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ACHIEVEMENT AND GENDER EFFECTS ON 5TH GRADER'S ACQUISITION OF SCIENCE PROCESS SKILLS IN A SOCIOECONOMICALLY DISADVANTAGED NEIGHBORHOOD

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Abstract. *Science process skills (SPSs) play a significant role in science education. This research aimed to determine the acquisition level of 5th-grade students in SPSs with classroom activities. The research was a case study, and the data were collected by focus group interviews, document analysis, and observations. The sample of the research was six students from the fifth grade selected based on maximum variation sampling. Science process skills focused worksheets, focus group interview schedule, and observation forms were used as data collection tools. As a result, it was found out that the students were at the average or above the average level in observing, predicting, measuring, comparing and classifying skills; and they were at below the average level in inferring, organizing data, identifying and using experimental materials, processing data and formulating models, controlling variables, experimenting, interpreting and inferring. Also, it was determined that students with high academic achievement have more acquisition in SPSs. Besides, it was found out that the development of SPSs is gender neutral, it depends on the number of activities that are made in the classroom and what is the role of the students in these activities.*

Keywords: *gender in science process skills, lower secondary school, science achievement, science activities, science process skills.*

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Introduction

In recent years, students are encouraged to be more active in the learning process, which can be observed most explicitly in continually updated curricula by Ministry of National Education (MoNE) in Turkey (MoNE, 2005; MoNE, 2013; MoNE, 2018). In the new curriculum, the subject matter was reduced, which provides more time for meaningful learning. Science process skills (SPSs) are one of the essential skills required for meaningful learning (Elmas, Bodner, Aydogdu, & Saban, 2018). SPSs are significant for students because students need to learn them to overcome daily life problems more successfully (Kamisah & Vevrianto, 2013). Through these skills, students can understand both science and scientific inquiry process (Duruk, Akgun, Dogan, & Gulsuyu, 2017; Gillies & Nichols, 2014). Furthermore, SPSs are also important determinants of scientific creativity since using them requires both scientific thinking and creativity to develop new solutions to problems (Ozdemir & Dikici, 2017). In the 2018 science curriculum of Turkey, SPSs are defined as the skills that scientists use such as observing, measuring, classifying, organizing data and formulating a hypothesis (MoNE, 2018). Ostlund (1992) stated that SPSs are the basic skills that are necessary to learn about the world. Myers, Washburn, and Dyer (2004) stated that SPSs are the core skills for a science lesson, so it is essential to acquire them. In this research, SPSs are considered as a more commonly used typology of basic and integrated process skills (Martin, 2012; Saat, 2004).

In the science curricula developed in 2013 and 2018 in Turkey, SPS goals aimed for the fifth grade were not clearly stated (Saban, Aydogdu, & Elmas, 2014). Therefore, it is seen that the goals in the curriculum are not directly linked with SPS goals. It is suggested that activities should be developed within subject integrity to provide skills related to SPSs and they should be presented in curricula (Yildirim, Calik, & Ozmen, 2016). As the result of the lack of those links stated above, 10 of the skills aimed at the fifth grade in the

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2005 science and technology lesson curriculum were included, and the activities supporting the development of those skills were carried out. The basic and integrated process skills examined in the research are given in Table 1.

Table 1. The basic and integrated process skills.

Basic Process Skills	Integrated Process Skills
Observing	Processing Data and Formulating Models
Classifying	Identifying of Variables and Controlling Variables
Predicting	Experimenting
Measuring	Interpreting and Inferring
Inferring	
Identifying and Using Experimental Tools	

Integrated process skills are more complex than basic process skills, and integrated process skills might require using basic skills (Martin, Sexton & Gerlovich, 2002; Rambuda & Fraser, 2004). Thus, basic skills are required to be obtained in advance. SPSs might be embedded in science activities to foster their development (Foulds & Rowe, 1996). Moreover, the development of the SPSs is not only specific to one discipline but requires interdisciplinary collaboration. Therefore, those skills should be included in both science and other disciplines (Rillero, 1998). As known, individuals who are proficient in those skills can solve their problems more effectively in daily life (Smith & Scharman, 1999). In this context, SPSs have different functions within the school and in daily life. For instance, it is highly essential to use SPSs to solve problems encountered in daily life. Furthermore, SPSs facilitate the learning of new information (Dash & Padhi, 2016). As a result, those skills are essentials to provide meaningful learning and to prevent students from content-based instruction (Dash & Padhi, 2016). Briefly, when teachers focus on improving students' science process skills through activities, they also develop positive attitudes towards science (Kim, 2007). Thus, the retention of information increases because of using science activities in the class. Therefore, it is suggested that science teaching is designed to include science activities which include the process of acquiring SPSs (Huppert, Lomask, & Lazarowitz, 2002; Saat, 2004; Saban et al., 2014).

In some studies, it was found that there is a significant relationship between SPSs and students' socioeconomic levels (Beaumont-Walters & Soyibo, 2001). In the survey conducted by Hazir and Turkmen (2008), it was found out that 5th-grade students studying at schools in low socioeconomic neighborhoods have a lower acquisition in SPSs than others. Ozturk, Tezel, and Acat (2010) found that variables based on socio-economic status are related to the acquisition of SPSs. In some studies, there is a positive correlation between SPSs and academic achievement (Germann, 1994; Sahin & Yilmaz, 2017). Therefore, researchers emphasized that underdeveloped SPSs might affect academic achievement. Also, in research by Aydogdu and Ergin (2008), it was stated that the development of SPSs enables students to improve academic achievement. However, researchers stated that high academic achievement might not necessarily mean that SPS would be well developed.

Moreover, the difference in the students' SPSs in terms of gender was explored. There are studies that lower secondary school students' science process skills did not differ significantly in terms of gender (Hazir & Turkmen, 2008; Ozturk, Tezel, & Acat, 2010; Guden & Timur, 2016) and in some studies, it was found out that female students have better SPSs (Zeidan & Jayosi, 2015). Female students were determined to have more success than male ones (Bahar, Ozen, & Gulacti, 2009). Although there is a positive correlation between students' academic success and SPSs, it is essential to analyze how SPSs of female students studying in low socio-economical neighborhood change. In this context, it was aimed to examine the 5th-grade students' acquisition in using SPSs at a lower secondary school in a socioeconomically disadvantaged neighborhood. That is, socioeconomic levels of students living in a neighborhood were low and their parents were not generally well-educated. Besides, the school did not include a science lab. There were only lab materials in a cupboard in the classroom. Also, this research is significant in terms of allowing determining the students' acquisition in using SPSs in science lessons, which was put into practice in the 2013-2014 academic year and finally updated in 2018. Thus, the research question of this research was:

What is the acquisition level of the 5th-grade students' in SPSs at a lower secondary school in a socioeconomically disadvantaged neighborhood in terms of success and gender?

The examples on the students' acquisition in SPSs were given, and the reasons for those examples were discussed. Besides, some experiences were developed to improve the students' SPSs during the activities. Those experiences were presented with concrete examples.

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Research Methodology

Research Design

This research was qualitative, and it was a case study (Patton, 2002). In this research, the themes such as levels of the students' SPSs, their perceptions on those skills, their collective and individual experiences and how they make sense of those experiences individually and as a group were explored. The research was carried out in the spring semester of the 2014-2015 academic year.

Participants

The participants of this research were six 5th grade students composed of three girls and three boys. The students' achievement in science lesson (according to teachers' opinions and grades) were determined as two high, two medium and two low, based on maximum variation sampling method (Merriam, 2013; Patton, 2002). Only six students were included because of its qualitative nature to explore the acquisition levels of SPS in detail.

The participants were given a nickname while explaining the findings. The participants at the low success level were named by starting with the first letter L as Lale (Girl name), Lemi (Boy name); those who were at the middle success level named by starting with the first letter M as Mine (Girl name), Mehmet (Boy name), and those at the high level of success named by starting with the letter H as Halime (Girl name), and Hakan (Boy name). This research was reviewed by the Human Research Ethical Committee at Afyon Kocatepe University, Afyonkarahisar, Turkey. Later, official permission of the Directorate of National Education, Afyonkarahisar, Turkey was obtained before conducting interviews with students. Informed consent forms were sent to parents of students in order to receive their permission as well.

Research Context

The research was conducted at a lower secondary school in a socioeconomically disadvantaged neighborhood at Afyonkarahisar province in Turkey. Afyonkarahisar is a middle - sized city located at the center of Turkey. The lower secondary school has limited facilities compared to average schools in terms of physical infrastructure such as the lack of science or computer laboratory. The school has basic science kits for science activities. The school is located in a low-income neighborhood in the suburbs of the city.

Data Collection Tools

Observations, focus group interviews, and document analyses techniques were used in the research. These three techniques were used to provide triangulation (Patton, 2002). An observation form was used to collect data. This form was developed by adding SPSs goals determined by MoNE (2005) to the observation form developed by Aydogdu (2009). One of the data sources was the worksheets prepared by the students. Those worksheets were examined with document analysis in detail.

Focus group (n=6) interviews were conducted following each activity. Focus group interview schedule was used in focus group interviews conducted after each of six activities. Therefore, a total of six focus group interviews were carried out. Two other science educators are contributed to the focus group interview questions, observation forms, and worksheets by checking for face validity and the appropriateness of documents. As a result of the experience obtained during the pilot research and feedback from the two science educators, revisions were made on the worksheets, observation, and semi-structured interview forms to finalize them.

Research Implementation

During the three-week implementation process, each week two, six activities were implemented focusing on SPSs. These activities were related to heat, force, fossil, groundwater, erosion, and electricity. The SPSs activities about the force, fossil and groundwater were adapted from the science textbook and the other three activities were developed by the researchers. The students carried out the activities by following the instructions on the worksheets by actively participating. Constructivist learning approach was used as a framework while developing

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activities, and the activities were aimed to expose and develop the students' acquisition in their SPSs. During the activity, the students were observed by using observation form, and essential field notes were taken. Following each activity, a focus group interview was conducted. After the activity, a 20-minute break was given for students to rest and to get prepared for the focus group interview. The focus group interview was carried out in a circular seating arrangement to ensure effective communication. The audio-recorder was located in the middle of the roundtable. Students were given their attention to listen to their peers for clear recording. Focus group interviews lasted in 15 minutes approximately. Students were encouraged to discuss their ideas in focus group interviews.

Data Analysis

Descriptive analysis with deductive coding was used to analyze the data (Strauss & Corbin, 1990). In the first step of the analysis, the focus group interview was transcribed verbatim. Data were coded regarding the pre-determined framework of themes including science process skills, which were congruent with MoNE's (2005) goals. Each transcript was independently coded by two researchers (Merriam & Tisdell, 2015). The consistency between the researchers (reliability of coding) was calculated as 85% (Miles & Huberman, 1994). A part of the code list is given in Table 2 as an example.

Table 2. Some examples from the code list.

Themes	Code
Observing	Observing by sight
Sorting and Classifying	Full Classification
Predicting	Reasoned Prediction
Measuring	Measurable Feature
Inferring	Partial Inference
Identifying of Experimental Materials and Using Experimental Materials	Safety Issue
Data Processing and Formulating Models	Draw a Table
Experimenting	Specifying Variables
Interpreting and Inferring	Setting Relations
Controlling Variables	Partial Success

Each sentence or visual was identified as an analysis unit for the analysis of the worksheets of the students. In accordance with the purpose of the research, the middle, below the middle and above the middle expressions were used to indicate students' acquisition of SPSs. The framework was developed to find out students' acquisition of SPSs based on the MoNE's (2005) goals. A part of this framework is given in Table 3 as an example.

Table 3. A part of framework summarizing students' acquisition of SPSs.

Skill	Category	Indicator	Case- Expression
Observation	Above the average	The student observes things and processes with more than one sense organ and explains observation in detail by emphasizing the features of the things and processes.	The veins in the leaf fossil are very apparent and easy to feel when touched.
	The average	The student observes things and processes with at least one sense organ and explains the observation.	The veins in the leaf fossil can be seen.
	Below the average	Student misinterprets the observation He does not answer.	The leaf seems different.

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Research Results

Document Analysis Findings

In the first activity, the students were expected to observe the inflation of the balloon as a result of the expansion of air. When the students' answers were analyzed, it was found out that all students could write their observations correctly except Lemi. Some of the students' expressions related to the observing skill on the worksheets were as follows.

> The balloon is noticeably swollen (Hakan).
> The balloon was swollen because of the air in the bottle (Mine).

At the same activity, the students were expected to predict that the air would expand and inflate the balloon with the effect of heat. Lemi made a false prediction by responding to this question on the worksheet as "There will be no change in the balloon." However, it was seen that the other students' predictions were all correct.

In the second activity, related to the measuring skill, the students were asked to determine the force applied to measure the objects by a dynamometer and to note it on their worksheets. When the students' measurements were examined, it was seen that all of them were correct. However, some of the students did not show expected acquisition in measuring skills in other activities. For instance, in the fourth activity, it was found that the students made severe mistakes when measuring the height of the water accumulated in the jars by the ruler. These mistakes were explained in the observation findings part in detail.

In the third activity, the students were asked to compare leaf and tree fossils. When the worksheets were examined, it was seen that Halime, Hakan, Lemi had lower acquisition level, and Mine, Mehmet and Lale had higher acquisition level. For instance, it can be understood from Lale's expression "While the patterns and lines are clearly seen on the leaf, it is not seen on the tree fossil" that she had an acquisition in sorting skill. The acquisition of sorting skill for Halime, Hakan and Lemi was able to be examined in the focus group interview because these students could not clearly express themselves in the worksheets. On the other hand, this shortcoming also gives information about the students' acquisition in organizing data skill. As a result of the fact that students cannot express themselves well in writing, they cannot organize the data thoroughly and clearly.

The organizing data skill was also included in the fifth activity. The students were expected to keep records on the relationship between surface slope and erosion. The students' expressions on the worksheets revealed that they were not able to show the expected success related to the organizing data skill in that activity. The relevant section on Hakan's worksheet is given in Figure 1 as an example.

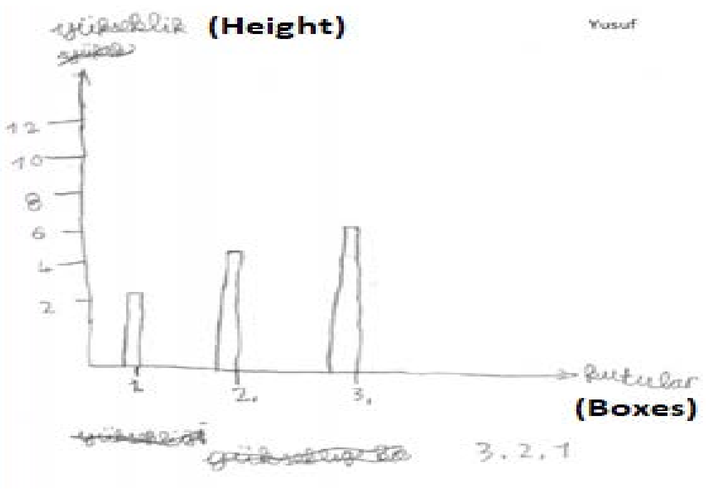

Figure 1. An example of the organizing data skill.

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Hakan had some shortcomings when organizing the data. For example, in a vertical direction, called height, the unit was not specified as "cm." Furthermore, there were some mistakes in those measurements, even if he had stated as "cm." Therefore, a mistake in the measuring skill negatively affected the organizing data skill. Moreover, it was seen that the expressions of the students with low academic success were illegible and difficult to understand.

In the fourth activity, the students were asked to explain the data obtained in the activity. Mehmet and Hakan were partially successful in that task for interpreting and inferring. For example, Hakan wrote on the worksheet that "We observed differences in water level because of the substances in the jar." However, he did not comment on such issues as how the properties of those substances affect the water level, and that situation has significant implications on groundwater in daily life. Besides, the other students also had a lower acquisition in that skill. Although the students with high academic achievement performed better, it was seen that they did not have the expected acquisition. For instance, in the fifth activity about erosion, Hakan was able to identify erosion with the statement "Without plants, soil erodes from the field". Halime's statement "Erosion slide." states that she confuses landslide with erosion. However, it is a topic for the students to learn erosion in the fourth grade in the science curriculum (MoNE, 2013). In the fourth activity, students were asked to present the data they obtained in different ways related to both processing data and formulating model skills. When the students' worksheets were examined, it was observed that mostly this section was left blank or given false answers except for Lemi and Mine. Lemi's answer is given in Figure 2.

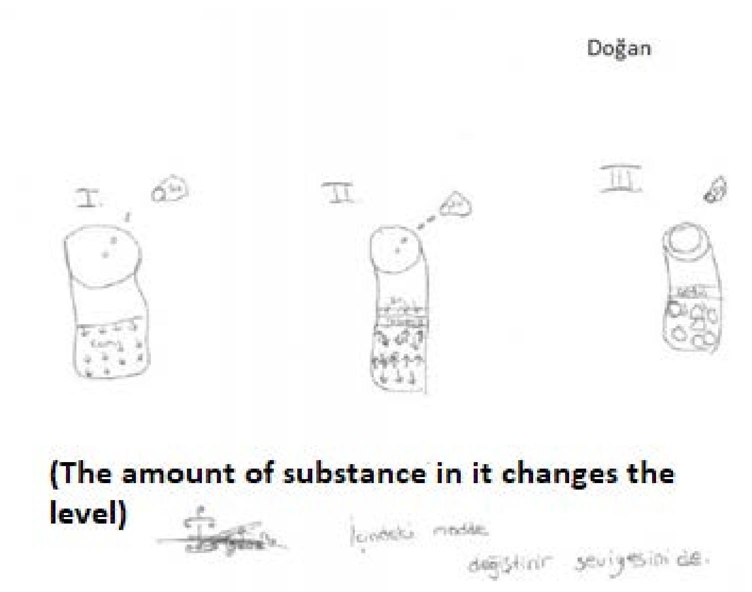

Figure 2. An example of both processing data and formulating model skills.

In Figure 2, Lemi could partially emphasize that the water levels in the jars are different. However, it is noteworthy that he did not specify these measurements in his drawing, although he measured in the activity. Furthermore, the jars in the activity were identical while they looked different in his drawing.

The content of the fifth activity was about the causes of erosion. It was expected that the students could infer that the lack of soil vegetation in the land might lead to erosion. Some of the statements of the students on the worksheets about this subject are as follows.

> As there was no plant on the first plate, more soil came with water (Lale).
> Less soil accumulated on the second plate because of the plants (Mehmet).

As seen above, Lale and Mehmet were proficient in inferring skill. However, in other activities, it was observed that the students' performances of inferring skill were not at the expected level. For example, in the sixth activity, an electrical circuit was constructed, and the brightness of the bulb was increased or decreased depending on the number of bulbs used in this circuit. Also, four of the students could not infer that the change in the brightness of

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the bulb was associated with the number of batteries.

In the sixth activity, as mentioned above, related to the inferring skill, a scenario was given to the students. In this scenario, they were asked to design an experiment in which variables that the brightness of the light bulb depends on would be investigated. When the worksheets were examined, it was detected that none of the students could accurately accomplish this task on experimenting. Halime was the most proficient student in this task shown in Figure 3 below.

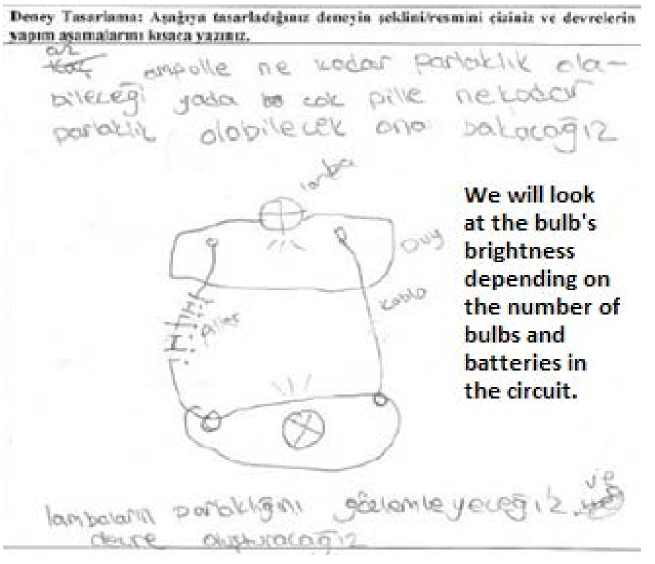

Figure 3. An example of the experimenting skill.

Halime correctly defined the purpose of the experiment with her statement, "We will examine the brightness of the light bulb." and she emphasized the independent variables. Therefore, the student was able to demonstrate the expected acquisition in experimenting in electricity topic.

In the same activity, the change in the brightness of the bulb was investigated by increasing the number of batteries regarding identifying and controlling variables skill. Therefore, the number of batteries in the activity was the independent variable, and the brightness of the light bulb dependent variable, and cables, lamp holder, etc. controlled variable. It was observed that all of the students made mistakes on the worksheets while specifying these variables. For example, Lale stated that the dependent variable was "the light bulb" and similarly, Mehmet stated "the lamp holder." Although the students' predictions were not correct, it was noteworthy that they had a tendency to indicate variables in one word. However, they were expected to use expressions such as "the brightness of the light bulb" or "the number of batteries." The reasons for the lack of this skill are presented in the focus group interview results below.

Focus Group Interviews Findings

In order to examine the reasons for lack of skill in identifying and controlling variables observed in the previous section, the students were asked to tell the independent variable in the first activity during the focus group interview. However, the students could not respond to this question. When the hints were given to the students with questions such as "What did we change in the activity?", "What is changing depending on what we change?" as the probe questions, it was seen that they could accurately identify variables without using concepts such as dependent or independent variables. Therefore, it was clear that the students could actually identify the variables but confused the concepts.

When the worksheets were examined, it was seen that higher achievers had more acquisition in science process skills. It was clear that those students' elaborative contributions in the focus group interview resulted from their comprehensive knowledge about the concepts. For example, Lale and Lemi did not react when they heard the term "independent variable," while Hakan and Halime asked each other "Which one was the independent variable?"

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and began talking. On the other hand, when the hint was given to Lale, she was able to identify the independent variable correctly. In addition, during the focus group interview, Lale stated that she had never heard about the independent variable before. Furthermore, it was noted that some students wrote the results of their measurement without stating the units. Thus, in the focus group interview, the students were asked which units of measurement should be used to indicate the mass and length of an object. Students stated different units of measurement. Lale stated "Meter," and Mehmet stated "Millimeter" for length. For the mass, Lemi responded as "Meter," Lale and Mine as "Centimeter," and Mehmet as "Newton" respectively.

The majority of students' responses in focus group interviews showed that they did not use units of measurements properly. Notably, students with high academic achievement made fewer mistakes in this regard. Students stated that they had very few activities regarding units of measurement and even they did not do the majority of the activities in the textbook, and only the multiple-choice questions for the high-stakes exams were exercised. Therefore, it was understood that science lessons were taught under the leadership of teacher and they were more teacher and textbook oriented then activity oriented. The reason why the students with high academic achievement are better at using units of measurement might be their higher enthusiasm than the others' because both Hakan and Halime's enthusiasm was higher in the full three-week period.

Moreover, it was observed that the students did not show the expected acquisition in inferring skill. Regarding this skill in the fifth activity, one of the reasons for erosion was the lack of soil vegetation. However, in the focus group interview, all of the students stated that the only reason for erosion is water. Water causes erosion, but it is not the only cause. For this reason, the students were given hints about slope and vegetation and asked how to reduce erosion, and various examples were highlighted from the activity. However, students were not made correct inferences from these hints either.

In the first activity, the balloon was swollen with the expansion of the air. In the focus group discussion after this activity, it was asked in what other circumstances the expansion could take place. For example, Mine stated that "Electrical wires expand in summer," and Hakan proposed that "We can observe substances in hot and cold settings.". It was concluded from these statements that students were partially successful in experimenting as a group. Furthermore, it was found that the conversation was not maintained, and the students could not complete the experiment.

Some of the students' responds to a question about using the experimental materials effectively and safely are given below.

> The thermometer is made of glass, and it can be broken (Lale).
> It is necessary to be careful when putting hot water in a jar (Halime).

These responses showed that students were aware of fundamental safety issues regarding the laboratory equipment. However, the presented behaviors in the activity showed that they were careless while using these types of laboratory equipment.

Observation Findings

The statements in the focus group interview showed that the students had basic knowledge about safety issues. However, the students' behaviors in activities contradict this situation. For example, it was observed that all students used the thermometer carelessly in the first activity. However, both Mine and Mehmet used the thermometer carefully. Students were reported that they do not frequently use laboratory equipment for activities or experiments. In the sixth activity, the male students looked sufficient in using materials such as batteries, cables and lamp holder. It is because these types of tasks are seen as work for men in the cultural codes. Although there are stereotypes about these kinds of tasks, the female students who were reluctant to perform the first activities were as successful as the male students when they were encouraged and given the opportunity. From the first activity to the sixth activity, girls' ability to recognize and use experiment tools has increased.

Surprisingly, the students having difficulty in using the thermometer were successful in using the dynamometry. For example, it was observed that the students used the dynamometer skillfully in a task. It was thought that students had used dynamometer frequently in school before. However, the students stated that they used the dynamometer frequently at their accommodation, not at their school. On the other hand, it was determined that the students made mistakes when using the ruler, a cheaper and accessible measurement tool. For example, Lemi and Halime failed to hold the ruler steady while they were measuring; moreover, these students mismeasured the

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lengths. In this respect, Lale stated that when she was asked to remeasure the length more carefully, she asked for help since she had limited experience with a ruler before. Lacking these basic skills will probably affect them drastically in their prospective years in school.

On the other hand, the students who were successful at measuring the sizes had difficulties in their ability to organize data. For example, it took a long time for these students to note their measurements accurately. For example, the temperature of water decreased until students wrote the measurement result in the first activity, and this led to less obvious changes to be observed by the students.

It was observed that students with high academic achievement perform better in activities with higher self-confidence. Besides, low achiever students could not answer the questions enthusiastically. For example, it was observed that Lale and Lemi did rarely participate in the discussion while Hakan, Halime, Mine and Mehmet made more frequent contributions while performing the activities. Lale and Lemi were able to make some contributions in a few words in some activities they liked more. In the latter activities (especially the sixth activity), it was observed that Lemi was more active and he made more accurate predictions. In addition, Lale was more active in the same activity than the others. Depending on our observations, their main problems can be their lack of self-confidence and understanding of some science concepts. The students' proficiencies in SPSs are summarized in Table 4.

Table 4 The students' acquisition of SPSs*.

Names of Students / Science Process Skills	Halime (HA)	Hakan (HA)	Mine (MA)	Mehmet (MA)	Lale (LA)	Lemi (LA)
Observing	H	H	H	M	M	H
Sorting and Classifying	M	H	H	H	H	M
Predicting	M	M	M	M	M	L
Measuring	M	M	M	L	M	M
Inferring	L	M	L	M	L	L
Organizing Data	M	M	M	L	L	L
Identifying of Experimental Materials and using Experimental Materials.	L	M	M	M	L	L
Data Processing and Formulating Models	L	L	M	L	L	M
Experimenting	H	M	L	M	L	L
Interpreting and Inferring	L	M	M	M	L	L
Identifying of Variables	M	M	L	L	L	L

** The symbols "H" for the high, "M" for the middle and "L" for the low-level acquisition*

Discussion

Students were determined to have an above average level of acquisition in observing and classifying, average acquisition in predicting and measuring; and below average acquisition in inferring, organizing data and identifying and using experimental materials. For all integrated process skills, the students were determined below the average level. Therefore, it might be asserted that the students' acquisition in SPSs is generally below the average level. In some studies, it is stated that the students' science process skills are lower than the expected level (below the average of the scale) (Hazir & Turkmen, 2008; Fang & Chen, 2010). One reason why they cannot demonstrate the expected acquisition in the SPSs is that students in this research are those living in a low socio-economic neighborhood and having limited income and resources. It was emphasized that the students' science process skills acquisition in rural areas were lower than the students' in the city center (Sayibo, 1992). In this context, it is imperative to create settings that help develop SPSs of the students studying in rural areas and suburbs. Particularly, open-ended or questioning-based science activities and practices might be developed to improve students' science process skills. In previous

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studies, open-ended and research-based activities and practices were emphasized to develop the acquisition level of students in science process skills (Knabb & Misquith, 2006; Myers & Dyer, 2006; Suits, 2004). For this reason, it is essential that teachers organize inquiry-based activities and encourage students who lack these skills (Prayitno, Corebima, Susilo, Zubaidah, & Ramli, 2017). Open-ended and research-based science experiments are fundamental in the development of integrated science process skills (Arabacioglu & Unver, 2016; Artimes, Susilo, Lestari, & Indriwati, 2017). Finding out unexpected and surprising results in such experiments will also keep students' interest and motivation alive (Rusek, Benes, & Carroll, 2018). Through such experiments, students will be able to use integrated science process skills actively. Science activities should be frequently used and repeated in science lessons for ensuring the quality of learning (Elmas, Aydogdu, & Saban, 2017).

Another reason why students do not achieve the expected acquisition in the SPSs is that science lessons are frequently taught in the leadership of the teacher. The students' comments indicated that practicing with multiple choice questions for high stake exams were very common rather than science activities. Because of assessment centered instruction than focusing on meaningful learning, students' acquisition levels in SPSs were underdeveloped than suggested in the intended curriculum (Prayitno, Corebima, Susilo, Zubaidah, & Ramli, 2017). However, it is necessary to embed student-centered activities into courses for the development of SPSs. Primarily, making students more active on science activities and tasks supports them to understand the joy of science practice and develops their integrated science process skills (Germann, Aram, & Burke, 1996; Turpin, 2000) Also, recent high stakes exams include more quality test questions which require some SPSs skills for responding to the questions (Elmas et al., 2018). Time spent on science activities should be seen as valuable as for practicing with multiple-choice questions (Pinto & El Boudamoussi, 2009; Preece & Brotherton, 1997).

The research indicates that the students are more successful at basic process skills than integrated process skills. Students' success in basic skills might be related to their former experience with these skills (Ferreira, 2004). This result is seen reasonably acceptable because the students in the sample were at the beginning of lower secondary education. However, there are many studies which reported the lack of acquisition in integrated SPSs similarly. Beaumont-Walters and Sayibo (2001) found that students could not demonstrate the expected acquisition in integrated process skills such as interpreting and inferring, identifying variables and formulating a hypothesis. Griffiths and Thompson (1993) found that students should need to work on forming hypotheses and they thought that the controlled variable also might change in the experiments.

Teachers are one of the essential stakeholders for students to develop SPSs (Artayasa, Susilo, Lestari, & Indriwati, 2017; Shahali, Halim, Treagust, Won, & Chandrasegaran, 2017). However, Fang & Chen (2010) emphasize that teachers fail to support their students to develop the SPSs. This might indicate that teachers need to take in-service training on SPSs. However, such in-service training on SPSs should not be theoretical but also as practical (Shahali, Halim, Treagust, Won, & Chandrasegaran, 2017). The development of teacher expertise on SPSs through in-service training will contribute to the development of both basic process skills and integrated process skills of students (Artayasa, Susilo, Lestari, & Indriwati, 2017).

Students with high academic achievement are more successful in measuring, predicting, observing, organizing and interpreting, and inferring data than students with lower achievement. It is stated that there is a positive relationship between academic achievement and SPSs (Germann, 1994; Sahin & Yilmaz, 2017). In this research, it was inferred that students with low academic achievement needed more encouragement for science activities. Therefore, even if students with low academic achievement exhibit lower performance in SPSs, they might be more successful if various measures are taken for participation (Prayitno, Corebima, Susilo, Zubaidah, & Ramli, 2017). The science activities developed to improve SPSs, multi-media applications and technology will also support the development of SPSs (Kamisah, & Vebrianto, 2013).

The current research found no significant difference according to gender. Similarly, some studies (Hazir & Turkmen, 2008; Guden & Timur, 2016) presented that the SPSs of lower secondary school students did not differ significantly in terms of gender. However, the female students were observed to be less keen compared to the male students at the beginning depending on the activity types. It is critical that science activities should not be biased for any gender (Song, & Black, 1991; Elmas, & Eryilmaz, 2015). Therefore, it would be beneficial to give similar duties to both male and female students in gender-neutral science activities.

Conclusions

Acquisition of SPSs including observing and classifying was at above the average level, predicting and mea-

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suring at the average level; and inferring, organizing data and identifying and using experimental materials were at below the average level. Students acquired all integrated process skills at below the average level. The research indicates that the students succeed in basic SPSs than integrated SPSs. High-achieving students are more successful in measuring, predicting, observing, organizing and interpreting, and inferring data than low-achievers. In this research, it was concluded that low-achieving students need to be encouraged more for science activities. The current research found no significant difference in terms of gender. However, the male students were determined to be keener compared to the female ones at the outset, depending on the activity types. Primarily in the socioeconomically disadvantaged regions, encouraging girls and giving them prominence for the development of SPSs are essential for ensuring equality.

Another added value of this research comes from its' more focused perspective on SPSs. There are many studies which could determine the lack of SPSs in almost all educational levels. Investigating what are the reasons for not well developed SPSs is more critical, then presenting the expected outcomes. In addition to that, while preparing activities for developing SPSs, it is essential to focus on these underlying reasons preventing and supporting the proper development of SPSs One example of this issue is preparing SPSs focused activities embedded in altruistic contexts, which favors girls more. Girls are more responsive to contexts which can have a lively meaning such as humans, animals and plants. Moreover, it can be clearly said that there is a relationship between academic achievement and SPSs so frequently providing SPSs focused activities can also help students academic achievement. Students should be active and need to make an informed decision making in these activities for making a higher impact.

Implications

In the regions with low socioeconomic level, it is essential to make a particular endeavor for keeping high-quality education. Thus, it is of great importance to employ the experienced and skilled teachers to support these students in these regions. Qualified teachers can make a difference in the instructional methods and school environment. Focusing on more skill-based instruction will help prospective years of the students who are living in socioeconomically disadvantaged regions.

Most of the studies in the related literature found out that SPSs are an essential prerequisite skill set for academic achievement, and students who are proficient in these skills are more inquisitive and scientific. Besides, to highlight female students especially in low socioeconomic status neighborhoods are critical, and to organize activities and events attracting interests of girls do really matter while there is no difference in acquisition and use of SPSs when the female and male are provided with equal opportunities. Thus, it is clear that the contexts selected for science activities need to be neutral to support girls (Song & Black, 1991; Elmas & Eryilmaz, 2015). It is also crucial that schools in low socioeconomic neighborhoods should be supported by creating new laboratories and providing educational materials. The instruction should move its focus more on assessment than skill- based development.

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