Effect of 5E instructional model in student success in primary school 6th year circulatory system topic

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Abstract

The aim of this study is to research the effect of the 5E instructional model on primary (sixth grade) student success during the circulatory system unit. This study was conducted with 38 students in two different classes by the same researcher in 2006-2007. One of the classes was assigned as the control group and the other as the experimental group. Appropriate activities using the 5E instructional model were used in the experimental group, while traditional teaching using question and answer methods was applied with the control group. To compare the treatments, the

percentage of correct statements and t test results were used. While initial levels of the experimental group and the control group were the same, a significant difference occurred in favor of the experimental group as a result of the application.

Keywords: 5E model, circulatory system, primary school

Introduction

Learning is permanent and persistent change in behaviors of individuals; a state in which students become aware of knowledge they have not known before and apply it an activity they have not previously achieved. Information can qualify as knowledge only when this source is given a meaning and turned into a part of the thinking system by individuals. Individual interests, curricular requirements and socio-cultural structures should be taken into account while constituting a learning environment (Witrock, M. 1974). An individual is recognized by the world when he or she effectively participates in the process of constituting meaning rather than receiving conveyed information and waiting for it to be oriented and formed (Olsen, 1999). One of the significant explanations of this process is the constructivist approach. The nature of knowledge and learning becomes the fundamental ground of the constructivism (Brooks & Brooks 1993; Cannella & Reiff, 1994; Lawson, 1995). This theory is based on establishing knowledge from basis (Caprio, 1994). The construction of knowledge and learners' application of knowledge exist at its core (Perkins, 1999). Learning is fulfilled through active participation in the learning process including activities such as discussion, experiences, , advocating ideas, developing hypothesis, interrogation and sharing ideas. Interactions among individuals are important. Learners do not accept knowledge as it is, rather they create or explore the knowledge (Perkins, 1999). Every knowledge gain establishes a base for increasing knowledge. New knowledge is built upon a base of previously constructed knowledge. Incidentaly, constructivist learning is the process of establishing a connection between former and new knowledge and integrating each new experience with existing knowledge. According to the constructivist learning theory, knowledge is developed while it is transmitting from an unbalanced to an equilibrium situation. If a new experience overlaps with former knowledge, it will be easily added to existing knowledge, and the individual is able to rapidly give meaning to new knowledge (Doolittle, 2001; Olsen, 1999; Yigit & Akdeniz, 1997). If a new experience does not overlap with previous knowledge, the individual will likely respond in one of four ways: 1. Destroying the existing knowledge. 2. Modifying existing former knowledge to conform to the new knowledge. 3. Modifying the new knowledge to conform to the former knowledge. 4. Rejecting the new knowledge (Witrock, 1974; Hand & Treagust, 1991).

Existing knowledge is expected to be made compatible with new knowledge for realization of meaningful learning. Examining the education system in our own

country, Turkey, a traditional structure is composed of an inward-oriented, restrictive class environment witha teacher and a group of students, textbooks, desks and a blackboard, which are all contrary to the views stressed in the constructivist approach (Alesandrini & Linda, 2002; Cepni, Akdeniz & Keser, 2000; Schineider & Renner, 1980). These indicators show that we have a structure that is far from providing permanent, persistent changes we expect to be achieved in students. Studies of student-centered approaches in recent years provide evidence that traditional approaches encourage students to become more passive and are not beneficial for ensuring permanent learning (Balkan, 2001; Isman, 1999).

Intensive efforts are being taken in order to develop a better education model in Turkey. The Ministry of Education decided to implement the constructivist education approach in all primary schools throughout the country beginning with the 2005–2006 school year. New constructivist education programs were prepared, and they were publicized in seminars organized for primary school teachers at the end of 2004–2005 school year (Cinar, Teyfur, & Teyfur, 2006).

Schineider and Renner (1980) found that for concrete operational students, the 5E teaching approach is superior compared to traditional approaches in intellectual development gains. Adams et al. (1999) have explored the 5E instructional model approach in their study. It was found that the 5E instructional model encouraged students to develop their own frames of thought. Caprio (1994) compared a class in which he taught with traditional methodology in 1985 to one in which he taught with 5E instructional model method in 1994. Marek et al. (1990) examined the relationship between high school science teachers' understanding of the Piagetian developmental model of intelligence, its inherent learning procedure of the 5E instructional model, and classroom teaching practices. In this study, the teachers expressed dissatisfaction with the teaching methods they had previously used. They displayed varying degrees of understanding of the learning cycle, which ranged from sound understanding to misunderstanding.

It seems that the constructivist approach could not be applied commonly in primary school science and technology education despite all these matters. The 5E instructional model that is used as the embodiment of the constructivist approach is composed of activities that increases students' concerns, supports their expectations related to the topic and includes active use of their knowledge and skills. In studies conducted using the 5E instructional model, evidence repeatedly reveals that the model increases the success of students, elevates their conceptual understandings and positively changes their attitudes (Baker & Piburn, 1997; Kor, 2006; Ozsevgec, Cepni & Ozsevgec, 2006; Saglam, 2006).

5E instructional model

Constructivism is the teaching philosophy that proposes learners need to build their own understanding of new ideas. Teaching via the Learning Cycle originated with the Science Curriculum Improvement Study (Trowbridge & Bybee, 1990). The five phases, (Seyhan & Morgil, 2007;Ozsevgec, Cepni & Ozsevgec, 2006) which capture the essence of the students' actions, are as follows:

Engagement: The activities in this section captures the students' attention, stimulates their thinking, and helps them access prior knowledge.

Exploration: Students are given time to think, plan, investigate, and organize collected information.

Explanation: Students are now involved in an analysis of their explorations. Their understanding is clarified and modified because of reflective activities.

Extension: This section gives students the opportunity to expand and solidify their understanding of the concept and/or apply it to a real world situation.

Evaluation: Evaluation occurs throughout the lesson. The teacher should observe students' knowledge and skills along with their application of new concepts and a change in thinking.

Aim of the Study

The purpose of this study was to research the effect of activities prepared in accordance to the 5E instructional model on students' success in a primary school's 6th grade (12-13 years old) class during a unit on the circulatory system.

This study, seeks the answer to the following question: Is teaching science with the 5E instructional model more effective than traditional science teaching methods while teaching of the human circulatory system in?

Methodology

This study examined whether or not activities prepared according to the 5E instructional model have an impact on student success. Experimental and control groups are composed of total 38 students studying at one school in Turkey. 19 students were in each of experimental and control groups. Lessons were given in both groups with two different methods for 4 weeks. The same researcher taught 38 students at the 6th grade level.

While the 5E instructional model activities were used in the experimental group, traditional teaching took place through the use question and answer methods.

Multiple choice achievement tests (15 questions composed of four answer options) were created by taking into account answers obtained during the interviews with 7th grade students in addition to a review of the research literature and specialists' opinions. Both the pre-test and post-test were scored out of 100. The reliability of achievement test prepared was calculated as 0.83. The achievement test was given to both groups as pre-test and post-test. The implementation continued in both groups for 4 class hours per week for a period of 4 weeks.

Treatments

The implementation continued in both groups for 4 class hours (40 min.) a week for 4 continuous weeks.

Teaching Approaches Used with the Experimental Group: Some questions about certain concepts relating to the circulatory system were asked in order to disclose pre-instructional knowledge and instill interest by students; this is consistent with the *engagement* stage of the class plan designed according to the 5E instructional model. Students had previous knowledge about the concepts like blood, the heart, vessels and lymph nodes. An interesting image symbolizing the circulatory system was presented to the students. In addition, a story about the relationship among the heart, blood and vessels was read. Images were distributed for each group to assist them to prepare a heart model in the *exploration* stage of our activity. Then, each group was expected to create a heart model by combining these images. Blood structure was examined under the microscope in the following class. The students were given the task of researching the structure of heart and blood at the end of exploration stage. The heart model created by the students was reinforced using the overhead projector and the parts of heart were described in the *explanation* stage. Information was given about blood structure and vessels, and questions from the students were answered. Information about systemic and pulmonary circulation and the lymph system was given. A research task about the importance of blood donation was given in *extension* stage. Moreover, the students were asked to prepare and exhibit a drama representing the systemic and pulmonary circulation. It was attempted to determine whether or not the students gained target behaviors by using different methods in the *evaluation* stage.

Approached Used with the Control Group: Traditional instruction methods were used with the control group. The researcher used direct teaching and question and answer methods to teach related topics and basic concepts. Basic explanations and question and answer methods suited the traditional teaching approach where students are completely passive, were used while teaching the circulatory system unit. Teaching strategies consisted of the researcher's explanations and textbooks. In this group, the researcher provided instruction through lecture and discussion methods to teach the concepts. The researcher structured the entire class as a unit,

wrote notes on the chalkboard about the definition of concepts, and passed out worksheets for students to complete. The primary underlying principle was that knowledge takes the form of information that is transmitted to students. After the teacher's explanations, some concepts were discussed, prompted by teacher-directed questions. Worksheets were developed specifically for each lesson. These required written responses and reinforced the concepts presented in the classroom sessions. They were collected and corrected by the researcher. Each lesson typically consisted of the researcher presenting the correct way to solve problems. The majority of instructional time was devoted to instruction and engaging in discussion stemming from the researcher's explanation and questions.

The multiple choice achievement test composed of 15 questions applied at the beginning was also administered to both groups at the end of the unit as the post test. The t-test and percentage expressions were used in the analysis of research data. Significance level was considered as $\alpha = 0.05$.

Results

The circulatory system achievement test was administered as the pre-test in both the experimental and control groups before beginning the unit. The pre-test average score was 31.68 for the experimental group and pre test average grade was 30.21 for the control group. It was calculated that there was no statistical significance difference between pre-test results of the experimental and control groups ($p = 0.385$) (Table 1).

Table 1. t-test results related with pre-test grades of experimental group and control group students in circulatory system achievement test

Test	Groups	N	X	SS	t	P
Circulatory System Achievement Test	Experimental Group	19	31.68	8.84	-889	0.385
	Control Group	19	30.21	9.63		

Looking at Table 2, the average score of the control group students on the post-test application was higher than the average from the pre-test. Four weeks of traditional science teaching method result in a post-test average score that went up to 53.42. Here, the control group students increased their correct answer percentages in the circulatory system achievement test at the end of four weeks. There was a significant difference between scores by the control group between the pre-test and post-test of the circulatory system achievement test.

Table 2. t-test results of control group students related with the pre-test and post-test grades in the circulatory system achievement test

Test	Control group	N	X	SS	t	P
Circulatory System Achievement Test	Pre Test	19	30.21	9.63	-4.64	.00
	Post Test	19	53.42	22.28		

Table 3. t-test results of the experimental group students related with the pre-test and post-test grades in the circulatory system achievement test

Test	Experimental Group	N	X	SS	t	P
Circulatory System Achievement Test	Pre Test	19	31.68	8.84	-9.60	.00
	Post Test	19	72.57	15.86		

Table 3 shows that the average post-test scores by the experimental group students (receiving the 5E instructional method) was than the average grade they obtained on the pre-test application. There was a significance difference between scores by the experimental group in pre-test and post-test of the circulatory system achievement test (p=.00).

Table 4. t-test results related with post-test grades of experimental group and control group students in circulatory system achievement test

Test	Groups	N	X	SS	t	P
Circulatory System Achievement Test	Experimental Group	19	72.57	15.86	-2.66	.00
	Control Group	19	53.42	22.28		

As seen in Table 4, average post-test application scores from the experimental group were higher than average scores obtained for the traditional science teaching method post-test application. There was a significant difference between post-test grades of the experimental group and control group in the circulatory system achievement test (p = 0.00).

Considering the statistical values in the experimental and control group before the application, it was determined that there was no significant difference in the circulatory system achievement test according to pre-test results (Table 1). Post-tests were given to all students in order to analyze the effect of the two different teaching methods to determine student success in learning about the circulatory system. It was found that the experimental group students obtained a higher degree of knowledge compared to the control group students. It was also found that both the experimental group and control group students obtained gains statistically, according to the circulatory system achievement test post-test data (Table 4). However, the experimental group students obtained a higher degree of knowledge compared to the control group students ($p = 0.00$). Moreover, the experimental group students achieved a 100% success in a question related with heart structure in the post-test.

Discussion

This study offers results that support work previously performed by other researchers (Adams, Bevevino & Dengel, 1999; Caprio, 1994; Cepni, Akdeniz & Keser, 2000; Sungur, Tekkaya & Geban, 2001; Demircioglu, Ozmen & Demircioglu, 2004; Lord, 1999; Marek, Eubanks & Gallaher, 1990; Bayar, 2005; Seyhan & Morgil, 2007). Seyhan & Morgil (2007) compared two classes taught by traditional methods with two classes taught using the 5E instructional model method. The study indicated that the experimental groups had much greater understanding of the information covered especially on questions that required interpretation. Saglam's study (2006) on the subject of developing 5E activities orienting to the Light and Sound Unit and evaluating its effectiveness determined that student teaching materials developed according to the 5E instructional model increased achievements and attitudes of the experimental group in 5th class more significantly than compared to the control group. Kor's (2006) study on the subject of the effect of materials developed based on integrative learning theory in an "Electricity in our Life" unit of a 5th grade class determined that it was effective for promoting learning concepts and the removal of conceptual errors through teaching based on a constructivist approach. Saka & Akdeniz studied (2006) developing computer-aided materials in genetics and their implementation according to the 5E instructional model that preparing class activities appropriate to 5E instructional model in topics with conceptual errors will not only release students from a monotonous class environment especially but also brings a good experience in teacher candidates by carrying out their classes appropriate with 5E instructional model.

Conclusion

Based on the evidence obtained through the activities carried out in scope of the research, positive changes from the experimental group of students receiving the

5E instructional model activities based on the constructivist approach have an effect of increasing success when learning about the circulatory system. It was observed that newly learned concepts were constructed in the mind correctly by removing concept errors existing in their pre-information.

Recommendations

Classroom teachers should consider how to prepare learning environments in which students will be active in accordance with students' characteristics and then present these environments to students. Creating techniques based on the 5E instructional model on various subjects will attach a higher degree of importance on the 5E instructional model based on the constructivist approach. In addition, the education of trainee teachers will benefit from these methods.

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