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Preparing and Retaining High Quality Chemistry Teachers in Greece

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Abstract

Designing an effective training program in order to prepare and retain high quality chemistry teachers is a complex and demanding task. This work aims at exploring the experiences and beliefs of in-service Greek chemistry teachers in respect with their training and their classroom practices via qualitative analysis of the data collected during workshop activities. In regard with the extent at which the different teaching dimensions were covered during pre-service and in-service training, it was shown that with the exception of pre-service subject matter, all other dimensions (pedagogical, psychological, social, ICT) were either inadequate or absent. A total of 13 factors were identified to have influenced the effectiveness of the received training with seven and six producing a negative or positive effect respectively. Four major obstacles which teachers face in their efforts to implement novel teaching approaches in the classroom were identified. Although the findings of this work suggest that there are some fundamental design flaws in the preparation of a chemistry teacher, the reported obstacles are mainly related to structural characteristics of the Greek educational system. Finally, the analysis of the workshop material also resulted in several proposals and suggestions related with different aspects of teacher training, namely the content, the type and the responsibility for the training program. It is anticipated that taking into account the actual classroom practices, beliefs and experiences of in-service chemistry teachers could aid towards the design of training programs possessing realistic aims and with maximal impact on the trainees.

1. Introduction

Effective teaching of chemistry is much more than the transmission of chemical knowledge and also much more than good pedagogy and knowledge of educational theory. An effective chemistry teacher must be able to analyse the content knowledge, her/his instructional behaviours, the quality and extent of the resultant student learning, and subsequently be able to modify or adapt her/his instruction in the most appropriate manner. Consequently, the design of effective professional development models for preparing (pre-service training) and retaining (in-service training) high quality chemistry teachers is complex and very demanding [1]. Carefully designed and innovative teachers' training programs can affect the ways in which teachers productively think about and analyse the relationships between teaching and learning and between students and subject matter [2, 3].

In terms of pre-service training, education scholars tend to adopt the simultaneous training of prospective teachers both in their science subject and in education-related courses, and the opportunities to integrate university course work with classroom apprenticeship teaching [4, 5]. All this implies that teacher education is a shared responsibility among various academic departments of the higher education institutions on one hand, and between the higher education institutions and the secondary education system on the other. The involvement of university communities in professional development for in-service teachers should also be seen as a vehicle for contributing to sound scholarship on professional development and on the interactions of theory and practice in professional classroom teaching.

Although the professional nature of teaching necessarily includes knowledge of relevant theories and research findings [3], research on teacher education in many countries has revealed that pre-service teachers regard theory and practice to be inconsistent [6, 7]. Teachers' and student teachers' beliefs stem from a combination of personal experience, knowledge, and social background [8]. Chemistry teachers tend to teach as they were taught in school and university, rather than teaching as they were taught to teach [8, 9]. A cross-level study of German student teachers' beliefs about teaching and



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learning chemistry revealed that the freshmen express very traditional beliefs about teaching and learning (characterized by teacher-centeredness and an understanding of learning as receptive consumption) [10]. Student teachers midway through their university teacher education program, and recently graduated teachers hold more modern beliefs about teaching and learning, which are in line with modern educational theory. Comparison of the latter two groups shows that the first one appears to have the most modern teaching beliefs. The graduated teachers who had just finished their university program and are gaining experience as full-time teachers regressed slightly in their beliefs, but still remained considerably oriented toward modern educational theory [10].

With a perspective of shared responsibility among tertiary and secondary educational levels, the primary objective of this paper is to explore the links between in-service Greek secondary chemistry teachers' classroom practices, their experiences and beliefs about training. This knowledge could aid towards the design of more effective science teacher training programs in Greece.

2. Methodology

2.1 Participants One primary school teacher, nine secondary school teachers and five scientific experts participated in a workshop that was coordinated by the second author of this work. The participants were asked to divide in groups of five people each so that each group contains one or two scientific experts. Subsequently, the coordinator made a short presentation of the workshop (goals, activities, anticipated results). A starting point of the workshop activities was the database of the "Chemistry Is All Around Network" project freely available on the Internet. The database intends to promote the learning of chemistry providing among others access to papers, reviews of publications and conference reports on the topic of chemistry teacher training.

2.2 The activities of the workshop The three groups of teachers and scientific experts participated in three activities during the workshop. In all activities the participants were given a specific amount of time (ca 20 minutes) to freely interact with the other members of their group and discuss the theme of the activity. At the end of this free interaction, each group was asked to present the summary of their in-between discussion via one spokesperson for a maximum period of 10 minutes.

During the first activity, there was a discussion on teacher training by focusing on two main themes: a) personal experiences of the participants in relation with their training and b) the information provided by the Papers and Publications related to "Teacher training" in the project database. All participants had already been asked to search thoroughly through the portal database and make two comments on either papers or publications. They had already completed this task and were familiar with the content of the database. In the second activity, the aim was to have an open discussion and exchange of experiences and opinions on different teaching approaches/methods of a chemistry subject. The discussion was focused on two main themes: a) Participants' opinions and training on innovative teaching approaches, b) Participants practices in chemistry classroom-laboratory. In the last activity of the workshop, the aim was to try and make proposals on different aspects of teacher training. More specifically, the discussion was focused on three main themes: a) Content of teacher training, b) Type of teacher training and c) Responsibility of teacher training.

3. Results and Discussion

In this section the main results emerged by the group discussions during the workshop activities are presented. In relation with pre-service training, all participants reported that during their undergraduate education they received intensive and in-depth academic training in the subject of their specialization (chemistry, physics, biology, chemical engineering) but very limited training related to psychology, pedagogy or chemistry education. The courses related to these latter subjects were few and always belonged to the category of elective or elective-obligatory in the best case. Moreover, all participants stated that they entered the teaching profession by considering their own science (physics/chemistry/biology) teachers as a prototype. The extent at which the different teaching dimensions are covered during preparing and retaining chemistry teachers as unveiled by participants' experiences, is presented in Table 1.



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Table 1. Dimensions of teaching covered by chemistry teachers' training

	Dimensions of teaching				
	Subject matter	Pedagogical	Psychological	Social	ICT
Pre-service training	adequate	absent	absent	absent	absent
In-service training	absent	inadequate	inadequate	inadequate	inadequate

In relation with in-service training, workshop participants made reference to both negative and positive experiences. Their experiences revealed various factors which influence the effectiveness of the training programmes and which are reported in Table 2. The obligatory three-phase initial training received by the regional training centres (PEK) was assessed as "not really very useful", because it provided mostly theoretical information inconsistent with classroom practice. There are three additional teacher training initiatives which are not obligatory and which were assessed by the workshop participants who had attended them: (a) The practical courses organized by the different regional EKFE (Secondary Education Science Laboratory Centre) (b) the practical courses provided by the two phases of the programme "Teachers' training on ICT in Education" and (c) The program of "Major Training" ("Meizona epimorfosi"). The participants felt that all these programs have been useful for their professional development, but they did not seem to have clear educational objectives and focus.

Table 2. Factors identified to influence negatively (1-7) or positively (8-13) the effectiveness of science teacher training programmes

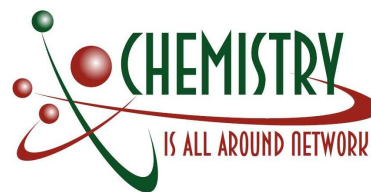
	Positive	Negative
1. Sporadic nature		+
2. Optional participation		+
3. Limited length of the program		+
4. Limited available number of trainees		+
5. Lack of active participation of the trainee		+
6. Presented experiments without a suitable teaching approach		+
7. Theory inconsistent with practice		+
8. Learning about the use of interactive ICT tools	+	
9. Learning the existence of different educational software	+	
10. Learning how to exploit ICT in the classroom	+	
11. Attending "live" experiments	+	
12. The cooperative teaching approach and group management issues	+	
13. Clear objective and focus	+	

The major obstacles teachers face in their efforts to implement novel teaching approaches in class, as identified via the analysis of the participant teachers experiences, are the following:

- the anchoring of upper secondary school to the Panhellenic exams for entering tertiary education institutions
- the closed curriculum and student evaluation method which are imposed horizontally in all secondary schools of the whole country.
- the competitive co-existence and conflict between the official school education and the private tutoring system ("Frontistirio"). In "Frontistirio" students are mostly trained in learning exercises solving techniques, in order to be able to get a good grade in the school exams.
- the lack of basic equipment from the large majority of science laboratories of public schools.

The analysis of the participant teachers experiences also resulted in several proposals and suggestions related with teacher training. In respect with the content of training, the following topics were proposed:

- active learning methods
- research based evaluation of ICT use in the teaching process



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- (c) pedagogical dimension of teaching based on findings of educational research
- (d) psychological dimension of teaching (developmental psychology focused on adolescents, cognitive psychology)
- (e) update on new scientific knowledge and general current trends in science

In respect with the type of training program, a continuous and systematically organized with a constant rate, but not in parallel with work, proposed as preferable for in-service training. In respect with the responsibility for the organization of the teacher training programs, an active collaboration and commitment between already existing University institutions and secondary school system was suggested as more effective, as also suggested in the literature [4, 5].

Careful analysis of the above presented beliefs and experiences of Greek chemistry teachers in respect with their training, reveals the importance given by them to specific characteristics which have been also been identified as more likely to produce enhanced knowledge and skills, in another cultural context (USA, [11]). These characteristics are the following: (i) the duration of the training program (Factor 3 in Table 2), (ii) the focusing on academic subject matter which is absent in in-service training (Table 1) and which is also a proposal made by the workshop teachers, (iii) the possibility for active learning (Factor 5 in Table 2 and teachers' proposal) and finally (iv) the overall coherence of the training program as evidenced by the identified inconsistency between theory and practice (Factor 7 in Table 2). This indicates that exploring the actual classroom practices, beliefs and experiences of in-service chemistry teachers could help towards the design of a teacher training program which will have realistic aims and maximal impact on the trainees.

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