

# **ELEMENTARY PRE-SERVICE TEACHERS' OPINIONS ON TEACHING SCIENCE**

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**Abstract.** This study investigates how pre-service teachers would like to teach science. For this purpose, they are asked about their beliefs on how they can teach science better; which methods they would like to employ; what they think about labs, making experiments and the features of experiments; their suggestions on recalling what is being learned. This subject is considered as important and investigated as the obtained results will give clues to the educators working in this field by reflecting both the quality and effectiveness of the program and training the students receive in order to become teachers and the quality of the opinions and suggestions of the pre-service teacher.

*Keywords:* pre-service teacher, science teaching, teacher education, teacher opinions

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## **1. Introduction**

Teacher training is one of the subjects considered important and current worldwide and various countries perform effective reforms concerning this issue. In the core of these reforms factors such as the need for individuals who

think, question and solve problems in accordance with the world concept developing and changing towards the importance of knowledge and the use of information are of great importance.

One of the reasons of the reforms carried out in teacher training is the fact that there are many important difficulties in teacher training programs such as the gap between theory and in-class applications and rejecting teaching strategies towards new education perception (De Jong & Brinkman, 1999)

Doyle (1997) indicated that the studies on teaching and teacher training moved from being teacher behavior oriented towards teachers' thoughts processes oriented.

Science education is an important part of general education and therefore the studies for activating science education are still an important issue (Hurd, 2002). Activating science education depends on giving a sound education by training capable and equipped teachers.

The first step of teaching better science is to train better science teachers. Howes (2002) examines what the question "how the pre-service teacher should be trained in order to teach science to everyone?" means. In his study, Howes approaches this question from the point of the difficulties the pre-service teacher encounter and determines these difficulties as the tendency towards inquiry approach, attention to children and awareness of school/society relationship.

Again Howes sees one of the typical shortcomings of primary school teachers as not knowing how to teach science and he suggests developing effective and inclusive science instruction. Mellado (1998) investigated the relation between teaching/learning science concepts and practice when teaching science and the results he obtained allow establishing a general correspondence between the two. He explains the reason of the situations as the fact that the academic knowledge (static knowledge) they receive during teacher training process is not sufficient to know how to teach science and it is necessary to

equipped them with the professional component (personal teaching experience and reflection, self-knowledge) named as dynamic knowledge.

Self-efficacy in teaching science is considered as an important quality that pre-service teacher need to have and many problems in teaching science can be solved by investigating the relationship between self efficacy and science teaching behaviors.

Cantrell et al. (2003) examined the factors effecting the efficacy of the pre-service teacher in teaching science and stated that the efficacy would increase if teacher training classes are focused on Bandura's (1977) four strategy (providing opportunities for mastery experiences, physiological and emotional arousal, vicarious experiences and social persuasion).

The quality of the science methodology classes also has an important part in teaching better science. Morrell & Carroll (2003) concluded that methodology classes positively affect the self efficacy of the pre-service teacher and stated that this result is quite encouraging due to the fact that classroom experience is considered as more important compared to previous studies and that methodology classes do not bring an additional value.

Doyle (1997) investigated the effects of the beliefs of pre-service teacher about the teaching program and found out that the act of learning and teaching had turned from a passive form in which teacher transmitted the knowledge into an active process in which teacher is the guide and that this result is related with the pre-service teacher' gaining experience in teaching situations. According to Skamp (1997), pre-service teacher need to focus on a good primary school science teacher concept that develops during teacher training process. In fact, as they are the teachers of the future, knowing what they think about learning and teaching situations might be an important factor in the development of teacher training programs (Aguirre & Heggerty, 1995). According to Brownlee et al. (2003), investigating the knowledge of the pre-service teacher about teaching provides assistance for effective learning in teacher training programs. According to Plourde (2002), finding answer to the ques-

tion ‘why the teachers cannot teach effective science’ will solve the problems related with this issue; because this is one of the major problems in science education.

In the last 20 years, the educators and programmers draw attention to the fact that how the pre-service teacher learn teaching and the conditions of better teaching (Minor et al., 2002). Educators need to know how teachers learn, what kind of knowledge they need to have in order to become effective teachers and the level of this information and they agree that knowledge and thoughts of the teacher are a critical factor in understanding how the teacher learns teaching and learning (Lowery, 2002). Also (De Jong & Brinkman 1999), teacher training and methods of lesson planning in different countries might interest the researchers from the fields other than science and mathematics. However, according to Tosun (2000) the beliefs of the pre-service teacher about the education systems are related with the teacher education programs as well as their attitudes.

This study investigates how primary school pre-service teacher would like to teach science. For this purpose, they are asked about their beliefs on how they can teach science better; which methods they would like to employ; what they think about laboratory, making experiments and the features of experiments; their suggestions on recalling what is being learned. This subject is considered as important and investigated as the obtained results will give clues to the educators working in this field by reflecting both the quality and effectiveness of the program and training the students receive in order to become teachers and the quality of the opinions and suggestions of the pre-service teacher.

### *1.1. Changes in teacher training programs in Turkey*

In Turkey, within the frame of a three-year National education development project implemented by YOK (Higher Education Council) with

the credit taken from World Bank, education faculties are reconstructed by performing a series of reforms on teacher training between the years 1994-1997. The project was put into practice in 1998-1999 academic year on (Tekkaya et al., 2004; Çakıroğlu & Çakıroğlu, 2003). The aim of the project is to improve the quality of teacher training for primary and secondary schools.

Starting in 1998, all faculties of education in Turkey follow a standardized curriculum<sup>1)</sup> prescribed by the Higher Education Council (YOK). Preparation for the teaching profession requires the acquisition of knowledge and skills in the three domains which include general culture, special subject training, and pedagogy. With regard to the classroom teaching program, for example, the pedagogical domain consists of 30 credit hours (including the teaching practicum) and method courses (such as Turkish teaching, math teaching, science teaching, social studies teaching, or art teaching) consist of 109 credits, Also 13 credit hours are related to the general culture domain (Saban, 2003). One of the important aspects of the teacher training reform was the emphasis placed on field experiences such as classroom observation and teaching practice. With these classes, the learners had the chance to demonstrate their knowledge and experiences in schools and developed themselves.

As a result of the change in teacher training, important changes were made in the year 2000 in primary school science programs for 6-14 age group and these changes were put into practice in 2001-2002 academic year. Generally, when compared with the previous program, the units were narrowed down in the scope, updated and organized according to reaching content by way of scientific processes in this program. Also, the program is learner centered and developing scientific attitudes is given importance as well.

## *1.2. Changes in elementary school science programs in Turkey*

In 2004 science classes programs were reorganized and another series of changes were made. The new programs were development. First of all, the name of the lesson is changed into Science and Technology. Major Features of the Program are: 1-Little amount of knowledge is concise (Instead of teaching great amount of knowledge to the students, it is aimed to provide meaningful learning by giving only fundamental concepts. Subjects related with technology and its applications were given emphasized); 2-Science and technology literacy (In their acquisition of knowledge related with every subject, acquisition of many skills related with science and technology literacy is given importance by making appropriate references); 3- Constructive teaching approach (Constructive approach is considered not only in its fundamental philosophy, but also in the learning and teaching activities in the teaching programs); 4- Learner centered teaching (As according to the constructive approach all of the learning-teaching activities should consider that the learner constructs knowledge in his mind, teaching is naturally learner centered); 5- Alternative evaluation and assessment approaches Process evaluation (As the program is based on constructive approach, assessment is a part of learning and alternative assessment approaches such as portfolio and process evaluation are emphasized); 6- Spiral principle (According to the spiral principle, major concepts and subjects are explained in the daily life experiences of the learner at every class level and the depth and scope of the subjects are increased as the class level increases); 7- Relating with other fields actively (In the teaching programs, clear references are made to the other subject fields such as mathematics and social sciences which are related with almost every acquisition) and 8- Considering the individual differences of the learners (As the fact that learning does not take place by transmitting knowledge packs into the minds of the learners but by constructing the new knowledge in the minds of the learners by using the advance information is

taken into consideration, individual differences are actively emphasized in all the learning and teaching activities naturally).<sup>2)</sup>

A fundamental shift towards student-centered/constructivist teaching and learning in classrooms is needed in order to fulfill the responsibility of producing members of society who will have the skills required to be effective citizens of the 21<sup>st</sup> century (Plourde & Alawiye, 2003).

These changes that have been overlapped with the teaching programs we have been practicing in Elementary Education Department of Education Faculty of Uludağ University. In Science teaching courses constructivist theory and teaching methods based on this theory.

Also science process skills and their importance are considered in detail. Practicing scientific processes skills are presented to the students. Because if educators do not change the way they come at the educational process, they will indeed maintain and support the status quo (Plourde &, Alawiye, 2003). Thus, pre-service teachers are provided with effective science teaching practice skills and knowledge. Effective science teaching gives the learners the opportunity to learn and considers how they learn.

## **2. Method**

The sample of the research was a total of 157 third year pre-service teachers at department of Education Faculty of Uludağ University. 72% of the pre-service teachers are female and 28% of the pre-service teachers are male. Pre-service teachers have received science teaching methodology courses for two terms and participated in two school experience studies.

The content of the classes is in harmony with the new science program, pre-service teachers are informed about the new program in detail; they have prepared the subjects in the program by using the methods they have learned and presented them in the classroom environment in primary schools, thus they have gained various experiences.

Survey method was used in the study. The questionnaire, consisting of open-ended 7 questions, is given to the pre-service teachers at the end of the two terms. It seeks answers to the following questions: 1. How would like to teach science? 2. Which teaching methods you think of using in science and why? 3. How can you make science courses interesting? 4. Do you have any suggestions for the things taught in science classes not to be forgotten? 5. What you would to make students love science classes? 6. What features should the experiments you perform have and think that they would be more effective that way? 7. Do you have any fear or anxiety on carrying out the experiments?

Written responses of the pre-service teachers are examined one by one and the analysis of this qualitative research data divided in categories based on before mentioned questions. Sample expressions that symbolize these categories best are given. Generalizations are made as a result of this categorization.

## **2. Findings**

Table 1 displays the best sample expressions and the categories determined according to the responses of the learners to the first question.



**Table 1.** Sample expressions and responses to the question “How would like to teach science?”

<i>Categories</i>	<i>Sample expressions</i>
<p>Organizing activities and experiments and carrying out the classes in the laboratory</p> <p>Carrying out classes that are not solely based on descriptions but related with the daily life</p> <p>Teaching in a way in which scientific process skills are emphasized and not based on memorization</p> <p>Using learner - centered methods</p> <p>Using out of class activities and excursions</p>	<p>I would like to teach with experiments. Teaching science classes with experiments causes the acquisition of knowledge and skills in the learners by increasing their creativity. Most important of all it gives them the opportunity to activate mental processes.</p> <p>I would like to carry out the classes in an environment in which the students can easily make the experiments on any subject.</p> <p>Get the students make connections with the subjects and experiments and their daily lives; make science useful in their daily lives.</p> <p>I would emphasize scientific process skills and carry out the classes in a way that will cause the students to gain these skills.</p> <p>When I become a teacher I would like to carry out the classes in a way where the students are happy and feel better for the things they are able to accomplish by preparing materials and environments that will cause them to discover the subjects instead of the way where students are worried about the problems they can not solve.</p> <p>I would like to present the classes with activities that are learner-centered and emphasize the creative skills of the learners.</p> <p>I would like to present science classes by using ample amount of materials and in a way where students can discover themselves.</p> <p>I would like to use the methods that keep students active join the classes.</p> <p>I would like to employ methods that will capture the attention of the learners, keep them active and at the same time entertain them.</p>

**Table 2.** The Answers to the questions “Which teaching methods you think of using in science and why?” and the rationales

<i>The methods they think of using in science courses</i>	<i>Rationale</i>
Inquiry Teaching	Full learning takes place. Learner is active and the cognitive, perceptive and psychomotor skills of the learner develop. Learner is constantly active, reaches the knowledge and takes it. Learning science by doing is the most effective.
Learning Cycles (5E, 7E)	Encourages learning. Learner takes the knowledge and it is motivating. It increases creativity.
Cooperative Learning	Active participation of the students is primary. Interaction among learners is important. Learners can easily display their creativity and skills.
Problem solving	They learn to solve problems they have throughout their lives. They develop their cognitive and research skills.

As seen in Table 1 there are five categories. Some students mentioned two or more categories simultaneously. When Table 1 is examined, it is seen that mostly pre-service teacher would like to teach science classes with the emphasis on experiments and practice.

The second question is “which teaching methods you think of using in science and why?” indicated in Table2. As seen in Table 2 pre-service teachers have preferred four methods. Pre-service teachers have preferred contemporary methods that are based on constructivist model and they have indicated that they would like to employ inquiry teaching method mostly.

Pre-service teachers were asked how they can make science classes interesting and their responses are listed in Table 3.

**Table 3.** The responses to the question ‘How can you make science courses interesting?’ and related frequencies

<i>Response Categories</i>	<i>F(%)</i>
By giving importance to attention and motivating and by doing many activities on the same subject	90
By giving importance to associating with life	54
By bringing interesting materials into the classroom	16
By making experiments with unexpected results, turning the classes into fun and talking about events that make students curious	13
By preparing lessons that address the needs and interests of the students	8
By using internet and science and technology journals for children	8
By using teaching methods effectively	5
By telling the lives and inventions of the scientists	2

According to Table 3, pre-service teacher indicated more than one category. Pre-service teacher have common opinions on making the classes as visual as possible by motivating and attracting attention and on presenting the classes by making references to the daily life.

The responses to the question four “do you have any suggestions for the things taught in science courses not to be forgotten?” are examined and some sample responses are given below:

- Ample amount of repetition and activities that increase the permanence prevent forgetting;
- After teaching a certain subject, I ask related questions and I repeat the unclear parts;
- If the subject is reinforced with examples from their daily lives or if previous knowledge is reminded while presenting the new subject by making references to the previous units, the probability of forgetting decreases;

- I try to prove the students that they would encounter what they learn in science classes in different parts of their lives by paying attention to the fact that subject and examples are related with the daily life;
- I think processing the knowledge in the memory and using appropriate teaching methods provides both making references to the daily life and not forgetting;
- Carrying out classes that largely rely on experiments prevents forgetting;
- I would carry out classes that are fun and learner-centered. Because keeping the students active is very important;
- For not forgetting the things they have learned, I would ask them to write the results of the activities performed as a report and hang these reports on the notice board of the class.

It is determined that what the pre-service teacher mention in their explanations most are by paying attention to the fact that subjects and examples are related with their daily lives, carrying out the classes with the emphasis on experiments and showing the students that they would face with what they learn in science classes in different parts of their lives.

Fifth question addressed to the pre-service teachers was “what they would to make students love science courses?”.

The responses to this question are:

- Increasing their interest by decreasing their fear of mark and turning science class into a skill course;
- Not following the course book line by line and making references to the other courses;
- When I was a student I disliked science classes, but I liked the experiments based on invention and even I liked the course. Therefore I would apply this method;
- We should unite it with the lives of the students; give examples related with real life and make experiments so that the students like the course;
- I think the attitude of the teacher is very important;

- We shouldn't be satisfied with the experiments in the books only; instead we should find and carry out different experiments from other sources and internet;
- I would present the subject by taking the needs and interests of the students into consideration;
- I would encourage my students for making research.

Most of the pre-service teacher indicated the need to unify science courses with the daily life and to make interesting and enjoyable experiments.

The responses to the question six “What features should the experiments you perform have and think that they would be more effective that way” are displayed in Table 4.

**Table 4.** Response categories for the question ‘What features should the experiments you perform have and think that they would be more effective that way’ and sample statements that represent these categories best

<i>Categories</i>	<i>Sample statements</i>
Experiments that are interesting, enjoyable, raise the interest of the students, with surprise results and related with the events the students encounter in their daily lives.	<p>I would make experiments related with the events that they are interested in their daily lives, such as the formation of the rainbow. Therefore I would make them like science classes.</p> <p>The subject of the experiment should capture the attention of the students and they should need the knowledge that will be attained at the end of the experiment. I think such experiments are effective in learning.</p>
Experiments that are made by using the simple equipment that can be found in the environment	<p>I would perform experiments with unexpected results. For example, causing the egg put on the brim of the bottle to fall into the bottle by burning a piece of cotton in the bottom.</p> <p>I can make science classes enjoyable and interesting by making them perform experiments with the simple equipment that can be found easily.</p> <p>We can develop their creativity by showing them that it is possible to make experiments with the simple equipment they use in their daily lives.</p>

Experiments that develop the creativity and problem solving skill of the students	I would make them perform experiments in which students have the leading role, participate actively and show their creativity.
Hypothesizing and testing	The students should attain the knowledge themselves at the end of the experiment. The experiment should lead them into thinking and making research.
	The students can be given the equipment of the experiment and asked to design and perform it; this is very important for the development of creativity.

When the given responses are examined, it is seen that the features given in the table-4 are seen most in the responses of the pre-service teacher. These features indicated open-ended experiments. Also pre-service teacher indicated that experiments have an important role in teaching science.

The responses of the pre-service teachers to the question seven ‘do you have any fear or anxiety on carrying out the experiments’ are generally as below:

- I am not afraid or anxious. I can use the computer for difficult experiments;
- I would not feel afraid or anxious if I am prepared, that is if I make the experiment before and know the result and how to do it;
- I do not have such fear or anxiety due to the new science content. Because it is simpler and as I will be using handy materials it is easy to make experiments;
- I feel anxious if I am inadequate about the subject;
- Not finding laboratories and equipment worries me;
- I am anxious because I am inexperienced and inadequate;
- I am afraid of making mistakes while performing the experiments.

Most of the pre-service teacher indicated that they are not afraid or anxious. They mentioned that they gain adequate amount of experience during their teacher education.

#### **4. Discussion and conclusion**

According to Table 1, it is seen that mostly pre-service teacher would like to teach science classes with the emphasis on experiments and practice. In Doyle's (1997) study, four themes about learning and teaching are determined. Many pre-service teachers described the act of learning as receiving information whereas some of them described it as exploring, discovering and understanding. Again, many pre-service teachers described the act of teaching as transmitting knowledge to the other party whereas some of them described it as making learning easier with the guidance of the teacher. The latter descriptions for both the act of learning and the act of teaching are in accordance with the findings of the present study. Lowery (2002) asked pre-service teachers about the most important aspects that the teacher should know while teaching science-mathematics and received responses such as teachers should work with students using hands-on and real world situation, make lessons relevant and challenging realize that abstracts concepts are hard and solve ample amount of problems. The responses are in accordance with the findings of the present study.

When analyzed Table 2, it is seen that pre-service teachers have preferred contemporary methods that are based on constructivist model and they have indicated that they would like to employ inquiry teaching method mostly. This result overlaps with Pekmez & Can's (2007) and Saban's (2003) findings. According to Pekmez & Can, pre-service teacher have positive thought about constructivism and think that they should develop their teaching activities based on this approach. In Saban's study students prefer learner-centered approaches more than knowledge transfer.

The given results in Tables 1 and 2 display clear clues on this issue. One of the results of Howes' (2002) study is that pre-service teacher prefer inquiry teaching method when teaching science for all. As seen is this study as well, it is surely promising that pre-service teacher prefer this certain method because

many teachers avoid using inquiry teaching method due to the reasons such as it's being time-consuming, not being able to change learning habits easily, not being able to find suitable laboratory equipment, students' being immature, not being able to control the class properly (Lawson, 1995). Damnjanovic (1999) compared the attitudes of pre-service teacher and in-service teachers towards inquiry based teaching and as a result indicated that teacher trainees do not make discrimination between contemporary and traditional methods; however, in-service teachers look more positive to using contemporary methods in science teaching. Plourde & Alawiye (2003) investigated the relation between the beliefs of pre-service teacher on constructivist approach and what they do in practice and found out that there is a strong positive relation between the two. This result is another indicator of how important the quality and adequacy of the knowledge received during teacher training education on this issue are. One of the methods projected in the study is learning cycles. Learning cycles are consisted of constructivist, inquiry and cooperative methods. Doyle (1997) found out that pre-service teacher considered teaching as a passive act and that they would feel more successful when they employed active teaching techniques. A few students (3 pre-service teachers) suggested presentation method but they did not state any rationale.

Mellado (1998) mentioned the presence of some studies which indicate that pre-service teacher bring the opinions, concepts and attitudes regarding learning and teaching with them when they start their university education and that these opinions, concepts and attitudes are strictly reserved and therefore would not change throughout their university education. Thus, based on this, as pre-service teacher come with such thoughts, the first thing that needs to be done regarding learning and teaching of science during their university education is to encourage them to find the best and the most suitable according to themselves. In fact, this seems to be the best solution. Because the education system in Turkey was teacher-centered until recently; the pre-service teachers in the present study were educated in such an education model. However, op-



posite of what is mentioned above, they are rejecting teacher-centered methods and support more effective and contemporary models.

When the given responses are examined, it is seen that the features given in the table-4 are seen most in the responses of the pre-service teacher. These features indicated open-ended experiments. Also pre-service teacher indicated that experiments have an important role in teaching science. According to Fraser & Walberg (1995), experiments play a key role in teaching and learning science in traditional and constructivist settings.

Only a few pre-service teacher mentioned fear and anxiety. Also they mentioned over confidence and adequate in experimenting. This result agrees with Küçükylmaz & Dubans' (2006) results. In their study, many of students (%94) find themselves adequate in experimenting. Also they indicated that they would not have such a problem if they know the source of their fear and anxiety and eliminate the causes of this situation; the given responses prove that they are aware of how they can attain this, for instance being inexperienced or inadequate. This is a pleasing result for us as well because it is seen that the fear and anxiety of working in the laboratory occupy important place in the literature.

This study tries to display the opinions and views of the pre-service teacher on science learning and teaching. The results are important because the most important factor in the development of education is the teacher. Today, it is seen that interpreting, comprehending scientific concepts and developing research skills are more important than knowing scientific knowledge and events. Additionally, based on the new 2005-2006 education program put into practice, further studies can be carried out with in service teachers to investigate the results brought by the change and with students to find out their opinions on success, interest and attitude.

## NOTES

1. Report on re-designing the teacher education programs at the faculties of education in Turkish Universities. YOK, Ankara, 1997.
2. [http://ttkb.meb.gov.tr/ogretmen/modules.php?name=Downloads&d\\_op=viewdownload&cid=48](http://ttkb.meb.gov.tr/ogretmen/modules.php?name=Downloads&d_op=viewdownload&cid=48)

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