CONTRIBUTION OF ACTIVITIES DEVELOPED FOR VISUALLY IMPAIRED STUDENTS TO SCIENTIFIC PROCESS SKILLS

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Abstract

Science education has an important role in children's understanding of the world, making the right decisions in accordance with their perceptions, using problem solving skills and scientific attitudes. In this study, the effects of activities prepared by considering the needs of visually impaired students on the development of scientific process skills were analyzed. The case study was used in the study. The sample of the study consisted of one blind and one low vision student. The Science Activity Observation Form (SAOF) was used as the data collection tool. In order to ensure the reliability of the study, SAOF was completed by two researchers and the analysis of the researchers were compared. It has been found that the science activities developed within the scope of the study made a significant contribution to the science process skills of visually impaired students.

Keywords: Visual impairment students; teaching science; science activity; science process skills.

INTRODUCTION

Visually impaired students differ from each other according to their functional view, socio-economic status, cultural backgrounds, age at onset of visual disability, existence of other disabilities and cognitive competences (Şafak, 2010). These individuals who consist heterogeneous groups have the same characteristics as their normal peers in terms of their mental functions, but they experience limitations in all or part of the fields of motor, concept learning, language and development. Motor development of visually impaired children varies greatly in terms of the degree of visual impairment compared to normal peers (Levack & Loumiet, 1993; Scholl, 1986).

The effect of visual impairment on mental development varies depending on the degree of visual information reaching the brain. Visual information positively affects mental development if it contributes to the formation of environmental perception and understanding the cause-effect relationship between objects. Therefore, visual impairment does not cause low intelligence, but only negatively affects cognitive development (Groenveld, 1993). However, some objects are too small to touch (flies, cells), some of the very large (elephant, buildings) some of the very far (star, sun) by touching can make it impossible to obtain information (Skaggs & Hopper, 1996).

Science education has a great importance in the development of children's scientific process skills, to answer scientific problems in daily life, to develop problem solving skills, to increase their experience and skills in life (American Association for the Advancement of Science [AAAS], 1990). Scientific process skills are basic skills that facilitate learning in science, enable students to be active, develop a sense of taking responsibility in their own learning, increase the permanence of learning (Levack & Loumiet, 1993; Mastropieri & Scruggs, 1995; Yamak, Bulut & Dündar, 2014; Wang, Wang, Tai & Chen, 2010). Scientific process skills are the thinking skills we use to create knowledge, think about problems and formulate results. These are the skills that scientists use during their work. By teaching these important skills to the students, we can enable them to understand and learn their worlds. These skills are the basis of thought and research in the content of science (Butts & Prescott, 1990; Hofstein, Nahum & Shore, 2001). Because the development of scientific process skills in individuals is solved by investigating the problems that can be encountered in daily life and individuals are actively involved in the process (Wallace & Kang, 2004; Flick, 2004). Individuals gain experience by observing every event that occurs in their environment (instruments work, animal movements, natural events etc.). In this way, individuals learn by living, doing their own questions, researching the questions they ask, and learning the information they need to learn (Oliveira, 2009).

The scientific process skills can be broadly conveyed, defined as a set of skills adopted for many disciplines and accepted as a reflection of the correct behavior of scientists. (Lunetta, Hofstein & Cloug, 2007). Basic scientific processes are observing, classifying, recording data, making measurements, using space / time relations, using numbers, making conclusions and estimating. These skills provide complementary process skills (changing and controlling variables, interpreting data, hypothesizing, using operational identification data, and model building and experimentation) to learn (Khan, Hussain, Ali, Majoka & Ramzan, 2011; Padilla, Okey & Dillashaw, 1983) hence, it is necessary to formulate situations in which individuals are able to construct knowledge in science teaching.

Understanding the nature of science is considered as an absolute need in science education. Because understanding the nature of science has an important place in the development of individuals who can make productive, informed decisions, solve the problems by taking scientific data and produce solutions (Mastropieri and Scruggs, 1995; Patton, 1995). When the nature of science is examined; observation, inference and theoretical elements are seen. As a pioneer in understanding the many inferential elements such as atom, molecule, orbital, gene, photon, magnetic field, gravity in the scientific world; an understanding of the difference between observation and inference. Observation and inference are among the scientific process skills. Other subjects seen in the nature of science are theories and laws (Hadary & Cohen, 1978; Sackes, Trundle & Bell, 2013).

Science education has been identified as one of the most useful and valuable content areas for many disabled students by some special educators. Because science education can provide better understanding of the world and ability to establish a scientific basis for the problems they face in everyday life (Hadary and Cohen, 1978; Sackes, Trundle & Bell, 2013). Furthermore, science education has an important place in the perception of children who need special education, making the right decisions according to their perceptions, developing problem solving skills, developing scientific attitudes, and increasing their experience and skills (Mastropieri and Scruggs, 1995; Patton, 1995). It provides students with the opportunity to experience rich experiences in order to understand the relationships between objects in the light of new ideas. Science education also provides students with great opportunities to develop high-level thinking skills and problem-solving strategies (Cawley, 1994; Dickerson, Smith & Moore, 1997; Kumar, Ramasamy & Stefanich, 2001). However, the science activities planned, prepared and applied for the students who need special education should be prepared in accordance with the individual requirements of the children.

METHODOLOGY

Case study was used in the study. Case studies provide a better understanding of current situations or situations (Creswell, 2007). In such studies, the researchers try to answer the questions of how and why (Yin, 2013). The steps of the study can be listed as follows:

I. At the first needs of visually impaired students to learn science lesson outcomes (Kızılaslan and Sözbilir, 2017; Zorluoglu and Sözbilir, 2017) were determined.
II. Along with these needs, the teaching plan and materials for the 'Changes in Matter' unit were developed.
III. At the second step of the teaching, the plan was applied.
IV. At the third step, the effects of activities on the scientific process skills of visually impaired students were determined.

The study group consisted of one blind and one student with low vision students in Agri and Isparta (Table 1).

Table 1. *Sample of the study*

Students	Gender	Age	Visual acuity	Mobility training	Use reading aids
S_1	Female	12	Blind	Receive training	No
S_2	Male	12	Low vision	No training	Yes

Data were collected by using the Science Activity Observation Form (SAOF). The activities for the six outcomes in the unit were analyzed through the activities that designed to visually impaired students to gain scientific process skills. Students' scientific process skills gaining status was analyzed by taking into consideration the outcomes in the 'Changes in Matter' unit. The outcomes of the unit are as follows:

1. Make inferences based on the data obtained from the experiments that the substances can change by the effect of heat.
2. Determines the melting, freezing and boiling points of pure substances as a result of experiments.
3. Explain the main differences between heat and temperature.
4. Experiments are carried out to test the results of heat exchange as a result of mixing of liquids with different temperature.
5. Discusses the results of experiments by experimenting with the effect of heat to expand and shrink the substances.
6. Relate samples from daily life to expansion and shrinkage events.

The data SAOF were subjected to descriptive analysis. While developing each activity, scientific process skills targeted by the activity were also determined. The activities were analyzed according to two categories as 'yes' and 'no' while analyzing the students' gaining scientific process skills. If the activity ensures the use of the targeted scientific process skills, it is placed in the category of 'yes' and 'no' if it does not. In order to ensure the reliability of the data, SAOF was filled by two researchers during the course and the SAOF data were compared by the researchers. In the activity of differences, the researchers discussed the observers and decided on a common skill level.

RESULTS AND DISCUSSION

In the study, the scientific process skills which are designed according to learning outcomes were analyzed. The science learning needs for visually impaired individuals were taken into consideration in the literature (Kızılaslan and Sözbilir, 2017; Zorluoglu and Sözbilir, 2017). In the literature, it is stated that the students who are visually impaired generally do not have courses for gaining scientific process skills and lessons are teacher-centered. For this reason, lesson plans were prepared considering the scientific process skills that can be gained to visually impaired students.

The descriptive analysis of data that are gathered from SAOF observation from will be given here. In order to ensure validity and reliability, the notes kept on the first observation form were compared with recorded videos after every lesson. Additionally, a copy of the observation form was given two experts to watch the videos and record their observations. It was requested from experts to watch the activity videos and examine whether the activities were efficient on acquiring of planned skills. A common consensus is reached after examining the different analyzes. Table 2 shows observational data on needs analysis before designing of the first activity of the instructional design.

Implementation of Teaching

The activities were developed by taking the needs of the students into account and supported by the teaching tools ‘magnifying glass, audible thermometer, Braille course documents, large-scale course documents and tactile materials’.

Table 2. *Example of the realization of teaching*

S_1 implementation observation results	S_2 implementation observation results
Teacher: We will do it now. I put this Braille paper in front of the information about this event. Try to read. Ask me if you don't get them. And then I'm gonna help you out. I'm also putting an audible thermometer here to make the event. S_1: I read OK. Teacher: One of the class's students can read about how to do the activity on the paper in front of you. Teacher: your friend has studied. Now we will determine the melting point of the ice on the activity sheet. I want you to constantly monitor the temperature of the ice with an audible thermometer and observe the transition from solid to liquid by touching the ice. S_1: OK, teacher. Teacher: now how many degrees do you measure the temperature before S1 gives heat to the ice? S_1: -5 says my teacher. He took S1 measurements continuously and told his friends. As the ice begins to melt, S1's observations and dialogue are: S_1: 1 degree of teacher. The ice is still solid. S1: Temperature 0 degrees. still solid teacher.	Teacher: I'm giving you a big piece of activity paper, can you read it? You'll learn how to do the experiment after you've read it. Then you're gonna do the experiment with your friend. Do you read the S_2 event? Listen to S_2 in other friends, you can read the paper in front of you. S_2 is expected to read Teacher: You will now perform the read event. Everybody take four groups. Get S_2's group here. You're going to do the experiment here. S_2 will make the measurements you'll observe melting S_2 with the magnifying glass in your hand, you'll check the melting. Now start the measurement. S_2: Currently -8. Measurement is continued after approximately 4-5 minutes of heat is applied S_2: My teacher was 0. Other students: my teacher began to melt. S_2: This teacher has shrunk. (looked at the ice with a magnifying glass) Teacher: Let's wait for the ice to shrink S_2: My teacher was in the water.

S_1: The temperature 0 sounds like water to my hand. Approximately 2-3 minutes S_1: My teacher has shrunk. The temperature still says 0 degrees. S_1: This is my teacher. Teacher: You can measure the temperature of the water. S_1: 3 degrees, my teacher said. Teacher: S_1, what do you think is that this temperature stays at 0 degrees for a long time and ice turns into water. S_1: We can say Melting. Teacher: What is the constant temperature? S_1: Melting point? Teacher: Yes, the temperature at which a substance passes from solid to liquid and remains constant for a short time is called melting point or melting point.	Teacher: Warm up. S_2: Is my teacher 0 still enough? Teacher: continue. S_2: My teacher is 2. Teacher: I guess everyone finished the experiment. Everybody try to answer now. What happened? Other students: melted, teacher. Teacher: How was the temperature when S_2 melted? S_2: The temperature was always 0. Teacher: can we call this point the melting temperature? Other students: Yes.

Analysis of Activities

In this section, the scientific process skills that the activities in the teaching plans developed for the ‘Changes in Matter’ unit outcomes are determined. Accordingly, it is aimed to realize that in Activity 1, substances can change their state by the effect of heat. The students were asked a few questions to activate their prior knowledge before starting the activity. Then the materials related to the activity (ice, water, beaker, sound thermometer, magnifier) were distributed to the students and the students were made to observe the materials by touching. Audible thermometer, magnifier; Braille activity paper and audible thermometer were distributed to the blind student and students were asked to read the paper. Water was added to one of the two beakers distributed within the scope of the activity and water was added to the other (Experimenting, changing and checking variables). During the activity, the visually impaired student will be able to measure the temperature with an audible thermometer (observing, saving data). After waiting for a while, they found that the ice melted, and the water boiled (observation) and recorded the temperature data for the temperature to remain constant at the melting and boiling points. Using ice and water at the event, both melting and boiling were understood (change and control variables).

Activity 2 aims to improve students' hypothesis skills by distributing TGA paper. Pre-event students were asked to establish a hypothesis (hypothesis). Then, students were allowed to take measurements with the sound thermometer by adding ice to the beaker and to record these measurements (Experiment, Measurement, Data recording).

The aim of Activity 3 is to determine the difference between the concept of heat and temperature. In order to attract the interest of the students, the previously prepared mechanism to understand that the concepts of heat and temperature are different concepts, and the students were given to recognize the mechanism (Observation). At the end of the course, it was aimed to teach the heat and temperature concept by analogy and the students were asked to observe the changes in the particles and asked them to take notes (Observing, recording the data).

It was aimed to determine that heat exchange was carried out as a result of mixing of liquids with different temperature in Activity 4. In this activity, two teachers with water at 70 ^{0}C and 20 ^{0}C were given control of each teacher and visually impaired students were asked to record temperature measurements and temperatures with an audible thermometer (measurement, data recording). In order to carry out the experiment, cold water was gradually added to the hot water and it was requested to take measurements at certain intervals as a result of this addition. In the same activity, it was requested to measure the water by adding hot water to the cold water at the same activity (Experiment, Measurement, Changing and checking the variables).

The aim of this course is to enable the students to understand the expansion and contraction of materials by the effect of heat. The materials required for Activity 5 were given to the students before starting the activity. Within the scope of the activity, students were asked to pass the metal rings prepared from copper and aluminum through fixed compartments by giving the mechanism developed to understand the effect of heat on the materials. They were then asked to predict which rings could pass through the fixed compartment when they were heated (using data and modeling, experimenting). The heating process was carried out under the supervision of the teacher and the students were asked to make an experiment, and to determine which item was passed and which one was not passed, they were asked to infer the reason why the passing ring did not pass (Measurement, Data Saving, Observation, Experiment). Then, the metal rings are placed in the ice water for the cooling process, which is the opposite of the heating, and after a while, it is provided to perform the mentioned activity in this way (Change and control the variables).

When the designed activities are examined in terms of the contribution of the visually impaired students to the scientific process skills, the skills included in Table 3 are carried out by the students in the implementation stage of the activities. Accordingly, the activities prepared for the Changes in Matter ' unit 'observation', 'measurement and classification', 'saving data', 'setting up hypothesis', using data and creating models', 'changing and controlling variables' experiment and' contributed to the acquisition of skills.

Table 3. *Analysis of Acquisition of Scientific Process Skills in Activities*

				Observation	Measurement classification	Data recording	Hypothesize	Using data and modeling	Testing variables	Experimentation	Critical thinking	Decision-making	Communication and team work
Activities	1	Planned situation		•	•	•			•	•		•	•
		Actualization situation	B	✓	✓	✓			✓	✓		✓	✓
			LV	✓	✓	✓			✓	✓		✓	✓
	2	Planned situation		•	•	•	•			•		•	•
		Actualization situation	B	✓	✓	✓	✓			✓		✓	✓
			LV	✓	✓	✓	✓			✓		✓	✓
	3	Planned situation		•		•					•	•	•
		Actualization situation	B	✓		✓					✓	✓	✓
			LV	✓		✓					✓	✓	✓
	4	Planned situation		•	•	•			•	•		•	•
		Actualization situation	B	✓	✓	✓			✓	✓		✓	✓
			LV	✓	✓	✓			✓	✓		✓	✓
	5	Planned situation		•	•	•		•	•	•		•	•
		Actualization situation	B	✓	✓	✓		✓	✓	✓		✓	✓
			LV	✓	✓	✓		✓	✓	✓		✓	✓

•: Planned situation X: It did not take place ✓: Take place B: Blind Student, LV: Low vision student

CONCLUSION

In this study, it has been determined that students with visual impairment can improve their scientific process skills and gain these skills through the lesson plans prepared in terms the needs of the visually impaired students. Within the scope of the study, it was determined that the visually impaired students gained scientific process skills by observing, measuring, classifying, data recording, hypothesis building, using data and creating models, changing and controlling variables, conducting experiments. The use of teaching materials for the learning needs of visually impaired students in the acquisition of these skills and the placement of scientific process skills to be learned in the lesson plan are thought to increase the effectiveness of the students in developing these skills (Kızılaslan, 2019). The use of teaching methods and techniques in the constructivist approach for developing and activating scientific process skills is more effective in developing scientific process skills and maximizing the use of these skills than traditional teaching methods (Jones, Taylor & Broadwell, 2009). This study demonstrates the positive effect of the lesson plans that are suitable for the constructivist approach that will enable the learning of the visually impaired students to the students' scientific process skills.

In order to improve the scientific process skills of the visually impaired students, it is necessary to support the teaching materials which will facilitate the teaching and enable the scientific process skills. In the study, it is thought that the supportive loupes, voice thermometers, large-scale documents and Braille documents enable the visually impaired students to use their scientific process skills actively.

Consequently, some adaptations should typically be made to enable students with visual impairment to have a safe and complete access to the science course program. The curriculum, objectives and content should be arranged in line with the needs of students with visual impairment. Individual visual needs of students should be taken into account when determining how to make teaching materials accessible. Science teaching materials or materials may include measuring devices, charts, reading equipment. Students with visual impairment use tactile and kinesthetic inputs to learn about their environment. The visual materials used in the classroom must be adapted to be used by students who do not have the necessary visual skills for the task. Graphs, models, maps and graphs will be more readable for visually impaired students if they are "readable" using touch sensation. Based on the results of this small-scale study, it should be provided to help visually impaired students continue to be part of the science education system. It is hoped that the experiences mentioned in this study will gain momentum for visually impaired students to begin to discover science fields which are very difficult to learn for a very long time

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