USE OF INSTRUCTIONAL TECHNOLOGIES IN SCIENCE CLASSROOMS: TEACHERS' PERSPECTIVES

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ABSTRACT
The purpose of this study was to investigate how science teachers use instructional technologies in science classrooms. Participants were 63 teachers who have just completed an alternative teaching certificate program in one of the largest universities in Turkey. They were asked to make a lesson plan based on any topic by assuming that they had an ideal school environment. Based on analysis of all lesson plans, participants were asked to explain their reasons for using those technologies. Findings revealed that PowerPoint was the most widely used instructional technology in their lesson plans. Textbooks and blackboards were other instructional technologies used by participants. Animations were the least used instructional technology by all participants. None of the participants used internet, interactive smart boards, spreadsheets, computer simulations, and educational software in their lesson plans even though they were told to assume that they had an ideal environment in terms of time, resources, and students.
Keywords: Instructional technologies, Science teachers, Information and communication technologies (ICT), High schools

INTRODUCTION

Use of instructional technologies in education has been widely discussed with advancement of new technologies (Koç & Bakır, 2010; Lavonen, Juuti, Aksela, & Meisalo, 2006; Linn, 2003; Lumpe, & Chanbers, 2001; Mumtaz, 2010; Serin, 2011; Spector, Merrill, Merrienboer, & Driscoll, 2008; Umay, 2004). Governments all over the world have made investment in order to integrate information and communication technologies in schools. For example, in the United States, more than 95% of schools and 72% of classrooms were connected to the internet by 2000 (Quality Education Data, 2000, as cited in Hogarty, Lang, & Kromrey, 2003) and the total spending cost $5.2 billion in 2001 (Reed et al., 2001, as cited in Hogarty, Lang, & Kromrey, 2003). Turkey also started projects related to integration information and communication technology in educational system as early as 1984 (Göktaş, 2006). The recent project was the FATIH Project initiated by the Ministry of National Education ([MNE], 2012) with the purpose of improving use of information and communication technologies in schools during the teaching and learning process. In this project, each classroom in schools will have computers with high speed internet connections, interactive smart boards, printers, and projections in order to reach information and communication technology based instruction by 2013 (MNE, 2012).

On the other hand, many scholars have discussed concerns about teacher beliefs, proficiency, and preparation about use of technology in their instruction (Al-Fuadil, & Mellar, 2008; Hogarty, Lang, & Kromrey, 2003; İşman, 2002; Mumtaz, 2000; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010; Tezci, 2009). The main purpose of this study was to investigate how science teachers use instructional technologies in science classrooms. Therefore, the paper may have contribution to the literature by providing some information for especially teacher educators about what instructional technologies science teachers tended to use and why or why not they use those technologies in their classrooms.

METHODOLOGY

Qualitative research methodology was adopted in the current study in order to response the following research questions: The first research question is what kind of instructional technologies that teachers are more likely to use in science classrooms. The second research question is why they prefer those instructional technologies.

Participants

Participants were 63 teachers (46 female, 17 male) who have just completed an alternative teaching certificate in one of the largest universities in Turkey. All participants completed educational technology and material design, teaching science methods courses as well as other educational courses classroom management, educational psychology, field experience and teaching practice by the time of the data collected. All participants have Bachelor of Science (B.Sc.) degree in physics, chemistry, and biology. Thirty eight percent (24) of the participants graduated from physics, 27% of them (17) from chemistry and 35% of the participants (22) from biology departments. More than 76% of the participants were serving as teachers in public or private schools by the time of the study conducted.

Data Collection

Data from lesson plans and an open-ended questionnaire were collected at the end of spring 2012. Participants were asked to make a lesson plan based on any topic they selected by assuming that they had an ideal school environment. They were not directed to use any kind of instructional technologies but they were told that they would imagine that they had an ideal school environment in terms of student, administration and resources. All lesson plans were analyzed in terms of instructional technologies they used. In an open-ended questionnaire, participants were asked to explain why or why not they use those technologies.

Data Analysis

Data were analyzed by using an inductive approach at two main steps. At the first step, all lesson plans were numbered and analyzed in terms of instructional technologies used. Instructional technologies used in the plans were categorized as PowerPoint presentations, textbooks, blackboards, laboratory work, videos, worksheets, supplementary books, and animations. Frequency analysis was conducted for each category. At the second step, participants' responses to an open-ended question why or why not they selected those instructional technologies were listed and analyzed. Then, students' responses were compared by department. All findings will be discussed in the next section by providing key quotations given by participants.

RESULTS

Table 1 shows that instructional technologies indicated by participants in the lesson plans based on their majors physics, chemistry and biology. The overall findings of the study reveal that PowerPoint was the most widely used instructional technology in the lesson plans. Sixty three percent of the participants (40) used PowerPoint presentation in their lesson plans. The second widely used instructional technology was textbooks indicated by 46% of the participants in their lesson plans. The third widely used instructional technology was blackboards stated by 41% of the participants. Laboratory work including demonstration and experiments is stated by 37% of the participants. Thirty percent of the participants planned to use videos while only 10% of the participants tended to use animations in their class. Twenty four percent of the participants tended to use worksheets in order to help students prepare for standard-based tests while 21% of the participants planned to use supplementary books for the same purpose.

As compared instructional technologies used in the lesson plans in terms of majors, PowerPoint presentation was instructional technology still widely used by chemistry and biology teachers (82% each) while only 33% of physics teachers in the study tended to use PowerPoint presentation in their class. The instructional technology most widely used by physics teachers (63%) was blackboards. The instructional technology second widely used by physics teachers (58%) in the study was textbooks. Laboratory work, worksheets, and supplementary books were other widely used by physics teachers (38%) in the study. Videos (17%) and animations (13%) were less widely used instructional technologies by physics teachers in the study.

Table 1: Instructional technologies used by participants based on their majors

	Physics		Chemistry		Biology		Total	
	f	%	f	%	f	%	f	%
PowerPoint slides	8	33	14	82	18	82	40	63
Textbooks	14	58	6	35	9	41	29	46
Blackboards	15	63	3	18	8	36	26	41
Laboratory work	9	38	9	53	5	23	23	37
Videos	4	17	4	24	11	50	19	30
Worksheets	9	38	3	18	3	14	15	24
Supplementary books	9	38	1	6	3	14	13	21
Animations	3	13	0	0	3	14	6	10

Both chemistry teachers (82%) and biology teachers (82%) in the study tended to most widely use PowerPoint presentation as instructional technology. However, the second widely used instructional technology by chemistry teachers (53%) was laboratory work while the second most widely used instructional technology by biology teachers (50%) was videos. The third widely used instructional technologies by chemistry (35%) and biology (41%) teachers in the study were textbooks. Blackboards were used by biology teachers (36%) while used by chemistry teachers (18%). Twenty four percent of chemistry teachers in the study used videos while 23% of the biology teachers used laboratory work. Fourteen percent of the biology teachers tended to equally use worksheets, supplementary books, and animations. However, 18% of the chemistry teachers tended to use worksheets while 6% of them used supplementary books. None of the chemistry teachers in the study indicated that they would use animation in their class. It is noteworthy since animations have a significant role in teaching and learning chemistry. Many scholars agree that students have difficulty in understanding chemistry concepts

because they do not see directly phenomena at the submicroscopic level and do not have the ability to move between macroscopic, submicroscopic and symbolic representations in chemistry (Gabel, 1999; Johnstone, 1999; Talanquer, 2011). Animations may help students to understand chemistry concepts by showing the phenomena at different representation levels (Chang, Quintana, & Krajcik, 2010). Another significant finding of the study was that internet, interactive smart boards, spreadsheets, computer simulations, and educational software were not found in participants' lesson plans.

The second research question was why teachers prefer to use those instructional technologies in their lesson plans. The instructional technology most widely used by participants (63%) was PowerPoint presentations. Participants indicated their reasons why they chose PowerPoint presentations in their class as providing visuals (15), saving time (13), getting students' attention (10), knowledge retention (10), active participation (4), easily used and prepared (3). For example, participant #34 emphasized saving time by saying that "I preferred to use PowerPoint presentations during lecturing. I provide students with copies of slides. My purpose of doing this was to do more practice by saving more time." Similarly, participant #41 said that "I planned to use PowerPoint slides because I believe that they are attractive and easy to understand for students. I also believe that PowerPoint slides have more visuals so I can give more knowledge stick in their mind." On the other hand, two participants indicated that PowerPoint presentations should not be necessarily used if the topic is easy or time is limited. For example, participant #19 stated that "PowerPoint slides might be prepared for this lesson, but since the topic is very easy and time is limited, it is not necessary."

Only two participants indicated their reasons for using textbooks as being economic and helping students understand the content. Two participants stated that they used blackboards for solving problems. One participant expressed that she might want to use interactive smart boards and tablet PCs but she thought that she was not able to use them due to lack of training for using those technologies.

Laboratory work was widely used by participants for several reasons. Some of the reasons stated by participants were providing visual learning (4), developing positive attitude towards science and scientists (2), making abstract concepts to more concrete (1), making scientific inquiry (1), having students' active participation (1), and gaining scientific process skills (1). For instance, participant #17 stated that "by using simple materials (wood, water, oil, cup), students have opportunity to observe liquid pressure." Three participants indicated that they did not use laboratory. Their reasons for not using laboratory work were limited class time, inappropriate with some topic, and preventing instruction. One participant stated that "this topic [shooting and force] is not appropriate for laboratory" (P#10).

Videos were used by participants (30%) in their lesson plans for several reasons: providing visual and auditory learning (8), getting attention (5), making connection with daily life and giving examples from everyday life (2), knowledge retention (2), having fun (1). One participant stated that "I chose video demonstration because I think that students can learn better by both visual and auditory ways" (P#42). One participant stated that she did not prefer to use videos since they might make students lose their attention. Participant #44 stated that "I think that students would lose their attention and time would not be enough if I used videos. Instead, watching videos can be given as homework outside of the classroom"

DISCUSSION AND CONCLUSION

The findings of the study offer important insights related to the literature about use of instructional technologies in science classrooms. The main findings of the study and a discussion of each finding with related literature are presented.

a. One of the major findings of the study was that a majority of the participants used PowerPoint presentations in their lesson plans. Chemistry and biology teachers most widely used PowerPoint slides in their instruction while physics teachers most widely used blackboards. The reason for this discrepancy probably may come from their beliefs that PowerPoint is more appropriate depending on the content taught.
b. In the current study, physics teachers were more likely to use textbooks, worksheets, and supplementary books rather than PowerPoint presentations, videos, and animations.
c. In the current study, chemistry teachers were more likely to use PowerPoint presentations, laboratory work, and textbooks rather than videos, blackboards, worksheets, and supplementary books. It is noteworthy that none of the participants having chemistry major used animations in their lesson plans although animations can be helpful for students to connect the relationship between macro, sub-micro and symbolic representation levels.
d. Biology teachers in the study were more likely to use PowerPoint presentations, videos, textbooks rather than blackboards, laboratory work, worksheets, supplementary books, and animations.

e. Animations were the least used instructional technology by all participants.
f. None of the participants used internet, interactive smart boards, spreadsheets, computer simulations, and educational software in their lesson plans even though they were told to assume that they had an ideal environment in terms of time, resources, and students. Therefore, resources and institutions as barriers for using information and communication technologies stated by Hew & Brush (2007) should not be concern for teachers. The reason for this finding may be due to the fact that they may be unfamiliar with those technologies or they may not know how to use those technologies in their lesson. As Hew & Brush (2007) stated, teachers' knowledge, skills, beliefs and attitudes can be barriers for making instructional decisions.
g. There may be some limitations of the current study. Findings of the study cannot be generalized to all science teachers in schools. The findings are limited with this group of participants. However, the findings may be applied to similar context. Moreover, participants in this study were asked to assume that they would have an ideal classroom environment in fact they did not have such an environment in real life. If they had had an ideal (high tech) classroom environment, they would have more responses in favor of using more high tech instructional technology tools and materials. Not having an ideal environment in real life, participants may have tended to use more traditional instructional tools in their lesson plans.
h. There is a need to increase teachers' knowledge and skills about how to use those instructional technologies and help them develop positive attitudes toward information and communication technologies. Teacher education programs play a key role in preparing well-informed teachers with positive attitudes toward using ICT. Further research can be conducted in order to develop content-based workshops where teachers learn enough knowledge and skills about ICT in science classrooms and have positive attitudes toward using them and investigate effects of these programs on teachers' knowledge, skills, and attitudes toward ICT.

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