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THE VIEWS OF A GROUP OF SCIENCE / PHYSICS TEACHERS ON LABORATORY ACTIVITIES SUPPORTED WITH TECHNOLOGY

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Abstract: Through a project planned by researchers, a number of pilot studies were initiated in relation to such activities as raising a team of leading teachers and furnishing science/physics teachers with required knowledge and skills. The project was thought to be accomplished by means of some planned experiments, demonstrations, some software applications such as Microsoft Excel, T1-Interactive, graphical calculator, CBL and CBR tools in accordance with physics subjects in the syllabus of science/physics subjects in upper elementary and secondary education of Turkish education system. The aim of this study was, prior to the onset of some technology supported laboratory activities arranged for science/physics teachers, to determine the participating teachers' opinions about *"The Technology Supported Science and Physics Experiments"* and to evaluate their opinions according to some variables. From the study carried out within the above mentioned framework, it was concluded that out of 103 science/physics teachers participating in the study from the province of Tekirdağ 13.6% used neither conventional nor new technology, 16.5% used audio-visual devices, 12.6% used OHPs (over head projector), 4.9% used computers, 19.4% used audio-visual devices and OHPs, 27.2% used audio-visual devices, OHPs and computers, 4.9% used OHP and computers, 1% used audio-visual devices and computers in education. Upon analyzing the data gathered, no significant difference was attained between science and physics teachers' personal characteristics (gender, graduating school, experience, specialized field, employing school and institution) and their opinions about laboratory activities. There was also no significant difference between their personal characteristics and their levels of their making use of technology in teaching science.

Keywords: Technology supported science and physics experiments, technology literacy, simulation software, professional efficiency of a teacher.

1. INTRODUCTION

One of the main tasks of a qualified and competent teacher is to set up a proper and enriched environment, and guide students to gain fundamental knowledge and advanced thinking skills. Teachers who educate individuals should utilize skills efficiently and produce new knowledge as well. It is however required to endeavor great efforts to train teachers qualified as above, because Turkey, like any other country, does not have this staff as granted. In addition to the pre-service education effective training and retraining programs and models should be launched and applied regularly in the sense of life-long learning. Even though personal endeavor is of great importance in enhancing qualifications of a teacher, he or she is also in need of technological support, a leading trainer and counsel from a specialist. Some services are demanded from universities and training experts. Within this context, the Turkish Physics Foundation (*TFV: Türk Fizik Vakfı*) has, for the past few years, implemented a number of in-service education and training (INSET) activities for science and physics teachers and has released some funds on in-service training. The goal of this study was, prior to the onset of some technology supported laboratory activities arranged for science and physics teachers, to determine the participating teachers' opinions about *"The Technology Supported Science and Physics Experiments"* and to evaluate their opinions according to some variables. Subject teachers, surveyed in some studies, stated that they demanded to get to know and utilize new technologies (Üstüner et al. 2002; Başer et al. 2003; Kaptan et al. 2004). A science and a physics teacher, who can make use of technology supported education, would be able to attract more interest of a student towards science and physics subjects, thereby would be able to help students overcome learning difficulties to some extends. Within this context, through a project planned by researchers, a number of pilot studies were initiated in relation to such activities as raising a team of leading teaching staff and furnishing science and physics teachers with required knowledge and skills. The project was thought to be accomplished by means of some planned experiments, demonstrations, some software applications such as Microsoft Excel, T1-Interactive, graphical calculator, CBL and CBR tools in accordance with physics subjects in the syllabus of secondary education and science/physics subjects in upper elementary education. Later, the Likert-type scale, developed by the researchers (Erdem et al. 2004), was applied to the teachers in order to determine their opinions about laboratory activities, technology and science education, outcome of which was some data to be applied to the new activities to be used in in-service education and training (INSET) of teachers. Some sections and interpretation gathered upon analyzing data are reported in this research.

There are, as it is known, numerous methods and techniques used in teaching natural sciences in general and physics in particular. After the decision is made, they should be applied in classrooms and schools effectively and properly. The teaching method with laboratories, for instance, means that students learn through a process of proving in experiments the basic knowledge of natural sciences (Çilenti, 1985). The basic philosophy of teaching with laboratories is to experiment some make-up events, observe their outcomes, and report the data, findings and relations. The aims in using laboratories can be stated as follows:

- To give students experience with the concrete materials in order to make students understand the subjects of natural sciences which are of abstract and complicated features.

- To furnish students with the abilities of study methods, problem solving, researching and generalization which are all necessary for a student to fully understand the essence of science.
- To make it easy for students to improve their personal abilities they can use in a broader area with the help of their experiences.
- To develop positive attitude of a student, who would enjoy practical studies, towards natural sciences.

On the other hand, educational technologies in general, information and communication technologies (ICTs) in particular have contributed new dimensions to teaching methods with laboratories. In order to make an effective and productive use of ICTs in micro level, all necessary technologies should be prepared prior to the lesson and they should as well be tested through researches and experimental studies (Tüy, 2003). According to the studies made by Üstüner et al. 2002, science and physics teachers were in need of in-service seminars on technology supported science and physics education. According to the studies of Kaptan, 2004, 90% of the participating teacher candidates gave the answer "OHP (overhead projector) to the question "Which teaching tool that you know how to use is the one you think you feel the most comfortable with?". Among the teachers, 45% answered "Yes" and 55% "No" to the question "Can you follow developments and innovations in the field of teaching technologies?". To the question "Is the education given at the universities about using a computer -knowledge and skills of using a computer- sufficient or insufficient?" all teacher candidates participating in the study answered "Insufficient". This yields a conclusion that teacher candidates find the education they have at the universities insufficient to improve their knowledge and skills of using a computer which is the most important tool for teaching technologies. According to the study made by Başer et al. 2003, teachers in Laboratory Schools have a positive attitude to the usage of computers. They also think that computer aided education (CAE) is a contemporary teaching method and using computers in classes has a positive effect on students' success, individual development and individual creativity. The teachers in laboratory schools are in the opinion that CAE contributes to individual education and should start at early ages. However, one of the conclusions that the researchers reached was that the teachers in laboratory schools had insufficient knowledge and skills to maintain CAE in classes even though they had been given INSET in the related area.

2. AIM, METHOD AND TOOLS

2.1 Aim, Study Problem and Variables

Aim: The aim of this study was to determine the participating teachers' opinions about *"The Technology Supported Science and Physics Experiments"*. What the opinions of a group of teachers about technology supported laboratory activities are and to what extend the teachers use the technology in their classes constitute the problem of this study.

Problems of the Study: We can classify the problems under two headings.

- **P1:** Are there any relations between the personal characteristics of the science/physics teachers and their opinions about the laboratory activities.
- **P2:** Are there any relations between the personal characteristics of the science/physics teachers and their level of using technology.

We can associate two hypotheses to these two problems as follows.

- **H1:** There is not any significant difference between the personal characteristics of the science/physics teachers (gender, graduating school, experience, specialized field, employing school and institution) and their opinions about the laboratory activities.
- **H2:** There is not any significant difference between the personal characteristics of the science/physics teachers and their level of using technology.

Variables: In the search, 6 independent and 26 dependent variables have been determined. Independent variables are individual information about teachers. Those are: gender, college/faculty that he/she graduated, teaching experience, branch of teaching, employing school and/or institution. Dependent variables are those stated in sub-problems; they contain 16 items about opinions of teachers about lab-activities and 10 items which include teachers' levels of using technology.

2.2. Population and Sample

The sub-population of the study is totally 234 science /physics teachers, 55 of whom teach in high schools or equivalent and 187 of whom teach in upper primary or elementary schools in the academic year of 2003-04. But, it is also possible to consider all science /physics teachers who teach in primary and secondary schools in Turkey as the population of the study. And the sample means those 103 teachers who participate in "Technology Supported Science / Physics Experiment Seminar", accomplished in Tekirdağ and Çorlu, dated from 15-16 and 30th of May, 2004 to 21st of June 2004 and replied the scale by their own desire.

2.3. Instruments: Tools for Gathering Data

For gathering information of teachers in the sample, a scale for teacher's views has been developed. While the scale was being developed by using material pool, a questionnaire, for getting solutions to search problems, a set of software of related field was screened, translated to Turkish and adopted to the syllabus. This model of questionnaire was practised on the group that would not be included in the sample. After pre-test results had been reviewed, the scale reached its final form. The scale consists of some questions about individual ICTs, teachers' lab-activities in science/physics education and using technologies.

LabEt Scale (Scale of Teachers' Opinions About Lab-activities): This scale consists of 10 items with 5 alternatives which is directed towards determining their attitudes about the importance of lab-activities in science/physics education. Those are some items such as importance of lab-activities in learning, relationship between lab-activities and students' success, proving subject with experiment, advantage of lab-activities and teacher's knowledge and ability about using tools and equipment in laboratory.
TekKu Scale (Scale of Teachers' Use of Technology): This scale consists of 10 items, each of which has 5 choices, which is directed towards determining science /physics teachers' technology used in science education and their attitudes about this technology usage. Those are some items with titles as, tools and equipment usage in science/physics lesson, computer and software usage, usage of computer and graphical calculator in lab-activities and views about animation-simulation programmes. First part's Cronbach alfa coefficient which pointed out teachers' viewpoints about lab-activities was 0.78: that one about technology usage was found as 0.81.

2.4. Meaning of Terms

Simulations with computers: Displaying of those, which are difficult to be perceived, both dangerous and expensive for practising in lab or some phenomenon / situations which are very quick / very slow, with animation is called simulation.
Laboratory supported by computer: Computer may be used in physics to facilitate and enrich lab-studies. By the computer support, some activities like getting data of heat, speed, the intensity of light sensitively, displaying them on graphics etc. can be made easily. Use of computer laboratory not only decreases students' responsibility but also takes away some faults such as reading and registering data which is resulted from the person who makes the experiment.

3. DATA ANALYSIS AND FINDINGS

By using developed scales, necessary data were collected from the teachers on subject in Tekirdağ. Analysis of the data was made in SPSS program some findings and their interpretation have been explained in the text.

3.1. Analysis-1: Descriptive Statistics

(a)Teachers' Curriculum Vitas: 103 of the teachers (100%) who have participated in the search live in Tekirdağ. Of the teachers on subject, 52 teachers (50.5%) are men, 51 (49.5%) women. Of those who replied the survey, 27 (26.2%) graduated from 2/3-year-college, 7 (6.8%) had BA degree, 33 (32%) had BA degree + certificate, 36 (35%) graduated from educational faculty (BA degree). Of the teachers, 11 (10.7%) were experienced 0-5 year, 26 (25.2%) were 6-11 years, 25 (24.3%) were 12-17 years, 24 (23.3%) were 18-23 years, 14 (16.6%) were 24-29 years and 3 (2.9%) were 30-35 years experienced.

(b)Comparison of teachers' experience to their technology usage:
Of those who participated in the study, it was understood that 14 (13.6%) used no technology, but 17 (16.5%) used audio-visual equipment, 13 (12.6%) OHP, 28 (27.2%) audio-visual equipment, OHP and computer, 5 (%4.9) OHP and computer, 1 (%1) used audio-visual equipment in education and teaching.

Table-1.Distribution of Teachers according to Experience and Technology (EXPERIENCE-TECHNOLOGY Cross-tabulation)

			TECHNOLOGY								Total
			no answer	audiovisual	OHP	Computer	audiovisual + OHP	audiovisual + OHP+ Computer	OHP+ Computer	audiovisual + Computer	
EXPERIENCE	0-5	Count	1	1	3		2	3		1	11
		% within experience	9,1%	9,1%	27,3%		18,2%	27,3%		9,1%	100,0%
	6-11	Count	2	5	2	1	7	7	2		26
		% within experience	7,7%	19,2%	7,7%	3,8%	26,9%	26,9%	7,7%		100,0%
	12-17	Count	4	5	3		5	8			25
		% within experience	16,0%	20,0%	12,0%		20,0%	32,0%			100,0%
	18-23	Count	5	4	4	3	3	5			24
		% within experience	20,8%	16,7%	16,7%	12,5%	12,5%	20,8%			100,0%
	24-29	Count	2	1	1	1	2	4	3		14
		% within experience	14,3%	7,1%	7,1%	7,1%	14,3%	28,6%	21,4%		100,0%
	30-35	Count		1			1	1			3
		% within experience		33,3%			33,3%	33,3%			100,0%
Total		Count	14	17	13	5	20	28	5	1	103
		% within experience	13,6%	16,5%	12,6%	4,9%	19,4%	27,2%	4,9%	1,0%	100,0%

Distribution of teachers as number and percentage, according to their experience and their use of technology, is shown on Table 1. According to the information on this table, it is understood that the teachers with 0-5, 6-11 and 12-17-year-experiences do not have sufficient computer education. 12.5% of those teachers with 18-23-year-experiences use a computer. Although this is the most sufficient group with computers, it is also the biggest group with the rate of 20.8% that did not give any answers to the other technology usages. 7.1% of those teachers with the experience of 24-25 years use a computer. Among the subject teachers, 30-35-year experienced teachers never use a computer.

(c) Levels of Teachers' Use of Technology: Technology usage levels by the subject teachers are shown on Table 2. According to the average points on this table, it is supposed that, with the average $\bar{x}$=4.1 and over that have sufficient usage level, $\bar{x}$=4 and below have insufficient usage level. According to that, it is observed that teachers don't use OHPs and laboratories sufficiently in science lessons. It is also said that using computer software, searching simulation programmes and levels of internet usage are insufficient. It is also understood that their computer and graphical calculator usage levels in lab-activities are insufficient. It may be realized by their views about animation-simulation programmes that their levels of considering on using simulation programmes and preparing animation are insufficient; they believe that virtual experiments are superior to actual experiments on the base of time ($\bar{x}$=4.02).

(d) Teachers' Views about Lab-activities: Views of subject teachers about lab-activities are shown on Table 3. According to the average points on this table, it is estimated that, those with an average of $\bar{x}$=4.1 and above are sufficient, those with points below $\bar{x}$=4.1 are insufficient. According to these results, attitudes of teachers about the importance of lab-activities in learning are important. The teachers are in dilemma with the relationship between lab-activities and students' success; in addition, it is underlined that they do not use laboratory in their schools. It may be said that these behaviours resulted from external factors. They believe that proving some knowledge/findings in the content of the subject is essential. Besides, since they believe the preparation to LGS (lise giriş sınavı: examination to enter some high schools) and UEE (university entrance examination) exams. It is interesting to notice that although teachers state using available tools and equipment, they accept that they do not make experiments even with simple tools and equipment. Every conclusion summarized here is open to comment so their reasons and should be searched.

Table 2. Teachers' Levels on Technology Usage

Tools-equipment usage in Science Lessons	**N**	**1**	**2**	**3**	**4**	**5**	$\bar{x}$	**S**
1. Episcope usage	103	24	12	31	27	9	2.85	1.29
2. Laboratory usage	103	4	7	33	44	15	3.57	.96
Usage of Computer Software								
3. Search for Simulation Programmes	103	23	22	35	20	3	2.59	1.12
4. Making use of Internet	103	25	22	33	18	5	2.57	1.18
Computer and Graphical Calculator								
5. Computer or graphical calculators' usage in the analysis of laboratory data	103	54	15	27	6	1	1.88	1.05
6. Effect of computer in science teaching	103	-	12	15	48	28	3.89	.94
7. Available educational software in school / class (SW)	103	12	49	9	22	11	2.72	1.23
Views about animation-simulation programmes								
8. Considering simulation programme usage	103	21	10	43	21	8	2.85	1.19
9. Considering preparation of animation programme (animating in visual material)	103	42	11	34	10	6	2.29	1.26
10. Believing in the superiority of conjectural experiment to actual experiment on the base of time	103	1	2	22	47	31	4.02	.83

Table 3. Teachers' Views about Lab-activities

Importance of Lab-Activities on Teaching	**N**	**1**	**2**	**3**	**4**	**5**	$\bar{x}$	**S**
01: Regular lab-works are essential for teaching scientific phenomenon	103	1	4	1	7	90	4.76	.75
02: Rate of remembrance is high in experiments which the students take part	103	2	1	2	7	91	4.78	.71
03: Lab-activities urge the students to produce new questions about in the subject.	103	1	1	-	22	79	4.72	.62
04: Lab-activities give a chance for students to produce scientific views(opinions) based on observed events and objects, using their own knowledge.	103	1	3	3	15	81	4.67	.76
05: Lab-activities give a chance for the students to solve a Science / Physics problem.	103	-	6	7	30	60	4.40	.86
Relationship between Lab-activities and student success								
06: Lab-activities in Science / Physics lessons are a loss of time.	103	2	5	4	8	84	4.62	.92
07: If the students learn subjects by lab-activities, they become more successful in exams.	103	3	4	3	23	70	4.49	.95
08: Lab-activities make the students obtain the ability of observation.	103	-	2	-	5	96	4.89	.46
09: I don't make use of laboratory in Science / Physics lesson.	103	-	8	3	18	74	4.53	.88
It is unnecessary to prove subject with experiment								

10: It is nonsense to prove an available Science / Physics law with experiment.	103	2	1	3	12	85	4.72	.75
11: If I had a chance, I would not let student make experiment in laboratory any longer.	103	2	2	2	15	82	4.68	.78
Lab-activities aren't useful								
12: I have the students make experiments (just for a change)	103	3	7	9	13	71	4.38	1.09
13: Lab-activities aren't useful for preparing students for the exams.	103	3	21	6	23	50	3.93	1.28
14: Lab-activities can't give a chance to the students to re-discover theories.	103	2	10	7	24	60	4.26	1.08
Teacher's knowledge and ability about using tools and equipment in laboratory								
15: I can use available tools-equipment in the school.	103	4	5	3	34	57	4.31	1.02
16: I have lack of knowledge about making experiments using simple tools-equipment.	103	3	15	4	16	65	4.21	1.22

3.2 Analysis-2. Commented Statistics

Collecting datum analyzed by being used SPSS; two hypothesis pointed out before were tested. The results were summarized below:

(a) Analysis results of Hypothesis 1: (Views about individual qualities and lab-activities)

- It underlines that there isn't a significant difference between science /physics teachers' gender and their views about lab-activities.
- It points out that there isn't a significant difference between the universities that the teachers graduated and their views about lab-activities.
- It points out that there isn't a significant difference between teachers' experience and their views about lab-activities.
- It underlines that there isn't a significant difference between science /physics teachers' branches and their views about lab-activities.
- It points out that there isn't a significant difference between the schools that science /physics teachers service (teach) and their views about lab-activities.
- It underlines that there isn't a significant difference between the institutions that science /physics teachers service (teach) and their views about lab-activities.

Hypothesis has been accepted because there aren't significant differences between science /physics teachers' individual qualities (gender, the university they graduated, experience, branch, the school they teach, the institution they serviced) and teachers' views about lab-activities.

(b) Analysis results of Hypothesis 2: (Views about individual qualities and using technology)

- It points out that there isn't a significant difference between science / physics' teachers' gender and teachers' levels about using technology in teaching.
- It underlines that there isn't a significant difference between the universities that science /physics teachers graduated and their levels about using technology in teaching.
- It points out that there isn't a significant difference between science /physics teachers' experience and their levels about using technology in teaching.
- It underlines that there isn't a significant difference between science /physics teachers' branches and teachers' levels about using technology in teaching.
- It points out that there isn't a significant difference between the schools that science /physics teachers teach and their levels about using technology in teaching.
- It underlines that there isn't a significant difference between the institutions that they teach and their levels about using technology in teaching.

Hypothesis 2 has been accepted because there aren't significant differences between science /physics teachers' individual qualities and their level about using technology in science teaching.

4. CONCLUSION AND SUGGESTIONS

Rate of the subject teachers who admit themselves sufficient about computer aided teaching is less than 5%, even, frankly 4.9%. Although audio-visual tools and OHPs are being used very often, the rate is still very low, only 12.6%. This conclusion, too, underlines the parallelism to the results of Kaptan's study (Kaptan, 2004).

If we look at the teachers' levels on teaching technology in laboratory, we see that they are insufficient in using OHPs and computers, they don't search for the simulation programs adequately and don't make use of Internet. It may be commented that they don't have a computer-lab at school, or, if they have, they aren't connected with Internet or they don't know how to use it properly. The search must be widened and important reasons must be determined. It is obvious that teachers will not be adequate in this subject since most of the schools don't have a graphical calculator. We may result that they don't consider using those since they don't have adequate information about applets and simulation programs.

It may be considered that teachers don't want to develop themselves about lab-skills and avoid from lab-works with some reasons such as absence of adequate labs at schools, or lack of tools or equipment in labs, the importance of LGS and UEE exams both for students and their parents, although they believe in the importance of lab in science/physics education.
In the mirror of these results, we suggest.

- INSET seminars should be held for teachers about simulation programs and educational software in accordance with the curriculums of science and physics lessons in upper primary schools and to the curriculums of physics lessons in secondary schools.
- Science and physics educational seminars supported by technological tools such as graphical calculator, CRL, CBR, etc. should be given to the teachers.
- INSET seminars about the introduction and effective usage of available tools-equipment related with educational technology and ICTs at schools.
- INSET seminars mentioned above may consist of following phases: showing the presence of technology, informing teachers of developments in technology and making them conscious of technology. These seminars may be scheduled as follows: One day for showing the presence of technology, two days for informing teachers of technology and one week for making teachers conscious of technology.

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