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Abstract

The purpose of this study is to investigate elementary pre-service teachers' image of science teaching, analyze the gender differences in image of science teaching, and evaluate restructured 2004 education reform by using a Draw-A-Science-Teacher-Test Checklist (DASTT-C). Two hundred thirteen (213) pre-service elementary teachers from three different western universities participated in the data collection for this study. The results of study showed that Turkish elementary pre-service teachers' perspective of science teaching style is 20% student-centered, 41% teacher-centered, and 39% between student-centered and teacher-centered. These results give some vital concerns regarding the preparation of future elementary teachers and the in-service development of teaching practice.

Keywords: Educational Reform, Science Education, DASTT-C

Introduction

Memorizing facts and information is not the most important skill in today's world. Facts change, and information is readily available everywhere, especially on the Internet. What's needed is an understanding of how to get and make sense of information. An old adage states: "*Tell me and I forget, show me and I remember, involve me and I understand*." And, just as it is important to be involved, understand and make sense of information in general, in science teaching, this becomes the essence of the discipline. Thus, many countries revised their education system in the light of constructivist perspective, not a description of teaching and learning and it has been contributed to by a number of significant intellectual movements contextual, dialectical, empirical, information-processing, methodological, moderate, Piagetian, post-epistemological, pragmatic, radical, realist, social, and socio-historical (Turkmen & Pedersen, 2003). In constructivist perspective, students are encouraged to ask their own questions, carry out their own experiments, make their own analogies and come to their own conclusions by teachers (Caprio 1994; Staver, 1998; Yılmaz, & Huyuguzel Cavas 2006)

Turkey is always paying close attention to innovations in education. The majority of Turkish people believe that Turkey can catch up to other developed countries through solid education. For these reasons, the Turkish government is aware of the importance of education and has made great efforts in modernizing the national educational system for the 21st century. The first big step for the Turkish government was to increase the length of compulsory primary schooling from five years to eight years in August, 1997. With the implementation of eight-year compulsory education, the Turkish education

system has been completely reorganized and the primary science curriculum (4th- 8th grade) was revised by the Ministry of National Education in 2000 (Ministry of National Education, 2001).

The U.S. and other modern European countries, especially those in European Union (EU), heavily influenced this reconceptualiztion effort (Turkmen, 2006). Turkey continues to shape and to renew her educational system, especially in the areas of learning theories, curriculum development, and educational technology. Some projects have played a larger role in shaping the Turkish education system such as: "Science for All Americans; Project 2061," "Benchmarks for Science Literacy," "National Science Education Standards," "Educational Multimedia Software in the fields of Education and Training," "Socrates I-II," and "Erasmus" (Turkmen & Pedersen, 2005). These reforms support the use of student-centered teaching approaches, technology in science classrooms, and the overall integration of educational technology into the Turkish educational system. Therefore, governmental initiatives have made student-centered teaching approaches with technology one of the major foci of educational policies and reforms in Turkey. Moreover, the results of international achievement studies, such as PIRLS, TIMSS, PISA, showed that Turkish 6-8 graders' performance in math and science are under the average of their peers in other countries. For example, current OECD research, done on two hundred fifty thousand 15 years-old students from 41 countries, showed Turkey is significantly behind many other OECD countries in science and problem solving in math, reading (Elevli, 2004, December 8). According to TIMMS 1999 reports Turkey was in 33/38 for math and science (TIMSS, 1999), 2003-PISA reports Turkey was in 39/45 for math (Council of the European Union; OECD Program for International Student Assessment, 2004; Ministry of National Education, 2006). Moreover, many national studies showed that in-service science teachers were insufficient to understand what nature of science is, to impact the pedagogy practices of science, to use technology in their class. Some Turkish philosophers and educators blame teacher education programs for inadequate preparation and instruction of elementary school teachers in science (Kaptan, 2005; Unal, Costu, & Karatas, 2004).

By increasing the length of compulsory primary schooling from 5 to 8 years in primary education schools another problem was created, the lack of qualified teachers to meet the needs of the additional students. The Council of Higher Education and the Ministry of National Education co-operated and established the need for teachers in each subject area, which caused the Council of Higher Education to restructure teacher education programs. The revised programs began in the 1998-99 academic year. The restructured program is based on three essential concepts, constructivist theory, multiple intelligence theory, and student-centered teaching approaches. In addition, alternative measurement and assessment methods were added to the new teacher education programs. Thus, pre-service teachers began to be more involved with school experience and teaching practice activities (hands-on-activities) (Ministry of National Education, 2000). Based on these initiatives to restructure teacher education, Turkish education faculties began to modify the teaching and preparation of science in the 2000's. Moreover, results of international studies were somewhat alarming and provided impetus for urgent action. Thus, Turkey started to revise primary science curriculum again in 2004. Even the name of the "science" course was changed to "science and technology" in primary education. After modification of Turkish primary science curriculum in 2004, the purpose of the science curriculum was widened to include preparing students to be scientifically literate citizens who are able to use scientific facts in their daily life in the light of constructivist perspective.

In this new perspective, students were to be equipped with advanced thinking; perception and problem solving skills; enabling them to contribute to modern civilization as well as mastering their own national culture. Turkish teachers have been educated in and have been encouraged to use other teaching approaches which have as its theory base constructivism and include inquiry and other student empowering methodologies. This purpose of modified science curriculum was evaluated by some Turkish academician. For example, Bozyilmaz and Bagci-Kilic (2005), and Cakir (2005) stated that scientific knowledge was diminished, scientific process skills were increased, and science-technology-society connection was much more focused on into science topics than 2000 reform effort.

In order to evaluate this new teacher education program, many researchers and educators have been studying teaching approaches; especially those linked to constructivism, teachers' and students' attitudes towards science, and science curriculum since 2000 (Demircioğlu, Ozmen, & Demircioğlu, 2004; Erdogan, 2005; Stevens, Sarigul, & Deger, 2002; Unal, & Ergin, 2006; Yılmaz, & Huyuguzel Cavas, 2006). While much thought and research has been spent on the teaching science, little has been done to examine students' perceptions about teaching science in Turkey

The Draw-A-Science-Teacher-Test Checklist (DASTT-C) is one tool that can be used to measure pre-service teachers perceptions of teaching science. DASTT-C is a modified instrument developed from Goodenough's original Draw-A Man-Test (1926) and Chambers (1983). Draw-A-Scientist-Test (DAST), which measured children's perceptions of scientists'. The original DAST used children's drawing and assessed the drawings according to seven basic standard image elements and discovered that higher-grade levels of students' images of scientists become more stereotypical. Schibeci and Sorensen (1983) found similar results in their study. Finson, Beaver, and Crammond, in1995 modified the DAST in order to further consider alternative images and facilitate ease of assessment as the Draw-A-Scientist-Test Checklist (DAST-C). DAST-C data indicated a significant shift from stereotypical images to more realistic images of the variety of persons involved in science as students increased contact with real-life scientists. The DAST-C was further modified and included characteristic of science classrooms and science teachers, calling the instrument the Draw-A-Science-Teacher Teaching Checklist (DASTT-C) by Thomas and Pedersen in 1998 and modified again by Thomas, Pedersen, and Finson (2001). They expected to illuminate the knowledge and beliefs pre-service elementary teachers construct prior to coursework in elementary science teaching methods. The main concept of DASTT-C is a listing of teacher-centered and student-centered attributes of an elementary science teacher rather than a scientist (Carnes, 2003; Carnes, Brown, Munn, & Shull, 2002; Pedersen & Thomas, 1999; Thomas & Pedersen, 1998a-1998b; Thomas, Pedersen & Finson, 2001). The purpose of this study is to investigate elementary pre-service teachers' image of science teachers and of science teaching using DASTT-C, analyze the gender differences in those images, and evaluate restructured 2004 education reform via pre-service teachers' drawings.

Method

Instrument

In this study, the DASTT-C was used as the primary data collection instrument. On the first page, students were instructed to "Draw a picture of yourself as a science teacher at work." On the second page the students' were instructed to write a brief explanation describing their drawings and specifically answer the questions, "What is the teacher doing" and "What are the students doing?" regarding their drawings.

The DASTT-C consists of three sections, (a) *Teacher*, including 2 subsections, teacher's activity and teacher's positions; (b) *Student*, including 2 subsections, student's activity and student's position; and (c) *Environment*, including 5 subsections, desks arranged in rows, teacher desk, lab organization, symbols of teaching, and symbols of science knowledge. Each subsection is scored in a dichotomous fashion with an indication of "present" or "not present" in the picture. Each element in each subsection of the instrument is considered by the instrument's developers to depict stereotypical elements of teaching and classroom images. If a stereotypical element appears in a student's drawings, that element on the checklist is marked. Total checklist scores can range from 0 to 13. Scores are grouped into three ranges on a continuum, with scores of 0-4 representative of *student-centered* teaching style, 10-13 representative of *teacher-centered* teaching style, and 5-9 representative of *neither student-centered nor teacher-centered* teaching style (appendix A, B, C). Thomas, Pedersen and Finson (2001) defined their use of the terms *student-centered* as representing exploratory or inquiry/constructivist teaching, in which students are actively engaged and the teacher is guiding or facilitating the learning and in which the students are selecting and pursuing those investigations of interest and importance to them; *teacher-centered* as

representing explicit/didactic teaching in which the teacher is the central image and one who is predominantly a transmitter of information, while students are relatively passive and often in desks arranged in rows; middle scores are represented by conceptual teaching showing students at the center, but likely to include more teacher images within the central aspects of the images and have them leading the development of concepts or providing information leading directly to concept formation and usually show students engaged in exploration and investigation with materials (Finson, 2001; Thomas & Pedersen, 2001; Thomas, Pedersen, & Finson, 2001).

Although DASTT-C developers, Thomas, Pedersen, and Finson, reported the instrument's reliability to be KR-20 = 0.82, we found the instrument's reliability to be KR-20 = 0.71. Three individuals who examined it for relevance of content determined the validity via review of drawings.

Subject

Two hundred thirteen (213) pre-service elementary teachers from three different western universities participated in the data collection for this study.

All the students attending this study were seniors and had taken 9 credits science courses (Science of Living Things, Chemistry, and Physics), 3 credits "Science Laboratory," and 6 credits "Teaching Science I-II" courses in their universities.

Research Question/Design

This study focused on the question, "What mental images do pre-service elementary teachers have of themselves as science teachers?" The DASTT-C was administered to the pre-service elementary teachers at the end of the 2005-06 semesters. As instructors, we only gave two directions, "Draw a picture of yourself as a science teacher at work" and "Answer the question at the bottom of the page to further explain the picture" (Thomas, Pedersen, & Finson, 2001, p. 300). Pre-service elementary teachers were provided the DASTT-C drawing section (requesting some demographic information at the top and providing a square space in the center of the page for the drawing), and explanation section (what you draw in the drawing section). The DASTT-C took 15-20 minutes to complete.

Analyzing the Data

In this study, 213 elementary pre-service teachers' teaching approaches were assessed using the Draw-a-Science-Teacher-Teaching Test Checklist (DASTT-C) and categorized along a continuum from student-centered to teacher-centered in orientation.

Three researchers found that some variables were difficult to score and not easily distinguishable from others. For example, in some pictures teachers appeared to be leading and in charge. It was difficult to determine whether teachers were lecturing, discussing, or giving directions except when the pre-service teacher had written what the teacher and/or students were saying and/or doing in the second page of survey.

Many pre-service teachers saw themselves as activity-oriented (hands-on) in the science classroom. In their drawings, most science concepts were selected from biology rather than other science areas. According to their narratives, most of students were aware of the importance of doing experiments and lab safety in teaching science but they did not indicate much information about science experimental techniques. Outdoor learning environments, science museums, science fairs, technology centers, and scientific research centers, were not drawn, and pre-service teachers rarely depicted drama, project-based learning and problem-based learning.

Teacher Patterns

One hundred twenty four Turkish elementary pre-service teachers drew themselves as a science teacher talking to the class (58%), one hundred fifty five giving directions and demonstrating experiment

(leading: 72%). As visual aids, one hundred six teachers were using computer, projector, and rarely charts (49%). One hundred ninety were standing (89%) behind the table or one hundred forty seven in fronts of chalkboards (69%).

Although many teachers were wearing well-cloths, like suits, ties, skirts and blouses, a few teachers were wearing facial hairs, lab coats, daily cloths like blue-jeans and t-shirts. Many teachers were smiling and had happy faces in their drawings. Some images showed the teacher with wild hair or a frown and was frustrated, angry and holding a ruler. Few of the pre-service teachers showed negative thoughts through their drawings about becoming science teachers related to bad experiences during their primary schooling years and/or the economical and physical problems of Turkish education system.

Student Patterns

In most pictures, while teachers were talking or lecturing, one hundred six students were sitting on desks (49%); one hundred fifty six were responding (73%) to teachers' questions; eighty four were listening (39%). Students were generally gathering around tables doing experiments, projects.

In some instances the pre-service teachers included speech balloons to indicate teacher-student interaction. In these pictures, teachers were engaged in conversation with their students rather than talking at their students. In some drawings, two or three students were doing an experiment in front of the class as the teacher guided them and their classmates were watched.

Learning Environment Patterns

It was more difficult to evaluate the nature of the science-learning environment regarding whether it was student-centered or teacher-centered. All of the learning environment elements could be found in 50% percent of drawings. Yet, the element of desks arranged in rows was drawn by only 33% pre-service teachers, which could be categorized as teacher-centered teaching. There was also a strong pattern of "inside" science across these drawings with few of the drawings showing outdoor learning environments, such as observing nature (Table I).

Table I: Environment Frequency

Environment	Desk arrangement	Teacher desk/table	Lab. organization	Symbols of teaching	Symbols of science knowledge
Score	71	110	113	124	112
	33	51	53	58	52

In most pictures pre-service teachers drew funnels and metric cups as lab equipment. It would seem that they link these stereotypical pieces of lab equipment with teaching and learning science. In addition, there was little indication of classroom design like a crest-shaped classroom and interesting science formulas written on the chalkboard.

Pre-service teachers' total mean score on the DASTT-C was 7.47, which falls in the upper range of the middle category—neither student or teacher centered and suggests that a stereotypical view of science teaching has more strongly influenced these future teachers' expectations of a "science teacher at work" (Figure 1 and 2).

Figure 1: Pre-service Elementary Teachers' Frequency

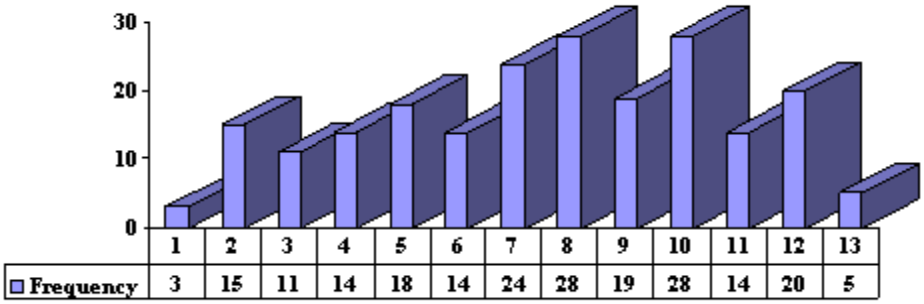
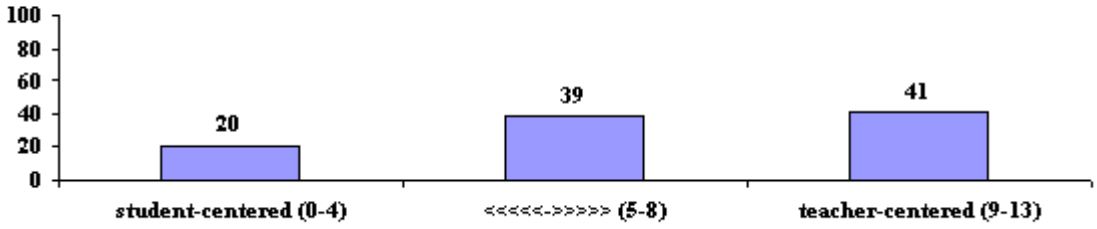


Figure 2: Pre-service Elementary Teachers' DASTT-C Percentage



In the teacher-centered teaching style, representing the 10-13 scores, teachers are leading or directing learning activities. Teachers are introducing a topic of science, preparing students and teaching them how to do an experiment (Figure 3).

Figure 3: Teacher-Centered DASTT-C Picture and Student's Explanation

Draw a picture of yourself as a science teacher at work.

What is the teacher doing? What are the students doing?

"Teacher is doing an experiment, which is prepared by herself, in front of the class and giving instruction of how to do the experiment to her students. At the same time, students are firstly watching their teacher and then try to do the experiment."

In the middle range of scores (5-9), it can be seen that students are doing same experiments with same materials, being led by teachers, or the teacher is encouraging students to ask questions, participate learning process. Students are raising their hands to answer questions and actively doing an experiment assisting by teacher.

Figure 4: No-decision DASTT-C Picture and Student's Explanation

Draw a picture of yourself as a science teacher at work.

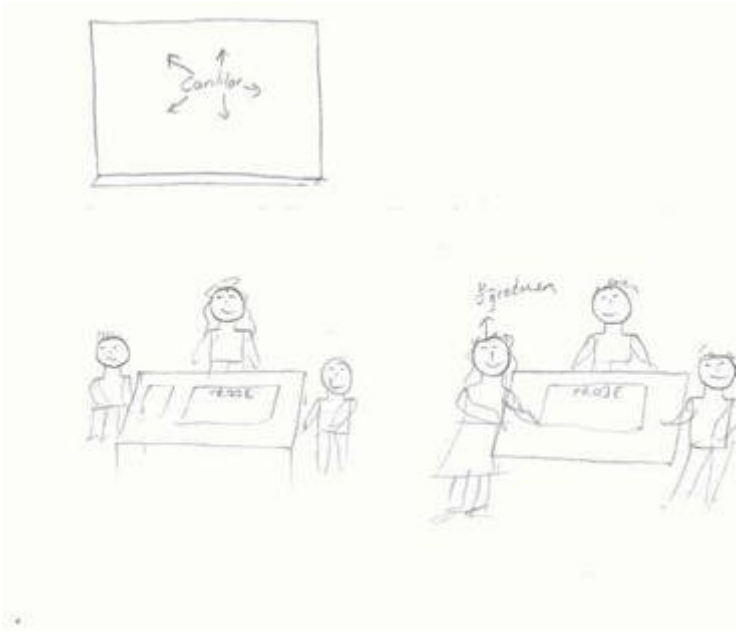
What is the teacher doing? What are the students doing?

"When the two students are doing experiment, teacher is watching, assisting, asking questions about experiment to them. By the way she is getting other students paying attention to the experiment and guessing how the experiment will go on. The other students are listening, responding to her questions and taking notes."

Student-centered images (0-4) indicates a constructivist learning environment where students are participating at different tables and/or the teacher is standing with one group of students while other group of students are doing experiment at a different tables.

Figure 5: Student-Centered DASTT-C Picture and Student's Explanation

Draw a picture of yourself as a science teacher at work.



What is the teacher doing? What are the students doing?

"Teacher is standing among the groups of students who are studying science projects and assisting about what the students' needs. Students can do science projects in class or outdoor learning environment. The students are gathering their data, brainstorming, and trying to make conclusion.

Independent t-test was conducted to evaluate any statistically differences between DASTT-C mean scores of pre-service students with regard to gender. As seen in Table II, there was no statistically difference between male and female students' DASTT-C mean scores.

Table II: Gender Differences

Gender	N	Mean	SD	df	p
Female	118	7,34	3,248	211	0,44*
Male	95	7,60	3,092		

*p<0.05.

Conclusion and Recommendation

The DASTT-C is one of the essential instruments that can be used to help to develop techniques and procedures for promoting reflection and analysis of pre-service teachers' thinking. Exploration of pre-service teachers' beliefs of elementary science teaching plays a vital role in their acquisition and interpretation of knowledge and subsequent teaching behavior. It directs science educators to devote efforts for changing pre-service teachers' beliefs to plan more insightful learning experiences in the teacher preparation program (Finson, Riggs, & Jesunathadas, 1999; Simmons et al., 1999; Thomas, & Pedersen, 1998a-1998b; Thomas, Pederson, & Finson, 2001).

This research is only a beginning in the quest to understand why Turkish government efforts have not still succeeded during the past five years in Turkey. In this study, though student-centered science teaching style was found twenty percent, the results also showed that forty-one percent of pre-service teachers see themselves using teacher-centered teaching approaches. This is true even though programs for teacher preparation were restructured in 1998. Most of the elementary pre-service teachers showed through their drawings a positive science teaching identification, which is an indication of changes being made in the way science is taught. According to Louca, Rigas, and Valanides (2002), "good teaching requires a blend of teacher-centered and student-centered skills and deep understanding of when to do what kind of teaching" (p. 247).

This study showed most of two hundred thirteen pre-service elementary teachers did not depict constructivist science teacher and constructivist learning environment in their drawings. However, it appears that they had images of constructivist science teacher and constructivist-learning environments in their minds because of their written captions, which noted what the teacher and/or students, were saying and/or doing. This discrepancy could also be linked to the students knowledge of the "correct words to use to describe teaching" but not having a full and deep understanding of the concepts behind the words which in turn is not depicted in their drawings. It seems clear that the pre-service teachers' personal theories and experiences were most influential in how they represented (through drawings) their perception of science teaching. Their images of science teaching are what they think science teaching should be, shaped by experiences throughout their life. There might be many reasons why Turkish pre-service elementary teachers lack constructivism integration in their educational experiences and why they are one step behind where to be expected in respect of restructured science programs. It seems that Turkish academics have not had a positive impact on the use of constructivism and may not sufficiently model the appropriate use of constructivism for instructional purposes in science courses.

Based on the results and findings of this study, there are several salient recommendations to be made relating to issues of integrating constructivist perspective, which is the essential of reform, into the Turkish education system.

- Pre-service teachers, in-service teachers, academics, Ministry of National Education, Council of Higher Education and Study should be organized to work together.
- Pre-service teachers and academics should be encouraged to use technology-supported supplementary materials during their science teaching/learning activities.
- School practice should be more based on constructivist approach.
- Teacher preparation programs should have strategies for helping students reflect upon their own and fellow students' perspectives.
- Further study of pre-service teachers using the DASTT-C will be useful for researchers to examine the relationship of elementary and secondary pre-service teachers, science teaching and perceptions about teaching science.
- The DASTT-C might be used as a pre/post assessment of the students' in science teaching methods course in order to investigate the whether any change in pre-service teachers' perceptions over the course.
- DASTT-C should be applied in different regions of Turkey to generalize perspective of Turkey.

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