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SCIENTIFIC PROCESS SKILLS: PRELIMINARY STUDY TOWARDS SENIOR HIGH SCHOOL STUDENT IN PALEMBANG

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ABSTRACT

The 21st-century challenges require the next generations to have various skills to deal with, including scientific process skills. This study aimed to describe the scientific process skills of senior high school student in Palembang in term of ecology subject. This descriptive quantitative research observed 231 respondents of tenth grade student from two different sub-districts in Palembang, Gandus and West Ilir. The student's scientific process skills were measured using test instrument and interview. The results showed that there were various outcomes for each indicator in Gandus i.e. 68.87% (observing), 75.00% (grouping), 54.81% (interpreting), 73.08% (predicting), 52.56% (formulating a hypothesis), 49.04% (planning an experiment), and 43.59% (communicating). Meanwhile in West Ilir the outcomes for students' scientific process skills were 69.48% (observing), 66.34% (grouping), 56.65% (interpreting), 64.04% (predicting), 59.64% (formulating a hypothesis), 47.85% (planning an experiment), and 41.39% (communicating). It can be concluded that the students' scientific process skills in Palembang were categorized as medium. Hence, strategies to promote students' scientific process skills in biology class still need to be improved especially in ecology learning.

Keywords: *21st-century skills, ecology subject, scientific process skills*

INTRODUCTION

Science and technology development in twenty-first century as considerable as industrial revolution 4.0 era have been bringing changes in daily life (Benešová & Tupaa, 2017; Hartmann & Bovenschulte, 2013; Osman, Hamid, & Hassan, 2009). Experience, knowledge, skills, and education are critical for human capital in society today (Agolla, 2018). The society is challenged to provide high quality human resources, which are able to deal with the globalization issues. Formal education plays the main role in preparing generations to be ready to compete in this global era through integrating adequate skills needed (Turiman, Omar, Daud, & Osman, 2012), including scientific process skills (Gropello, 2010).

Scientific process skills are directed to the both cognitive and psychomotor abilities to carry out scientific investigations, find concepts, principles, as well as theories to develop pre-existing concepts (Akani, 2015; Germann, 1989; Heong et al., 2011; Safaah, Muslim, & Liliawati, 2017). As the foundation of scientific method, these skills are divided into two groups i.e. basic scientific process skill and integrated process skills (Aydoğdu, 2015; Turiman et al., 2012). Basic scientific process skills including observing, classifying, inferring, measuring, communicating, and predicting, while integrated process skills including identifying variables, constructing hypotheses, tabulating and graphing data, defining variables, designing investigations, and experimenting (Germann, 1989; Ongowo & Indoshi, 2013; Rezba, Sprague, & Fiel, 2003; Subali, Paidi, & Mariyam, 2016)

Scientific process skills are thinking skills which are used to build knowledge and applied to solve problems as well as formulate results (Germann, 1989; Özgelen, 2014; Turiman et al., 2012). These skills are integrated together when individuals design and conduct experiments in the lab or even in fair trial; they do in their daily life. Students in the earliest grades will spend

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more time using skills such as observation and communication. In contrast, when students are getting older, they start to devote their time more in training their inference and prediction skills. Meanwhile, classification and measurement tend to be used at the higher grade due to the various ways in classifying in which the complexity is also increase as well. Moreover, the both measurement method and system must also be introduced to student gradually over time (Akani, 2015; Irwanto, Rohaeti, Widjajanti, & Suyanta, 2017; Lederman, Lederman, & Antink, 2013; Özgelen, 2014).

It is compulsory to provide education, which accommodates and supports students' scientific process skills. However, nowadays education in Indonesia has not develop these skills comprehensively yet (Irwanto et al., 2017; Safaah et al., 2017; Siahaan, Suryani, Kaniawati, Suhendi, & Samsudin, 2017; Sukarno, Permanasari, & Hamidah, 2013; Sunyono, 2018; Susanti, Anwar, & Ermayanti, 2018). International Mathematics and Science Study (TIMSS) reported that the trend of science achievement of 4th grade of Indonesian students' was low. Indonesia was ranked as the 44th of 47 participating countries (Mullis, Martin, Foy, & Hooper, 2016). This has been presumed as the effect of education quality in Indonesia, which does not cover students' scientific process skills yet.

Students' scientific process skills can be accomplished during learning process in the classroom, particularly in biology class. Biology characterized as a study, which encompass natural phenomena, human body system, animal and plant anatomy, ecology, and the other branches, which require scientific process skills. By mastering scientific process skills, not only do the biology materials can be assimilated properly, but they also can promote a scientific habit toward the student (Abdullah, Parris, Lie, Guzdar, & Tour, 2015; Hardianti & Kuswanto, 2017; Hodosyová, Útla, Vnuková, & Lapitková, 2015; Irwanto et al., 2017; Pratono, Sumarti, & Wijayati, 2018; Subali et al., 2016). Moreover, the learners who are trained in scientific process skills will have high learning outcomes (Nirwana, Putu N, & Maharta, 2014; Syafriyansyah, Eko Suyanto, & I Dewa Putu Nyeneng, 2013).

Based on the interview addressed to the teacher in sub-district Gandus and West Ilir, Palembang, the results showed that: 1) student interest and motivation were low, thus, they decide to be passive in class discussion; 2) the facilities and infrastructure were inadequate in term of the both reference book and laboratory equipment; 3) the learning source used was worksheet, in addition, it is rarely to give students the experience in the laboratory. Regarding to that situations, neither does teacher accommodate the all aspects of scientific process skills in learning process nor provide an assessment which measure student's scientific process skills. Therefore, this study aimed to describe the scientific process skills of senior high school student in Palembang, especially in biology classes on ecology subject. Ecology deals with environmental issues regarding survival on the. Students, as the gold generation, need to understand the basic principles of ecology and the need to regulate their lives accordingly (PISA, 2013). This, in turn, enables them to accommodate their scientific process skills.

METHOD

This descriptive quantitative involved 231 students of tenth grade as respondents. Student came from four different schools in two different sub-districts in Palembang, Gandus and West Ilir. The students' scientific process skills were measured by using questionnaire, interview, and observation. The instrument used in this research was modified from Fadillah (2017) which is consist of 17 questions. It was developed based on scientific process skill indicators, i.e. observing, grouping, interpreting, predicting, formulating hypothesis, planning experiment, and communicating (Fadillah, 2017; Irwanto et al., 2017; Özgelen, 2014; Rustaman, 2005). The data were analysed using the calculation of the percentage score in each indicator of scientific process skills using Formula 1 (Purwanto, 2009).

$$NP = \frac{R}{SM} x100\% \quad (1)$$

Description:
NP = percentage score in each indicator of scientific process skills
R = score in each indicator of scientific process skills
SM = maximum score in each indicator of scientific process skills

Referred to Azwar (2003), the achievement of students' scientific process skills was

grouped into three categories, namely high, medium, and low (Table 1).

Table 1. The categories of student's scientific process skills achievement

No.	Category	Percentage score (%)
1	High	$66.67 \leq X$
2	Medium	$33.33 \leq X < 66.67$
3	Low	$X < 33.33$

RESULTS AND DISCUSSION

The study was conducted in two different sub-districts in Palembang i.e. Gandus and West Ilir. Thus, the discussion was also divided into two parts based on the place the research conducted.

Students' Scientific process Skills in Gandus

The data analysis results of student's scientific process skills in Gandus is presented in Table 2.

Table 2. The achievement student's scientific process skills in Gandus

No.	Indicator	Percentage score	Category
1	Observing	69.87	High
2	Grouping	75.00	High
3	Interpreting	54.81	Medium
4	Predicting	73.08	High
5	Formulating hypothesis	52.56	Medium
6	Planning experiment	49.04	Medium
7	Communicating	43.59	Medium

Based on the research done in Gandus, there were various achievements gained by students for each indicator. The highest percentage score achieved was for 'grouping' indicator; while the lowest was for 'communicating' indicator. This has been strengthen by the observation results during learning process. Teacher guided the students to identify the characteristics possessed by each component in ecosystem as well as trained them to classify the component based on the characteristics they found. Moreover, teacher gave the real examples of ecosystem surround them. This eased the students to fulfil 'grouping' indicator which is one of scientific process skills (Guevara, 2015). Learning activities which directly related to daily phenomena enable the students to classify a certain object (Subali et al., 2016; Turiman et al., 2012).

Refer to the assessment results of students' answer about grouping indicator, they have been able to differ the components compose ecosystem, the component interaction, and succession process based on the data gained. This skill appears in students' learning activities. They proceeded the observation results noted by identifying them based on the object similarities found. In order to sharpen this skill, the students' knowledge was enriched with the materials given in classroom which related to scientific classification (Dewi & Hayat, 2016; Fadillah, 2017; Hardianti & Kuswanto, 2017; Irwanto et al., 2017; Rahman, Wahyuni, & Rifqiawati, 2017).

On contrary, even though it was classified as 'medium', the 'communicating' indicator was the lowest percentage score gained. This can be understood as the lack of learning activities, which guided them to communicate effectively. The teacher did not conducted the instructional activities by using group discussion model or the other learning models, which educate the students to deliver the message textually, or in verbal. Thus, no proper context created intentionally by teacher to habituate the students to communicate in well manner. As the consequences, class members were passive and only focused on listening the teacher's explanation without giving any response. The method used in the classroom was limited on lecture so that teacher did not habituate the students to explain the materials through graph or table.

The low communication level of students in Gandus district was the effect of the less frequent of students to deliver their scientific activities results neither in writing nor in speaking. This in line with the interview results, which showed there almost no scientific event for students held in this district. The low communication level, refer to Siska, Kurnia, & Sunarya (2013); Tuada, Gunawan, & Susilawati (2017) can be caused by the students' habit to collect the data and serve it in proper form. Yet, this skill is a crucial aspect in scientific process skill to cope the all challenges faced (Benešová & Tupaa, 2017; Gropello, 2010; Levin, 2001; Turiman et al., 2012). Therefore, school as well as teachers must train students to develop their communication skill.

Students' scientific process skills in West Ilir

The data analysis results of student's scientific process skills in West Ilir is presented in Table 3. From Table 3, it can be seen that the research results showed that of the seven indicators measured, the highest percentage was

possessed by 'observing', while the lowest was 'communicating'. The high achievement of student's observing skill in West Ilir district appeared from the results of student's answers on their worksheets. The students were able to observe each object given by using their senses. They collected the relevant data from the questions written on their worksheets. In this worksheet, teacher has served certain phenomena, object/biological picture to observe. After guiding students to focus on certain object, teacher asked them to observe some aspects of the object served. The observation activities to collect data and find facts related to learning materials will give the students meaningful experiences (Abdullah et al., 2015; Lepiyanto, 2014; Listiani, Syamswisna, & Yokhebed, 2016; Molefe, Stears, & Hobden, 2016; Pratono et al., 2018).

Table 3. The achievement student's scientific process skills in West Ilir

No.	Indicator	Percentage score	Category
1	Observing	69.48	High
2	Grouping	66.34	Medium
3	Interpreting	56.65	Medium
4	Predicting	64.04	Medium
5	Formulating a hypothesis	59.64	Medium
6	Planning an experiment	47.85	Medium
7	Communicating	41.39	Medium

Similar to Gandus district, the communicating skill goal in West Ilir district was the lowest percentage compare to the others. This also appeared during the learning process in the classroom in which teacher dominated the discussion sessions. This issue can be assumed as the effect of the low literacy among students. Thus, the limited vocabularies, which are the main tools to deliver message, cannot be avoided. This assumption was strengthened by the fact of the limited source used by teacher in the class (only worksheet). This, somehow, led the students to have low self-esteem to express their opinion in front of the class, as they do not have adequate evidence to support their arguments.

On the other hand, they were also required to explain the data they gained in their writing or orally. As they did not have any example from wider sources but their worksheet, they were confuse the way to serve it. As the consequences, the negative perception will arise within them or even they face anxiety to make a mistake if they serve the data as they wish.

The above assumptions are in line with some previous studies which reported that the low communication skill can be caused by the both external and internal factors: 1) the low learning motivation of students (Filak & Sheldon, 2008; Kitsantas & Zimmerman, 1998; Nurwidodo, Hendayana, Hindun, & Sarimanah, 2018; Wicaksono, Minarti, & Roshayanti, 2018), 2) the students' passive habit in learning, 3) the low ability in mastering language components, 4) the low quality of students' mentality, 5) the bad interactions between teacher and students (Hodge & Anderson, 2007), 6) the low interaction quality among students, and 7) the improper learning media utilized by teacher (Firdausi, Prabawa, & Sutarno, 2017; Putra, Abdurrahman, & Suana, 2015; Spiliotopoulos, Antonakaki, Ioannidis, & Fragopoulou, 2016)

Students' communication skill can be optimized through various ways. Cholvistaria, (2012); Siska et al. (2013); and Tuada et al. (2017) stated that to enact this skill, students could be motivated to implement science process in their daily communication particularly during discussion and presentation sessions. In addition, project-based learning model can be applied in instructional process (Cook & Walsh, 2012; Nawawi, Amilda, & Sari, 2017), problem-based learning (Elder, 2015; Permana, Suwono, & Listyorini, 2016; Talat & Chaudhry, 2014), inquiry learning (Listiani et al., 2016; Ramdan & Hamidah, 2015; Rofi'ah, Suwono, & Listyorini, 2016; Siska et al., 2013; Syafriyansyah et al., 2013), disscovery learning (Hayati & Berlianti, 2016; Nurmala & Priantari, 2017). By conducting continuous efforts and trainings, students' communicating skills will be well cultivated among students, including in ecology learning.

CONCLUSION

The results showed that students' scientific process skills achievement in Gandus were various for each indicator, i.e. 68.87% (observing), 75.00% (grouping), 54.81% (interpreting), 73.08% (predicting), 52.56% (formulating hypothesis), 49.04% (planning experiment), and 43.59% (communicating). Meanwhile, in West Ilir, the outcomes for students' scientific process skills were 69.48% (observing), 66.34% (grouping), 56.65% (interpreting), 64.04% (predicting), 59.64% (formulating hypothesis), 47.85% (planning

experiment), and 41.39% (communicating). In the other word, student's scientific process skills in Gandus was categorized as high for grouping, predicting, and observing skills, and the others were medium. While in West Ilir, the only skill classified as high was observing skill while the other remain skills were medium. Regarding to that results, some strategies to promote students' scientific process skills in biology class are crucial to be improved, especially in ecology learning. Teachers can implement various strategies in their classroom, such as project-based learning, problem-based learning, inquiry, and discovery learning.

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