. Have you incorporated innovative approaches to improve your teaching? What are the main difficulties in developing them?
(In this question and in the previous one disadvantages of innovative proposals must be mentioned and so the reasons why he/she does not use them or the difficulties to do it. If innovative approaches are not used it is time to ask about disadvantages of doing it.)
9. What are the major successes achieved by incorporating innovative approaches?
10. Do you have any comment to do or something you think we have forgotten? (...)

3. Results and discussion

21 out of the 28 teachers answering the questions from this research worked in public schools and the others in private schools supported by public means. Although there is an important amount of teachers working in this kind of private schools in Valencian Community, most of them participate in the master's private universities.

The first thing we have observed is that teachers in general are quite refractory to be observed by external researchers and one prove of this rejection is that only 14 of them answered initially the written questionnaire. So the initial results were subsequently increased with the interviews. About the initial curriculum, 21 of the teachers have a degree in Chemistry, three of them are Physicists, 1 is Biochemistry and we have no data of three of them. All of them have many years of experience (25.2), higher in the case of civil servants (28.4) than those teachers from private schools (15.8), as a consequence of the educational policies of the latest years.

Regarding the initial didactic education, all the teachers have carried out the initial training marked up by Royal Decree 1834/2008 which has been replaced by the current Master in Secondary Education Teachers. Then all teachers have taken courses in training (an average of 8) which have mostly been focused on updating content, resources, ICT and so on. The courses and activities devoted to science education are limited to specific contributions ("alternative conceptions", "Laboratory Practice) which are scanty to achieve the incorporation of teachers to the new focus on education (Jiménez-Aleixandre & Sanmartí, 1995).

Teacher's participation in educational research and innovation reaches very low marks. 22 teachers can name but only one journal of science education (*Alambique* or *Enseñanza de las Ciencias*) and only one of them has scientific publications. Seven teachers have been involved in groups of innovation in science education and have taught science courses and / or its didactic in Teachers' Centres or at the University. Finally, three of them have some book or articles in popular science published.

Next, we describe the information obtained from our observation chart. Two different sorts of observation have been done. Students doing teaching training have acted as observers of their master tutors at the school. This observation took place in the later stages of the master's degree. In that phase students already knew the theoretical frame and had done most of their practices time. They had been previously instructed by a researcher in order to get

the most objective and complete observations possible. Subsequently two more researchers have performed a second observation to contrast their information with the previous obtained results.

After the application of the questionnaire we have obtained the following results: Knowledge of subject to teach (2,9), Knowledge of research in science didactics (2,8), Conceptual and epistemological teaching strategies (3,4), Methodological teaching strategies (2,8), Classroom climate (3,7), Evaluation (3,0), Learning materials (curriculum materials) (2,8) and Student use of ICT (2,1). These results show that the biggest assessment values corresponds to Classroom climate and Conceptual Teaching strategies. This suggests us that a big experience is satisfactory for teachers. Therefore, they voluntarily offer themselves as a practicum mentor. The lower assessment, below the average, is Student's use of ICT. The expressed reasons are very varied naming primarily the absence of computer equipment in the classroom (although all the schools have one or more computer rooms). The oldest teachers mainly name the lack of knowledge or interest in this field too.

As a result of our work we can emphasize also a low formation in didactics. This conclusion arises both from the limited use of innovative materials and for the basic knowledge of science didactics (for example, the existence of alternative ideas or the lack of interest given to research initiation). On this matter it is interesting to mention that most of teachers use a conventional textbook on which the innovative proposals mentioned is minimal.

Finally, information has been completed by means of interviews (10) based on an agreed model and carried out by a researcher. They have been done according to teachers' availability to answer it. In the first phase, it was decided to interview the teachers who had obtained the highest assessments in the observation test and had not answered the questionnaire. The results are coincident with those obtained from the observation chart. They show that the more influential aspects in the incorporation of punctual innovations are not the derivatives of courses or readings in journals but personal ones, such as an interest in science and/or science teaching, as well as the satisfaction in the achievement of their work.

4. Conclusions and perspectives

Although most of the teachers included in the sample have a big experience, the results obtained show that they seldom use innovative material nor acquire knowledge coming from science didactics. On the other hand, utilization of ICT scores very lowly, possibly linking to teachers' age more than to the absence of means or formative opportunities. Likewise, it is observed that the factors that have influenced the most in their teaching quality are personal interest in science and a satisfactory practice.

As for this research perspective, we are carrying a second phase in which the number of participating teachers will be increased and so we will do with the interviews. Likewise, we would carry out the interviews and questionnaires to an experimental group formed by teachers who did their PhD in the Science Didactics Program of Valencia University. So, we will try to verify or put in question our main hypothesis: investigation can improve the teaching practice. On the other hand, a similar research is being carried out in Argentina. Similarities and differences between these two researches will allow us to compare the results and put proposals to improve teaching formations projects that are so necessary in every time but specially in Spain in these moments when changes in teachers' initial formation is being carried out.

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