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DETERMINING AND COMPARING THE SCIENCE PROCESS SKILL LEVELS OF 5th AND 8th GRADE STUDENTS

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ABSTRACT: The aims of this study are to determine and compare the levels of scientific process skills of 5th and 8th grade students. The skills which were examined specifically for this research are as following: Observation, classification, measurement, recording data, establishing space and number relationships, predicting, identifying variables, interpreting data, inference, hypothesizing, modelling, and experimenting.

Research was conducted with a total of 200 students, 100 students at 5th grade and 100 students at 8th grade, attending to a middle school in the province of Kars. In this research the survey method was utilized. Science Process Skills Test (SPST) consisting of multiple choice questions administered to students of each grades to determine their level of science process skills. Data was examined by utilizing frequency and percentage distributions.

The findings show that the percentage of success achieved by the 8th grade students is higher than the 5th grade students. In addition, both 5th graders and 8th graders' performance level for experimenting and establishing space and number relationships are lower compared to other process skills. Findings also showed that 5th grade students are better in recording data, and 8th graders are better in creating a model in compare to other science process skills.

Key words: science process skills, teaching science

INTRODUCTION

In today's information and technology era scientific knowledge grows exponentially, technological innovations progress rapidly and science and technology affect every area of our lives significantly. Under these conditions, it is evident that science and technology education plays a key role for the future of a society. Topsakal (2005) defines science and technology course as a window that helps students to acquire necessary knowledge, skills, attitudes and values that will allow them to be conscious and responsible citizens and successful in their future professions. In this regard, all communities, particularly the developed countries are in a constant effort to improve the quality of the science and technology education (Aydogdu & Kesercioğlu, 2005). Science and technology education has an extremely important role in training individuals who possess science process skills such as observing, collecting data, and inferring, as well as skills of searching information, critical thinking, identifying problems, and problem solving.

Science process skills are basic skills that facilitate learning, help students to acquire necessary knowledge and methods to perform an inquiry, and develop a sense of responsibility for their own learning (Çepni, Ayas, Jonhson and Turgut, 1997). According to Lind (1998), scientific process skills are thinking skills that persons use in constructing knowledge, reflecting on a problem and formulating the results (Tan &Temiz, 2003). Acquiring these skills in science and technology courses in the teaching process has an important place. Students can be helped to acquire science process skills by planning activities which are appropriate for their mental and

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physical status. As Bağcı-Kılıç (2003) stated, students might not be expected to design and conduct scientific research in very early grades, however, they might be helped to acquire basic process skills. Skills such as observation, measurement, classification, and prediction can be acquired to students by planning short term activities. These preliminary skills then can be a basis for the higher grades in developing more complex skills such as recording data, interpreting data, formulating hypothesis, and experimenting.

Çepni et al (1997) classify science process skills in three categories: **basic science process skills**, **causal science process skills**, and **experimental science process skills**. Basic skills are measurement, classification, number/space relations, and recording data, whereas causal skills includes predicting, identifying variables, data interpretation, and inference. The experimental skills are formulating hypothesis, analysing data, creating a model, controlling and changing variables, and decision-making.

Observing

Observation is identifying the properties of an object or event using our senses (Arslan &Tertemiz, 2004). When children make observation, they use five senses to gather information about objects or events in the environment. Observation is the simplest of all scientific process skills and the primary means for obtaining information (Monhardt & Monhardt, 2006).

Measuring

Measurement is using standard measures or estimations to describe specific dimensions of an object or event. (Padilla, 1990). These measurements can be made to determine properties such as length, mass, volume and the time (Monhardt & Monhardt, 2006).

Classifying

It is simply organizing the data collected through observation. It can be expressed as a grouping or arranging of the events or objects according to similarities or differences (Karamustafaoğlu & Meşeci, 2014).

Recording Data

Students collect both qualitative and quantitative data in experimental processes. These data are recorded as charts, tables, graphs or models. Organizing data in this way simplifies interpretations and results (Kesercioğlu & Aydoğdu, 2005).

Setting Number and Space Relations

Students try to understand and describe objects according to their planar or three-dimensional shapes in order to learn space-related processes. Number relationship can be defined as the process of using numbers to define the outputs or ongoing properties of an activity (Çepni et al., 1997).

Predicting

Predicting is guessing the most likely outcome of a future event based upon evidence. Information about what will happen after continuation or modification of a process is determined by predicting (Arslan & Tertemiz, 2004).

Identifying Variables

This skill means ability for figuring out the factors that can affect an experiment. Students should perform controlled experiments to develop this process skill. It is important to change only the variable being tested (independent variable) and keep the others constant in controlled experiments. The aim of this process is to monitor the changes occurring in dependent variable by the changes in independent variable (Aydoğdu & Kesercioğlu, 2005).

Interpreting Data

Delen and Kesercioğlu (2012) explain the interpretation of data as transferring information by using graphs and tables. Aydogdu and Kesercioğlu (2005), in addition, includes the meaning to be given to the results of experiments and observations in process of interpretation of data.

Inference

An inference is an explanation based on an observation or experience. Inference is usually confused with prediction. However, while prediction is guessing what will happen as an outcome of an event, inference is drawing conclusion from an observed event. Our conclusions must be based on data. We make inferences about causes of phenomena we observe based on the data which was collected through observation (Aydoğdu & Kesercioğlu, 2005).

Hypothesizing

A hypothesis is a testable statement of the investigator's best guess depending on experience and observation as to the relationship between two variables. When a student formulates a hypothesis, he suggests an explanation consistent with available observations, questions and evidence (Arthur, 1993, 12-13; cited by Tan & Temiz, 2003).

Making Models

A model is a verbal, structural, or graphic representation of the physical world. Models can be magnified samples of small objects, reduced size samples of large objects, or conceptual models which are prepared for understanding of complex ideas (Kesercioğlu & Aydogdu, 2005). Therefore, making models can be explained as making a concrete design of objects, events or ideas.

Experimenting

Conducting an experiment contains the skills of asking appropriate questions, formulating hypotheses, identifying variables and controlling these variables, designing experiment, performing the experiment and interpreting the results (Padilla, 1990). The aims of this study are to determine and compare the levels of scientific process skills of 5^{th} and 8^{th} grade students.

METHOD

Descriptive survey research model is used in this study in order to determine and compare the 5^{th} and 8^{th} grade middle school students' level of scientific process skills. Survey model is a research approach which aims to describe a current or past situation as it is. The event, individual or an object subject to the research is tried to be described as it is in its own conditions. (Karasar, 2005). Research was carried out with 5^{th} grade(N=100) and 8^{th} grade(N=100) students who are attending a middle school in Kars city centre.

Science Process Skills Test consisting of 21 multiple choice questions is utilized as data collection instrument. Number of questions to measure each skill is as following: Observation=2; classification = 2; measurement= 3; recording the data= 1; the number and space relationships= 2; prediction= 2; identifying the variables= 3; interpreting data= 2; inference= 2; formulating hypothesis =2; modelling= 1; and experimenting= 1. Since the questions for measuring observation skill were also used to measure two other skills, test consists of 21 questions in total. The test was developed by the researchers. Content validity of the test was established by experts in science education. Frequency and percentage distributions were utilized in the analysis of the data.

RESULTS and DISCUSSION

Each correct answer on Science Process Skills test was scored as 1 point; and each wrong answer was scored as 0 point. Accordingly, the lowest score on the test will be 0, while the highest score is 21. Fifth graders' average score on the test is $\bar{X}$=12.31, while the average score of 8^{th} graders' is calculated as $\bar{X}$=14.75. The success rate of 5^{th} grade and 8^{th} grade students' are 58.61 %, and 70.23% respectively. These results showed that science process skills of 5^{th} grade students were at a moderate level, whereas 8^{th} grade students' science process skills were found to be at a more advanced level. Table 1 shows question numbers measuring each skill in the test; and frequency and percentage of the students who answered the questions for each skill correctly.

Table 1. Frequency And Percentages Of Correct Responses By 5^{th} Graders On Science Process Skills Test

Questions	SPS	Frequency (f)	Percentage (%)
7 & 19	Observing	129	64,5
1 & 2	Classifying	137	68,5

3, 5, v&11	Measuring	171	57
8	Recording data	74	74
9 & 10	Number Space relations	62	31
4 & 13	Prediction	138	69
7, 14, & 15	Identifying variables	197	65,6
16 & 17	Interpreting data	125	62,5
6 & 12	Inference	106	53
18 & 19	Hypothesizing	106	53
20	Making models	72	72
21	Experimenting	43	43

Middle School 5th grade students' most advanced skills are determined as recording data (74%) and modelling (72%). In addition, students reached a relatively high level for the skills of observation, classification, prediction, identifying variables and data interpretation (62.5% -69%). They showed a moderate ability in inference and hypothesis (53%-57%). However, their skills in number and space relationship (31%) and conducting experiments (43%) were at a low level.

Table 2. Frequency And Percentages Of Correct Responses By 8th Graders On Science Process Skills Test

Questions	SPS	Frequency(f)	Percentage (%)
7 & 19	Observing	147	73,5
1 & 2	Classifying	169	84,5
3, 5 , & 11	Measuring	197	65,6
8	Recording data	79	79
9 & 10	Number Space relations	91	45,5
4 & 13	Prediction	156	78
7, 14, & 15	Identifying variables	230	76,6
16 & 17	Interpreting data	127	63,5
6 & 12	Inference	144	72
18 & 19	Hypothesizing	136	68
20	Modelling	86	86
21	Experimenting	60	60

Eighth grade students' highest level of success were determined in classification (84.5%) and making models (86%). They were also found to be highly successful in making observations, recording data, prediction, identifying variables and inference skills (72%-79%). However, their skills in measuring, interpreting data, and formulating hypotheses were found to be at a moderate level (60-68%). The lowest success was determined for number and space relationship. Only 45.5% of the students reached at a good level in number and space relationship.

Table 3.Frequency And Percentages Of Correct Responses By 5th And 8th Graders On Science Process Skills Test

SPS	5th Grade students		8th Grade students	
	Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
Observing	129	64,5	147	73,5
Classifying	137	68,5	169	84,5
Measuring	171	57	197	65,6
Recording data	74	74	79	79
Number Space relations	62	31	91	45,5
Prediction	138	69	156	78
Identifying variables	197	65,6	230	76,6
Interpreting data	125	62,5	127	63,5
Inference	106	53	144	72
Hypothesizing	106	53	136	68
Modelling	72	72	86	86
Experimenting	43	43	60	60

Comparison of the results for 5th and 8th grade students in science process skills showed that they were nearly at the same skill level for recording data and interpreting data. However, 8th grade students' skill levels for observation, measurement, prediction, identifying variables, formulating hypothesis and modelling are moderately higher than the 5th graders. In addition, there is a large difference in classification, inference and

experimenting skills in favour of 8th graders. However, for both grades the lowest success rate was for number and space relationships. Fifth grade students were found to be most skilful in recording data while 8th graders' most developed skill was modelling.

Analysis of the data showed a moderate success level in science process skills by 5th grade students. This result is consistent with the results of the research by Özdemir (2009), which determined a moderate level of scientific process skills by 5th grade students as well. However, low level of success in experimenting skills (43%) which is essential in science learning raises concern. Similarly, low ratio of students (31%) who are advanced in number and space relationships skills. This result suggest that activity based science classes are absent or students are not provided with opportunities to facilitate their learning of abstract concepts by using concrete models or simulations.

Eight grade students' science process skills were found to be more developed compare to 5th graders. However, their level in experimenting and number and space relationship were quite low comparing to other process skills. This result suggest that students do not have enough opportunities for doing experiments, which might be as a result of not sparing time for hands on learning, or the school's deficiencies concerning laboratory facilities.

Çakar (2008) study which was carried out with 5th grade students determined the level of students' science process skills. The data obtained from the study showed that 5th grade students did not fully realized science process skills which were an essential goal of the science and technology course curriculum. Özdoğru (2013) study also showed that 6th grade students' performance level of scientific process skills were below 50%. Similarly, Aydogdu (2006) study with 7th grade students, reported that they were at below average level. Another study by Ünal-Çoban (2009), conducted with 7th grade students, found mean score on science process skills test by experimental and control groups as $\bar{X}$ = 3.81 and $\bar{X}$ =3.19 respectively while the highest attainable score was 23. These averages indicate very low levels of the scientific process skills. However, research by Öztürk (2008) carried out with 7th grade student students reported a positive result in which students reached above moderate level in science process skills.

CONCLUSION

Comparing science process skill levels of 5th and 8th grade students showed that most of the skills developed through the years of schooling or by age of the students. However, some skills such as recording data and interpreting data remain at the same level. This result suggests that students have showed less development regarding cause-effect relationships. Based on the results of the study, it is suggested that students should perform activities that they need to think about the results of an event. In addition, during the activities students should be given opportunities to comment and express their opinions and discuss about their comments or opinions.

REFERENCES

Arslan, A., & Tertemiz, N. (2004). İlköğretimde Bilimsel Süreç Becerilerinin Geliştirilmesi. *Türk Eğitim Bilimleri Dergisi* 2 (4).

Aydoğdu, M., & Kesercioğlu, T. (2005). İlköğretimde Fen ve Teknoloji Öğretimi. Ankara: Anı Yayıncılık.

Bağcı-Kılıç, G. (2003). Üçüncü Uluslararası Matematik ve Fen Araştırması (TIMSS): Fen Öğretimi, Bilimsel Araştırma ve Bilimin Doğası. *İlköğretim-Online* 2(1).

Bıyıklı, C., & Yağcı, E. (2014). 5E Öğrenme Modeline Göre Düzenlenmiş Eğitim Durumlarının Bilimsel Süreç Becerilerine Etkisi. Ege Eğitim Dergisi 15, s.50.Çepni, S., Ayas, A.,Jonhson, D., & Turgut, M. F. (1997). Fizik Öğretimi. Ankara: Milli Eğitimi Geliştirme Projesi Hizmet Öncesi Öğretmen Eğitimi.

Delen, İ., & Kesercioğlu, T. (2012). How Middle School Students' Science Process Skills Affected by Turkey's National Curriculum Change?. *Türk Fen Eğitimi Dergisi*, 9 (4), 3-9.

Karamustafaoğlu, S., & Meşeci, B. (2014). Maddenin Tanecikli Yapısı Ünitesine Yönelik 4E Modeli Destekli Etkinliklerin Bilimsel Süreç Becerilerine Etkisi. *Kuramsal Eğitimbilim Dergisi* 7 (3) s. 304-321.

Karasar, N. (2005). Bilimsel Araştırma Yöntemi. Ankara: Nobel Yayın Dağıtım 14. Baskı.

Monhardt, L., & Monhardt, R. (2006). Creating a Context for the Learning of Science Process Skills Through Picture Books. *Early Childhood Education Journal*, 34 (1), 67-71.

Özdemir, H. (2009). İlköğretim 5. Sınıf Öğrencilerinin Bilimsel Süreç Becerilerine Sahip Olma Düzeyleri (Afyonkarahisar İli Örneği). Yüksek Lisans Tezi, Afyonkarahisar, Afyon Kocatepe Üniversitesi Sosyal Bilimler Enstitüsü.

Padilla, M. J. (1990). The science process skills. Research Matters - to the Science Teacher, 9004.

Topsakal, S. (2005). Fen ve Teknoloji Öğretimi. Ankara: Nobel Yayın.

Tan, M., & Temiz, B.K. (2003). Fen Öğretiminde Bilimsel Süreç Becerilerinin Yeri ve Önemi. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi Sayı:13.*