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Usage of Graphic Organizers in Science and Technology Lessons

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Abstract

Graphic organizers are teaching and learning tools that show organization of concepts as well as relationships between them into a visual format. The purpose of this study is to show why graphic organizers are important teaching and learning tools, how graphic organizers help students comprehend knowledge and establish relationship among concepts, and how they can be prepared and used in Science and Technology courses. For this purpose, twelve graphic organizers have been prepared for selected topics placed in 6th, 7th, and 8th grade. After then, the use of graphic organizers during teaching duration and their effectiveness in improving learning outcomes have been explained. The graphic organizers prepared in this study are semantic future analysis, pyramid, flow diagram, comparison contrast matrix, spider web, mind map, fishbone, miniature painting, positive and negative-interest diagram, word mapping, persuade map, cause-effect diagram.

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1. Introduction

According to Ausubel's theory (1960), meaningful learning occurs when an individual's existing knowledge interacts with new information in a non-arbitrary way (cited in Daros ve Onwuegbuzie, 1999: 3). Ausubel's Meaningful Learning Theory applies only to reception (expository) learning in schools. Ausubel (1960) found that learning meaningful verbal material could be enhanced by using an advance organizer. An advance organizer is the tool that is presented prior to the material to be learned, and that helps learners to organize and interpret new incoming information. Advance organizers in cognitive instructional promote the learning and retention of new information. It is important with linking old information with something new. They help students recognize that the topic they are beginning to learn is not totally new and provide teaching explanations which include concepts. Advance organizers are different from a simple overview, a review of what was learnt in the previous lesson, telling something about the new topic, and stating the objectives of the lesson which simply emphasize key ideas. *Advance organizers* have also been presented graphically. They are also called *graphic advance organizers* in some researches. *Graphic organizers* are teaching and learning tools that show organization of concepts as well as

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relationships between them into a visual format. While *Advance organizers* are being used in the beginning of the lesson, *graphic organizers* can be used in any processes of lesson with different aims. They can be used a teaching tool throughout a lesson, or for review at a later time. Being visual is so important in *graphic organizers*, but advance organizers can be visual or solely prose (Nakiboğlu et al. 2010). Graphic organizers can help students organize their knowledge and encourage them become actively engaged during the discussion of topic and its concepts. Therefore, use of graphic organizer can be assist make expository texts which is difficult to understand because of problematic nature of the topics more understandable for the students (Gil-Garcia and Joaquin, 2003).

In Turkey, the philosophy of the Science and Technology Curriculum renewed in 2006 is based on the constructivist learning approach (MEB, 2006). Also it is stated that using graphics, sounds and simulations in a creative way is promoted to establish a meaningful and interactive dialogue with students and to support them to gain the information, skill and understanding. As can be seen here, the philosophy of the new curriculum of Science and Technology is quite consistent with the idea of using *graphic organizers* in teaching. Because of the fact that *graphic organizers* which help the teacher teach the complex issues, the preparation of sample materials for teachers to use in their lessons is important in terms of making teaching period more effective and efficient. The purpose of this study is to show why graphic organizers are important teaching and learning tools, how *graphic organizers* help students comprehend knowledge and establish relationship among concepts, and how they can be prepared and used in Science and Technology courses.

2. Methods

2.1. The selection of graphic organizer type and topics

In this study, twelve graphic organizers have been prepared for selected topics placed in 6th, 7th, and 8th grade Science and Technology curriculum which are cell, from cell to organism, Soil, Elements and Compounds, Central Nervous System, visual organ Eye, Do we leave these to our grandchildren?, Genetic Diseases, Genetic Engineering and Biotechnology, Meiosis, Pressure, Acid rains. The *graphic organizers* prepared in this study are semantic feature analysis, pyramid, flow diagram, comparison contrast matrix, spider web, mind map, fishbone, miniature painting, positive and negative - interest diagram, word mapping, persuade map, cause - effect diagram. While selecting of graphic organizers, 6, 7 and 8th class topics which are appropriate to the intended use of graphic organizers are preferred. Physics, chemistry and biology are introduced for the selection of the subjects. Especially, that subjects which are abstract and have less opportunity for experiment was intended on support with visual quality. For example, such as cell and genetic biology topics are abstract for students. Elements and Compounds are abstract for the 6th grade students who are at the end of the concrete operational period, because they contain particles those are not possible to see. Pressure is the most difficult subject to learn for 8th grade students. Considering all these factors for the selection of topics, graphic organizers were prepared. In the findings section, the use of *graphic organizers* prepared in this study during teaching duration and their effectiveness in improving learning outcomes for students have been discussed for each of graphic organizers.

3. Findings and Discussion

3.1. Semantic feature analysis

The semantic feature analysis that has grid shape uses to help learners explore how sets of things are related to one another. Semantic feature analysis can be used, when the task is comparing characteristics among a group of

items (“Graphic Organizers”, 2010). In this study, semantic feature analysis has been prepared for the topic “liveliness begins with cell” placed in 6th grade textbook. The example of semantic feature analysis prepared in this study is given Figure 1. Topic of cell is one of the important topics in biology. To teach differences between plant and animal cell as both functional and structural is important. Some studies have showed that students had problems about cell and its function, so it was suggested that using visual material for teaching this subject was important (cited in Nakiboğlu, et al. 2002). The example of semantic feature analysis in figure 1 was prepared to assess students’ learning about the difference between plant and animal cell at the end of lesson.

Features	Plant Cell	Animal Cell
Angular form	+	-
Cell wall	+	-
Major koful	+	-
Chloroplast	+	-
Centrosome	-	+
Lysosome	-	+
Cell membrane	+	+
Cytoplasm	+	+
Nucleus	+	+

Figure 1. Semantic feature analysis

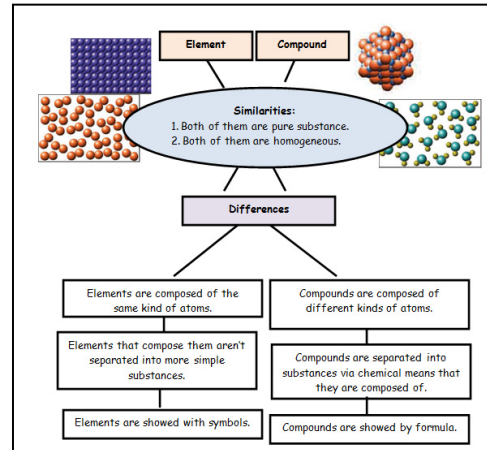


Figure 2. Comparison contrast matrix

3.2. Flow diagram

The flow diagram is a graphic organizer of presenting, describing, or analyzing a process, an experiment or a subject. The flow diagram can be used, when the topic involves a chain of instructions to follow, with a beginning and multiple possible outcomes at some node, with rules at some nodes (“Graphic Organizers”, 2010). In this study, flow diagram has been prepared for the topic “soil” placed in 6th grade textbook.

3.3. Fishbone

The fishbone is the graphic organizer that helps to visually display the many potential causes for a specific problem or effect. Fishbone can be used, when the topic involves investigating multiple cause-and-effect factors associated with a complex topic and how they inter-relate (“Graphic Organizers”, 2010). The fishbone has been arranged for the topic “do we leave these to our grandchildren” in 7th grade textbook. The fishbone was prepared to assess students’ learning about cause and effect of ecosystem deformations at the end of lesson. This fishbone can be also used in order to explain the topic of ecosystem deformations during teaching duration.

3.4. Persuade Map

The Persuade map is the graphic organizer that enables students to map out their arguments for a persuasive essay or debate. In the first step of persuade map a goal or thesis is written (“Persuasion Map”, 2013). Later, reasons and examples are presented. The thesis in this study is “The pressure of solid depends on an object’s weight and the

surface area of contacting the ground” for the topic “pressure” placed in 8th grade textbook. The persuade map was designed to teach the factors that effect on solid pressure during lesson period.

3.5. Word Mapping

The word map is the graphic organizer that promotes concept development. Using the word map, students think about concepts in several ways. The word map engages students in developing a definition, synonyms, antonyms, and a picture for a given vocabulary word or concept (“Word Maps”, 2013). The word map has been prepared for meiosis topic placed in 8th grade textbook. Research has showed that students had problems about the mitosis and meiosis, and about the nature of difference between mitosis and meiosis (Chattopadhyay, 2012).

3.6. Comparison Contrast Matrix

The comparison contrast matrix is the graphic organizer that can be used for comparing and contrasting two concepts along several different aspects. It can also be used when the differences and similarities between concepts are compared. The comparison contrast matrix has been arranged for “elements and compounds” topics placed in 6th grade. The example of comparison contrast matrix prepared in this study is given Figure 2. Taber (2002) has cited that students have problems about element and compound concepts. To teach this concept is also very problematic for teacher. So this kind of graphic organizer can be help to teachers.

3.7. Miniature Painting

The miniature painting is the graphic organizer that is shown basic concepts of subject with miniature painting. The miniature painting has been prepared to show genetic diseases placed in 8th grade textbook. In this material a table was prepared to show the thirty five photographs concerning genetic diseases such as, *sickle cell anemia*, *hemophilia*, *Down syndrome* and *albinos*.

3.8. Cause-Effect Diagram

The cause-effect diagram is the graphic organizer that is shown the relationship of all factors (causes) that lead to the given situation (effect). Cause-Effect Diagram can be used when the task is examining possible causes and effects in a process (“Graphic Organizers”, 2010). The cause-effect diagram has been prepared to show effect of acid rains placed in 8th grade textbook.

3.9. Spider web (Network concept)

The spider web is the graphic organizer that can be used when the topic involves investigating attributes associated with a single topic, and then obtaining more details on each of these ideas (“Graphic Organizers”, 2010). The spider web has been prepared to show central nervous system placed in 7th grade. It can be used to explain details of central nervous system in presenting of topic in the lesson.

3.10. Positive-Negative-Interest Diagram

The positive-negative-interest diagram is the graphic organizer that can be analyzed any problem, issue or area of interest (“De Bono’s PMI Models”, 2013). Positive-Negative-Interest Diagram can be used when the task involves analyzing the plusses, minuses, and implications of a decision (“Graphic Organizers”, 2010). This diagram has been prepared to show plus, minus and interesting way of genetic engineering and biotechnology placed in 8th grade textbook. This diagram was designed to show details of genetic engineering and biotechnology for the topic presentation in the lesson.

3.11. Mind map

The mind map is the graphic organizer that helps learners learn more effectively, improves the way that learners record information, and supports and enhances creative problem solving (“Mind Maps”, 2013). The mind map has been prepared for the topic “Visual organ eye” placed in 7th grade textbook. It was prepared to show details of eye in explain process of the lesson.

3.12. Pyramid

The pyramid is the graphic organizer that is a great way to illustrate a hierarchy. In social studies, the pyramid is frequently used to show the class stratification of a particular society (“Pyramid”, 2013). The pyramid has been prepared to show hierarchy for the topic “from cell to organism placed in 6th grade textbook. This pyramid was designed to explain the hierarchy from cell to organism. This can be used to assess students’ learning at the end of lesson as well.

4. Conclusions

The graphic organizers can provide learning of complex and problematic topics easily (Hall and Strongman, 2008). Therefore, the preparation of sample materials is important for lessons. In this study, twelve graphic organizers have been prepared and explained how they can be used in Science and Technology lesson. The preparation and usage of graphic organizers can be recommended for other lessons. Students can remember concepts and topics easily if a graphic organizer use during lesson. The students can also be arranged graphic organizers themselves for their lesson when they are taught. If graphic organizers are explained in teacher books, the teachers can be designed their own graphic organizer and use them in their lessons. It is recommended that the explanations about how graphic organizers can be prepared are presented in teacher books.

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