

In-service training programs concerning Physics Education in Elementary School. A one year Seminar Course promoting the role of experiment as a form of PCK in Science Education performed in the Science Education Laboratory Centre (SELC) of Piraeus

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Abstract. *Long-term professional development projects have been designed in order to change the classroom practices of teachers, especially the role of experiments within them*

Some of them are based on the principles of distance education and/or contact training while others on the effort to introduce the idea of PCK to student-teachers.

A one year in-service training program for teachers of Primary Education has been designed and performed by the Science Education Laboratory Centre (SELC) of Piraeus in order to enhance both subject knowledge and pedagogical content Knowledge based on the role of laboratory experiments in physics education in particular.

After the intervention teachers' lesson plans had a stronger conceptual base and also teachers seemed to have developed a sense of confidence.

Keywords. Science teaching, Primary Education, In-service training programs, Experiments, PCK,

1. Introduction

Because elementary teachers can teach a dozen subjects, they require (but do not necessarily have) a rich, integrated, flexible knowledge base (Ball, 2000). Their knowledge base needs to include pedagogical knowledge, subject matter knowledge across numerous disciplines, and pedagogical content knowledge.

Many different training courses, concerning science teaching, have been designed based on the principles of distance education and/or contact training. Some include e-mail

discussions, lectures, exercises and seminars, private work and group discussions. (Lavonen, 2004). Others have been based on the effort to introduce the idea of pedagogical content knowledge - (PCK, the ways of representing and formulating the subject that makes it comprehensible for others (Shulman 1987)- to student-teachers using issues of particular science content as well as specific ways of teaching that content captured and portrayed for students-teachers. ITPT- In-Service Training for Physics Teachers- has been designed in order to change the classroom practices of teachers, especially the role of experiments within them as a form of PCK in this specific domain. Other proposals have chosen to focus on three goals in their elementary science methods course related to inquiry-oriented science teaching, the use of curriculum materials and students ideas as crucial –but not the only- areas of focus for elementary science teacher education (Davis, 2007).

Epistemic beliefs, though, affect the way in which the teachers use experiments in a school laboratory, or indeed whether they utilize experiments at all (Hodson 1992, Lumpe 2000). Teachers should choose experiments so that conceptual and procedural understanding of students could be developed. Resistance to change the beliefs of the teachers is one of the reasons for the slow rate of change in physics education (Haney 1996). Various approaches have been suggested to help change unfavorable teachers' beliefs and to assist the adoption and use of new models of teaching (Fullan 1991). Educational reforms and improvement in science teaching through in-service training are much more complex tasks than seems at first sight (Fullan 1991).

Students-teachers are commonly disappointed with their teacher education programs (Korthagen 2001) and educational theory – included PCK– courses provided by Universities (Skillbeck 2005). Most student-teachers have preconceived views about teaching, and about what they need to learn about teaching, that are at odds with those of their teacher educators (Pajares, 1992). For student-teachers, there often seems to be a big gap between the practice of teaching and the theories being espoused by their teacher educators, which are seen as having little value (Holt-Reynolds, 2000). Student-teachers tend to underestimate the cognitive aspects of teaching. As school learners, they did not have access to their teachers' thinking and decision-making as they were being taught (Munby, Russell 2001).

An additional problem for science teacher educators arises from the intertwined nature of PCK and subject-matter Knowledge. Studies suggest that student-teachers often lack a deep conceptual understanding of the content they are supposed to teach, and that their subject matter knowledge is fragmented, compartmentalized and poorly organized making it difficult to access this knowledge efficiently when teaching (Gess Newsome 1999). But a teacher who does not both understand and have a real affection for a subject will never be able to teach it well. (Berry 2008)

Therefore, in spite of all such efforts, reported development of teaching practice remains low. Real development occurs particularly in those few groups that follow the recommendation to involve their own students, and to try out the experiments in real classroom situations. Teachers should be helped to examine their pre-existing knowledge and beliefs, and to be assisted by both physicists and educationists (Jari Lavonen, 2004).

In-class discussions, recommended, provide opportunities for intellectual and expertise development and give a strong potential for fostering change (Grossman 2001). Teachers educators, also, can provide experiences that prepare teachers to develop PCK a preparation known as PCK readiness (Smithey, 2008). In this way a teacher can learn about the content, how to represent content to learners, and common ideas their learners bring to science class. This initial knowledge is developing gradually to PCK and eventually, usable knowledge (Smithey, 2008).

2. Intervention

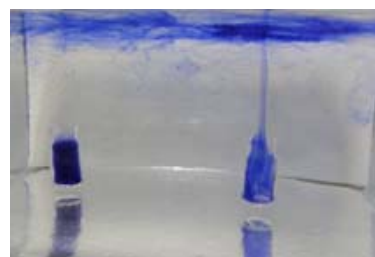
Taking these parameters into account a training program was designed and performed in the Science Education Laboratory Centre (S.E.L.C.) of Piraeus during academic year 2009-2010. Totally, two hundred in-service teachers coming from eighty five different elementary schools attended twenty five seminars. Every participant attended a cycle of three seminars concerning experimental activities in teaching Heat, Electricity and Optics in Fifth and Sixth Grade of Elementary School. A group of about twenty teachers each time attended all three seminars lasted for two hours every Thursday or Friday 12.00 to 14.00. During seminars teachers in group of five performed fifteen experiments under the guidance of the educators related to the Session of the course book to be taught in the classroom. Discussion involving interpretation and comments took place after each experiment had been performed.

The purpose of these seminars was not only the performance and interpretation of the experiments as another topic of Physics but also as a procedure for teaching experience exchange. Alternative ways of teaching methodology were described and specific spots were highlighted so that difficulties in classroom could easily be overcome. A characteristic number of experiments are presented in tables 1, 2 and 3.

Table 1. Experiments concerning Heat.



1 Heat transfer: Convection



Hot colored water rises while cold colored water stays inside the little bottle.

2

Expansion of gases



Bubbles coming from a pot as the air inside expands when glass comes in conduct with our palms.

Table 2. Experiments concerning Electricity



1

Attraction between neutral and charged body



The little pieces of paper jump as they are attracted by the plastic surface of the box being charged as we rub it with a piece of cloth.

2

Attraction between neutral and charged body



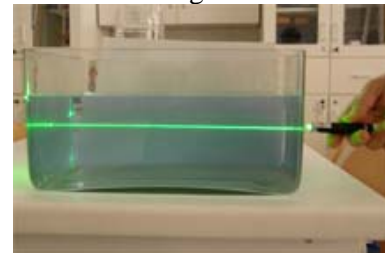
A tin is rolling towards a charged ruler.

Table 3. Experiments concerning Optics



1

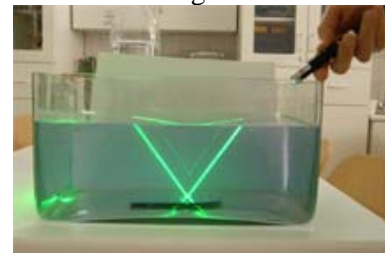
Transition of light



We can detect the light beam coming from a laser pointer traveling in straight line through colored water.

2

Reflection of light



The light beam is reflected when strikes the surface of a mirror inside a pot of colored water.

3

Pin-hole camera



We can see objects upside down looking through a hand made pin-hole camera.

4

Refraction of light



We can see a coin at the bottom of a glass rising as we fill gradually the glass with water.

5

Analysis of light



The light beam coming from a transparency reflector passing through a prism or a glass of water is analyzed.

3. Discussion

Although data analysis of the questionnaires given is still in progress, after the intervention, student-teachers' lesson plans seem to have a stronger conceptual base. Teachers performed most of the experiments presented in the training program having developed a sense of confidence. In a future version though seminars are planned to be more balanced as it was observed that in-service teachers lack a great amount of content knowledge as science is concerned. It is important for the participants of the seminar to have enough time so as to deal with the information provided and make the connection between theory and practice.

4. Acknowledgements

We acknowledge our colleagues at SELC of Piraus, teachers of Secondary Education, Elias Gavrilis, John Giapitzakis, Nikos Papadimitropoulos and Sophia Platanistioti for their support and useful remarks.

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