THE EFFECTS OF PROBLEM SOLVING SKILLS ON TEACHING TECHNOLOGIES AND MATERIAL ASSISTED SCIENCE AND TECHNOLOGY EDUCATION ON PRIMARY SCHOOL 5TH YEAR STUDENTS[1]

(ÖĞRETİM TEKNOLOJİLERİ VE MATERYAL DESTEKLİ FEN VE TEKNOLOJİ ÖĞRETİMİNİN, İLKÖĞRETİM 5. SINIF ÖĞRENCİLERİNİN PROBLEM ÇÖZME BECERİLERİ ÜZERİNDEKİ ETKİSİ)

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ABSTRACT

The aim of this research is to determine the effects of Teaching Technologies and Material Assisted Science and Technology Education on the Primary School 5th Year Students' Problem Solving Skills. Through the aim, the effects of the software that was prepared on the subject of Science and Technology course "the earth, the sun, and the moon" on the primary school 5th year students' problem solving skills. This study which is semi-experimental that is appropriate to "pre-test, post-test control grouped" model was held with 56 students who were in the 5th year at Cumhuriyet Primary School in Keşap district in Giresun province during 2009-2010 academic year. As a data collecting tool, "Problem Solving Inventory for Children" (PSIC) that was prepared by Serin, Bulut Serin & Saygılı (2010) towards the 1st grade students was used. In the analysis of the data, mean, standard deviation, and in order to compare the results of pre-test, post-test, Mann Whitney-U test were used and after the normality of the data and equivalence of pre-test scores were tested, whether there was significant differentiation before and after experimental operation was determined by using Co-varience analysis (ANCOVA). As a result of this research it was seen that the program that was registered was not effective on problem solving skills of the students.

Keywords: Science and technology program, constructive science and technology education, teaching technologies and materials, primary school 5th class, problem solving skill.

ÖZ

Bu araştırmanın amacı; Öğretim teknolojileri ve materyal destekli fen ve teknoloji öğretiminin, ilköğretim 5. sınıf öğrencilerinin problem çözme becerileri üzerindeki etkisini belirlemektir. Bu amaç doğrultusunda Fen ve Teknoloji dersi "Dünya, Güneş ve Ay" konusunda hazırlanan yazılımın ilköğretim 5.sınıf öğrencilerinin, problem çözme becerilerine etkisi araştırılmıştır. "Ön-test, Son-test kontrol gruplu" modele uygun yarı deneysel bir çalışma olan bu araştırma, 2009–2010 eğitim-öğretim yılında Giresun İli, Keşap İlçesi Cumhuriyet İlköğretim Okulunda beşinci sınıfa devam eden 56 öğrenci ile yürütülmüştür. Araştırmada veri toplama aracı olarak Serin, Bulut Serin & Saygılı (2010) tarafından I. Kademe öğrencilerine yönelik geliştirilen "Çocuklar İçin Problem Çözme Envanteri", kullanılmıştır. Araştırmada elde edilen verilerin analizinde; aritmetik ortalama, standart sapma ile iki grubun ön-test, son-test sonuçlarının karşılaştırılmasında Mann Whitney-U testi ve verilerin normalliği ile öntest puanlarının denkliği sınandıktan sonra deneysel işlemin öncesinde ve sonrasında gruplar arasında anlamlı bir farklılık olup olmadığı *kovaryans analizi* (*ANCOVA*) kullanılarak saptanmıştır. Bu araştırmanın sonucunda uygulanan programın öğrencilerin; problem çözme becerilerini anlamlı düzeyde arttırmada etkili olmadığı görülmüştür.

Anahtar Sözcükler: Fen ve teknoloji programı, yapılandırmacı fen ve teknoloji öğretimi, öğretim teknolojileri ve materyalleri, ilköğretim beşinci sınıf, problem çözme becerisi.

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INTRODUCTION

1.1. Problem

In Science and Technology Curriculum, which bases on constructivist education, and in which student centered teaching comes into prominence, it is aimed that all students are educated as science and technology literates regardless of their individual and cultural differences. Science and technology literacy is usually explained as that individuals improve their study, questioning, critical thinking, problem solving and decision-making skills, that they become individuals who learn throughout life, and a combination of skills, attitude, merits, understanding and knowledge about science which are necessary to maintain curiosity sense about the world around them (MEB, 2004). Constructivist education concept is, however, defined as that training activities are organized according to constructivist approach (Özden, 2003, p68). This is a theory which is about information and learning grounds on creating the knowledge basically (Demirel, 2000, p, 233). In this respect, we can state, in the light of literature, the points to pay attention for constructivist science and technology education in this way:

- Short or long term observations should be carried out according to the subjects on discussing the subject (Kaptan, 1999, p144)
- Laboratory works should be practiced for students to learn the science subjects more efficiently and more meaningfully (Çepni, Akdeniz & Ayaş, 1995)
- Mind maps should be used to provide that students learn comprehending and to reduce misunderstanding (Kaptan & Korkmaz, 2001)
- Modern science education, which bases on experiment, study and discussion, should be allowed for (Gürdal & Yavru, 1998).
- Experiments which allow students to learn by performing and living should be made (Ergin, Pekmaz & Öngel, 2005).
- Presentations in which students can take a part should be allowed for (Gözütok, 2000, p62).
- Projects and research tasks which students can do individually or in group should be given (Özden, 1998, pp.164-168).
- In science and technology education, student-centered methods and techniques should be used. On the other hand, explanation method should be applied in cases of drawing attention of the students to a new unit or subject, summarizing a new lesson or unit, giving an initial idea to the students about the experiments and observations to perform, etc. (Akgün, 2001, p104).

▪ It should be elaborated to use alternative assessment approaches in science and technology education. (Korkmaz, 2004). In other words, in addition to multiple choice tests or short-answered open ended tests, it should be cared to assess students by using some which are suitable for himself/herself of personal development files, attitude scales, personal interviews, reports, projects, mind maps, puzzles and observations (Kılıç, 2001, pp.15-19).

Educational technology deals with how to reach the goals determined in education at the earliest and in the most effective way. Therefore, it focuses on the educational environment which is essential to make individuals gain the desired behaviors and on the organization of living and non-living sources to take parts in these environments (Hızal, 1991, p.6). Instructional technology, on the other hand, means the operation of the guidance of the relevant learning intended for the instruction of a subject (Alkan, 1998, p17-19). Instructional technology in sciences means the structures and the processes related with the effective enforcement of the present man power and other sources to fulfill special goals determined for the instruction of sciences (Uşun, 2000, p.41). In a sense, it means a systematic approach which includes designing, execution and evaluation of the teaching-learning processes to provide effective education in the fulfillment of special goals (Ergin, 1995, p.6). Students have more affluent learning experiences in educational environments which are supported with instructional technologies and materials (Halis, 2002, pp.111-116). In other words, using technology in educational environments presents more affluent educational environments to the students, arouses interest, increases motivation and makes them recall their old knowledge about the subject (İşman, 2003).

In this research, which is supposed to support the efforts to raise and improve the effectiveness of science and technology education in primary schools, it is aimed to reveal the effectiveness of instructional technologies and materials in acquisition of basic knowledge, skill and merits which are anticipated in constructivist science and technology education process. The development level of students' problem-solving skills of educational software-assisted curriculum prepared in accordance with this objective was examined. Problem-solving skill is the cognitive, sensual and social skills which are used in the process to overcome the difficulties which the individual encounters to reach his goal (Bingham, 2004). These skills, which help the individual, overcome the difficulties he encounters better, appear in the skills which are possible to learn or improve and considered necessary to gain especially in early ages. Problem cases which may occur at any time in life and requires making a mental effort usually appear when the individual meets with obstacles reaching a goal. The aim is to remove that hindering obstacle (Cüceloğlu, 2003, pp.219-222). In the process of overcoming the encountered

difficulties, the individual has to make the necessary effort for the solution of the problem using his own knowledge and skills instead of waiting for others to make a decision or help. Therefore, he has opportunity to develop his self-respect and self-esteem feelings beside his personal talents (Bingham, 2004, pp.26-36).

In addition, the researches made for problem-solving skills clarify many benefits of the process about the need for the education of these skills. It shapes the social attitude of the child. It provides the child with opportunities to have healthy and good relationships with his family, peers and other people. The child learns how to behave others, and to deal with the difficulties he meets in society (Ekşi, 1990). It helps the individual improve his ability to develop applicable strategies to cope with problems and to adjust these strategies to a given problem case when it is necessary (Sezgin et al., 1998). It is possible to implement this process with any mains and to make individuals gain these skills, for problem-solving is a process which includes cognitive, sensual and psychomotor activities (Kalaycı, 2001). It helps the individual develop his personality traits. It can be effective for the individual to have an objective opinion, not to get too anxious and to be impulsive (Saygılı, 2000). It is useful to eliminate hypobulias experienced meeting with obstacles and obviation situations in daily life (Albayrak, 2002). Problem-solving makes it easier for the child to develop and to be adequate by discovering his own abilities (Erden & Akman, 2002). It contributes to them to grow as the individuals who hold by their own decisions, can think critically and analytically, can dare to solve different problems they meet and take responsibility to overcome the obstacles (Bilen, 1999). The problem-solving experiences which children have had before substantially affect their achievements and attitudes in problem-solving. Successful problem-solving experiences increase their self-esteem (Kasap, 1997).

1.2. Research Question
How is the effect of teaching technologies and materials assisted science and technology education on the 5th year primary school students?

1.3. Hypothesis
This hypothesis is tested bound to the research question:
When pre-test problem solving scores of experimental group where teaching technologies and materials assisted science and technology education was used and control group where the activities that are only in the program of secience and technology course were analysed, there is a significant difference in favor of experimental group among post-test problem solving skills score means.

1.4. The Aim and Importance of the Research

The main aim of the research is to try efficiency of teaching technologies and materials use in the primary school 5th year science and technology education course; to evaluate the effect of it on the development level of problem solving skills of the students. This research that was held through this aim is seen important on account of contributing to usage of constructive course softwares that make students active; provide them to construct their own knowledge by themselves in education and teaching. In the era of information and communication, as a result of the need to profit from the facilities that computer technologies provide, it is seen necessary to analyse how and in which aspect the effects of the technology applications in teaching and learning on problem solving skills of the students.

1.5 Assumptions

Basic assumptions are in this research are as follows:

- Students gave right and reliable answers to the data collecting tools.
- Measurements during the research, reflects the true state of the students.
- Variables that cannot be controlled affected both groups at the same level.
- Students attended to studies as volunteers.

1.6 Limitations

Research is limited by the following points:

- 56 students who were in the 5th year at Cumhuriyet Primary School in Keşap district in Giresun province during 2009-2010 academic year.
- The teaching subject in the research was 5th year Science and Technology course "the earth, the sun, and the moon" in the area of "the earth and universe"
- The teaching technologies and materials software that covers the subject "the earth, the sun, and the moon"
- 3 weeks and total 12 hours
- Testing hyphothesis.

METHOD

In this part, research model, working group, data collecting tools, data collection and analyzing data are stressed.

2.1 Research Model

The effect of Teaching Technologies and Material Assisted Science and Technology Education on the Primary School 5th Year Students' Problem Solving Skills was searched. The independent variable of this research, in which pretest-posttest control grouped semi experimental design was used, was software in which "teaching technologies and materials" were used; and the dependent variable was students' problem solving skills. In this context, whether the independent variable was effective on dependent variable was tested in the research.

In this study, two groups, one of them was experimental group and the other was control group, were constituted by random sampling. In control group, activities in 2009-2010 academic year Science and Technology program was applied and in experimental group, in addition to activities in Science and Technology program a learning package assisted teaching that was applied. Teaching material that used in experimental group covered teaching subject of Science and Technology course "the earth, the sun, and the moon" in the area of "the earth and universe". Educational program that was used in the research was prepared by using the program Macromedia Flash 8. In the model that was used, some measurements were done to both groups before and after the experiment. In other words, measurement tools that were given to the groups before the experimental operations as pretest were given as posttest after experimental operations. The experimental design of the research is given in the Table 1.

Table 1. Experimental Design of the Research

Group Number	Group Name	Pre-test	Applied program	Post-test
01-R	E	PSIC	MNE (Ministry of National Education) Science and Technology Teaching Program in which Teaching Technologies and materials are used	PSIC
02-R	C	PSIC	MNE Science and Technology Teaching Program	PSIC

2.2. Sampling

Sampling of this study which is semi-experimental that is appropriate to "pre-test, post-test control grouped" model consisted of 56 students who were in the 5th year at Cumhuriyet Primary School in Keşap district in Giresun province during 2009-2010 academic year. The study was held by two groups, one of them was experimental group, the other was control group that were constructed by random sampling. In the study, significance level of the

difference between two groups and statistical analyses of the data that was acquired as a result of the measurements before and after the experimental operations were analyzed.

2.3. Data collecting tool

In this research that was held in order to determine the effects of Teaching Technologies and Material Assisted Science and Technology Education on the Primary School 5th Year Students' Problem Solving Skills, "Problem Solving Inventory for Children" (PSIC) whose validity and reliability studies were done by Serin, Bulut Serin & Saygılı (2010) was used as a data collecting tool.

Table 2. Application Steps of PSIC

MEASUREMET TOOL	The AIM of MEASUREMENT TOOL's USAGE	In WHICH STEP IT WAS USED	
		PRETEST	POSTTEST
Problem Solving Inventory for Children (PSIC)	It was used in order to determine the effects of Teaching Technologies and Material Assisted Science and Technology Education on the Primary School 5th Year Students' Problem Solving Skills.	X	X

The inventory that was developed towards self perception of the students at primary school level about problem solving skills of the students in order to measure problem solving approach and behavior consists of 24 items and 3 factors. Information about reliability of sub-factors and the entire inventory is given in Table 3.

Table 3. Cronbach Alpha Values of Sub-factors

	n	Trust for Problem Solving Skills	Self-control	Avoidance	Total
Cronbach alpha	568	0,85	0,78	0,66	0,80
Test-retest reliability	100	0,84	0,79	0,70	0,85

PSIC, 5 likert type that is scored 1-5, is a personal evaluation scale that measures individual's self-perception about problem solving skills. Score range is 24-120. While the scores were being calculated, scores of items that reflects self-control and avoidance tendency and all of which are in the second (18, 19, 20, 21, 28, 49, 58) and third (41, 43, 59, 62, 64) factor were coded as opposite. Higher scores got from the scale show that individuals percept themselves as adequate about problem solving. Items about sub-factors of the scale are given in Table 4.

Tablo 4. Sub-factors of the Scale and Related Items

Factors	Item No	Items
Factor 1 (trust to problem solving skills)	2	Instead of escaping, I try to solve my problem.
	10	I try to be calm when I encounter a problem.
	11	I believe everybody can experience problems that I have experienced.
	12	I don't give up the solution I have found until it works.
	14	If I have problems, I always ask questions to myself and seek solutions.
	29	I try all the ways of solutions in order to get rid of the problem I encountered.
	32	First of all I try to find the root of the problem.
	33	I try hard till I find a solution instead of escaping them.
	36	I behave patiently and decisively against problems.
	52	I ask for help from my parents or friends when I cannot solve the problem.
	53	In general, I can find creative and effective solutions to my problems.
	54	When I encounter a problem I believe that I can solve the problem by thinking all the ways of solution.
Factor 2 (Self-control)	18	Whenever I have a problem, I feel pessimistic and I cannot get over easily.
	19	If I have question marks in my mind, I am angry and I say words that I don't want to.
	20	When I have a problem, I suddenly become sad.
	21	I couldn't get over for a long time when I have a problem.
	28	I don't want to do anything when I cannot solve my problems.
	49	I cannot adapt to the course when I have a problem.
	58	When I have a problem with my friends, I fight with them instead of speaking.

	41	I have many excuses in order to escape my duties and responsibilities.
	43	When I have a problem, I think I cannot solve it whatever I do.
Factor 3 (Avoidance)	59	In general, I am not good at solving my problems.
	62	When I have problems, behaving like an infant makes me feel relaxed.
	64	When I have a problem I give up everything instead of seeking the ways of solution.

The inventory consists of three factors "Trust for Problem Solving Skills" (12 items), "Self Control" (7 items) ve "Avoidance" (5 items) and 24 items; this inventory is the first and original inventory about how primary school students percept themselves on the problem solving skills. Studies about measurement tools whose Turkish validity and reliability studies have done on problem solving skills in Turkey are shown in Table 5.

Tablo 5. Studies on Problem Solving Inventory in the Literature

Data Collecting Tool	*To Whom It is Applied*	*Researchers*
Problem Solving Inventory	Adult	Heppner & Peterson (1982)
Problem Solving Inventory	Adult	Taylan (1990)
Problem Solving Inventory	Adult	Şahin, Şahin & Heppner (1993)
Problem Solving Inventory	University Students	Yaman (2003)
Interpersonal Problem Solving Inventory	High school students	Çam ve Tümkaya (2008)
Problem Solving Inventory for children	Primary school students	Serin, Serin ve Saygılı (2010)

Reference: Serin, Bulut Serin ve Saygılı (2010)

2.4. Analysis of the Data

SPSS 12.00 was used in the statistical analysis of the data that were acquired from the measurement tools that was given as pre-test, post-test. .05 was accepted as the significance level in the interpretation of the data (Büyüköztürk, 2004).

In order to test the hypothesis of the research these statistical analyses have been done. Mann Whitney-U test were used and after the normality of the data and equivalence of pre-test scores were tested, whether there was significant differentiation before and after experimental operation was determined by using Co-varience analysis (ANCOVA).

FINDINGS AND INTERPRETATIONS

Findings that were held as a result of application of the software are interpreted statistically in this section. Data that were held as a result of the research analyzed by using appropriate techniques and these analyses are interpreted bound to the hypothesis by drawing tables. Therefore, the effect of Teaching Technologies and Material Assisted Science and Technology Education on the Primary School 5th Year Students' Problem Solving Skills is interpreted as experimentally.

In order to evaluate the efficiency of the educational software scores that were acquired by experimental and control groups from the "Problem Solving Inventory for Children" (PSIC) are taken into consideration. Statistical analysis, findings and interpretations are given in tables below.

3.1 Findings about data

The hypothesis of the research is expressed as "When pre-test problem solving scores of experimental group where teaching technologies and materials assisted science and technology education was used and control group where the activities that are only in the program of secience and technology course were analysed, there is a significant difference among post-test problem solving skills score means."

In order to evaluate the efficiency of the educational software scores that were acquired by experimental and control groups from the "Problem Solving Inventory for Children" (PSIC) are taken into consideration. In terms of skill scores as an indicator of efficiency, the effect of the software was tried to determine by comparing groups in themselves and between groups. Towards this aim, significance level of difference between pre-test and post-test scores was analyzed.

Means, standard deviation values, modified post-test means and standard error values of students' pre-test, post-test skill scores from the problem solving inventory in experimental and control groups are shown in Table 6

Table 6. Means, Standard Deviation Values, Modified Post-test Means and Standard Error Values of Students' Pre-test, Post-test Skill Scores from the Problem Solving Inventory in Experimental and Control Groups

GROUPS	N	PRE-TEST		POST-TEST		MODIFIED POST-TEST	
		X	SD	X	SD	Xd	Se
Experiment	29	84,48	13,76	82,68	13,05	82,31	2,23
Control	27	82,25	13,96	82,74	12,58	82,13	2,31

When the Table 6 is analyzed; while pre-test scores of the students in experimental group in which teaching technologies and materials assisted science and technology education was used are ($\overline{X}$ =84,48), it is seen that their modified post-test scores are ($\overline{X}$ =82,31) after experimental operations. While pre-test scores of the students in control group in which activities that are only in the program of secience and technology course were used are ($\overline{X}$ =82,25) and it is seen that their modified post-test scores are ($\overline{X}$ =82,13) after experimental operations.

ANCOVA test results that were registered in order to analyze whether there is a significant difference or not are given in the Table 7.

Table 7. ANCOVA Results that Belong to Pre-test, Post-test Problem Solving Score Means of the Students in Experimental and Control Groups

Variance Source	KT	Sd	KO	F	p
Problem Solving Skill	1239.40	1	1239.40	8.58	.005
Group (E /C)	9.32	1	9.32	.065	.800*
Error	7647.99	53	144.30		
Total	8887.42	55			

*p>0.05

When ANCOVA results that belong to pre-test, post-test problem solving score means of the students in experimental and control groups that is shown in Table 7 were analyzed, it seen that groups do not differentiate in terms of modified problem solving score means (F=.065 p =.800).

RESULTS, DISCUSSION AND SUGGESTIONS

The result below was acquired under the light of research data.

When pre-test problem solving scores of experimental group in which teaching technologies and materials assisted science and technology education was used and control group where the activities that are only in the program of secience and technology course were analysed, a significant difference in favor of experimental group among post-test problem solving skills score means was not determined.

As a result of the research, a significant difference in favor of experimental group was not determined when the problem solving skill scores of the group in which teaching technologies and materials assisted science and technology education was used compared to. This situation shows us that applied educational software is not effective in increasing problem solving

skills at significant level. Therefore, it can be said that the students of the group in which educational software assisted teaching program is applied in addition to current program are as successful as the students of the group in which current program is applied.

Suggestions
These suggestions are given according to the results of research.

When the affective characteristics of the students are taken into the consideration, new methods should be tried to be found that do not decrease interaction and emotional ties between the teacher and the students in the environments in which softwares or computers are used as learning tools.

Education applications which contribute students to develop problem solving and scientific process in addition to learning basic concepts and principles should take part in heavily.

Determining different variables' or different subjects' effects on problem solving skills with a long lastiong applications can be suggested.

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