Effects of Computer Supported Education on the Success of Students on Teaching of Newton's Laws of Motion

İzzet Kara and Harun Yakar

University of Pamukkale, Faculty of Education, Department of Primary Education,
Division of Science Education, 20020, Denizli, Turkey

Abstract: In this study, it has been focused on proving technology is necessary for physics education, finding hard-proofs on that and how technology would be used effectively on this area. Samples of this research were Pamukkale University (PAU), Education Faculty, Scientific Department of the Turkish Language Teaching first class students who have not any specific physics education. To get an acceptable result, two experimentation groups were compared to control group shaped students educated with traditional methods. This method is experimented first in scientific literature. Research results proved that ones who are members of experiment group were more positively progressed than control group members.

Key words: Computer Based Education % Newton's laws % non-major % Computer Assisted Teaching % physics education

INTRODUCTION

Using technology in teaching environments provides more wide-range alternatives as learning climates, attracts their interests, supports their motivations. This type of using technology plays very important role [1]. As a result of using computers for animations, simulations, improvements visual and audio materials for educational environments, Computer Based Education Concept (CBEC) came to light. It has been necessitated to new educational methods to support traditional curriculum for which not only educational institutes but also other sectors. To improve these new methods using information systems became a must [2]. All completed or ongoing researches indicate that CBEC is more effective than all traditional methods [3-6]. CBEC practices provide that students easily construct all concepts, which are normally difficult to understand, in their brains thorough using animations and interactive simulations. On the other hand, it is generally accepted that after changing some parameteres using simulations are more advantageous than using animations [7].

During our research CBEC applied students were seen as they got more oriented towards physics classes [8-10]. Traditional education couldn't effect students' approach towards both Computer and physics classes [11]. It has been expected that teachers use CBEC to improve abilities of information age community individuals [12-15]. It is possible that to make classes more attractive by preparing some slayt shows on computer. This visual and audio scene enrichment may affect student's concentrations and support their learning processes [16].

MATERIALS AND METHODS

Research Methodology: Nowadays, the computer has established its place in teaching. The question of "how to use the computer efficiently?" has been begun to be researched rather than the efficiency of the computer.

Traditional Teaching Method: The student is in a listener position in the classroom. The student must content with what the teacher presents during the lesson. He/She does not have a right of change in lesson materials and lesson method. The students who use this method have been named as Group-1.

Passive Applied Computer Assisted Teaching Method: In this method, the student is in a viewer position in front of the computer. Program control and program management are performed by the teacher. The students

Corresponding Author: Dr. İzzet Kara, University of Pamukkale, Faculty of Education, Department of Primary Education, Division of Science Education, 20020, Denizli, Turkey

follow the material their teacher presents on computer screens. Students' computers can be controlled from the teacher's main computer with the help of assistant programs. The students can by no means make changes in teaching materials. The students content with what the teacher presents to them during the lesson. In this method, teacher is active, whereas the students are passive. The students who use this method have been named as Group-2.

Active Applied Computer Assisted Teaching Method: In this method, the student is in an active position using the computer. Program control and program management are performed by the students. Teaching materials are installed in all students' computers. The students freely work with computers by themselves and call for teacher's help when needed. The teacher is in the background position in this method. In this method, students are active, whereas the teacher is passive. The students who use this method have been named as Group-3.

In this respect; answers have been seek for the questions "Is there a significant difference between the success levels of students from Group-1 and Group-2? Is there a significant difference between the success levels of students from Group-1 and Group-3? Is there a significant difference between the success levels of students from Group-2 and Group-3?"

Full experimental method has been used in this research. This method is a design that involves an experimental approach in which random distribution is used to assign people to experiment group and control group [17]. This research involves 60 students in 3 groups of 20 students who are in the 1st grade of Turkish Teaching Division in Pamukkale University Faculty of Education. 20 students selected with random assignment constitute the 1st experiment group (Group-1), 20 students constitute the 2nd experiment group (Group-2) and the other 20 students constitute the 3rd experiment group (Group-3). The assignment of these groups as experiment group and control group has been also done with random selection.

In this research, "Force Concept Inventory" developed by Hestenes [18] has been used in answering the questions and sub-questions. Generated "Force Concept Inventory" questions have been applied as pre-test and post-test. Kuder-Richardson reliability of this inventory has been identified as 0.89. Computer lesson software applied in Group-2 and Group-3 has been prepared with the help of Java applets and

Flash. Topics have been formed into presentations one after another. Simulations have been added at the end of each topic. Flexible forward and backward buttons have been installed in each presentation. Questions have been added at the end of each presentation.

In the traditional teaching, students do not have the opportunity to observe the change in force, speed and acceleration which affect the moving object. However; with the generated software, not only force, speed and acceleration values and magnitudes in the requested point in the system can be seen, but also quantitative changes in these variables during movement process can be analyzed. By this way, it has been aimed to make sure that students develop their conceptual understanding by observing these changes. In other words, it has been aimed to enable students who use this software to learn in their speed of understanding and to concretize the abstract concepts in their minds. The data used in the research have been obtained from students' points taken in pre-tests and post-tests.

Pre-test has been applied on all groups before application. The topic has been presented with traditional methods in Group-1. The software has been used with presentation method in Group-2 under the control of the class teacher. Necessary details have been explained with question-answer method and animations. The right of control of the software has been given to students in Group-3. The students in this group have interactively followed the sequence of topic titles in the computer software by themselves. The right of change in the values of the questions in the software has been given to students. Necessary details have been explained with question-answer method and animations. Post-test has been applied on the students of all groups 1 week following the end of topic.

RESULTS AND DISCUSSION

Points taken by the students in pre-test have been observed and t-test has been used to search whether there is a significant difference between the groups or not. t-test has been used as a statistical method to understand whether the difference in the arithmetic averages of the pre-test points of groups is significant or not.

As seen in Table 1, there are differences between the mean scores taken by the groups in pre-test. t-test has been applied for the difference between 2 independent variables to observe whether this difference is significant or not.

Table 1: Pre-test findings of experiment groups

	Number of Subjects	Mean Score	Standard Deviation	Standard Error
Group-1	20	22.6	9.38	2.09
Group-2	20	24.6	12.26	2.74
Group-3	20	26.4	7.58	1.69

Table 2: t-test analysis of the pre-test findings of Group-1 and Group-2

	Number of Subjects	Mean score	Standard Deviation	Standard Error
Group-1 Pre-test	20	22.6	9.383	2.098
Group-2 Pre-test	20	24.6	12.262	2.742
F	Sig	t	Df	p
0.117	0.735	-0.579	38	0.566

$0.05 < p = 0.566 H_0$ accept

Table 3: t-test analysis of the pre-test findings of Group-1 and Group-3

	Number of Subjects	Mean Score	Standard Deviation	Standard Error
Group-1 Pre-test	20	22.6	9.383	2.098
Group-3 Pre-test	20	26.4	7.584	1.696
F	Sig	t	Df	p
2,563	0.118	-1.14	38	0.167

$0.05 < p = 0.167 H_0$ accept

Table 4: t-test analysis of the pre-test findings of Group-2 and Group-3

	Number of Subjects	Mean Score	Standard Deviation	Standard Error
Group-2 Pre-test	20	24.6	12.262	2.742
Group-3 Pre-test	20	26.4	7.584	1.696
F	Sig	t	Df	p
2.029	0.162	-0.558	38	0.58

$0.05 < p = 0.58 H_0$ accept

Table 5: Post-test findings of experiment groups

	Number of Subjects	Mean Score	Standard Deviation	Standard Error
Group-1 Post-test	20	38.8	11.69	2.61
Group-2 Post-test	20	61.0	12.23	2.74
Group-3 Post-test	20	60.8	8.56	1.92

Table 6: t-test analysis for the post-test points between Group-1 and Group-3

	Number of Subjects	Mean Score	Standard Deviationn	Standard Error
Group-1 Post-test	20	38.8	11.687	2.613
Group-3 Post-test	20	60.8	8.569	1.916
F	Sig	t	Df	p
1.974	0.168	-0.579	38	0

$0.05 > p = 0 H_0$ reject H_1 accept

Table 7: t-test analysis for the post-test points between Group-1 and Group-2

	Number of Subjects	Mean Score	Standard Deviation	Standard Error
Group-1 Post-test	20	38.8	11.687	2.613
Group-2 Post-test	20	61	12.230	2.740
F	Sig	t	Df	p
0.139	0.711	-5.868	38	0

$0.05 > p = 0 H_0$ reject H_1 accept

Table 8: t-test analysis for the post-test points between Group-2 and Group-3

	Number of Subjects	Mean Score	Standard Deviation	Standard Error
Group-2 Post-test	20	61	12.23	2.74
Group-3 Post-test	20	60.8	8.57	1.92
F	Sig	t	Df	p
3.457	0.711	0.06	38	0.953

$0.05 < p = 0.953 H_0$ accept H_1 reject

t-test results of two bilateral independent mean scores taken by Group-1 and Group-2 in success test is in 0.05 significance level Table 2. This shows that there is no statistically significant difference between the mean scores taken in the success test.

Table 3 shows that t-test results of two bilateral independent mean scores taken by Group-1 and Group-3 in the success test is in 0.05 significance level. This indicate that there is no statistically significance difference between the mean scores taken in the success test.

As it is seen in Table 4, t-test results of two bilateral independent mean scores in points taken by Group-2 and Group-3 in success test is in 0.05 significance level. This shows that there is no statistically significance difference between the mean scores of points taken in success test. These results point out that there is no statistically significance difference between the mean scores of success test points. These values indicate that the subjects in the experiment groups that have participated the research are equal in terms of knowledge according to their t-test results.

Findings on Research Question: The findings have been given in Table 5 on whether the difference between the mean scores of the pos-test points of students in Group-1 and Group-2 is significant or not.

As it is understood from Table 5, the difference between the mean scores of Group-1 and Group-3 is 22.0. t-test has been applied for the difference between two

independent mean scores to observe whether this difference is significant or not (Table 6).

When this difference has been examined with t-test whether it is significant or not, it has been in 0.05 (95%) significance level. In view of this finding, there is a significant difference between the two groups. A significant difference in favor of Group-2 has been found between Group-2 and Group-3. According to this, Group-3 is more successful than Group-1.

Findings and Opinions on Research Question: As it is understood in Table 5, the difference between the mean scores of Group-1 and Group-2 is 22.20. t-test has been applied for the difference between two independent mean scores to observe whether this difference is significant or not Table 7.

When this difference has been examined with t-test whether it is significant or not, it has been found as 0.05 (95%) significance level, $0.05 > p = 0$. In view of this finding, there is a significant difference between the two groups. A significant difference in favor of Group-2 has been found between Group-1 and Group-2. According to this, Group-2 is more successful than Group-1.

Findings and Opinions on Research Question: As it is understood in Table 5, the difference between the mean scores of Group-1 and Group-2 is 0.20. t-test has been applied for the difference between two independent mean scores to observe whether this difference is significant or not Table 8.

When this difference has been examined with t-test whether it is significant or not, it has been found as 0.05 (95%) significance level, $0.05 > p = 0.953$. In view of this finding, there is no significant difference between the two groups. Success rates of both groups are the same. No group has scored over the other group. This has showed that Computer Assisted Teaching Methods has more positive results on the students than the traditional teaching and it improves students' success in physics lesson. When Group-2 and Group-3 is compared, the fact that student's mean scores is high in the first condition where he/she is in a passive position leads to conclusion that he/she is more successful. However, it is observed in the statistical analysis that this difference is not significant.

When the data obtained in this section is examined generally, it is seen that the teaching given to experiment groups with dynamic system simulation program has been more successful than the teaching given to control group with traditional methods. In other words, it is observed that the understanding level of experiment group students

on the related topic is higher than the other group. The result which occurred in favor of experiment group after the performed teaching holds parallelism with the results of researches performed in the related field on different topics and concepts [5]. Similarly; in the concept teaching performed with computer simulations, Hewson [19] has succeeded in speed concept, Tao [20] has succeeded in mechanics concepts and Pena & Alessi [21] have succeeded in free fall subject.

It has been observed that Computer Assisted Teaching not only improves success but also develops higher level thinking abilities of students and students learn by comprehension rather than memorizing [22]. In a study conducted on the contributions of computer assisted teaching in chemistry teaching, it has been found that the students who make use of computer assisted teaching in addition to traditional teaching method is more successful and there is a positive increase in their attitudes towards chemistry [23, 24]. He has shown that Computer Assisted Teaching method is more successful than the other methods in improving the attention in science lessons. It has been found that Computer Assisted Teaching is more successful when compared with traditional teaching methods [4-6].

This condition shows that teaching of "Newton's Laws of Motion" performed with simulation in the scope of Computer Assisted Teaching is a more productive approach than the teaching performed with traditional methods in terms of improving the student success and concept teaching. Like this research, some researchers conducted on science concepts have shown that concept teaching success has not been obtained in the required levels with the traditional teaching methods [25, 26]. On the other hand, the efficiency of teaching performed with simulations has been taken into account and various applications have been developed accordingly [27].

CONCLUSIONS AND RECOMMENDATIONS

It has been aimed to determine the effect of the related with "Newton's Laws of Motion" on the student success by using animations and interactive simulations in the scope of experimental method.

"Force Concept Inventory" has been used to test the efficiency of application methods. t-test has been used for the difference between two independent averages as a statistical method in the analysis of data. Significance level has been determined as 95%. The primary results obtained in the research are as follows:

1- There is a significant difference between success levels of students from Group-1 and Group-2. Group-2 has been found as more successful.

2- There is a significant difference between success levels of students from Group-1 and Group-3. Group-3 has been found as more successful.

3- No significant difference has been observed between success levels of students from Group-2 and Group-3. Success levels of both groups have been examined with t-test and it has been found that both groups are equal. In view of this, it can be stated that Group-2 and Group-3 affect student success level equally.

The wish of students to actively participate the learning activities plays an important role in the efficiency of the learning. In this respect, it is known that Computer Assisted Teaching activities are effective in motivating students and improving their wishes to participate laboratory activities [28]. Thereby, it is assumed that a visual teaching with Computer Assisted Teaching will make positive contributions in student success in science topics and concepts.

This study has shown that the same learning condition can be provided with a single computer controlled by a teacher with adequate computer knowledge instead of giving a computer to each student.

RECOMMENDATIONS

Since technical knowledge is required in computer assisted teaching, the students may need help in many subjects in the beginning. Basic computer skills must be given to students before such activities.

1. Class settlement order must be arranged to provide class control in Computer Assisted Teaching method and all computers must be seen by the teacher.
2. The software to be used in the lesson presentation must be prepared by specialist individuals.

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