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IS TECHNOLOGY INTEGRATED INTO SCIENCE: A CASE OF ELEMENTARY EDUCATION

ABSTRACT

This study aims to investigate the level of technology integration into Science and Technology courses at a public elementary school in a rural region of Turkey. The design of the study is a case study utilizing qualitative research methods. The data were collected through interviews and document analysis. The findings of the study showed that teachers rarely use technology in Science and Technology lessons. The analysis of the documents resulted with similar findings indicating that there was very limited technology integration in Science and Technology Course textbooks and lesson plans. Science related activities were also fewer in Information Technology teachers' book. Additionally, the findings indicated some important barriers in technology integration into Science and Technology course which were time limitation, lack of knowledge and skills about how to integrate technology into the course, physical deficiencies, and inadequate administrative support.

Keywords: Technology Integration, Information Technologies, Science and Technology Course, K12, Teachers

FEN ALANI İLE TEKNOLOJİ BÜTÜNLEŞTİRİLİYOR MU: BİR İLKÖĞRETİM DURUMU

ÖZET

Bu çalışma, Türkiye'nin kırsal bölgesindeki bir devlet okulunda Fen ve Teknoloji derslerinin teknoloji ile bütünleştirilmesi düzeyini araştırmaktadır. Araştırma, nitel veri toplama yöntemleri kullanan bir durum çalışmasıdır. Veriler görüşme ve döküman analizi yöntemleri kullanılarak toplanmıştır. Bulgular öğretmenlerin teknolojiyi Fen ve Teknoloji derslerinde nadiren kullandıklarını göstermiştir. Döküman analizi de benzer bulgularla Fen ve Teknoloji kitap ve ders planlarında, teknolojinin kullanımına çok sınırlı bir düzeyde yer verildiğini ortaya koymuştur. Bunlara ek olarak, Bilişim Teknolojileri öğretmen kitabındaki fen bilimleri ile ilgili etkinliklerin sayısının çok az olduğu belirlenmiştir. Ayrıca bulgular zaman yetersizliği, teknolojinin derste nasıl kullanılması gerektiği ile ilgili bilgi ve becerilerin yetersizliği, fiziksel koşulların yetersizliği ve idari desteğin yetersizliği gibi bazı önemli bileşenlerin Fen ve Teknoloji derslerinin teknoloji ile bütünleştirilmesinde engel oluşturduğunu göstermiştir.

Anahtar Kelimeler: Teknolojinin Bütünleştirilmesi, Öğretim Teknolojileri, Fen ve Teknoloji Dersi, İlköğretim, Öğretmenler

1. INTRODUCTION (GİRİŞ)

Information technologies have rapidly become a part of our educational system although controversies about contribution of technology into education are going on (Dwyer, 1996) due to the fact that they have the potential to support and to make learning processes more efficient (Waight & Abd-El-Khalick, 2007). Until recently, there have been different kinds of technology integration into education to realize different kinds of goals in different disciplines. Bottino and Ott (2006) used computers to provide mind games for primary school students and aimed to search the impact of computer games into students' thinking skills, logical reasoning, and strategic thinking. Turvey (2006) used computers as communication tools to support interaction among two primary schools' students. They were used as supporting tools for learning dialogues in a primary school in the research of Wegerif, Littleton, and Jones (2003).

In spite of presence of many studies related to technology integration, huge budget most of which has been spent for technological equipment and all the policies made related to integration of Information Technologies (IT) into education, technology integration has not been achieved yet. According to Yang (2002), computers can be integrated into teaching and learning successively by using computers as cognitive tools with the help of suitable approaches such as applying constructivist approaches, integrating technology into curriculum, minimizing distraction, and managing all these support in an organizational way (p.2). In the present study, how computers are used as cognitive tools for Science and Technology learning at 6th grade level at a public primary school will be investigated through teachers' opinions and related courses' guide books. In order to analyze computer usages, all Science teachers at the school were interviewed, Science and Technology teachers' guide book for sixth grade was examined to find out if there are activities that require technology integration, and Information Technologies teachers' guide book for sixth grade were explored to find out if there are science related activities.

2. RESEARCH SIGNIFICANCE (ÇALIŞMANIN ÖNEMİ)

In order to have students gain required 21st century skills, teachers should be able to integrate technology into the teaching and learning process (Redditt, 2007). Additionally, to develop students' higher order thinking skills, it is important to use technology as cognitive tools in instructional settings. However, there are very few studies that investigate technology integration as cognitive tools into science lessons at elementary education level. The current study is expected to contribute to the related literature in that respect by exploring how Science and Technology teachers practice and perceive technology integration, and what the barriers that prevent teachers from integrating technology into their teaching are. Moreover, it provides an opportunity to realize the barriers that teachers face in the process of technology integration into science teaching and to take actions to eliminate those barriers.

3. LITERATURE REVIEW (ALANYAZIN TARAMASI)

Hsieh, Cho, Liu, and Schallert (2008) found that the use of technology enriched learning environment based on authentic collaborative self-directed problem based learning had positive effect on students' self-efficacy, goal orientation, and science knowledge. In another research, with the help of 'Exploring the Nardoo' as a computerized cognitive tool, students were provided a metaphor supporting them in investigating and applying scientific concepts in a real world situation (Hedberg, Harper, Wright & Wollongong, 1997).

Likewise, Iiyoshi and Hannafin (2002) used computers as supporting tools in open ended student-centered learning environments including information-seeking tools, information-presentation tools, knowledge organization tools, knowledge integration tools, and knowledge generation tools suggesting well-designed, domain-free tools, and some questions to evaluate their quality. With the help of Internet, Wallace, Kupperman, Krajcik, and Soloway (2000) suggested a web-based digital library helping students to investigate scientific concepts. Due to the fact that they found that inquiry-based activities could not reach its aim as students did tasks in the shortest way instead of comprehending.

Louca and Zacharia (2008) use computer-based programming environments for science modeling in order to find the beneficial characteristics of such environments for fifth grade students' modeling natural phenomena. Similarly, Bera and Liu (2004) investigated the effect of the cognitive tools (including tools sharing cognitive overload, supporting cognitive process, supporting otherwise out-of-reach activities, and supporting hypothesis testing on sixth grade) on students' science learning in problem-based hypermedia learning environment. They found that students who accessed the tools less learned better; but they claimed that this might be because of students' appropriate choice of the tools in appropriate times. They (2005) had another research, and found that students using relevant tools in an efficient way were actively (higher level) engaged in problem-solving. In their other study, Li and Liu (2007) investigated the effect of databases as cognitive tools on sixth grade students' understanding of science in a problem-based multimedia learning environment. The research results indicated that computer-based databases comparison to paper-based databases and no databases decreased students' cognitive overload and increased their science scores.

The studies which showed computers' positive effects on learning can be increased despite the difference in the type of computer usages, the goals and approaches. In addition to their potential contributions, many researchers also agree that teachers have essential roles in the quality of learning (Bottino and Ott, 2006; Turvey, 2006). Thus, to be able to achieve the integration of technology into education effectively, teachers' opinions are very crucial. Moreover, how teachers are guided is also an important issue due to the fact that students' level of understanding could be improved through simplified system dynamic approach with the help of certain developments in curriculum and techniques (Nuhoğlu and Nuhoğlu, 2007). Therefore, the purpose of this study is to investigate how Science and Technology teachers use IT in their courses before, during and after the lesson, and how they are guided in the process of technology integration into their courses.

4. METHOD (YÖNTEM)

The design of this study is a case study utilizing qualitative research methods, and focused on a single case with a purposive sampling. The study was conducted in an elementary school. The school is in a rural region of Turkey, and had approximately 100 students. Due to the fact that it was a small size school, there were only three teachers who were teaching Science and Technology subject. One of the teachers were Science and Technology teacher who was teaching Science and Technology course from sixth to eight grade. The other two teachers were classroom teachers who were teaching the fourth and the fifth graders.

The data were collected through interviews and document analysis in which teachers' guide books were examined with the help of the



checklist based on technology usages in Science and Technology course. Interviews focused on how often, with what intention, and when teachers use technology in their courses. All three teachers were interviewed about how they use technology before, during and after the lessons in Science and Technology courses, how technology should be used in Science and Technology course, and if the teachers were using technology as cognitive tools in their lessons. They also were asked why they used or not used technology, which equipment and software they used, and what the barriers of using technology were. Through document analysis, sixth grade Science and Technology course textbooks and lesson plans, and Information Technology course teacher's book were examined to find out technology integration into the course. The lesson plans and activities in the books were investigated to find out technology usages by separating their usages whether they were planned to be utilized as before the lessons, during the lessons or after the lessons. Moreover, they were also analyzed whether they were planned to be used as cognitive tool or not.

The data analysis mainly focused on the interview results. The data gathered through interview and documents were subjected to content analysis. After the interviews were recorded, they were penned to a document, and then they were analyzed to find out the main themes. In order to support main findings discovered through interviews, teachers-books were examined with the help of checklist based on technology usages before, during and after the lessons. While examining both the interviews and course guide books, it was also checked for whether the usages were as cognitive tool or not.

5. FINDINGS (BULGULAR)

The findings of the study showed that teachers rarely used technology in Science and Technology lessons. Even though the teachers thought that technology had a positive effect on students' learning and it should have been used, their usages were very limited. They thought that technology is helpful in attracting students, makes students understand the subject better through visualizing and concretizing, and enables them to make their knowledge more permanent. On the other hand, they also indicated that technology usage is time consuming, distracting for students, exposed to unexpected problems, and difficult to follow.

All the teachers used technology mostly before the lesson with the aim of preparation for lessons such as planning the lesson, and finding presentation, animation or questions for practice. Most of the time, they did not use technology during the lesson. They only used visual presentations such as slide shows and animations to support students' learning. Only one teacher told that she sometimes used computers to provide practice through some science related Web sites and to help students assess their own learning with the help of games. The teachers stated that they used computers, computer projector, and overhead projector as equipment, and flash player, word processor, spreadsheet, Web browser and presentation program as software. They told that they found animations, presentations, videos, and graphics as supportive for their students' learning.

The analyses of documents resulted with similar findings indicating that there was very limited technology integration in Science and Technology course books and lesson plans. The guide book directed teachers to assign students search in the Internet prior to lessons in only one unit. In another unit, it suggests teachers to prepare for the next lesson with the help of Information Technologies CD. For IT usage during the lesson, an alternative activity as an Internet search task was provided only one time in the book. It was referred to the related parts to the topics in the IT CD three times,



and the use of overhead projector was suggested in a unit. Finally, the book promoted the Internet search as after lesson activity in a unit. Similarly, there were science related activities in three units in Information Technology teachers' book, and computer usages in those activities were during and after lesson.

Additionally, the interview findings indicated some important barriers in technology integration into Science and Technology course. One of the barriers was time limitation because of the heavy curriculum, nationwide exams, competitions and science festivals and extra vacations. Another one was lack of pedagogical knowledge about how to integrate technology in to teaching as the result of insufficient teacher training programs. Additionally, insufficient technology integrated activities in Science and Technology teacher's book were indicated as some of the reasons for lack of technology integration in Science and Technology courses. Some other barriers as indicated by teachers were physical infrastructure deficiencies such as a lack of Internet connection in Science and Technology classroom, lack of suitable classrooms, and a lack of appropriate materials and applications. Finally, inadequate administrative support was indicated as another barrier for Science and Technology teachers' rare technology usage.

6. DISCUSSION (TARTIŞMA)

Even though the findings of this study cannot be generalized beyond the case examined in this study, they are discussed and made some recommendations to facilitate technology integration into teaching and learning in the following section.

The teachers indicated some IT contributions as making Science learning more permanent, more understandable, and more attractive. Although there is no exact indication of computer usage as cognitive tool, the teachers thought that IT improved students' performance as supported by Kiridis, Drossos and Tsakiridou (2006) which may signalize computer usages as cognitive tools. When the examples and the materials the teachers used, and technology integration found in teachers' guide books were considered, it can be stated that the teachers did not have enough materials or guidance to use computers as cognitive tools. One of the teachers stated that she tried to obtain interaction by pausing and asking questions, and this was one of the very few examples for supporting students' cognitive processes if we assume that the teacher used the teaching technique appropriately. This again showed that teachers needed rich materials and pedagogical guidance. Therefore, it can be concluded that the barriers that hinder technology integration into teaching and learning should be abated and teachers should be supported with appropriate instructional methods, techniques and materials (Yang, 2002). Furthermore, management support, procurement of needed equipment, software and applications needs to be considered

According to the results, the teachers could use computers and other technologies in their Science and Technology course but not frequently. The main barrier is the time limitation (Lim & Khine, 2006). While the given time was already inadequate for heavy curriculum, seminars during the semesters that take teachers teaching time, unexpected holidays, and other important festivals dates made it more limited. Therefore, the teachers had to choose the shortest and traditional way to make students to learn the subject. As stated in findings, there are very few activities that require technology integration in teachers' guide books. Moreover, there is no guidance for cognitive technology usages. Therefore, when teachers try to integrate IT in their courses, they would need extra time to design

such activities that support students' cognitive processing. So, this will make teachers' limited time more inadequate.

The next important barrier is the curriculum and the lesson plans according to the interview results. Document analysis findings also showed that there was no lesson using technology as cognitive tools or in an efficient way. That is, the teachers did not know how they could implement the activities in an efficient way by using IT. They could use only slide show and assign homework search at the Internet to the students by worrying that students might not learn anything because of possibility to copy-paste without any reading or other cognitive processes. So, they used limited forms of technology as they did not know what they could have used in which part of their lessons. Therefore, they needed a guidance showing instructional methods and techniques helping them to use technologies before, during, and after lessons appropriately. The reason why one of the teachers did not want to give poster as homework might be the deficiency in guiding the teacher pedagogically. The need to provide teachers with effective IT-integrated lessons with materials also appeared in the study of Lim & Khine (2006). Passey (2006) stated that teachers needed to learn which forms of IT should be used in which part of the learning process. If the teachers' guide book would have directed them to use which IT tools, in what way, and when they should have been utilized, it would be better especially for the teachers who did not have the required training or who are novices in terms of IT us.

The other barrier making the integration of IT difficult is a lack of suitable software and electronic materials. The reason behind one of the teachers not using IT in making projects to attend competitions or festivals might be the same. Projects created by using available technological software and materials would not have been appropriate for these competitions. Moreover, the teacher believed that students learned best through learning by creating models with cardboard and foam if it is possible because she did not know how she could facilitate students to create models through technologies. Therefore, the teachers should be provided software and lesson plans that they can create a product while learning Science. The teachers' guide book should also have a DVD or it should point out a Web site including required software such as puzzling programs, model creator programs, poster maker programs, etc. and materials such as animations, videos, games, presentations, competitions, etc. enabling students and teachers to use technology in line with the objectives of the course. A DVD referred by teachers' guide book can be the best solution as teachers cannot know what they will do with a variety of materials as seen in the study of Lim and Khine (2006).

Beside these, the teacher should be provided related trainings to implement appropriate instructional strategies to integrate IT into Science and Technology course (Kiridis, Drossos & Tsakiridou, 2006, p.90; Lim & Khine, 2006, p.118). But, the experiences that the teachers will have during trainings should be beneficial for their subject area teaching. The trainings of teachers can include both developing their computer skills and making them to gain required pedagogical knowledge to integrate IT in an efficient way (Karagiorgi & Charalambous, 2006) Policies cannot expect them to implement integration of IT in an efficient way without providing appropriate training and support. The teachers also mentioned about classroom management problems because of the classroom order or lack of enough space for activities. This may be partly because of the lack of software that motivates students in addition to the equipment. The equipment and software should be assured and organized in accordance with school context and the teachers' needs. In this context,



classrooms can be donated with one computer with Internet connection and projector. Moreover, IT classroom can be reorganized according to the needs of the teachers or a new ICT classroom for other disciplines can be created with some of the computers in IT classroom and computer coming from donations. To achieve this, each school should determine its own requirements.

The teachers said that there is no support by the administration and they struggled with problems on their own as teachers. On the other hand, the research of Tondeur, Keer, Braak, and Valcke (2008) pointed that teachers' perceptions were affected from the policy-makers. Therefore teachers should be supported by administration (Lim & Khine, 2006) both at local and Ministry of education levels.

NOTICE (NOT)

In this study, 22-24 September 2011 in Elazig between the "ICITS-2011) 5 International Computer and Instructional Technologies Symposium" presented as an oral presentation in.

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