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The Investigation of Effects of Modelling and Computer Assisted Instruction on Academic Achievement

(Model Oluşturma ve Bilgisayar Destekli Öğretimin Akademik Başarı Üzerindeki Etkilerinin İncelenmesi)

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Abstract: The study aimed to investigate the effects of modelling and computer assisted instruction (CAI) on academic achievement of the students. For this purpose, the study was conducted with 132 second grade students who were attending Education Faculty, Science and Technology Education Department of 19 Mayıs University. Students were distributed into three groups as control, modelling and computer assisted instruction groups and the topic of cell division was taught by the use of three different methods. According to the pre and post-test results, there were significant differences between the groups in terms of academic achievement. Whilst control group students to whom topics were taught by the use of traditional method were found the less successful group, modelling group was found the most successful group. Study results revealed that students to whom topics were taught by the use of supplementary tools were more successful.

Keywords: cell division, modelling, computer assisted instruction (CAI)

Öz: Bu çalışmada, model oluşturma ve bilgisayar destekli öğretimin öğrencilerin akademik başarısını nasıl etkilediği incelenmiştir. Bu amaçla Ondokuz Mayıs Üniversitesi, Eğitim Fakültesi, Fen Bilgisi Öğretmenliği 2.sınıf öğrencilerinden 132 öğrenci ile hücre bölünmesi konusunda çalışma yapılmıştır. Çalışmada, kontrol grubu, modelleme grubu ve bilgisayar destekli grup olarak üç grup oluşturulmuş ve hücre bölünmesi konusu üç farklı yöntemle anlatılmıştır. Yapılan ön test- son test başarı testleri sonucunda gruplar arasında önemli farklar olduğu gözlenmiştir. Geleneksel öğretimin yapıldığı kontrol grubu en başarısız grup olarak belirlenmiş ve en başarılı grup ise modelleme grubu olmuştur. Öğrencilerin yardımcı öğretim araçları kullanıldığında daha başarılı oldukları ve özellikle yaparak daha iyi öğrendikleri saptanmıştır.

Anahtar kelimeler: hücre bölünmesi, modelleme, bilgisayar destekli öğretim

Introduction

Biology as an exact science is hard to be learnt due to its abstract concept and large curriculum. Teacher-centered or old-fashioned analogue way of teaching methods and strict involvement of course books make biology courses boring and make it difficult for the students to learn abstract concepts (Yaman & Soran, 2000; Tekkaya et all, 2000). Despite have been taught repeatedly in educational process, the topic of cell division were considered difficult and can not be learnt thoroughly by the students (Bahar, Johnstone & Hansell, 1999; Tekkaya, Özlem & Sungur, 2001; Güneş & Güneş, 2005).

As cell division can only be imaged at microscopic level, some conceptual errors can occur during learning process and it is hard for the students to grasp the subject thoroughly (Kindfield, 1994; Lewis, Leach & Wood-Robinson, 2000). Atılboz (2004), stated that teaching through concrete teaching with supporting materials at microscopic level may help preventing conceptual errors by making abstract knowledge formed as concrete. True and permanent learning and can only be achieved when teaching method involves more than one sense (Demirel, 2002). Therefore, to achieve an easy and permanent learning it would be helpful using supporting teaching tools in education process. Educational technological tools play an important role in concretizing such abstract concepts according to the students' level and presenting as if alive, meaningful learning and observing incidents repetitively (Akpınar, Aktamış & Ergin, 2005).

In previous studies, it was suggested that using computers as supporting teaching tools, affect students' understanding and performance positively and help students for mental configuration (Akarsu et all, 1988; Sezgin & Köymen, 2002; Atılboz, 2004). Computer assisted instruction (CAI) is a teaching method which is formed by combining interactive learning principles and computer technology in which computer is used as a supporting device for the teacher in teaching and strengthens teaching process and students' motivation and makes it possible for a student to learn according to his/her learning speed (Şahin & Yıldırım, 1990; Uşun, 2000). The students can configure the concepts which they have difficulty in understanding with the use of CAI applications with computer assisted software especially using simulations of abstract concepts and animations which allow students participate in learning process interactively (Karamustafaoğlu, Aydın & Özmen, 2005).

Modelling is one of the most important methods used in concreting abstract concepts. The term of modelling refers all the process used for illustrating a new subject and the term of model refers to the product of these all process (Harrison, 2001; Treagust, 2002). Models and modelling are the inseparable parts of science teaching. Especially, the abstract concept of science requires a wide and functional use of models in science teaching. Sometimes it is hard for the teachers to make abstract concept more concrete. Models provide a learning process through living and experiences. Making a model requires using both hands and eyes and stimulates more than one parts of brain and improves the meaningful learning (Haury, 1989; Lavoie, 1993). According to Justi and Gilbert (2000), the ability of simplifying the most complex context is the most important function of models.

Taking into consideration with the previous studies, the study aimed to investigate the effects of the use of CAI applications on academic achievement in teaching "cell division" topic which is hard to be learnt by the students. The study also compares the instruction methods in terms of their efficiency. We hope this finding would be helpful for Biology education.

Method

Subjects

The population of the study is the students of 19 Mayıs University, Education Faculty Science and Technology Education Department. The sample included 132 second grade students from the same department. The study was carried out with one control and two experimental groups to whom the topic of cell division (mitosis-meiosis) were taught within the context of Biology I courses.

The Instrument

While the topic of cell division were taught to the control group students by the use of the traditional instruction method, in experimental group computer assisted instruction was followed. Topics were taught to forty four students in the second experimental group by the use of both traditional instruction and modelling methods.

Topics were taught to control group students in accordance with the curriculum and by the use of the traditional instruction method. Computer assisted instruction were followed for the first experimental group in computer laboratory. PowerPoint presentation and animations were used to instruct the subjects. Initially, subjects were taught to the second experimental group students by the use of the traditional instruction method than they were asked to create their own models related to the topic of cell division. Students were asked to consider and point out some difficult concepts such as homologous, chromosome, chromatid, chromatin, chromatin fiber, tetrat, synapse and crossing-over.

Second experimental group students developed such models related to the topic of cell division by the use of the plasticine, yarn, wire, button and bead. They developed models for each phase of mitosis and symbolized events occur during that phase. These models were evaluated in the classroom and than errors were corrected.

Success test was used to determine the levels of students' knowledge related to cell division. A pilot study using 40 multiple choice questions was applied to 47 students. Questions tend to have lower reliability were excluded and Cronbach-alpha reliability coefficient of the success test (consisting remaining 25 questions) was calculated as 0.839.

Data Analysis

All groups were applied pre-tests and than applications were administered. After having completed all applications, success test was applied to all groups as a post-test. SPSS Package Program was used in the analysis of the data. T-test was used to analyze the level of academic differences between the control and the experimental groups. Results were shown in tables in results chapter. To analyze t-test results, the significance level of p value was assessed as 0.05.

Findings

According to the control and experimental group students' independent t-test results; the averages of the first experimental, the second experimental and the control group students were calculated as 48, 23; 52, 27 and 51, 68 respectively. According to the results of t-test which was used as a pre-test to analyze the significant differences between the groups with different academic achievement levels, no significant differences between the groups were observed (as p value significant level was .05). These findings demonstrated that control and experimental group students' achievement levels were close to each other (Table 1).

Table 1

T-test Results of the Control and Experimental Groups' Pre-test Scores

Test	Group	Number of Student	Mean	Standard Deviation (SD)	t value	p value	Commentary
Pre-test	I. Experimental	44	48.23	12.643	1.388	.169	p > .05
	Control	44	51.68	10.618			not significant
Pre-test	II.	44	52.27	10.823			p > .05

	Experimental				-0.259	.797	not significant
		44	51.68	10.618			
	Control						
Pre-test	I. Experimental	44	48.23	12.643			p > .05
					-1.612	.111	not significant
	II. Experimental	44	52.27	10.823			

According to the first and the second experimental groups'post-test results, there were significant differences between the groups in terms of test scores as p< .05. The averages of the first, second and the control groups were calculated as 81.18, 90.45 and 69.05 respectively. The difference between the I. experimental and the control groups was in favour of the I. experimental group. The difference between second experimental and control groups was in favour of second experimental group. The difference between first experimental and second experimental groups was in favour of second experimental group. There were significant differences between experimental and control groups and between first and second experimental groups. That is to say, experimental groups' students were more successful than control group students; second experimental group students were more successful than I. experimental group students.

Table 2

T-test Results of the Control and Experimental Groups' Post-test Scores

Test	Group	Number of Student	Mean	Standard Deviation (SD)	t value	p value	Commentary
Post-test	I. Experimental	44	81.18	6.986			p < .05
					-6.923	.000	significant
	Control	44	69.05	9.296			
Post-test	II. Experimental	44	90.45	6.410			p < .05
					-12.576	.000	significant
	Control	44	69.05	9.296			
Post-test	I. Experimental	44	81.18	6.986			p < .05
					-6,487	.000	significant
	II. Experimental	44	90.45	6.410			

The average of the I. experimental group pre-test scores was calculated as 48.23 and the average of the I. experimental group post-test scores was calculated as 81.18; the average of second experimental group pre-test scores was calculated as 52.27, where as the post-test score was 90.45. The averages of control group pre-test and post-test scores were calculated as 51.68 and 69.05 respectively (Table 3). When pre and post-tests results analyzed, there was a statistically significant difference in favour of post-test results between the average of groups' success test scores according to the experimental and control groups pre and post-test results (Table 3).

Table 3

T-test Results of the Control and Experimental Groups' Pre and Post-test Scores

Test	Group	Number of Student	Mean	Standard Deviation (SD)	t value	p value	Commentary
Pre-test	I. Experimental	44	48.23	12.643	-8.933	.000	p < .05
Post-test		44	81.18	6.986			significant
Pre-test	II. Experimental	44	52.27	10.823	-21.676	.000	p < .05
Post-test		44	90.45	6.410			significant
Pre-test	Control	44	51.68	10.618	-9.187	.000	p < .05
Post-test		44	69.05	9.296			significant

Discussion and Conclusion

Abstract concepts are not easy to instruct in educational process and mental restructuring is becoming a great problem. Therefore, visuals aids which enable perception and visualisation such as computer animations, posters and models should be used in teaching abstract concepts. These kinds of visual aids stimulate more than one sense and students do not forget these experiences easily and thus more effective learning can be achieved (Friedler & Tamir, 1990; Yiğit & Akdeniz, 2000). Students have some difficulties in learning cell division topic and some conceptual errors occur in education process (Kindfield, 1994; Bahar, Johnstone & Hansel, 1999; Clark & Mathis, 2000; Wood-Robinson, Levis & Leach, 2000). It has been suggested that using computer assisted instruction may help preventing these kinds of errors seen in traditional instruction method (Sezgin & Köymen, 2002; Atılboz, 2004). Our study results showed that CAI group was more successful than control group and these findings are consistent with those found in literature. In his previous study, Baki (2002) stated that the use of computers play an important role in motivation and learning process.

Meaningful learning requires mental modelling (mental configuration). In teaching abstract concept at microscopic level such as cell division, models are being used for mental modelling. The term of modelling refers all the process used for illustrating a new subject and the term of model refers to the product of these processes (Harrison, 2001; Treagust, 2002).

In our study, it is determined that using models such as plasticine, yarn, wire, button and bead help students to achieve better conceptual understanding and students learn what happens in each phase by living and experiences in a group.

As a conclusion, it is revealed that supportive educational devices improve success level of students and the use of these kinds of tools was more effective than computers in teaching such abstract concepts. Our study results demonstrated that modelling can increase students' motivation and success level. In the light of these data it is concluded that the subjects learnt by visual aids (models) are more permanent than the subjects learnt by computer assisted tools. Computer assisted instruction help students to visualize abstract concept but making models helps individual learning process according to their perception skills. Science teacher should consider this fact in their courses.

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