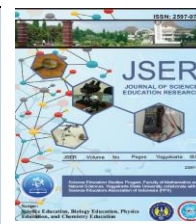




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Profile of Students' Science Process Skills on Conventional Biotechnology Material

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Keywords

Science process skills,
Conventional biotechnology material, Teacher's role, Teachers' science process skills

Abstract

The study aimed to find out students' science process skill profile in grade XII. The research was conducted at SMAN 1 Tanah Putih Tanjung Melawan, Riau. The study was conducted by providing tests to students consisting of 10 questions on the scope of conventional biotechnology materials. This test used to measure students' science process skills, namely the ability to observe, communicate, interpret, propose hypotheses, apply concepts, ask questions, predict, use tools/materials, plan experiments, and classify. The research sample consisted of 70 students. The reliability value of the instrument was 0.948 of high category. It was obtained that the science process skill of students was categorized as medium with a percentage of 39.3%. The percentage of observing, communicating, interpreting, formulating hypotheses, applying concepts, asking questions, predicting, using tools/materials, planning experiments, and classifying abilities were 43.2%, 35.4%, 39.3%, 28.2%, 26.8%, 36.8%, 46.4%, 49.6%, 37.1%, and 50%, respectively. Some of the science process skill aspects showed a low category, namely in the aspects of formulating hypotheses and applying concepts. Other aspects showed medium category and almost all aspects were below 50%. The teacher's role was very decisive as the main actor in improving students' science process skills.

INTRODUCTION

Education is the most appropriate way to improve and develop human resource quality. Teaching and learning processes are an important part in building students' skills to survive and face the 21st century. In fact, this passive learning process causes students to be used to memorize materials so students are difficult to connect or discuss the phenomena in everyday life. Thus, in addition to developing the dimension of student knowledge, the role of teachers in facilitating the learning process is indispensable in developing various skills, attitudes, and knowledge needed in the face of this globalization era.

Knowledge of skills that can be developed is the skills of science processes and the ability to adapt to the situation. Skill development can be developed through a science process approach because the development of science is so fast that teachers are unlikely to teach all the facts and concepts to their students and also students can understand complicated concepts if accompanied by

reasonable examples (Rufaida and Mulyaningrum, 2016). A process skill approach is a teaching approach that allows students to participate in the discovering or drafting process of a concept as a process skill (Sagala and Syaiful, 2010).

Science process skills are raised as integrated abilities in subject matter, meaning that science process skills are just as essential as science concepts (Hashim, 2018). Science process skills are important in that all students use scientific method to develop new knowledge (Zeidan and Jayosi, 2015). So, new knowledge in science is obtained through a scientific method, namely problem solving process. This scientific process occurs when the skills of scientific processes are used in performing the scientific works to produce scientific products (Handayani *et al.*, 2018). Promoting students' science process skills means preparing a scientist who has science literacy and allows using scientific information for students in daily life (Ergül *et al.*, 2011).

Table 1. Integrated and Basic Science Process Skills (Ongowo & Indoshi, 2013)

No.	Basic Science Process Skill	Description
1.	Observing	Using the senses to recognize the characteristics of living beings.
2.	Inferring	Explanation of observation results and data.
3.	Measuring	Using standard and non-standard measure to describe dimensions.
4.	Communicating	Using words or symbols to describe an action, object or event.
5.	Classifying	Sorting, grouping, and arranging base on similarities and differences.
6.	Predicting	Stating the outcome of future events based on a pattern of evidence.
No.	Integrated Science Process Skill	Description
1.	Controlling Variable	Identifying variables, keeping variables constant and manipulating.
2.	Defining operationally	Stating how to measure a variable in an experiment.
3.	Formulating hypotheses	Stating the expected results of an experiment.
4.	Interpreting data	Organizing, inferring from data and understanding data.
5.	Experimenting	Testing by following procedures to produce verifiable results.
6.	Formulating a model	Creating a mental or physical model of a process or event.

Science process skill is the ability of students to perform scientific method in understanding, developing, and finding science. Science process skill is an important skill for students as a skill to execute the scientific method in acquiring new knowledge or developing the knowledge that has been possessed (Dahar, 2011). Furthermore, Subali (2011) explained that science process skills contain cognitive and sensory-motor aspects. By studying science, students can come up with ideas to solve problems. The ideas and knowledge depends on students' understanding of the conditions and characteristics of the observed phenomena.

Furthermore, according to Ozgelen (2012), process skills involve the development of cognitive skills. Meanwhile, Germann (1994) explains that students use cognitive skills in performing process skills where the development of good cognitive abilities make students tend to be better at science process skills. Manual skills may be seen when students use experimental equipment and materials, take measurements, and perform the drafting and assembling of tools. Finally, social skills may be seen when students interact with other students, such as in conducting discussions related to the results of experiments and observations.

According to Sultan (2013), science process skills are students' ability in observing, investigating, communicating, proposing hypotheses, measuring, and conducting experiments

to discover, develop, and perform the principles, concepts, and laws of science. Gurses *et al.* (2015) states that the way to acquire knowledge is through a process that is not instantaneous and easy, namely the skills of scientific processes. Process skills are usually used to perform investigations. In investigating problems, issues, questions, and natural phenomena, scientists use process skills, but, actually, the skills of science processes are not only used by scientists but also a person since its birth.

Rauf (2013) argues that every student needs process skills both in scientific discovery and in learning activities. Then, Al Rabadi *et al.* (2013) states that the scientific process can help students in developing the ability to solve problems and making decisions independently. Science process skills allow students to collect the factual information that they need to build, conceptualize, form scientific principles, and understand the theory. When students engage in process skills, students explain phenomena and objects, ask questions, construct explanations, try to explain the scientific knowledge, and share their ideas with others. In addition, students also identify their findings, opinions by thinking critically, and considering the findings. Ergul (2011) argues the skills that support science learning ensure students are active in participating, build a sense of responsibility in learning, improve learning, and acquire the ways, methods, think, and behave like a scientist.

So, science process skills are all science skills that are used to obtain, develop, and apply science concepts and theories. This skill is not only needed in the learning process but also needed in everyday life (Bell, 2010). Process skills may be interpreted as treatment that is carried out in the learning process using the ability to think and create effectively and efficiently to achieve the expected goals. Meanwhile, the purpose of process skills is to develop students' creativity in the learning process. Students can actively develop and apply their abilities. In other words, students not only obtain the final results but also learn how to process the results.

Science process skills are divided into two, i.e.: basic and integrated science process skills. Basic skills consist of measuring, inferring, observing, communicating, classifying or grouping, and predicting. Meanwhile, integrated skills consist of defining operationally, controlling variables, interpreting data, formulating variables, experimenting, and formulating models. Nugraha *et al.* (2017) state that science process skills are skills in thinking, reasoning, and acting logically in researching and building science concepts needed in the problem-solving process. Science at the basic level performs investigations on the environment. In reality, some teachers who apply teacher-centred learning are not able to build students' science process skills. Meanwhile, the 2013 Curriculum refers to student-centred learning. So based on the above description, this study tries to find out students' science process skills and describe the learning process applied by teachers in schools. Then, the study aims to find out the science process skill profiles of students grade XII on conventional biotechnological material.

RESEARCH METHOD

This study aimed to find out the science process skill profile of students in Grade XII. This was a descriptive research. Fraenkel *et al.* (2012) state that descriptive research is carried out to reveal the characteristics of the population. Hence, in this research, the science process skill profile of students

can be known. The research was conducted at SMAN 1 Tanah Putih Tanjung Melawan, Rokan Hilir Regency, Riau Province. The research was conducted by providing tests to students consisting of 10 questions on the scope of conventional biotechnology material in biology subject. This test was used to measure students' science process skills, namely the ability to observe, interpret, communicate, propose hypotheses, apply concepts, ask questions, predict, use tools or materials, plan experiments, and classify. The research sample consisted of 70 students. The instrument was validated by the experts. The reliability value of the instrument was 0.948 in the high category.

Then, the data was analysed by calculating the percentage score of each aspect with the following equation:

$$NP = \frac{R}{SM} \times 100\%, \quad (1)$$

where NP is the percentage; *R* is the obtained score of students; and *SM* is the maximum score. After that, the score of each aspect was categorized into some categories, namely low, medium, and high. This categorization was presented in Table 2.

Table 2. Categorization of Science Process Skill

Category	Percentage (%)
High	66.67 – 100
Medium	33.33 - 66.66
Low	0 - 33.32

RESULTS AND DISCUSSION

Science process skills are important skills that have to be known and mastered by every student in the era of globalization and the 21st century. Science process skills are needed for students to survive and adapt to the real world so that they can live a good life in daily life. Therefore, teachers' need to facilitate students in the learning activities that support students' science process skills. The research aims to find out students' science process skills. The high score of students' science process skills become one of the indicators for students' readiness to enter the life in the 21st century, which is full of challenges.

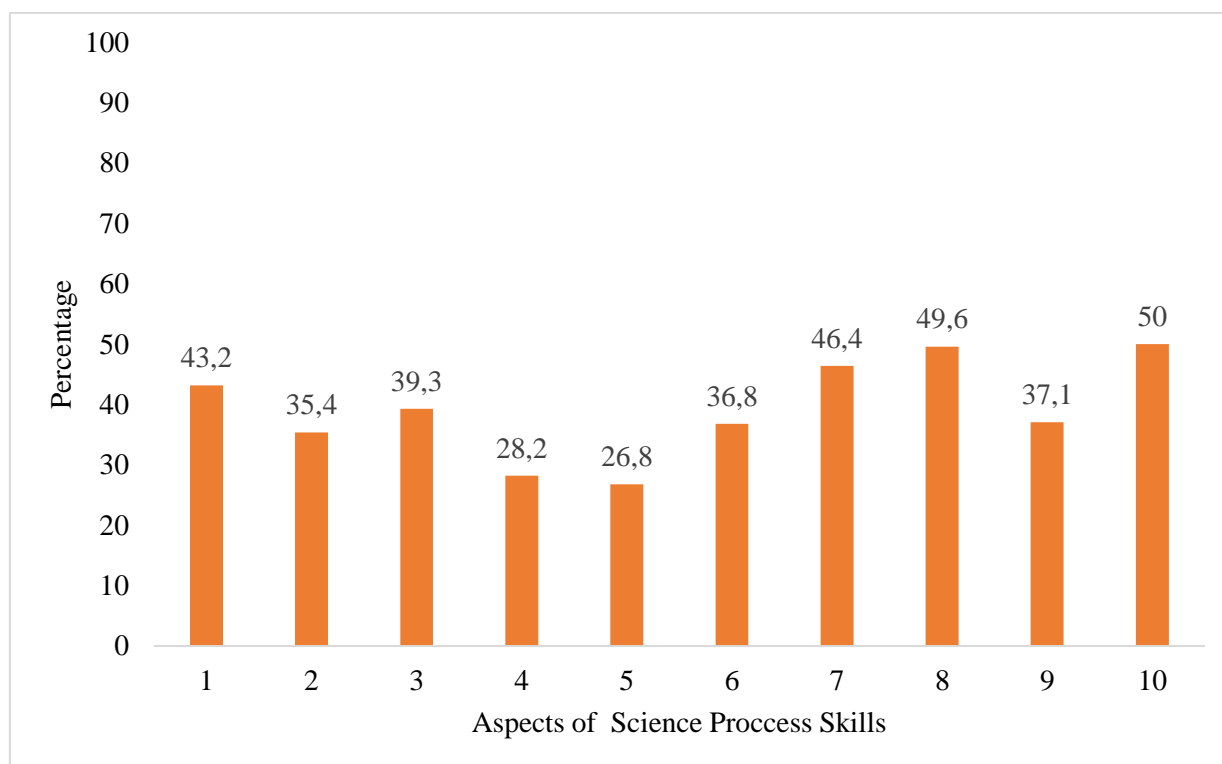


Figure 1. Percentage of Science Process Skill Aspects

Based on the results of data analysis on 70 students at one of the schools in Riau Province, it is obtained that the science process skills of students was in the medium category with a percentage of 39.3%. Although it is in the medium category, the percentage is very close to low. When viewed from the student's ability based on the aspects discussed in science process skills, then some aspects are categorized as low. As previously stated, the research discusses students' science process skills in several aspects, namely the ability to observe, communicate, interpret, formulate hypotheses, apply concepts, ask questions, predict, use tools or materials, plan experiments, and classify. Figure 1 explains students' science process skills in every aspect.

Figure 1 shows that the percentages of observing, communicating, interpreting, formulating hypotheses, applying concepts, asking questions, predicting, using tools or materials, planning experiments, and classifying abilities are 43.2%, 35.4%, 39.3%, 28.2%, 26.8%, 36.8%, 46.4%, 49.6%, 37.1%, and 50%, respectively. Two aspects of science process skills show a low category, namely the aspects of formulating hypotheses and applying concepts. Meanwhile, other aspects are in the medium category. Almost all aspects are below 50%, which is an indicator that Indonesian education still needs to improve students' science process skills, especially by teachers.

Based on the above analysis, there are at least five possible reasons for the low category of students' science process skills, namely 1) students are not used to solving science process skill problems (Mahmudah *et al.*, 2019); 2) low ability of teachers' skills (Sukarno *et al.*, 2013); 3) lack of teaching activities and materials that support science process skills; 4) teacher-centred learning; 5) lack of guidance in compiling science process skills-based assessment tools both for teachers and students. Thus, Atmojo (2012) states that to improve the science process skills and student learning outcomes, Natural Sciences learning tools need to be developed. Andiasari (2015) states that the learning applied by teachers in the classroom is supposed to be active learning where students not only receive knowledge from teachers but also seek knowledge with the guidance of teachers. Foulds and Rowe (1996) suggest ways to help students' perform science process skill aspects, one of which is to allow them to train themselves to make conclusions based only on indirect instructions or evidences.

The implementation of active learning methods must also be applied in biology learning. The biology subject makes it possible to connect theory with practice, which is to construct students' knowledge of the surrounding environment. However, the problem arises when students are unable to relate what they learn to how the knowledge is used.

The conventional biotechnology material consists of how to use organisms directly to produce goods and services that are beneficial to humans through the fermentation process. The learning process uses a mini-project-based learning model through practicum activities to improve student skills so that students can relate what they learn to how the knowledge is used or utilized. Therefore, in learning, students should be allowed to explore and search information for themselves through reading various books directly, presenting the results of observations, communicating the results of their activities to others, working in groups, giving their suggestions or ideas to others, and other activities.

A lot of studies have been conducted in various schools in Indonesia related to science process skills. Anam's research (2014) on 30 students in Sumedang Regency shows that the average of students' process skills in 4 aspects, namely observing, grouping or classifying, planning experiments, and making tables are in the less proficient category, and not proficient in inferring skills. Rahman *et al.* (2017) show that students' science process skills are still low on some of the science process skill aspects measured, namely observing, grouping or classifying, interpreting, predicting, and using tools or materials. Then, a study by Adiningsih (2019) on the science process skill profile of high school students shows that among some of the science process skill aspects tested, inferring skills are less mastered by students. Meanwhile, a study by Jumania (2019) on junior high school students show that the science process skills of students are in the good category and supported by the finding that teachers have implemented the learning process following the 2013 Curriculum. Teachers already build the students' science process skills using learning methods, such as group discussions and experiments.

Science process skills are abilities that can activate and promote curiosity, responsibility, self-study, assist students in conducting research, and other process abilities (Janah *et al.*, 2018). In this case, the learning process is the interaction of all components or elements of learning that are interconnected to achieve the goal of learning. One of the indications is the success of students to face problems in everyday life (Wardani *et al.*, 2009). Therefore, the science learning process is carried out through scientific activities that provide a hands-on experience. The purposes are to teach students to solve problems and make decisions, have a positive attitude towards technology and society, possess understanding and knowledge of scientific principles and concepts, and develop science process skills to investigate the environment. The

output is the increase of the science achievement (Wijanarko *et al.*, 2017).

Temiz *et al.* (2006) explain that active students have a better understanding than passive students who only depend on the teacher's explanations. The challenge for teachers in science learning is to create a more interesting and innovative learning process (Putra *et al.*, 2020). The success of students in knowing and understanding the subject matter depends on the role of the teacher as a good motivator and facilitator (Delismar *et al.*, 2013). The role of teachers in providing guidance to students and the application of learning models is very significant for the improvement of science process skills (Ariani *et al.*, 2015). In line with the opinion stated by Zakiyah (2013), science process skills can be build with habits that are performed continuously. Thus, the role of the teacher is very decisive as the main actor in improving students' science process skills. Then, the role of the government is to improve teachers' science process skills through teacher training programs.

CONCLUSION

The purpose of the study is to know and find out the science process skill profile of students in grade XII. It is obtained that students' science process skills are in the medium category. Although in the medium category, the percentage obtained by these students is very close to low category. Based on the students' ability from the aspects discussed in the science process skills, some aspects are categorized as low, namely the aspects of formulating hypotheses and applying concepts. Meanwhile, other aspects are in the medium category and almost all aspects are below 50%. The teacher is decisive as the main actor in improving students' science process skills. Moreover, the role of the government is to improve the teachers' science process skills through teacher training programs. It is also found that students' science process skills can only be supported by the mastery of teachers' science process skills.

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