

[Research Article]

SCIENCE PROCESS SKILLS ANALYSIS OF STUDENTS IN BASIC ELECTRONICS PRACTICE

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ABSTRACT

This research is a quantitative descriptive study that aims to analyze students' science process skills in introductory electronics practicum. This research was conducted in the basic electronics laboratory, Physics Education Study Program, Faculty of Tarbiyah and Teacher Training at UIN Alauddin Makassar. The research subjects are physics education students batch 2020 who program Basic Electronics courses in the third semester, the 2021/2022 academic year. The research subjects were 60 students spread evenly in 3 class groups: Physics A, Physics B and C. The instrument used was an observation sheet. The results of this study indicate that students of the Physics Education study program class of 2020, Faculty of Tarbiyah and Teacher Training, UIN Alauddin Makassar, who programmed the Basic Electronics course in the odd semester of the 2021/2022 academic year, have good science process skills in introductory electronics practicum.

Keywords: science process skills, practicum, basic electronics

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1. INTRODUCTION

Indonesia has undergone curriculum changes, from the KTSP to the curriculum used today, namely the 2013 Curriculum. The current curriculum is used following the development and progress of science and technology. The curriculum change is intended to improve the quality of education in Indonesia following its understanding. Pedagogically the curriculum is an educational design that provides opportunities for students to develop their potential in a pleasant learning atmosphere and follow their abilities to have the qualities desired by the community and nation (Ekosari et al., 2018). Referring to this explanation, education in Indonesia prioritizes increasing three domains of ability, namely the cognitive, psychomotor, and affective domains, so education actors must strive for improvement in these three domains.

Physics is one of the subjects in the science family, which is seen as a process, product and attitude. "Physics is a subject that studies natural phenomena and phenomena empirically and logically, systematically and rationally which involves scientific processes and attitudes". Physics learning must be directed to seek information and act to help students gain more profound concepts. Therefore, physics learning must emphasize the provision of student-centred direct experience (Nosela et al., 2021).

The physics education study program at the State Islamic University (UIN) Alauddin Makassar has graduate competencies that refer to the Indonesian National Qualifications Framework (KKNI), including attitudes, knowledge, and skills. The main focus of learning in higher education is actively involving students in the learning process. In addition to honing their understanding skills, physics education students are also guided to improve their skills, one of which is skills in practice. This is because a student is directed to be able to prove the concept understood through a practicum activity. Therefore, physics learning cannot be separated from activities

related to the laboratory, especially practicum activities.

According to Kustijono (2011), laboratory/practical activities in physics education are necessary because they support increasing the understanding of physics concepts. In addition, students can be trained in the skills that underlie experiments, such as using measuring instruments, choosing the suitable measurement data collection method, skills in processing the measurement data obtained and so on. Thus, students must have not only knowledge and skills (hard skills) but also soft skills such as being able to solve problems, always thinking critically, working together, having sensitivity, having a leadership spirit, and being careful in making decisions etc., known as soft skills, with the provision of skills that are balanced between hard skills and soft skills, after graduation students are expected to be able to play a leading role both in the scope of their work and on the broader community. Therefore, universities must be able to adapt to the needs that develop in society, including providing balanced hard skills and soft skills for college graduates.

One of the subjects that must be programmed by physics education students, UIN Alauddin Makassar, is basic electronics. The course is a combination of theory and practicum, so students are required to complete both components in order to pass the introductory electronics course. Especially in practical activities, this course has learning outcomes in the field of general skills, namely being able to collaborate in teams, demonstrating the ability of science process skills (science process skills), creative (creativity skills), innovative (innovation skills), critical thinking (critical thinking) and problem-solving (problem-solving skills) in scientific development. Therefore, through introductory electronics courses and understanding theory, students are led to have scientific process skills.

Elvanisi et al. (2018) state that science process skills are essential skills that facilitate learning in science, enable students to be active, develop a sense of responsibility, and improve learning and research methods. Science process skills

are a person's skills in using thoughts, reasoning and actions effectively and efficiently to achieve a particular result. Siswono (2017) adds that science process skills help students learn, get discoveries and research methods and methods, are more active, increase responsibility and help understand lessons, and increase awareness to be responsible for their knowledge.

Science process skills can activate, and develop curiosity, responsibility, independent learning, assist students in conducting research, and other process abilities. The process, in this case, is the interaction of all components or elements of learning that are interconnected to achieve the goal. One of the indications is students' success in facing everyday problems (Janah et al., 2018).

In the teaching and learning process of science, science process skills are used as a teaching approach. Science process skills encourage the formation of skills applied to acquire knowledge and then disseminate what is acquired, thereby increasing the optimal use of mental and psychomotor skills. This is because the science process skills teaching and learning process is designed so that students can fulfil facts and concepts and relate to theory using scientific process skills and attitudes themselves (Turiman et al., 2012). Gultepe (2016) explains that science process skills are tools that students use to investigate the world around them and construct science concepts, so it is essential for educators to have a good understanding of these skills.

According to Turiman et al. (2012), science process skills can be divided into two, namely basic science process skills and integrated science process skills. Basic science process skills include observing, classifying, measuring, using numbers, making inferences, predicting, communicating, and using space and time relationships. Meanwhile, integrated science process skills consist of interpreting data, operational definitions, control variables, making hypotheses and experimenting. Basic science process skills must be mastered before one can master integrated science process skills.

In line with Turiman's opinion, AYDOĞDU (2015) explains that science process skills are the basis of scientific thinking and research. In addition, science process skills are thinking skills used to obtain information. These skills are the ability to identify problems, formulate hypotheses about problems, make valid predictions, identify and define variables, design experiments to test hypotheses, collect and analyze data and present rational findings that support the data. These skills are divided into two categories: primary and integrated process skills.

Basic science process skills form the basis of integrated science process skills. Some basic process skills are observing, classifying, communicating, measuring, using space/time relationships, using numbers, inferring and predicting. Some integrated process skills are identifying problems, identifying and controlling variables, formulating hypotheses, interpreting data, operationally defining, reading /making a graph and experimenting. Integrated process skills are essential skills for solving problems or conducting science experiments. Integrated science process skills require a more advanced knowledge base.

On the other hand, Rizal & Ridwan (2019) explained that science process skills consist of nine indicators: observing, interpreting observations, classifying, predicting, communicating, hypothesizing, applying concepts, planning research, and asking questions.

In line with this opinion, Safaah et al. (2017) stated that the indicators of science process skills include: a) observing: paying attention to the properties of objects and events using the five senses, or an image of what is perceived; b) explain particular objects or events; c) predict: predict future events based on past observations or formed data patterns; d) asking: asking for an explanation about a phenomenon; e) hypothesize: express a presumptive tentative answer from observations or conclusions but are ultimately subject to direct testing or by one or more experiments; f) designing experiments:

determining the tools or materials of the investigation, the steps of the investigation, and the variables to be observed in the investigation; g) applying concepts: using preconceived concepts to describe an event in a new situation; and h) communicating: using words, symbols, or graphics to describe an object, action or event.

Verawati et al. (2016) add that science process skills are a form of science. In science learning, it is essential to help students learn science processes or inquiry skills to solve problems. Science process skills are a form of science as a process. The intellectual process skills expected in science-oriented learning are 1) building principles through induction, 2) explaining and predicting, 3) observing and recording data, 4) identifying and controlling variables, 5) making graphs to find relationships, 6) designing and carrying out scientific investigations, 7) using technology and mathematics during investigations, 8) drawing conclusions from the evidence.

Given the importance of science process skills possessed by physics education students, it is necessary to conduct a study to analyze students' science process skills in practical activities, especially in introductory electronics practicum. The results of this study are expected to provide information to study programs and educators to improve the learning process in the future further.

2. METHOD

This research type is descriptive quantitative research, a study that aims to describe a variable or phenomenon in a simple way. This research was conducted at the Basic Electronics Laboratory, Physics Education Study Program, Faculty of Tarbiyah and Teacher Training, UIN Alauddin Makassar.

The subjects of this study were students of the Physics Education Study Program, UIN Alauddin Makassar batch 2020, who programmed Basic Electronics courses in the odd semester of the 2021/2022 academic year. The number of research subjects was 60, spread evenly into 3 class groups: Physics A, Physics B and C.

The research data were collected using an observation sheet instrument. Observation sheets are prepared based on indicators of science process skills which are the benchmark in assigning student practicum scores. This observation sheet is distributed to the practicum companion team to be used as a guide in assessing the science process skills of students who carry out introductory electronics practicum.

The data analysis technique used is the proportion formula offered by Siregar (2015), as follows:

$$P = \frac{f}{N} \times 100\%$$

where P is the proportion of categories, f is the frequency of categories, and N is the number of respondents.

The description of the level or category of students' science process skills in the introductory electronics practicum refers to the range of values for the science process skills of Nosela et al. (2021).

Table 1. The criteria for the success of science process skills.

Score	Criteria
81 - 100	Excellent
71 - 80	Very Good
61 - 70	Good
51 - 60	Weak
0 - 50	Poor

3. RESEARCH AND DISCUSSION

Based on the data collection results using observation sheets, a description of the students' science process skills in basic electronics practicum is obtained.

3.1 Overview of Science Process Skills for Physics Class A Students

The description of the science process skills of Physics A class students in the introductory electronics practicum is shown in Table 2.

Table 2. Criteria for science process skills for Physics class A students

Score	<i>f</i>	%	Criteria
81 – 100	9	45	Excellent
71 – 80	8	40	Very Good
61 – 70	3	15	Good
51 – 60	0	0	Weak
0 – 50	0	0	Poor

The data distribution in Table 2 shows that of the 20 students observed. Nine students had a science process skill level (KPS) on the very good criteria, eight on the KPS on the good criteria, and 3 were quite good. Based on these results, it can be stated that students from Physics class A have excellent science process skills.

3.2 Overview of Science Process Skills for Physics Class B Students

The description of the science process skills of Physics B class students in introductory electronics practicum is shown in Table 3.

Table 3. Criteria for science process skills for Physics class B students

Score	<i>f</i>	%	Criteria
81 – 100	7	35	Excellent
71 – 80	10	50	Very Good
61 – 70	2	10	Good
51 – 60	1	5	Weak
0 – 50	0	0	Poor

The data distribution in Table 3 shows that of the 20 students observed. Seven students have a science process skill level on excellent criteria, ten on good criteria, two on fairly good criteria, and one has a science process skill level on weak criteria. Based on these results, it can be stated that the students of class B Physics have good science process skills.

3.3 Overview of Science Process Skills for Physics Class C students

The description of science process skills for Physics class C students in introductory electronics practicum is shown in Table 4.

Table 4. Criteria for science process skills for Physics class C students

Score	<i>f</i>	%	Criteria
81 – 100	8	40	Excellent
71 – 80	7	40	Very Good
61 – 70	5	20	Good
51 – 60	0	0	Weak
0 – 50	0	0	Poor

The results in table 4 show that of the 20 students observed, eight students had a science process skill level (KPS) on the very good criteria, seven people with the KPS level on the good criteria, and five on the sufficient criteria. Based on these results, it can be concluded that students of class C Physics have excellent science process skills (KPS).

3.4 Overview of Science Process Skills (KPS) Class of 2020 Students, Physics Education Study Program

Based on the description of the student science process skills (KPS) criteria obtained from 3 classes, students' overall science process skills can be described according to Table 5.

Table 5. student science process skills

Score	<i>f</i>	%	Criteria
81 – 100	24	40	Excellent
71 – 80	26	43	Very Good
61 – 70	9	15	Good
51 – 60	1	2	Weak
0 – 50	0	0	Poor

Based on the data in Table 5, it can be shown that in general, students of the Physics Education Study Program class of 2020, Faculty of Tarbiyah and Teacher Training, UIN Alauddin Makassar have a science process skill level (KPS) on good criteria. This is because of the 60 students observed. Twenty-six students are in good criteria, 24 are in very good criteria, nine are in sufficient criteria, and one is in poor criteria.

This research is in line with the research of Ongowo & Indoshi (2013), who conducted a research entitled Science Process Skills in the Kenya Certificate of Secondary Education Biology Practical Examinations. The results showed that the percentage of basic science process skills was high, 73.73%.

The results of this study are not in line with the research results of Darmaji et al. (2018), which showed that students had not mastered science process skills on several indicators. Therefore, it is necessary to have a process skills-based practical guidebook to improve students' science process skills through practical activities.

Keterampilan proses sains merupakan keterampilan intelektual dan dapat dipraktikkan, dipelajari dan dikembangkan oleh anak melalui proses pembelajaran dan menjadikan peserta didik lebih mampu menghadapi tantangan abad 21. Sebuah studi lokal yang dilakukan di sekolah dasar oleh Rohaida dan Kamariah (2005) menemukan bahwa analisis data verbal dan non-verbal mengungkapkan bahwa ada beberapa faktor yang mempengaruhi perolehan keterampilan proses sains: 1) bahan ajar berbasis web; 2) laboratorium fisik; 3) peran guru dan 4) kesiapan siswa. Penelitian lain juga menunjukkan bahwa pembelajaran keterampilan proses sains paling baik dilakukan dengan menggunakan media ajar dalam penelitian ini peneliti mengembangkan alat peraga dengan ahli multimedia dan lingkungan berupa perangkat lunak dan modul TIK berbasis lingkungan (Osman & Vebrianto, 2013).

Jack (2013) revealed that science process skills are not influenced by gender, school location and type of school but by student attitudes, completeness of laboratory facilities and infrastructure and class size. Based on the findings, recommendations were made, including equipping all laboratories to enable educators to adopt methods that would lead students to have appropriate skills and have positive attitudes towards science and to use a supportive environment that discourages large class sizes in science classes.

Meanwhile, Kruea-In & Thongperm (2014), through their research entitled Teaching of Science Process Skills in Thai Contexts: Status, Supports and Obstacles, obtained information that the best support for teaching science process skills is the belief of educators. With strong beliefs about the effectiveness of science

process skills, educators dedicate their efforts to engaging students to practice and perform science process skills. A positive attitude determines how much educators can motivate and help their students to succeed. Educators' competencies in science content and skills form productive and meaningful science practicum activities. Educators also revise science activities every year. They redesign, add or exclude some activities, improve materials and worksheets, and develop test items.

Educators must utilize science process skills in delivering scientific facts effectively. This is because science is not just knowledge but a way to understand the environment systematically. Students need science process skills to study the world of science and technology more thoroughly (Turiman et al., 2012).

The role of the science process skills approach in teaching and learning is very important to the success of learning. Training and developing science process skills in students will benefit students not only as a process to build knowledge in learning but also useful in everyday life, so science process skills are essential for students because they are preparation and practice in facing the realities of life in the world. Community because students are trained to think logically in solving a problem that exists in society (Lestari & Diana, 2018)

4. CONCLUSION

According to the research results obtained, it can be concluded that the students of the Physics Education study program class of 2020, Faculty of Tarbiyah and Teacher Training, UIN Alauddin Makassar, who programmed the Basic Electronics course in the odd semester of the 2021/2022 academic year, can process science skills (KPS) on a good basic electronics practicum.

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