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An Accurate Picture of What is Currently Happening in Turkish Science Classrooms

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ABSTRACT *The purpose of this study was to investigate the extent to which primary science teachers understand the new reform implemented in Turkey and to examine their perceptions regarding science instruction. Thus, it could be possible to show an accurate picture of what is currently happening in primary science classrooms and identify the kind of support primary science teachers may need. In this study, a survey was distributed to all in-service primary school science teachers in the area of Izmir, Turkey. The sample consisted of 389 primary science teachers from 72 primary schools. This study was carried out using quantitative and qualitative methodologies. The "Survey on K-12 Science Education" was used for collecting quantitative data. For collecting the qualitative data, primary science teachers were asked to specify the main goals in their teaching science and what would help them in achieving these goals. The results showed that they were not enough actively engaged in classroom science activities, and that they should be trained to apply more effective teaching approaches, and how to integrate science with other subject areas and real life.*

KEY WORDS: *Science education, science teaching, Turkish education.*

Introduction

Teaching science in an effective and attractive way is especially difficult for beginning primary science teachers. Educators in developed countries unanimously agree that constructivist approaches should be central to science learning. These approaches seem difficult for being implemented, because they require teachers to adopt teaching approaches that are different from the way teachers have been taught. Students live however in a fast changing world, where international and global cooperation on science, math, and technology education transcends the national and continental boundaries. International assessments, such as, Program for International Student Assessment (PISA), the Trends in International Mathematics and Science Study (TIMSS), Progress in International Reading Literacy Study (PIRLS), provided evidence highlighting the existing differences among different educational systems and specified guidelines for implementing appropriate reforms in science, math, and reading.

The results of these international studies have been taken into consideration for the development of educational programs in Turkey as well. For example, Turkey ranked 31st among 38 countries in terms of student achievement in math, and 33rd in science achievement of eighth graders in TIMMS 1999 (EARGED, 2003a, 2003b; Ersoy, 2006; MoNE, 2002; TIMMS, 2000). The 2003 results of PISA

for 15-year-olds showed that, among 38 other countries, thirty-four countries scored above Turkey in mathematics, thirty-three in reading, and thirty-five in science. Similar results were confirmed in all mathematical skill areas from geometry and algebra to statistics and computation, as well as in reading and science (MoNE, 2004; PISA, 2003). Moreover, many national studies indicated that students do not learn and do not use their school knowledge into their daily life problems (Ayas & Ozmen, 1998; Ozmen, Ibrahimoğlu, & Ayas, 2000).

Of course, there might be many reasons why Turkey ranked below the average and why Turkish pupils face problems in learning and using science. Some of the reasons relate to the traditional education system, inadequate educational standards (Cakır, 2005; Ünal, Coştu, & Karataş, 2004), inadequate preparation of teachers (Keser, 2005; Tekkaya, Çakıroglu, & Özkan, 2004), and limited budget for education. Thus, the existing infrastructure and the limited or inappropriate resources and educational practices do not foster the development of conceptual learning (Arslan, 2000; Ayas, Özmen, Çepni, Yiğit, Akdeniz, & Ayvacı, 2005).

Turkish theorists, philosophers and educators place the blame on college and university teachers. There is evidence of a vicious cycle in which too many prospective teachers enter college with an insufficient understanding of school science, with little college instruction focusing on the science prospective teachers will teach, and with inadequate preparation to enter their classrooms to teach science to the next generation of students (Demircioglu, Özmen, & Demircioglu, 2004; Güneş, Gülçiçek, & Bagcı, 2004). Teacher educators are usually obliged to teach pre-service teachers specific courses using lecture-based methods that emphasize rote learning of disconnected facts. Thus, they usually affect prospective teachers' understanding of what science is and their pedagogical practices (Krajcik & Pennic, 1989; Young & Kellogg, 1993), because teachers tend to teach the way they had been taught. Thus, Turkish theorists, philosophers and educators blame teacher education programs for the inadequate preparation of primary school teachers in science as well (Ginns & Watters, 1995; Kaptan, 2005; Ünal, Coştu, & Karataş, 2004).

The Turkish national concerns about poor students' performance on science topics accompanied by the increasing need for scientific and technological knowledge and skills that are needed for active participation in society provided the impetus for new reform efforts. There was also an attempt to base the reforms on the American National Science Standards, Project 2061, and EU educational requirements for improving science education programs (Keser, 2005). The first reform effort was undertaken in 2000 and attempted to align science teaching with constructivististic principles. Primary school teachers did not adopt the constructivist perspective in their science classes (Arslan, 2000; Bokmaz, 2003; Bozdogan, & Yalçın, 2005; Güzel, 2000; Kaptan, 2005), and did not use portfolios, observation forms, student self-evaluation forms, and peer-evaluation forms in their classrooms (Çakır, 2005). Under these circumstances, a new reform attempt was initiated in 2004. Multiple intelligence theory, student-centered teaching approaches, and alternative measurement and assessment methods were incorporated into the new teacher education programs. Firstly, all science teacher educators who had a science education degree were trained by the Ministry of National Education and then they were offered a brief in-service workshop that lasted 3 days and targeted

educational reform for in-service teachers. Meanwhile, university science education programs were changed for pre-service teachers in 2005. Following these changes, an expanded educational reform was initiated in 2005-2006 academic year. Bozyılmaz and Bagcı-Kılıç (2005), and Çakır, (2005) evaluated this expanded science education reform. They found that emphasis on scientific knowledge was reduced, while science process skills and science-technology-society connections were more emphasized in comparison with the 2000 reform effort. It can be easily concluded that the main purpose of the current reform is to prepare students to be scientifically literate citizens, who are able to use scientific facts in their daily life, and to prepare Turkish teachers to educate accordingly and to encourage the use of other teaching approaches based on constructivist theory and inquiry approaches.

This reform initiated significant changes and there is a need to investigate whether or not primary science teachers understand and integrate this reform in their lessons. From this perspective, the purpose of this study was to examine what primary science teachers' goals are when teaching science and to identify the kind of support teachers need.

Methodology

The Sample

In this study, a survey was distributed to all in-service primary school science teachers in the area of Izmir in Turkey, at the end of 2005/06 semester. The researchers attempted to collect data from a more or less representative sample of primary school science teachers, including teachers from rural and urban part of the area. After contacting 944 teachers by letter and email, 410 teachers of them volunteered to participate in the present study. When evaluating data, it was found that 21 teachers provided incomplete or inaccurate data. Thus, the total sample consisted of 389 (153 male, 236 female) teachers from 72 primary schools. The sample consisted of teachers with a variety of education background as indicated in Table 1.

Table 1
Teachers' Educational background

Science Education		Biology		Chemistry		Physics		Primary Education		Total	
n	%	n	%	n	%	n	%	n	%	n	%
166	43	66	17	92	24	56	14	9	2	389	100

Collection of Data

This study was carried out using quantitative and qualitative methodologies. For collecting quantitative data, the "Survey on K-12 Science Education," developed by Translating Ideas into Practice (TIPs), was used. This survey was jointly translated from English to Turkish by four university teachers. The translated survey had 11 items that included 3 demographic information questions, 4 questions regarding "science class activities," and 4 questions regarding "professional development." Responses to "science class activities" items were evaluated using 5- and 4-point Likert scales, "professional development" items were evaluated using a 3-

point Likert scale. The qualitative part had 2 open-ended questions that asked primary science teachers to specify their main goals when teaching science, and what kind of help they needed to achieve these goals. The respondents needed 15-20 minutes to complete the survey.

Results

The Cronbach's alpha for the eight-item scale was found to be 0.74 and was considered acceptable for the internal reliability of the items. The first part of the instrument related to "Science Class Activities." As indicated in Table 2, the percentages of hands-on activities were "within the last month" (43.9%), "within the last 3 months" (23.1%), and "Within the last week" (21.6%). These results indicate that primary school science teachers did not include enough hands-on activities in their science classes.

Table 2
Science Class Activities

Q: When was the most recent time your students did a hands-on science activity in your class?	Within the last week	Within the last month	Within the last three months	More than three months ago	Not a part of our instruction this year
	21.6%	43.9%	23.1%	11.4%	—

On the other hand, the textbooks (85.6%) recommended by the Ministry of National Education and District-developed materials (77.1%) were the main sources affecting primary science teachers' decisions on whether or not to use hands-on activities, as indicated in Table 3.

Table 3
Sources of Science Lessons

Q: Which of the following do you use in your science instruction? (Check all that apply.)	Commercially published textbook recommended by the Ministry of National Education	Commercially published kits	Other published program materials	District-developed materials	Teacher developed materials
	85.6%	64%	60.1%	77.1%	34%

Teachers were also asked to specify how often the students in their classes were involved in several activities as part of their science instruction. Primary science teachers' responses indicated that the mean scores on a five-point Likert scale were for "Answering textbook/ Worksheet questions" and for "Teacher demonstration of a science related principle or phenomena" 4.07 and 4.06, respectively. On the contrary, participating in "Field trip / Field work" and "Work on extended science projects" (2.23) had mean scores of 2.26 and 2.23, respectively. Thus, primary science teachers appeared to use several kinds of activities as part of their science instruction, but Field trip / Field work and science projects had the lowest mean scores.

Although the "Ministry of National Education requirements," "Student interest in the topic," and "Teachers interest in the topic" seemed to affect the choice of science topics, the "Availability of materials" (3.14) and "My knowledge of the topic" (3.13) had a big influence on teachers' decisions.

Many philosophers and educators suggested that if students are to learn how to conduct scientific investigations, they should have appropriate practice or that they should be offered opportunities to do more investigations (hands-on activities) rather than just follow teachers' recipes. But, the results showed that student-initiated hands-on activities were not frequent in Turkish schools despite the reform guidelines. The existing curriculum kits apparently tend to emphasize fairly scripted investigations, because of the overloaded curriculum. Curriculum design and teaching methods, textbook production and distribution, teacher recruitment and promotion, school building construction and maintenance, and payment of teachers' salaries have been always under the central control of the government. Thus, we were not too surprised that we did not identify in this study a lot of student-driven investigations, especially science projects and Field trip / Field work

A large percentage of teachers (35.7%) participated in professional development activities targeting science teaching in the last three years. Thus, it was expected that teachers had enough information about "Hands-on science" (81%) and "Real-world science applications" (79%), and they would feel very confident and use appropriate teaching with their students. On the contrary, the frequency of "Authentic assessment" was found to be very low (28.5) indicating that science teachers in Turkey are not aware and do not frequently apply authentic assessment strategies.

Science teachers do not also believe that working with science specialists or consultants in their classroom will improve their science teaching. Many science teachers were not even considering the possibility of allowing students to learn science from "specialists" other than their classroom teachers. This tendency makes it far more difficult to link science to learning in other subject areas. On the other hand, if teachers have appropriate science kits that include activities and materials for any grade level, and more money to buy science equipment and supplies, then it will be very easy and useful to teach science concepts to their students and improve their science teaching, because they will have much free time to prepare themselves for their lessons.

Teachers also stated that they had an "overloaded curriculum and not enough time to teach science" (2.84), "enough appropriate science materials easily available" (2.80), and "not having workable system for storing and managing science materials" (2.83). These circumstances influenced their performance, but they still enjoyed teaching science, and they clearly stated that without any lack of materials, storage space and other limitations, they expressed a strong belief that they could catch up other countries level in teaching science.

Figure 1 summarizes the frequencies of primary science teachers' response to the question "What are your main goals in teaching science?" as these have been grouped in categories. The results in Figure 1 indicate that one out of four Turkish primary science teachers correctly conceptualized how ideal science teaching should be. They clearly stated how important is for every student to study science

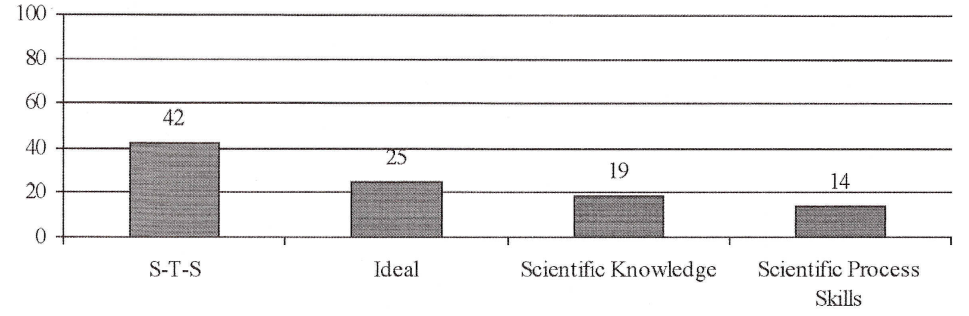

Figure 1. The frequency of "What are your main goals in teaching science?" results.

and develop correct scientific understandings. Thus, they also understood how important should be for teachers to design and conduct scientific investigations using appropriate methods (constructivist approach), link inquiry investigations to students' prior knowledge and experience, guide students when using scientific process skills, such as making observations and measurements, analyzing data, and recording and reporting results; make connections of scientific knowledge with real life and other content areas, and to integrate technology in teaching science in order to foster student learning and motivation, and encourage them to use scientific process skills to solve real life problems.

Among the other teachers, 42% stated the importance of science-technology-society connection, and that technology and science play a major role in shaping our modern world, but technological and scientific changes were infrequently reflected in the way most schools in Turkey prepare students. The STS connection should not only serve the needs of the students who will continue to study and work in science- and technology-related jobs, but also the needs of the total population of students who will be become the citizens of the 21st century. Turkish students should be taught about science, technology, and society from a global perspective and be prepared for real life. One female teacher who had been teaching for six years explained that:

> *We should make connections of science and real life by using whatever we have, such as, textbooks, lab equipments, and technological devices.*

Some Turkish science teachers (19%) stated the importance of scientific knowledge, but they thought that scientific knowledge is really an important thing to understand and useful for life, and they considered that it was really important to perform well in school exams, national enterance to high school and university exams, and even international exams (TIMMS, PISA). A few teachers noticed that scientific knowledge can also provide educational, cultural and intellectual enrichment and can lead to technological advances and economic benefits. Fourteen percent of primary science teachers also agreed that scientific process skills, such as, observations, testing hypotheses, measurements, analyzing data, and recording and reporting results, are very crucial and of utmost importance. One male Turkish science teacher (working for 27 years) stated that:

> *Scientific process skills can enable the students to acquire scientific thinking ability. If students acquired it, they will think like scientists and solve the problems easily in*

their life. Thus, we, as science teachers, should give opportunities to students to get experience in applying scientific thinking skills to familiar everyday situations.

The information in Figure 2 summarizes primary science teachers' response to the question "What would help you in achieving these goals?" The responses were categorized into four issues, Materials and Physical Environment, Parents-Students-Teachers Interaction, Educational Policies and Programs, and In-service Workshops.

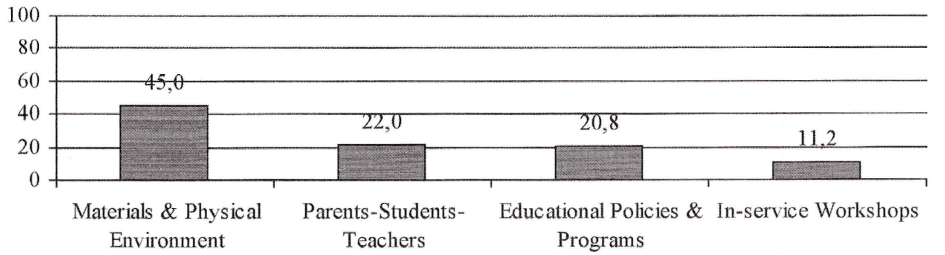

Figure 2. The frequency of "What would help you in achieving these goals?" results.

Almost half of science teachers (45%) stated their complains relating to the lack of materials, especially lab materials, computer and other technological devices, and inconvenient physical environment, such as, small classrooms, lack of science labs and computer labs, and inadequate libraries. They also explained that the physical environment usually affects children's behavior and development, and that the quality of the physical space and the available materials can also affect both children's level of involvement and the quality of interaction between teacher and children.

Twenty two percent of science teachers focused on parents-teacher-students communications. According to them, students usually spent 6-7 hours in school, and the rest of the time they are either with parents and/or friends. Thus, they wanted to involve students' parents in the learning and development process of their children. Many studies indicated that children are much more successful when parents are really involved and interested in their children's education. Otherwise, students are not willing to study at home, and, consequently, teachers and parents should work together in a cooordinated way for the purpose of helping the students to increase their achievement in science and in other disiplines.

One out of five teachers (20.8%) agreed with the National educational policies and the curriculum reforms. They also condemned the overloaded curriculum that was considered as obstacle that did not encourage contructivisistc and student-centred teaching approaches. Based on the reform guidelines, all the textbooks have been changed and aligned to constructivistic approaches. Temiz and Tan (2003) stated that the distribution of lab activities in each unit were not excatly related to scientitic knowledge, but more emphasis was put on science processes. Similar results in science textbooks were reported by Bakac and Kesercioglu (2000), Kanli, and Yagbasan, (2004), Unsal and Gunes, (2002; 2003a-b). They stated that science textbooks do not include only scientific knowledge, but are full of new technological information and terminology. Moreover, Çepni, Ayvacı, and Keleş, (2001) also

found that physics teachers agreed that scientific concepts were not always correct and that physics textbooks were overloaded with content.

Eleven percent of primary science teachers stated that effective workshops should be scheduled and offered to all primary science teachers. These workshops should provide guidance and concrete examples relating to the required teaching approaches, to classroom management, and to ways of integrating educational technology (computer) in teaching and learning. These suggestions were also supported by Aytaç (2000), Kanlı and Yagbasan (2002), and Kaya, Çepni, and Küçük (2004). They also suggested that although universities play a central role regarding teacher education and training in modern countries, the MoNE does not offer enough and effective workshops to science teachers, and the MoNE did not establish yet effective channels of cooperation with universities.

Conclusion

The results of the study offer a more or less accurate picture of what is currently happening in primary school classrooms and enough information indicating the kind of support that primary science teachers need. The study also provides evidence indicating the extent to which the guidelines of the new educational reform in Turkey are really put in practice and identifies some of the obstacles that prevent its implementation. Teachers are making intensive attempts to give students opportunities to perform real scientific investigations, but there are limited attempts to link their teaching with students' lives outside the classroom. They have been teaching with not enough science materials and science kits, and consequently students are not extensively engaged in science activities and have limited opportunities to understand scientific methodology and its associated processes, or pursue their own scientific investigations. The majority of primary science teachers seemed to lack the appropriate skills and correct understandings about the nature and value of inquiry in science teaching. Despite the fact that the Turkish government took some initiatives to foster and promote teachers' continuous professional development, the majority of teachers need more intensive training and more experiences aligned with inquiry-based science learning, problem-solving techniques, and cooperative-learning approaches. Similarly, they should be trained how to integrate science with other subject matter areas, how to connect their teaching with real life situations, and other how to take real advantage of authentic assessment techniques. It also appears that teachers need more incentives and an increase of their basic salary, while more funding for education is urgently needed. An increased funding for education seems rather necessary, because money is needed for appropriate science equipment and materials that are necessary for improving science teaching.

Despite the identified limitations, teachers seem to be at least aware of several effective ways of science teaching, such as, inquiry teaching, hands-on activities, and cooperative learning approaches. More importantly, they appeared to recognize the need to shift away from emphasizing content coverage and invest on pedagogical knowledge and care for inter-personal and intra-personal knowledge. They also seemed to understand that they shoud focus on real-world problems and take into consideration students' alternative conceptions and perspectives, so that they have opportunities to apply science concepts and processes to personally rel-

evant problems or social issues, such as, global warming, earthqueks, acid rains etc.

Successful implementation of any reform requires teachers to deeply understand the goals of the reform by offering them opportunities to reflect with colleagues, science educators, and even scientists. Thus, the MoNE should organize effective workshops in cooperation with faculties of education. Professional pre-service and in-service education programs should not offer scientific and pedagogical knowledge, but these should also provide adequate training and involvement in research activities for teachers, in order to evaluate their work and improve their teaching.

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