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THE EFFECT OF CONCEPT CARTOONS ON ACADEMIC ACHIEVEMENT AND INQUIRY LEARNING SKILLS

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Abstract
The aim of this study is to determine the effects of concept cartoon supported learning activities on academic achievement about “Chemistry and Energy” and perception of inquiry learning skills. The sample of the study is 100 students attending to the 11th class of Amasya Social Sciences High School in 2015-2016 spring semester. As data collection tools Academic Achievement Test developed by researchers and Inquiry Learning Skills Perception Scale developed by Balım et. al. (2007) will be used. At the beginning of the study Inquiry Learning Skills Perception Scale will be used as pre-test. While the "Chemistry and Energy" unit will be studied with the aid of concept cartoons in the experiment group, it will be studied using the present curriculum in the control group. At the end of the study Inquiry Learning Skills Perception Scale will be used as post-test. The results will be analyzed using SPSS programme.

Keywords: Concept cartoon, chemistry and energy, perception of inquiry learning skills, academic achievement.

INTRODUCTION

Concept cartoons have recently been used across the world so as to provide an innovative learning-teaching strategy in the constructivist approach, which is available in the curricula of many countries (Keogh and Naylor, 2015). Learning process rather than learning outcome is in the centre, and learners rather than teachers are put in the centre in the curricula designed on the basis of constructivism. Therefore, learners think actively, they inquire, develop their upper order learning skills, they wonder, they research, they solve problems, they build new knowledge on the previous knowledge, and thus they make their learning permanent.

Concept cartoons are drawings in the form of cartoons employed so as to state opinions on scientific concepts, and they also focus on issues that learners can experience in their daily life (Naylor & Keogh, 1999). Webb, Williams and Meiring (2008) define concept cartoons as a method which is made up of drawings, which makes the characters inside discuss in relation to science concepts of real life, and which thus encourages learners to think.

Concept cartoons are among the visual aids which can be implemented in various ways. They can be used for such purposes as to uncover students’ views, to encourage students to think and to develop their ideas, to offer them alternative perspectives, to function as a stimulant for discussion, to encourage thinking and reasoning, to help learners ask their own questions, to form a starting point for scientific research and for enquiry, to form a sense of goal for the rest of the lesson, to raise motivation and to encourage participation in the lesson, to put forward open-ended questions, to offer extra activities, to summarise or revise a topic, and to make use of out-of- the- class time effectively (homework, etc) (Naylor and Keogh, 2010). Concept cartoons

can also be used at the beginning of a class or a topic, as stimulants in discussions, and to identify domains of question which are indistinct and which need to be answered (Naylor and Keogh, 2010).

A review of studies concerning concept cartoons demonstrates that they generally analyse students' academic achievement (Özyılmaz, Akamca, Ellez and Hamurcu, 2009; Keogh, Naylor and Wilson, 1998; Keogh and Naylor, 1999; Stephenson and Warwick, 2002), students' attitudes towards a course (Özyılmaz, Akamca, Ellez and Hamurcu, 2009), and identification of misconceptions and eliminating them (Stephenson and Warwick, 2002; Chin and Teou ,2010; Kabapınar, 2005).

Considering the fact that concept cartoons present the conversations between characters by relating the concepts to daily life, it becomes clear that students should be engaged in inquiry. It can be stated in this context that students' use of inquiry skills is closely related with concept cartoons enabling students to gain discussion and research skills (Chin and Teou 2009; Keogh and Naylor, 1999). Using concept cartoons in 7th grade science lessons, Balım, Inel and Evrekli (2008) found that concept cartoons influenced students' inquiry-based learning skills. In their study of science education, Keogh and Naylor (1996) concluded that concept cartoons were influential in discovering students' views through discussions, in developing their ideas, in ensuring high levels of involvement and motivation, and in encouraging students to do research. It is evident from studies conducted that concept cartoons are usually examined in terms of effects on students' academic achievement, their attitudes towards a course, and on identifying and eliminating misconceptions. Yet, only a small number of studies concerning the effects of concept cartoons on students' inquiry learning skills are available in the literature. Therefore, this study aims to determine the effects of concept cartoon supported learning activities on academic achievement about "Chemistry and Energy" and perception of inquiry learning skills. The reason for choosing the unit of Chemistry and Energy in this study is that such concepts as entropy, enthalpy, heat, temperature, isochoric and isobaric systems, Gibbs energy and labour are too abstract for learners to understand, and thus learners have various misconceptions about them (Reiner et al. 2000, Doige and Day, 2012., Krajcik, 1991; Lewis and Linn, 1994; Banerjee, 1995; Thomas 1997; Thomas and Schwenz 1998; Greenbowe and Melzer, 2003).

METHOD

Sample

The sample of the study is 88 students attending the 11th grade of Amasya Social Sciences High School in 2015-2016 spring semester. Initially, 44 students were assigned to the experimental group, and the remaining 44 students were assigned to the control group randomly. The students in the experimental and the control groups attended the same high school, and they had the same level of achievement in chemistry.

Data Collection Tools

Inquiry Learning Skills Perception Scale

The "Inquiry Learning Skills Perception Scale" developed by Balım et al. (2007) was used in this study so as to measure learners' inquiry learning skills perception. There are three factors in the scale: "items for negative perceptions", "items for positive perceptions", and "items for perception of inquiring the accuracy". The reliability for these items are 0.73, 0.67 and 0.71. Cronbach Alpha reliability for the overall scale is 0.84, and internal consistency coefficient for Spearman-Brown test half-life is 0.82 (Balım et al., 2007).

"Chemistry and Energy" Achievement Test

The achievement test prepared by the researchers was composed of 10 open-ended questions. The content validity of the test was attained by obtaining expert opinion.

Research Problems

The research problems for the study, which analysed the effects of a lesson of the unit of "Chemistry and Energy" taught through concept cartoons on academic achievement and on inquiry learning skills perceptions, were formulated as in the following:

1. At what level are the experimental and the control group students in terms of inquiry learning skills perceptions prior to and following the application?
2. Are there any statistically significant differences between the experimental and the control group students' inquiry learning skills perceptions prior to and following the application?
3. Are there any statistically significant differences between the experimental and the control group students' academic achievement prior to and following the application?

Procedure

At the beginning, the Inquiry Learning Skills Perception Scale was administered to the students in the experimental and the control groups as the pre-test. The students in the control group were taught the concepts of the unit of Chemistry and Energy through the curriculum available and in traditional method for four weeks.

The same concepts were taught to the students in the experimental group through concept cartoons. The students in both groups learnt the concepts in the unit for the first time, and their prior knowledge was restricted to the curriculum applied in the previous grade levels. At the beginning of the lesson, the researcher handed out to the students the concept cartoons prepared for the concepts and sub-headings in the teaching unit on the computer, and introduced the thoughts held by the characters in the cartoons to the students. Then, the researcher asked the students which characters they agreed with and why they agreed with them. The students discussed in groups the views and thoughts held by the characters and the concepts, and they stated their opinions. Having received the alternative ideas and criticisms, the statements in the cartoons were considered again, and the researcher taught the subject, and thus the lesson was finished.

FINDINGS

Table 1 shows the independent-samples t-test results for the experimental and the control group students' inquiry learning skills perceptions (ILSP) prior to and following the application.

Table 1: The Independent-Samples T-Test Results for the Experimental and the Control Group Students' Inquiry Learning Skills Perceptions (ILPS) Prior to and Following the Application

	Group	N	X	Ss	t	p
(ILPS) Pre-test	Experimental	44	85.61	9.36	0.60	0.54
	Control	44	84.18	1.54		
(ILPS) Post-test	Experimental	44	84.36	8.68	-0.57	0.56
	Control	44	85.50	9.73		

According to Table 1, students have quite high levels of inquiry learning skills perceptions both before and after the application. Yet, the difference between experimental group and control group students' inquiry learning skills perceptions before and after the application was not statistically significant ($p>0.05$).

Table 2 shows the independent-samples t-test results for the experimental and the control group students' academic achievement in the unit of Chemistry and Energy prior to and following the application.

Table 2: The Independent-Samples T-Test Results for the Experimental and the Control Group Students' Academic Achievement in the Unit of Chemistry and Energy Prior to and Following the Application

Group	N	X	Ss	t	p
Experimental	44	82.59	18.79	2.62	0.01
Control	44	72.05	18.41		

According to Table 2, statistically significant differences were found in favour of the experimental group students on examining the experimental and the control group students' score differences for academic achievement test after the application ($X_{experimental}=82.59$; $X_{control}=72.05$ $p<0.05$).

CONCLUSIONS AND DISCUSSIONS

On examining the differences between the experimental and the control group students' academic achievement test scores after the application, this study- which analysed the effects of a lesson of the unit of "Chemistry and Energy" taught through concept cartoons on academic achievement and on inquiry learning skills perceptions- found statistically significant differences in favour of the students in the experimental group. In a similar vein, Gölgeli and Saraçoğlu (2011) researched the effects of using concept cartoons in Science and Technology classes on students' academic achievement. In their application, the subject of "Light and Sound" was taught in the discussion method to the control group while it was taught through concept cartoons to the experimental group.

It was found in the above mentioned research, where academic achievement test was used as the tool of data collection, that concept cartoons affected learners' academic achievement in positive ways. Similarly, in their research conducted with primary school fourth grade students, Özyılmaz-Akamca, Ellez and Hamurcu (2009) found that computer assisted concept cartoons had positive effects on learning achievement.

With the application of concept cartoons in inquiry learning of "Chemistry and Energy", the students discussed the different opinions available in the cartoons, set up hypotheses, and had the opportunity to perform reasoning. The teacher acted as a guide and helped in this process so that reasoning could be done effectively by acting as a guide. In this way, the students learnt the concepts of heat, energy, labour and entropy included in the unit of Chemistry and Energy more effectively by configuring them in their mind.

Besides, concept cartoons became the focus of interest due to the characters they contained, and thus helped to extend the length of motivation. These findings are also consistent with Roesky and Kennepohl's (2008) views.

It was observed in the research that students had quite high levels of inquiry learning skills perceptions both before and after the application.

However, statistically significant differences were not available between the experimental and the control group students' inquiry learning skills perceptions prior to and following the application. The reason for it might be that the four-week applications were not adequate to develop students' inquiry learning skills perceptions. Evrekli (2010) analysed the effects of mind maps and concept cartoons on students' academic achievement on their perceptions of and inquiry learning skills. Following the application, the Inquiry Learning Skills Perception Scale was administered to the experimental and the control groups as the post-test, and it was found that there were no significant differences between the experimental and the control group students' post-test academic achievement scores. Yet, on examining the rank sums for the groups, the experimental group was found to have bigger rank sum than the control group, and thus it was found that the applications did not lead to significant differences between students' perceptions of inquiry learning skills but that the applications led to an increase. On the other hand, Balım, İnel and Evrekli (2008) found that using concept cartoons caused significant differences between students' perceptions of inquiry learning skills.

RECOMMENDATIONS

- Long-term research studies containing differing issues could be conducted so as to make improvements in students' perceptions of inquiry learning skills.
- Concept cartoons – which are very effective in discovering students' ideas and in encouraging them to discuss and produce alternative ideas- and the fields of use should be introduced to prospective teachers in courses such as Special Teaching Methods, Instructional Technologies, and Materials Development.
- Concept cartoons should be prepared with the support of technology. Thus, time and location limitations could be removed.

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