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THE EFFECT OF INTERACTIVE COMPUTER SOFTWARE AND VISUAL MATERIALS ON ACADEMIC SUCCESS IN PHYSICS

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Abstract:
This study researched the effect of interactive computer programs and visual materials on the success and retention of physics lesson. Inclined projectile motion was selected as the subject. While the lessons were taught with interactive physics, various visual computer programs and the support of computer in the experimental group, they were taught according to the conventional teaching method in the control group. As a consequence, it was aimed to compare the effect of these two applications upon the academic success and retention of learning. The sample of the study was consisted of 84 students receiving education at a secondary school in Ankara. Pretest-posttest experimental design with control group was used in the study. According to the t-test results of independent groups that were performed on experimental and control groups after teaching, it was concluded that the teaching, which was performed on the experimental group with interactive computer programs and visual materials, were more successful compared to the teaching, which was performed on the control group with conventional methods. At the end of the study, the required suggestions were presented according to the data obtained from applications, which were performed with interactive computer programs and visual materials.

Keywords: interactive computer programs, visual materials, conventional method, inclined projectile motion

1. Introduction

Rapid progress of information and communication technology makes it inevitable to avail of these technological facilities in school and class environment, as well. In that

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context, the use of teaching technologies in teaching environments presents students better learning conditions, arouses interest, places the student in the center and increases their motivations. From this aspect, the use of technology plays a significant role especially in the learning-teaching process of interactive education (Isman et al., 2002).

Interactive education is an educational technique, which enables people to receive qualified education via computer units wherever and whenever they desire. Education could be made permanent with the help of visual, audial and probably affective animation techniques that are used within the program (Aydogan, 2008). In the interactive computer assisted teaching method, while the teacher mainly supervises the time-scale progress of the program, summarizes the subject according to the program and enables the information flow; the interaction mechanisms of the systems enable the student to structure her/his own thoughts and try to develop the problem-solving skill of the student and reveal her/his creativity. Teacher leaves the students alone in individual parts of the lesson by including the computer aid within the general lesson plan and s/he emphasizes the basic points related to the lesson by enabling students to listen to her/him in parts, which would be taught in company with the class (Kaya, 2008).

The findings, which support the fact that the use of computer in educational environments enables effective learning, have caused a more effective use of computers in constructivist teaching environments, where the students would participate actively, various learning activities could be applied and students could easily associate different information with one another (Hancer & Yalcın, 2007). General purpose of computer assisted teaching could be expressed as enabling the student to learn according to her/his own speed by individualising the process of learning, providing the complete learning by starting over a subject that has been missed, enabling the subject repetition, having a less cost and increasing the retention by performing the process of teaching with visualization (Tavukcu, 2008). Another purpose of education is to individualise and ease the education. It is not possible to analyse some dangerous or expensive experiments and studies in the laboratory environment empirically. Visual programs and animations enable this ideally and serve for a visual, fast and tenacious learning. Visual programs and animations present all these features in company with color and sound in motion and together with simple graphic symbols that symbolize the nature of motion (Arıcı & Dalkılıc, 2006). It is of a great importance to use interactive computer programs and visual materials in education and especially physical sciences. Physical sciences constitute the method of questioning the accuracy of scientific information or the process of reasoning, comprehending the nature of information and producing new information (Dogan et al., 2003). Many countries consider the scientific problem-solving skills to be the educational target of 2000s. The most efficient way of attaining

this goal is to use the technology for the solution of scientific problems (Halis, 2002). Students get used to comprehend the life through using the scientific information, which are learned by means of the science education they receive (Cepni et al., 1997).

Secondary education is the first phase of attaining the science in a conscious way and the everyday events are also related with physics, chemistry and biology. When the students become scientific literates, this will promote their future lives. Physics lesson is related with events that are encountered by individuals in daily life and explains these events. If the students comprehend the fact that the information of physics lesson are related with their own lives, in other words, if they realize that the information of physics lesson are not abstract, they will learn willingly since their interest in and attitude towards the lesson will increase and by this way, the learning will become more permanent. It is obvious that the physics education is necessary for people to perceive and interpret the technological developments, which affect every phase of life (Bakac & Kumru, 1998). It is required to use the educational technologies in such a way to be effective in the educational condition, in order to enable the students to envisage abstract concepts better, learn on their own with trial-and-error method and in short, to be successful in physics education. A physics lesson that is performed with computer enables the student to learn the complicated concepts and relations between these concepts. Additionally, being different from conventional methods, computers should also be used in an attempt to make the students love the lesson and increase the efficiency of the lesson. It is a well-known fact that today's students are considerably interested in technological developments. The fact that this interest is also shown towards computerized physics education will enable the new-generation students to become individuals equipped with innovations of the era, who can use information and technology efficiently in the following years (Isman, 2002; Saka & Yılmaz 2005). Within the scope of relevant scientific studies, it is mentioned that perceived computer self-efficacy is a significant parameter in using computers (Askar, & Umay 2001; Isıksal, 2003; Isman & Celikli, 2009) and various scales were used to measure perceived computer self-efficacy (Harrison & Kelly, 1992; Torkzadeh & Koufteros 1994; Akkoyunlu, Orhan & Umay, 2005). The basic outcome expected from the education institutes is to train self-learning individuals equipped with knowledge and talents, who can manipulate technology (Akkoyunlu & Orhan, 2003). Among the problems caused by conventional teaching applications are that the information being taught are not permanent, they are memorized for exams and then rapidly forgotten, majority of information are misunderstood by students and that students cannot use the information and skills they learn efficiently in their future lives. Such problems that are caused by the conventional understanding have enabled the educators to develop more effective, efficient and attractive teaching applications (Ergin, 2006).

2. The study

2.1 Model that was used in the study

Experimental model was used in the study. Emphasizing the importance of experimental studies in Science and Technology, Novak indicated that such studies especially support programs, make the students active and reveal a number of features (Yaman, 2003). The basic feature of all these experimental studies is that they can control the independent variables (McMillan, 2000).

2.2 Experimental pattern of the study

Experimental pattern of the study is the experimental pattern with pretest-posttest control group. The variable whose effect was analysed on the experimental group is the computer assisted educational (CAE) approach, where interactive computer programs and visual materials are applied. On the other hand, a conventional learning-based approach was followed in the control group. In other words; no variable was used on this group that would affect the measured features positively or negatively. The same dependent variables were observed on both of the groups and comparisons were made between and within the groups by using the pretest-posttest scores.

Table 1: Experimental pattern of the study

Group	Method	Pre-Test	Post-Test	Retention Test
Experimental	CAE	MCSTIPM	MCSTIPM	MCSTIPM
Control	TM	MCSTIPM	MCSTIPM	MCSTIPM

CAE : Computer Assisted Educational
MCSTIPM : Multiple-Choice Success Test of Inclined Projectile Motion
TM : Traditional Method

2.3 Target population of the study

Target population of this study is consisted of 84 students receiving education at a secondary school in Ankara. Sample of the study, on the other hand, is consisted of totally 84 10th grade students at this school. Among these students, experimental and control groups were selected in an objective and random way. While two departments were determined as the experimental group (2nd and 3rd departments), other two departments were determined as the control group (1st and 4th departments).

Table 2: The number of students in the experimental and control groups

Group	Departments	N
Experimental	2. Department	22
	3. Department	22
Control	1. Department	19
	4. Department	21
Total		84

Examining Table 2; it is seen that there are totally 84 students (44 in the experimental group where "Interactive Computer Programs and Visual Materials" are applied and 40 in the control group where conventional teaching is used).

2.4 Application

The applications that were performed in this study were performed within the scope of "Inclined Projectile Motion". While the subject was taught with the support of interactive computer programs and visual materials in two departments, it was taught with conventional methods in the other two departments. In departments where the lessons were taught with conventional methods, the subjects were written on the board, concepts were expressed verbally and sample problems solvings were performed. In the physics lesson that was taught with the support of interactive computer programs and visual materials, on the other hand, the same subjects were presented to students through a presentation, which was constituted with computer programs and visual materials that were prepared in accordance with the content of the subject, various interactive computer programs and animations were presented to students during the lesson, and an interactive lesson, which would be learned by students through experience, was performed with the help of students who used these programs and animations.

In the study; before the practice in physics lesson, which was taught for 2 lesson hours in a week, students in the experimental group were separated into groups of five and six people. In order to enable the students to use the cooperation time effectively, they were enabled to constitute their own groups, the teacher did not intervene in groups. Group study is a method that is especially effective upon projects, cooperative learning, problem-solving studies and practical studies (Walker & Angelo, 1998). The purpose of separating the students into groups during the application of interactive computer programs and visual materials is to create an environment of competition between the groups and enable them to help one another in cooperation. For it would provide assistance in teaching the subject, a lesson note that was prepared in accordance with interactive computer programs and visual materials was presented to the experimental group and a lesson note that was prepared in accordance with conventional teaching was presented to the control group and steps were taken according to these lesson notes during the lessons of both groups. Besides, interactive computer programs and visual materials were used in an attempt to enable the experimental group students to envisage the subject being taught during the lesson and increase the visual richness. In addition to these programs, animations and performances that were found by the researcher through various resources were presented to students via computer. Interactive computer programs and visual materials were used for experimental group students, on which interactive computer

programs and visual materials were applied. By this way, they could apply these programs and materials through experience and various examples of the subject in the training centers of computer assisted education (CAE). The visual materials that were related with the subject were prepared for students before they came to classes and designed in such a way to draw their attentions to the lesson and the students were required to be occupied with materials during the lesson (Figure 1).

Figure 1: Pictures of pre-prepared lesson with visual support materials

While students are taught inclined projectile motion in the applications of computer assisted education classes, the change of horizontal range and the connection of the angle to the range are analysed by changing the angle of the substance with the horizontal that was thrown during the inclined projectile motion, with the help the interactive physics program in Figure 2. Using the application interactively, the students observed the changes related with the inclined projectile motion as a result of the values they changed. They explored new ideas about the motion. While the lesson was taught via the presentation of these applications, students were enabled to participate in the lesson by changing the variables on applications related with the subject of the inclined projectile motion in the program.

Students were required to exchange opinions within the group via computers in the class and pay their attention to interactive physics program, as well as relevant visual programs, animations and computer shows on the web site without spoiling the groups. Students were also required to observe the incidents and note down the events, shapes on working papers by changing the concepts such as speed, projectile angle, etc. on the relevant displays in this program. Similarly, they were required to note down the necessary details related with the subject by examining the displays and animations on the web site. While students were noting on their papers, answers were sought for the following questions and they were required to pay attention to find answers:

- Pay attention to force or forces that affect the unconstant throughout the projectile motion.
- Pay attention to the acceleration of the unconstant.

- Pay attention to the change on the orbit of the unconstant when the initial speed is increased or slowed.
- Does the change on the initial speed make a change on the advance performed by the substance vertically and horizontally? Pay attention to this (Figure 2).

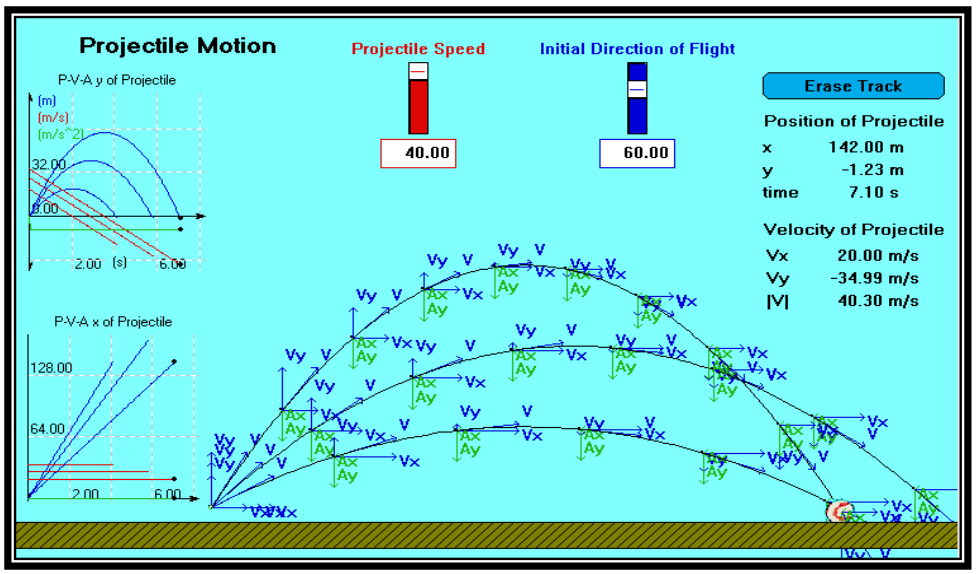

Figure 2. The display image of interactive physics program

Although the students did not experience the events in the display image of Figure 2, they had the opportunity of commanding the event by changing some of the concepts on the computer displays. These activities tried to enable the exploration and comprehension of the subject properly. Students were also required to review and remember the concepts that were theoretically observed throughout this phase. They were required to be very careful observers at this point and this situation was constantly followed.

During the lessons of the experimental group, the experimental apparatus in Figure 3 was established and the students performed applications with inclined projectile gun by changing the angles made with the horizontal. These applications increased both the learning levels of the subject and interest of students in the lesson and subject.

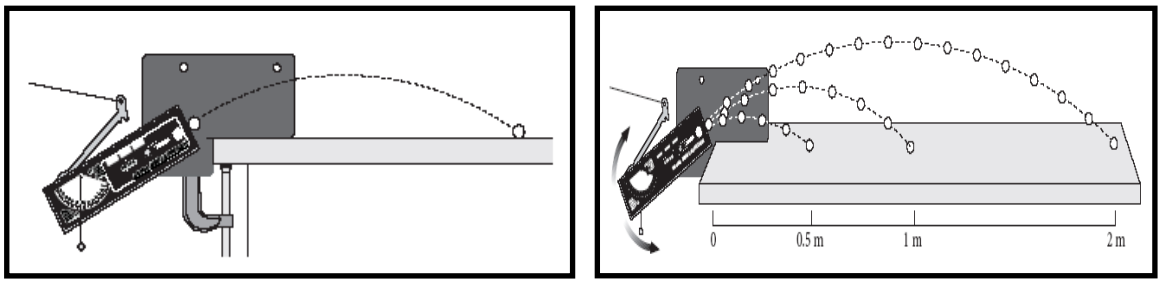

Figure 3: Image picture experimental apparatus

Similarly, during the lessons of the experimental group, visual images in Figure 4, 5, 6 were displayed in the form of a presentation as vital examples.

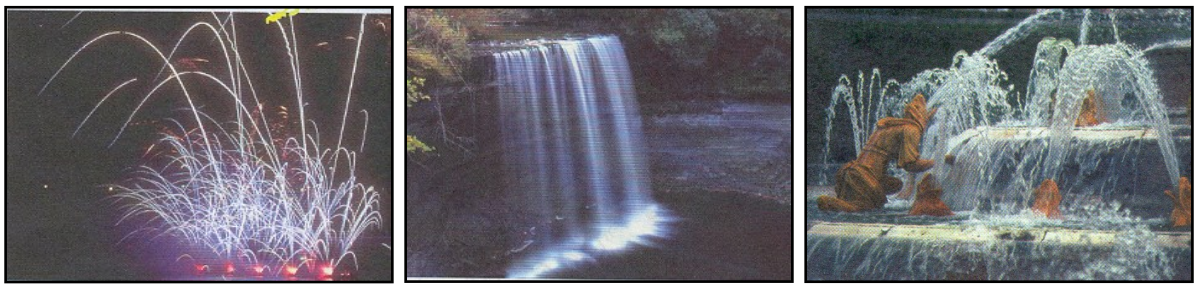

Figure 4: Inclined projectile motion pictures image assisted

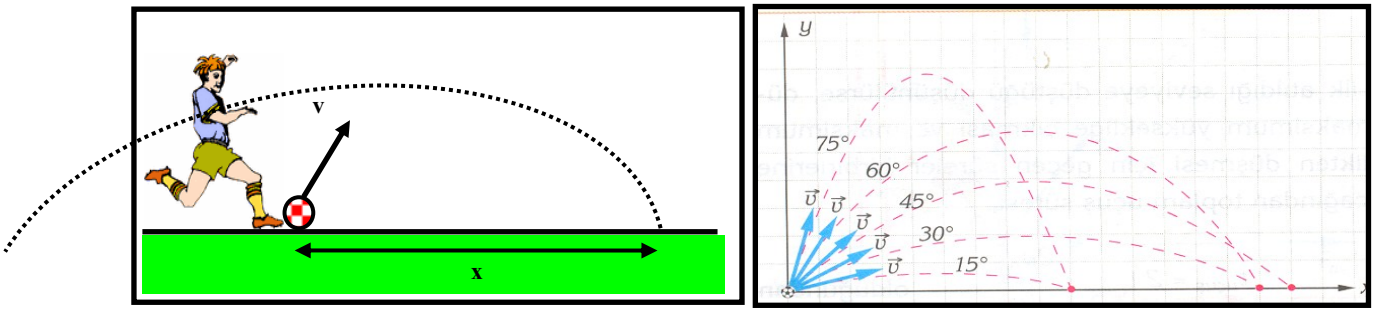

Figure 5: Inclined projectile motion pictures image assisted

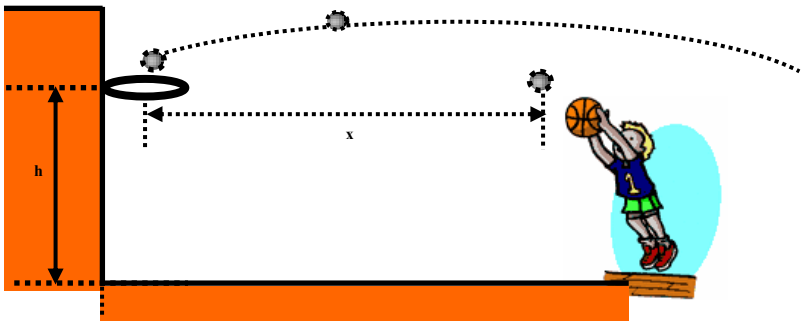

Figure 6: Inclined projectile motion pictures image assisted

During the lessons of the experimental group, the motion of the substance performing inclined projectile motion in Figure 7 and the formulas that were used during the motion are shown on the figure in detail.

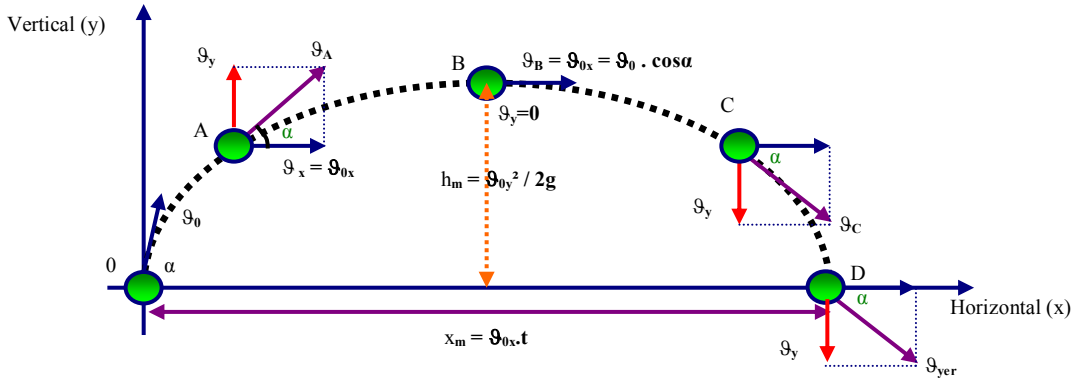

Figure 7: Image display formulas of inclined projectile motion

2.5 Data collection techniques and tools

Independent groups were compared with one another, in an attempt to adjust the similarity levels of experimental and control groups, on which the study would be performed. Statistical techniques that were performed for that purpose became independent groups, t-test and correlation coefficient. Examining these data, the groups were determined to be similar.

In order to measure the academical success levels of students regarding the Inclined Projectile Motion, "Multiple-Choice Success Test of Inclined Projectile Motion" (MCSTIPM) was prepared by the researcher and applied as an assessment instrument. The validity and reliability studies of the test, which was performed before the experimental phase of the study, were implemented by the researcher. Reliability of the MCSTIPM was found as (0.88).

At the end of the study process, MCSTIPM was performed on both of the experimental and control groups as posttest. Additionally, in order to understand which method was more effective upon the determination of retention, MCSTIPM was reapplied 4 weeks after the posttest application, as the test of the determination of retention. In each application of these tests, changes were made on the order of questions and locations of answer options. The data that were obtained from all these tests were entered into the statistical packaged software and analyses were performed by determining the required statistical techniques.

3. Findings

Findings of the data, which were obtained from experimental and control groups where interactive computer programs, visual materials and conventional method were applied, are presented below.

A. Findings that were obtained before the experimental process and the ınterpretations

Pre-experimental process t-test results for MCSTIPM are seen in Table 3.

Table 3: Results of independent groups t-test analyzing about MCSTIPM pre-test scores in relation to students in experimental and control groups

Group	N	$\overline{X}$	s	sd	t	p
Control	40	10.000	3.281	82	.888	.377
Experimental	44	9.386	3.028			

p<0.05

Examining Table 3; two average score values are very close to one another. Whether the difference between these averages was statistically significant was examined through the t-test of independent groups and no significant difference was observed between the groups according to the calculated t value and significance level.

B. Findings that were obtained after the experimental process and the ınterpretations

Post-experimental process t-test results for MCSTIPM are seen in Table 4.

Table 4: Results of independent groups t-test analyzing about MCSTIPM post-test scores in relation to students in experimental and control groups

Group	N	$\overline{X}$	s	sd	t	p
Control	40	18.575	3.062	82	9.809	.000
Experimental	44	24.272	2.128			

p<0.05

Examining Table 4; it is seen that the two average score values are very different from one another. Whether the difference between these averages was statistically significant was examined through the t-test of independent groups and a significant difference was observed between the groups in favour of the experimental group, according to the calculated t value and significance level.

Observing that experimental group was more successful according to the MCSTIPM posttest scores of experimental and control group, the relation between the pretest-posttest scores of experimental and control group were tried to be revealed. Results of the t-test analysis of independent groups, which was performed in an

attempt to determine whether there was a significant difference between pretest-posttest scores of experimental and control groups, are seen in Table 5 and Table 6.

Table 5: Results of dependent groups t-test analyzing about MCSTIPM pre-test post-test scores in relation to students in experimental group

Measurement	N	$\overline{X}$	s	sd	t	p
Pre-Test	44	9.386	3.028	43	23.543	.000
Post-Test	44	24.272	2.128			

p<0.05

Examining Table 5; it is seen that two average score values are very different from one another. As a result of the t-test analysis that was performed for dependent groups, a significant difference was observed between the pretest-posttest scores of the experimental group in favour of posttest scores of the experimental group, in terms of MCSTIPM according to the calculated t value and significance level.

Table 6: Results of dependent groups t-test analyzing about MCSTIPM pre-test-post test scores in relation to students in control group

Measurement	N	$\overline{X}$	s	sd	t	p
Pre-Test	40	10.000	3.281	39	14.856	.000
Post-Test	40	18.575	3.062			

p<0.05

Examining Table 6; it is seen that two average score values are very different from one another. As a result of the t-test analysis that was performed for dependent groups, a significant difference was observed between the pretest-posttest scores of the control group in favour of posttest scores of the control group, in terms of MCSTIPM according to the calculated t value and significance level. Comparing the groups; while the MCSTIPM pretest score average of the experimental group is 9.386 and pretest score average of the control group is 10.000; posttest score average of the experimental group is 24.272 and posttest score average of the control group is 18.575. As is seen in results, although there is no difference in pretest scores of groups, there is a significant difference in posttest scores in favour of the experimental group.

The results of t-test, which was performed on the experimental group students who were taught according to interactive computer programs and visual materials and control group students who were taught according to conventional teaching in an attempt to determine the retention of MCSTIPM 4 weeks after the experimental process, are seen in Table 7.

Table 7: Results of independent groups t-test analyzing about MCSTIPM determination retention test scores in relation to students in experimental and control groups

Group	N	$\overline{X}$	s	sd	t	p
Control	40	14.525	5.602	82	6.642	.000
Experimental	44	21.590	3.907			

p<0.05

Examining Table 7; it is seen that two average score values are very different from one another. Whether the difference between these averages was statistically significant was examined through the t-test of independent groups and a significant difference was observed between the groups in favour of the experimental group, according to the calculated t value and significance level.

4. Conclusions

It is clearly seen that the success of education will increase as the use of interactive computer programs and visual materials is efficiently reflected on education; however, the planning of technological use in education is restricted with the facilities of schools. It is obvious that an education that is planned to be provided with unavailable and unsupported instruments will do more harm than good. The teachings being performed shall always be supported by the use of interactive computer programs and visual materials, in accordance with the facilities of schools. In our country, teachers and students shall be informed about this subject and required projects shall be constituted for education, which is supported by interactive computer programs and visual materials. In-service training of both administrators and teachers has a great importance for the use of interactive computer programs and visual materials in education. Advantages of teaching that is supported by interactive computer programs and visual materials shall be used in bringing features such as the use of scientific method, problem solving, objective thinking, making accurate decisions, learning the learning, which are revealed by contemporary learning and teaching theories, in students and developing those features. Rather than an objective, the teaching method that is supported by interactive computer programs and visual materials shall be considered an instrument that would support teachers and students. Lesson programs that are convenient for the features of information technologies and teaching principles shall be prepared and generalized according to subject contents of the physics lesson. The benefit to be obtained from the method of teaching that is supported by interactive computer programs and visual materials is closely related with the development of effective educational programs. During the preparation of educational programs, which directly affect the success in the application process of the teaching that is supported by interactive computer programs and visual materials, visual program techniques shall be

applied for the purpose of addressing to all of the sense organs. During the application of the method of teaching that is supported by interactive computer programs and visual materials; it shall be taken into consideration that students are supposed to participate in learning actively, students learn with very different ways and speeds and that learning is a process for both individuals and groups. Teaching programs that are supported by interactive computer programs and visual materials shall be prepared in such a way to consider the age group of the target student, convey the information ideally, focus the interest through the effects of color, sound and image, reward the success, support the process of learning with games and make even the most boring or difficult subjests entertaining.

In this study, which was conducted in an attempt to contribute to the assessment of teaching activities that are supported by interactive computer programs and visual materials and have increased together with the inclusion of computers within schools as teaching instruments in parallel with rapid changes in technology, the effect of the subject of Inclined Projectile Motion upon the learning of 10th grade physics students was tried to be determined through the use of interactive physics program, within the scope of experimental method. Before teaching the students this subject, no significant difference was determined between the results of the pretest that was performed on experimental and control groups. In other words, experimental and control groups are on the same level in the beginning, in terms of inclined projectile motion.

Examining the data about the analysis of academical success and retention levels of learning, regarding the experimental and control groups that were used in the study; it is seen that the experimental group is more successful. Besides, examining the successes of the retention test, the experimental group was determined to be more successful.

Regarding the experimental and control groups, their pretest-posttest scores within the group and posttest successes between the groups were compared statistically. As a result of the posttest comparison of both groups, it was concluded that the teaching, which was performed on the experimental group with the help of interactive computer programs and visual materials, was more successful compared to the teaching, which was performed on the control group with conventional methods. This result, which shows that the success that is obtained through interactive computer programs and visual materials are more effective than conventional methods, is supported by some studies (Andoloro & et al., 1997; Rodrigues, 1997). (Kahvecioglu, 2007; Aytun, 2007, Ayvacı, Ozsevgec & Aydın, 2004; Ozmen & Kolomuc, 2004; Yigit & Akdeniz, 2003; Chang, 2002; Jimoyiannis & Komis, 2001; Hacker & Sova, 1998; Yalcınalp, Geban & Ozkan, 1995), Geban, Askar & Ozkan, 1992; Hounshell & Hill, 1989) that are performed on computer assisted teaching.

5. Suggestions

Considering the findings revealed by the study, which examines the effect of the learning environment supported by interactive computer programs and visual materials upon the academical success of the 10th grade secondary education students and the retention; the following suggestions were made for new studies:

- This study examined the effect of interactive computer programs and visual materials upon the academical success of students and the retention, regarding the "Inclined Projectile Motion". In future studies, the effect of interactive computer programs and visual materials upon students of different class and age groups might be examined in different units or different lessons, in terms of various variables.
- Computers and information technology classes at schools shall keep pace with the technological developments of the era in terms of both hardware and software, and be updated.
- Outside of lessons, the computers in the school laboratory shall be opened to the use of interactive computer programs and visual materials related with lessons that are hardly understood by students and students shall be enabled to avail of computers and internet efficiently. By this way, the interest of students in the lesson might be increased.
- In order to make a country-wide generalization with the obtained results, studies shall be conducted with larger student groups that are selected from different regions and schools.
- Teachers shall be supported with the in-service training related with the method of computer assisted teaching and by this way, they will be enabled to avail of technology and especially computers effectively in their lessons.
- Use of technological devices (computer, projection device, multimedia, smart board, etc.) shall be emphasized during the physics lesson.
- Considering on the basis of physics subject, in order to take the heavy mathematical pressure off students and make the physics subjects more understandable, programs, animations and visual materials regarding this subject shall necessarily be included in the educational environment and enabled to be used.
- In order to develop the computer literacy of physics teachers, the required computer infrastructure education shall be provided for teachers during both the undergraduate study and occupational processes.

- Interactive computer programs and visual materials might enable the teaching of difficult physics concepts regarding the inclined projectile motion and the related diagrams and figures could be displayed.
- The use of animations and simulations with interactive computer programs and visual materials might enable the expensive and time-consuming laboratory experiments to be cheaper and less dangerous.

Students' desire of participating in learning activities actively plays an important role in the efficiency of learning. In that context, it was seen in this study that activities where interactive computer programs and visual materials are applied are effective upon motivating students and increasing their desire of participating in laboratory activities. Therefore, a visual teaching to be performed with the help of interactive computer programs and visual materials is thought to make a positive contribution to the student success, in terms of many physics concepts and subjects. However, it should not be forgotten that the use of a program that is well-arranged with interactive computer programs and visual materials is not enough alone and in order to obtain a good efficiency from teaching, the programs to be used shall be supported by instructional programs regarding the relevant subjects and concepts. Additionally, the plan of the subject to be taught shall be revealed in detail and the transactions to be carried out by the student in association with the use of the prepared programs and parameters related with the subject or concept that could be changed on the system shall clearly be defined. It is believed that by this way, the learning will become permanent for the student after the activities, which will be conducted for the physics education within the scope of interactive computer programs and visual materials.

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