

The effectiveness of using student and teacher centered analogies on the development of the students' cognitive and affective skills

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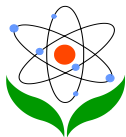
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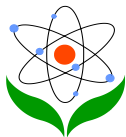
Abstract

The aim of this study was to investigate the effects of teacher-centered and student-centered analogies on student academic achievement, conceptual understanding and attitude, concerning the topic of the circulatory system in a science and technology lesson. A quasi-experimental design was used. The sample consists of 49 sixth grade students in Turkey. The result is that both groups of students showed a significant difference comparing pre-test and post-test results in terms of academic achievement, conceptual understanding and attitude toward science course.

Keywords: Science Education, Analogy Technique, Circulatory System

Introduction

There are lots of complex science concepts. Students generally use science textbooks to study concepts throughout the primary school years. However, it is quite difficult for the students to learn from text books. Teachers should help students to link the newly acquired concepts with the previously known concepts.

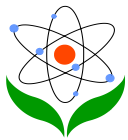


The analogy technique is one of the most effective ways of how the teachers do this (Glynn, 1996).

The analogy technique to explain a fact which seems strange is by means of associating with a fact which does not seem strange and is familiar. The fact which is not familiar is the target. And the familiar fact is the source (Gürdal et al, 2001). The analogies are used in the situations in which the concepts which are acquired process are difficult for the student (Garde, 1986). While the children learn new information through analogy, they also benefit from the similarities with the previously learned information (Stavy, 1991).

Four types of different analogy techniques have been defined: simple analogies; story-type analogies; dramatized analogies and illustrated analogies (Sahin, 2000). The illustrated analogy technique is used in this study. The events which require to be explained by means of the illustrated analogies are expressed by means of illustrations. The visual memory is involved in this type of analogies.

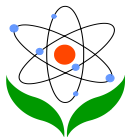
In some of the studies carried out at the primary school stage relating to the perception level, (Akyüz, 2007; Chiu and Lin, 2005; Sagirli, 2002; Crowley, 2002; Glynn, 1996; Mason, 1994) indicated that the use of the analogy technique develops perception level. Also in some of the studies which are carried out at the primary school stage (Akyüz, 2007; Crowley, 2002; Sagirli, 2002; Pittman, 1999; Harrison 1992; Stavy, 1991), were concluded that the use of the analogy technique positively influenced the student success. Newburg (1993) found in his study that the use of the analogies is effective with students in in-depth learning of the concepts and recalling them afterwards. It is seen that in some of the studies which were carried out in the secondary school (Baker and Lawson, 2001; Glynn, 1997), the use of analogy in biology courses increases success particularly in the learning of the complicated and difficult concepts. However some of the students still have difficulty in differing the concepts. In the studies which were carried out relating to chemistry courses (Kiliç, 2007; Vural, 2005; Sarantapoulos and Tsaporlis 2004; Bilgin and Geban, 2001; Garde, 1986), they concluded that analogies are effective in eliminating conceptual mistakes and in the retention of knowledge. In the studies which were carried out by means of using analogy in physics (Cerit, 2008; Duru, 2002; Yilmaz et al., 2002; Hewitt, 1992) and mathematics (Saygili, 2008), they concluded that the use of analogical models positively affected the success of the students.



In contrast to the above studies, Turgut (2007), compared the influence of 'question and answer method' and 'analogy method' on the mathematical successes of the students in teaching 7th grade mathematics subjects and as a result, no significant difference was obtained between two groups. Kaptan and Arslan (2002), in their study carried out with the 8th grade students, compared the influence of 'question and answer method' and 'analogy method' on student success. At the end of the study, it was concluded that there was no significant difference with regard to the successes of the students. Similarly, Zook and Divesta (1991) also reached the conclusion that the use of the analogy technique did not give rise to any difference in success.

In some of the studies carried out in preschool education (Bilaloglu, 2006; Küçüküran et al., 2000), it was concluded that the groups in which the analogy technique were used were more successful. However there was no difference with regard to the retention of the concepts. (Bilaloglu, 2006). In some of the studies carried out at the university level (Akar, 2007; Atav et al., 2006; Dilber, 2006; Gülçiçek et al., 2003), it was concluded that analogy use has positive influence on learning. However this level was not at the required level. Analogies are not formed by the teacher alone. Student-centered analogies also play an important role. Student-centered analogies ensure that students are actively thinking. Analogies which are formed by the students not only ensure thinking by the students but also help the teachers to see correct or incorrect concepts and relations which are formed in the minds of the students (Wong, 1993).

Stavy and Tirosh (1993) stated that analogies play an important role in acquiring and developing science concepts. However, they indicate that, in some cases, the persons see an irrelevant situation as relevant and found analogy where none existed and thus the analogies may damage learning. The purpose of our study is to investigate whether analogies which are formed by the students or analogies which are presented as ready by the teachers are more effective in teaching. For this purpose, the illustrated analogy technique is used to ensuring the students use also their visual memories and it is a focus to compare teacher and student centered analogy techniques.



The Aim of the Study

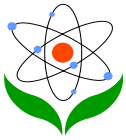
The influence of student centered analogy and the teacher centered analogy techniques on academic successes, conceptual understanding levels and attitudes of the sixth grade students, in the subject of the circulation system which is a science and technology course is examined by means of this study. The research questions are:

1. Does the teacher and student centered analogy use have an influence on the success in the subject of “Circulation System” in Science and Technology course of the primary school 6th grade students?
2. Is there any significant difference between the post-test results of the students who are taught courses by using teacher-centered analogy technique and student-centered analogy?
3. Is there any significant difference between conceptual understanding levels of the students who are taught by using teacher-centered analogy technique and the student-centered analogy technique?
4. Are there any significant science attitude differences between male and female students?

Methodology

The research is organized according to the experimental design with two test groups (Karasar, 2006). Two groups were formed by means of impartial assignment in order to examine the effectiveness of the student centered and teacher centered analogy techniques. In the research, “a subject success test about sixth grade circulation system”, “a survey consisting of 15 open-ended questions about sixth grade circulation system” and attitude toward science course scale are given as a pre- and post-test at the end of the experimental process.

The illustrated analogy technique is used in the groups. In both classes, the course teaching is carried out by one of the researchers in accordance with the course plans which were prepared by means of taking the opinion of the Science and Technology teachers. The study was continued for 14 course hours in total (3.5 weeks, per week 4 course hours).



Course Content

Teacher Centered Analogy Technique

The course was taught to the students by using the analogy technique and in the end of the subject teaching the papers which include examples of illustrated analogies relating to the subject. The teacher formed the analogies relating to every subject and implemented the course teaching process step by step by means of using the analogies which were also included in the lesson books. Sometimes, it is observed that the students stop learning in where the analogies are deformed and then these points are explained by the teacher and the potential concept confusions are tried to be avoided.

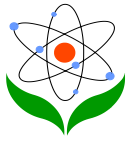
For example, the researcher explained below analogy about the blood types.

- 0 (general donater) → Teachers who teaches the knowledge
- AB (general reciever) → Students who get the knowledge
- A → Students who want to get science knowledge
- B → Students who want to get Turkish knowledge

Some students said that the teachers also get knowledge from the students. Thus, the researcher explained that the teachers learn from the students but they did not get their basic (science or other) knowledge from the students.

The Student Centered Analogy Technique

In this class, the analogy technique is not used during the teaching process. However, the researcher explained the analogy technique and showed analogy examples relating to the subject prepared to the students for one course hour. The students are requested to form their own analogies relating to the subject taught after the end of every subject for one course hour. The students were separated into groups which were formed separately from the male and female students during the study and every group is requested to form its own analogy. Because the analogies are the materials which are formed based on their preliminary information and previous lives of the students, to the researcher observed whether the analogies



which are formed by the students in different genders were associated with their own areas of interest and their own lives or not.

Sample

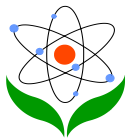
The sample of the study consists of 49 students in two 6th grade classes in Turkey. While the circulation system was taught by means of using the teacher centered analogy technique in 6-B class, it was taught by means of using the student centered analogy technique in 6-A class. There were in total 24 students (9 male and 15 female students) in 6-A class and there were in total 25 students (10 male and 15 female students) in 6-B class.

Data Collection

Achievement Test, Open-Ended Questions and Attitude toward Science Course Scale were administrated to collect the data.

Achievement Test: The success test was prepared to test subject knowledge of the topic. The success test was selected from various schoolbooks at the preparation stage and prepared by the researcher. The success test for which the opinions were taken from 3 Science teachers and 2 experts took final shape by means of reducing the questions which measure same knowledge and reducing to 30 based on the validity and reliability findings as a result of the pilot application. The reliability of the success test was 0.66 by means of ITEMAN statistics program.

Open-Ended Questions: The Open-Ended Questions were prepared for the purpose of measuring the concept, knowing levels of the students before the subject teaching and measuring the concept learning levels relating to the subject after the subject teaching process. The open end questions which were used in the study were prepared by the researcher according to the Science and Technology Course curriculum of the primary school schedule and passed through expert opinion. (a few examples from open-ended questions: 1. What are the functions of the heart in human body? 2. What are the benefits of blood donations? 3. Please write that what you know about immune system.) In answering the open ended questions, the researcher attended the class and tried to explain the matters which could not be understood. The evaluation of the open end questions was performed according to



the perception levels grouping which was developed by Abraham and his colleagues as used also by Bayram et al. (Bayram et al, 1997).

Attitude Scale Toward Science Course: “Attitude Scale Toward Science Course” which is used in the present research was developed by Akinoglu (2001), and its reliability was determined as 0.89 (Akinoglu, 2001).

Analysis of the Data

The data obtained were evaluated in the SPSS 14.00 package program. The Wilcoxon Marked Orders Test is used in order to compare the results before and after the application of the groups while performing the evaluation of the Success Test, Open-Ended Questions and Attitude Scales concerning both groups. The Mann Whitney U-test was used in order to compare the meaningfulness of the differences between the groups. Because the number of students in the classes which form the sample group of the study is below 30, the Wilcoxon Marked Orders Test and the Mann Whitney U-test were used in the analysis of the results.

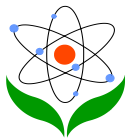
Findings

The post-test results of the groups on which the student and teacher centered analogy technique are performed is given in the Table-1.

Table 1. Comparison of the Post-Test Results between Student and Teacher Centered Analogy Technique Classes

| Group | N | Order Average | Order Total | U | p |
|------------------|----|---------------|-------------|-----|------|
| Student Centered | 24 | 25.38 | 609 | 291 | .857 |
| Teacher Centered | 25 | 24.64 | 616 | | |

It was found that there is not any significant difference between two groups. (U:291 $p>.05$). When the sequence averages are taken into consideration, it is understood that post test results of the students who were taught by means of using the student-centered analogy technique are higher than the students who were taught by



means of using the teacher-centered analogy technique; however this difference was not at a significant level.

The comparison of the conceptual understanding levels after the application of the groups is given in the Table 2.

Table 2. Comparison of the Conceptual Understanding Levels between Student and Teacher Centered Analogy Technique Classes

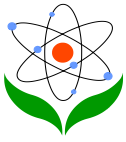
| Group | N | Order Average | Order Total | U | p |
|------------------|----|---------------|-------------|-----|------|
| Student Centered | 24 | 31.65 | 759.50 | 140 | .001 |
| Teacher Centered | 25 | 18.62 | 465.50 | | |

When the Table-2 is examined, it is found that there is no significant difference between the conceptual understanding results after the application of the groups. (U:140.5, $p > .05$). When the sequence averages are taken into consideration, it could be said that the conceptual understanding level results after the application are higher in the students who are taught by the student-centered analogy technique in comparison with the students who are taught by the teacher-centered analogy technique and the student-centered analogy technique is more effective in the learning process.

The comparison of the attitude scale results after the application is given for the groups in the Table-3.

Table 3. Comparison of the Attitude Toward Science Course Scale Results between Student and Teacher Centered Analogy Technique Classes

| Group | n | Order Average | Order Total | U | p |
|------------------|----|---------------|-------------|--------|------|
| Student Centered | 24 | 26.73 | 641.50 | 258.50 | .405 |
| Teacher Centered | 25 | 23.34 | 538.50 | | |



When the Table-3 is examined, it is found that there is no significant difference between the attitude scale results of the groups after the application. ($U:258.50$, $p>.05$). When the sequence averages are taken into consideration, it is understood that post-test results of the students who are taught by means of using the student-centered analogy technique are higher than the students who are taught by means of using the teacher-centered analogy technique, but this difference is not at the significant level.

The influence of the gender factor on the influence of the analogy technique usage on the attitude is given in the Table-4.

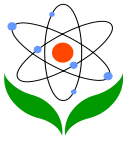
Table 4. Gender Factor in the influence of the Analogy Technique Usage on the Attitude Toward Science Course

| Group | n | Order Average | Order Total | U | p |
|-------|----|---------------|-------------|--------|------|
| Girl | 29 | 29.31 | 850.50 | 165.00 | .011 |
| Boy | 20 | 18.75 | 375.00 | | |

There is a significant difference between the attitude scale results and genders of the students on which the application is performed ($U:165.00$, $p<.05$). When the sequence averages are taken into consideration, it could be said that the attitude scale results of the female students are higher and the usage of the analogy technique positively influences the attitudes of the female students towards the course.

Conclusions and Discussion

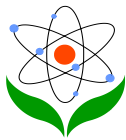
Before the application, no significant difference was obtained between the achievement, conceptual understanding level and attitude toward science course scale results of the students in both groups where the student and teacher centered analogy technique was used. In this respect, it is accepted that both of the group were equal to each other and it was also assumed that the groups were homogenous.



It is seen that there is a significant difference between the pre- test and post-test, conceptual understanding level and attitude toward science course scale results of the students in the class where the student centered analogy technique is used. Similarly, a significant difference is obtained between the pre-test and post-test, conceptual understanding level and attitude scale results of the students in the class where the student centered analogy technique is used. Obtaining the significant difference between the success, conceptual understanding level and attitude scale results after teaching students in both of the groups is an expected situation as a result of learning a new subject which is not known and which is not familiar for the students before.

When the post-tests of the groups are compared as a result of our study, statistically no significant difference could be obtained with regard to the success. When our result is evaluated according to the studies which are carried out on the comparison of the analogy technique and the other techniques in the past, in the study carried out by Karadogu (2007), he concluded that the courses which are taught by means of the analogy do not produce a significant difference in success in comparison with the courses which are taught by means of using the teachers' guide only. In our study, the difficulty of the students in this age group in using and understanding the analogy technique in an entire subject by them. Insufficient level of the pre-learning process of the students because the school is a small town school may be influential in the failure in obtaining a significant difference in success.

After-application, when conceptual understanding level results of the groups are compared, it is concluded that the class in which the student centered analogy technique is used is more successful. When the analogy technique is used appropriately, it can be important factor which helps the students without exposing them to concept confusion, improving their effective listening, problem solving, establishing communication with their peers, converting the abstract concepts into concrete ones and ensures a better learning process. Especially the usage of the short and simple analogies by the students helps the students to understand and learn the concepts easily. Akyüz (2007) and Sagirli (2002) also compared the analogy technique and the traditional explaining method in their study and they concluded that the group in which the analogy technique is used is more successful with regard to the perception levels of the students.

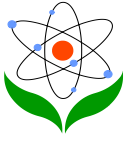


In our study, it was seen that the attitudes of the students towards the course in both groups in which the student and teacher centered analogy technique were used changed positively. However there is not any statistical significant difference between both of the groups. There are not only studies which reach the conclusion that the analogy technique influences the attitude (Sagirli, 2002; Kaptan and Arslan, 2002), but also there are studies which reach the conclusion that it does not have any influence at all (Karadogu, 2007). In addition to this, it is seen that the attitudes of the students in both of the groups vary according to the gender and it shows a significant difference in favor of the female students. In line with this result, in the study of Karadogu (2007), it is concluded that the points of the students differed according to gender in the last application and this difference is in favor of the female students. The illustrated analogy technique is used in the study. Because the female students in this age group attach more importance to the visual images, this situation may ensure their development of positive attitudes. In addition to this, the students were divided into groups for the purpose of observing whether the students will form the analogies which are close to their own areas of interest or not. It was also seen that the groups which were formed by the students form analogies which are close to their areas of interest such as a football match, military, traffic for the male students and such as shopping center, hospital for the female students. Similarly, in the study which is carried out with 700 7th and 8th grade students by Pittman (1999), he requested the female and male students to form their own analogies separately and it was seen that the students form the analogies which are close to their own areas of interest, similar to the results in our study.

As a consequence, we could say that the student centered analogy technique, in comparison with the teacher centered analogy technique, is a technique which is more effective in the concept learning process particularly when it is enhanced with the illustrations and which ensures the active participation of the students in the class by establishing correlation between the daily knowledge and the scientific knowledge by means of revealing the pre-learning of the students.

Implications

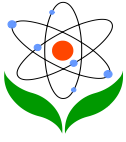
Our study is carried out with the primary school 6th class students and the students were requested to form their own analogies as a result of the study where the student centered analogy technique was used. However, because the students at this



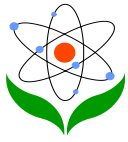
stage sometimes can not enter the abstract processes period, it is observed that they have difficulty in forming their analogies. Because of this reason, it could be more useful to apply the analogy technique in the new studies on the students in upper stages.

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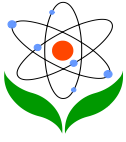
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