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Analysis of Students' Science Process Skills in Practicum-Based Animal Physiology Learning

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Abstract: Research on student science process skills in practicum-based animal physiology learning with the aim of analysing the science process skills possessed by Biology Education students of FKIP Jambi University. The research method used is quantitative descriptive with data collection techniques in the form of observation sheets, interviews and documentation on the implementation of practicum activities carried out by 116 Biology Education Study Programme students. The results illustrate that in the implementation of animal physiology practicum activities, the science process skills of Biology Education students class of 2022 still have a less skilled category including classification skills at 51%, prediction at 52%, interpretation at 52% and applying concepts at 54% this is due to the lack of understanding of the concept of student theory taught by lecturers so that in practicum activities less mascimal in applying new theories, while the skills of planning experiments, using tools and materials, asking questions, observation, hypothesising, and communication are skilled categories. In conclusion, based on these results, the average student's science process skills are still categorised as less skilled, there are four skills with a percentage below 63% and an average skilled category of six skills with a percentage above 69%.

Keywords: Animal physiology; Practical learning; Science process skills

Introduction

The demands and challenges of the 21st century have an impact on changes in learning patterns in Indonesian education. Education must be able to develop competent and competitive human resources. These challenges and demands must be answered by all educational institutions, especially universities in Indonesia, to produce prospective teachers who can develop education according to the demands of the 21st century. As a Jambi University Education Development Institution through the Faculty of Teacher Training and Education Sciences in order to produce prospective teachers who can develop education in accordance with the 21st century. Educators at this time must be able to develop learning that is not only oriented towards memorizing and convention activities, but can innovate in the development of creative learning so that it can make prospective teachers competent. This is supported by Ekici & Erdem (2020), Pachler et al. (2010), and Sachyani et al. (2023) learning is a process that has a content of meaning, and meaning cannot be transferred directly to the learner through symbols, images, or words either created through individuals or groups. Educators at this time must be able to develop creativity in learning that is not only oriented towards memorizing and convention activities, but can innovate in the development of learning (Mukaromah et al., 2022; Owolade et al., 2022; Purtadi et al., 2023).

Learning that can be done is one of them with skill or psychomotor learning. One of the skills that can be developed to prepare 21st century teacher candidates is science process skills. Science process skills are also skills that can make measurements in seeing the ability of

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students in learning, this can be seen in research by Eliyana (2022), Husna et al. (2022), Ariyansyah & Nurfathurrahmah (2022), Larashati et al. (2023), and Suryaningsih (2017) explained that from all KPS indicators it can be seen that communication skills, observing, asking questions, and predicting are indicators that often appear, because in the learning process students will communicate a lot of things that they have just encountered or found.

According to Adiyanto et al. (2024), Agustina et al. (2021), Pakaya et al. (2023), and Rahmah et al. (2019) KPS is a skill that can make students know their ability to obtain, develop and apply concepts, principles, in the form of science skills. According to Rustaman (2005), science process skills also have skills, namely observation skills, classification, interpretation, prediction, asking questions, hypothesizing, planning experiments, using tools/materials, applying concepts and communicating.

The Biology Education Study Programmed through its laboratory prepares a space and place to develop learning based on psychomotor development. Based on preliminary data, observations made in the Biology Education laboratory randomly with students from 2021 to 2023 and practicum assistants and lecturers show the results that science process skills have not been maximized by students. In 2023 in the biology education laboratory there are several subjects that carry out practicum activities including animal physiology, plant physiology, genetics and microbiology. The facts obtained in the initial observation process that current courses have been combined between the number of credits of theory and practicum, so that based on interviews with teaching assistants, practicum activities at the student level are quite well organized, but information about the ability to apply scientific process skills has not been maximally obtained, so that sometimes students only carry out practicum as a requirement to pass in practicum-based courses without knowing or wanting to develop skills in the scientific field provided by lecturers or teaching assistants.

Another problem is that students convey that in conducting practicum they are not optimal in the process of using laboratory equipment such as observations using microscopes, surgical instruments, and making chemical mixtures with certain proportions. Hamidah (2022) in his research during the observation process in preliminary interviews showed that students had difficulty in biological materials, especially animal physiology, especially those related to practicum activities, it can be seen from the practicum reports that they made not maximally analyzing the results of experiments when the practicum was carried out based on work procedures. Learning outcomes were not achieved to develop psychomotor KPS in these students.

In addition to the problem of material that they sometimes do not understand, the factor of applying concepts and how to interpret the results of the practicum findings obtained is not optimal and they are not optimal in conveying the findings verbally after practicum activities, but in the form of practicum reports they are able to explain the findings obtained and supported by literature sources. According to Guswita et al. (2018), Nwuba et al. (2022), and Turiman et al. (2012) that while conducting research on KPS in practicum activities on digestive system and respiratory system material, science process skills that often arise are asking questions, observation, planning experiments and conducting experiments which show sufficient category results.

This became an anomaly in the process of giving grades to their reports that were declared complete, while in the process of practicum activities their KPS did not appear to be maximally visible. This could have happened because they wrote the findings and discussion based on the results of cheating from their friends or getting examples of reports from sources that were almost the same as what they did, this would make them less active in the practicum process but could get a complete score. In this case, it is part of the KPS indicator itself to develop itself when becoming a prospective teacher in the field of biology or science (Senisum et al., 2022; Ulger & Cepni, 2020).

Based on this explanation, this study was conducted with the aim of describing students' KPS based on the assessment of laboratory learning activities. The information obtained in this study is expected to provide an overview of the distribution of student KPS in practicum-based animal physiology learning.

Method

This research uses a quantitative descriptive research model. This research involves researchers so that they will understand the context with the situation and setting of natural phenomena according to what is being studied. The size of the sample is determined by the amount of data or observations in the sample, the sample of this study was biology education study programmed students majoring in PMIPA FKIP Jambi University who took animal physiology courses in the academic year 2023/2024 semester 3 batch 2022 with a total of 116 people. The instrument used in this study was a validated KPS observation sheet.

The research method used was observation of the implementation of animal physiology practicum using a practicum guide on blood coagulation material. The data

analysis technique used includes stages, one, data collection using KPS observation sheets containing 10 indicators with 14 statement items and observed skills such as shown in Table 1.

The data were obtained from observations with the help of 4 observers on the process of implementing animal physiology practicum by practitioners, assessment of practicum reports prepared by each practitioner and assessment of practicum report presentations; two, data reduction, classifying, grouping data and simplifying in such a way as to obtain meaningful information and facilitate drawing conclusions; three, data display or presentation of data using descriptive statistics in the form of tables, to easily understand the pattern of the relationship of each information obtained so as to provide the possibility of drawing conclusions; four, triangulation, a process of checking the validity of data, which is done by comparing data obtained from direct observation of the process of practicum implementation by practitioners and practicum reports prepared by each practitioner and lecturer interviews; five, conclusion drawing is done by paying attention to data reduction and triangulation results. The research data is interpreted based on the Table 2.

Table 1. KPS indicators

No.	KPS Indicator
1	Planning the Experiment
2	Asking Questions
3	Using tools/materials
4	Observation
5	Classification
6	Predictions
7	Hypothesize
8	Interpretation
9	Applying the Concept
10	communication

Table 2. Science process skills observation sheet rating category

Scale Value	Score	Percentage (%)	Category
4	42.25–56	81.25–100	Highly Skilled
3	32.5–42.24	62.5–81.24	Skilled
2	22.75–32.4	43.75–62.4	Less Skilled
1	14–22.74	25–43.74	Very Less Skilled

The data obtained was then analysed descriptively using a formula adapted from Dakhi (2022) as follows:

$$\text{Percentage} = \frac{\sum \text{Observation result score}}{\text{Maximum score}} \times 100\% \quad (1)$$

Result and Discussion

Students' science process skills are obtained from observation sheet data filled in by observers in all groups of 2022 Biology Education students, where each observer is responsible and coordinates with each other to observe each student in a practicum group consisting of 4-5 people. This observation sheet contains 14 statements made based on indicators of student science process skills aspects with the provision that each statement has a lowest score of 1 and a highest score of 4 so that a minimum score of 14 and a maximum score of 56 are obtained. the results of KPS by direct observation and the results of observations of student science process skills can be seen in Table 3.

Table 3. Results of student KPS observation

KPS Indicator	Average Percentage (%)	Category
Planning the Experiment	73	Skilled
Asking Questions	71	Skilled
Using Tools and Materials	70	Skilled
Observation	70	Skilled
Classification	51	Less Skilled
Predictions	52	Less Skilled
Hypothesized	64	Skilled
Interpretation	52	Less Skilled
Applying the Concept	54	Less Skilled
Communication	68	Skilled

Based on the observation sheet of students' science process skills in practicum, the average percentage is obtained in the process skills of planning experiments of 73% with the skilled category. In this indicator of planning experiments, students are assessed for skills in providing tools and materials and knowing information on the uses of tools and materials that will be used in practicum. Students in the skilled category are due to all the instructions for practicum activities already contained in the guide so that students only need to read and carry out according to the practicum guide. However, not all students understand the information on the usefulness of the tools and materials to be used so that it takes time for the teaching assistant to explain many times before they understand it and students lack initiative in finding information related to information on the tools and materials to be used. Then in observations in the field it was also found that students did not maximally understand the objectives, practicum systematics because they were lazy to read the guide, the guide was only read if there was a pretest and posttest only, so this made students have to be reminded many times related to KPS in randomizing the experiment. This is also explained by Abdjul et al. (2022), Hunegnaw

& Melesse (2023), Nbuwa et al. (2022), Mutmainnah et al. (2019), and Sen & Vekli (2016) designing or planning student experiments in the medium category, this is because students are still unable to plan a practicum experiment properly. It is necessary to improve the quality of skills in designing or planning experiments so that students will find it easier to carry out practicum activities.

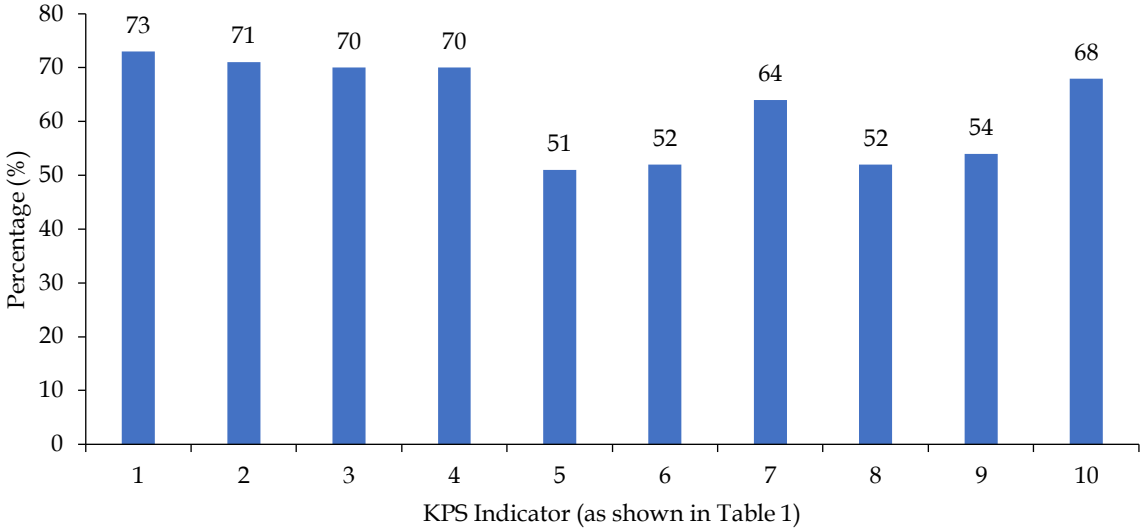

Figure 1. Student KPS indicator results

The skill of asking questions is obtained at 71% with a skilled category, this is because in almost all practicum materials the enthusiasm of students who ask is quite decent even though they ask by repeating what is already in the practicum guide, but not all students actively ask there are also students who are passive in asking this is because the attitude of curiosity of students based on observations in the field is still lacking so that sometimes they only receive enough information through the practicum guide in this case it plays a role for them in the process of developing knowledge. Actually, students have a good ability to ask questions because there is already a guide that they can read related to the material to be practiced, sometimes based on the results of field observations they ask about the technical activities of practicum steps while the lecturers and assistants expect them to ask more about things related to the material that has been learned to prove it when the practicum is carried out even though not all students are passive there are still some who ask questions with good material so that KPS asking questions looks skillful in all the material (Anita, 2022; Hidayah et al., 2023).

Skills in using tools and materials obtained a percentage of 70% with the skilled category. at the beginning of the practicum students were still very lacking in using tools such as the use of microscopes, loops, anemometers, park's hammers and blood detectors. In chemicals, student information is still lacking even in field notes when using chemicals, some students do not bring gloves and do not use mouth masks. Skills in using tools and materials are also tested on students by bringing a microscope and during the practicum process students are wrong in carrying it. While in the practicum guide, the tools and materials that will be used in each practicum have been delivered, but students only look for tools and materials but do not know their functions and uses and students do not take the initiative in finding information related to the tools and materials they will use in practicum with existing literature sources. Anita (2022), Ilvayani et al. (2023), and Mutmainnah et al. (2019) explained that students' skills in using the tools, materials and sources used were quite good, but some students still did not fully understand how to determine work steps, treatment of tools and materials and how to determine what was recorded in the implementation of practicum, this is also supported by research, sometimes students find it difficult to use tools and materials because during the learning process they rarely get practicum learning at school and when continuing to higher education with practicum makes them unfamiliar with the tools and materials they encounter during their time as students so that this aspect of KPS often shows a sufficient category.

Observation skills obtained a percentage of 70% with the skilled category, in this observation indicator is translated into two statement items used with an indication of students being able to make observations with all senses and students being able to compare the results of their observations, in these two items students still do not understand at the beginning of the practicum meeting more practicum assistants carry out the

observation process carried out, while as the practicum progresses with increasingly in-depth material students begin to be skilled in the process of observing with all their senses, but there are other findings in students who chat a lot and talk about non-practicum material with their own classmates. In the findings obtained at the beginning of the practicum material, students still lack confidence and low curiosity when making observations so that sometimes in one group there are only 1 to 2 people who work and observe the results of the practical experiments carried out. Beichumila et al. (2022), Darmaji et al. (2018b), and Parthiban & Stanly (2024) where students can connect direct practice with the theory that has been learned when going through the observation process so that students are able to mobilize all five senses in the process of practicum activities.

Classification skills obtained a percentage of 51% in the less skilled category, in this classification indicator there are still students who have difficulty in classifying the findings without the help of practicum assistants, for example in the tadpole blood fluid material students are asked to determine the arteries and veins in frogs, but students always say they don't find the results, while when the assistant does it, the arteries and veins of the young frog are found. This skill is very instrumental for students because it is a skill that must be able to classify the findings with the theory they learnt. Anbiya et al. (2023) and Darmaji et al. (2018a) explained that classification skills help students in the process of data that will be used to obtain a concept, if the classification process skills are low it will hinder the process of understanding the concept. This always happens in every material that they find difficult in the implementation process.

The next indicator that is less skilled with a percentage of 52% is the prediction indicator, this prediction indicator needs to be considered with an understanding of the concept and also skills in hypothesis because in principle this indicator predicts what will happen in new activities in practicum, lecturers can make literature reviews or stages of making material journals before practicum assigned to students for concept understanding, and can seek information with the task of viewing videos related to practicum material that will be carried out during the observation process in the form of a daily practicum journal. Anita (2022), Hasmawati et al. (2023), and Kamariyah et al. (2023) in their research that not all students were able to describe what possibilities could occur before the practicum. In this indicator, students are expected to be able to understand the patterns seen then the pattern can give rise to a tendency to be able to ask questions or predictions, but with the continued learning of practicum some students have begun to be able to carry out this indicator well to continue on the next indicator in drawing conclusions.

The ability of students is still many who have not been able to formulate hypotheses at the beginning of practicum activities so that in their practicum reports there is still a lack of hypotheses found. However, as the practicum activities progressed, students began to be able to formulate hypotheses based on observation sheets carried out with their group members, based on the results of field notes it was also found that there were still students who had to get more explanations from practicum assistants regarding hypotheses. Some students who understand have immediately formulated and discussed the hypothesis that will be asked or written in the practicum report. this is a KPS indicator that makes students' skills in making temporary conjectures related to the process and experimental findings. The ability of many students is still not able to formulate hypotheses at the beginning of practicum activities so that in their practicum reports there is still a lack of hypotheses found. However, as the practicum activities progressed, students began to be able to formulate hypotheses based on observation sheets carried out with their group members, based on the results of field notes it was also found that there were still students who had to get more explanations from practicum assistants related to doing hypotheses.

Some students who understand have immediately formulated and discussed the hypothesis that will be asked or written in the practicum report. This is also seen from research of Hartati et al. (2022) and Mutmainnah et al. (2019) that the hypothesizing process skills are categorized as quite good where some students have been able to formulate hypotheses or temporary conjectures from the experiments to be carried out.

Interpretation skills obtained 52% with the category less skilled. this is because students still do not appear to find patterns in making data or analyzing the data obtained. It can be seen from some of the practicum reports they made that there were data patterns whose language styles and structures imitated other students and copied and pasted from internet sources so that the data patterns obtained from the practicum results were different in the practicum reports. This skill is not optimal because it is also related to the application of concepts found in students, in some practicum topics there is still a clear percentage of less skilled, this is because students are less skilled in interpreting the findings and there are still many students who have not been able to convey the scientific events found so that they are still passive in conveying outside the practicum activities they find.

This indicator needs to be carried out in a gradual process starting from the behavior obtained by students

in understanding the theoretical concepts given by lecturers so that students can interpret the findings of the results that are adjusted on each topic, other things that can be done by doing a pretest performance test so that during the practicum students can already understand the concept of interpreting the results of their findings. This is also supported by research of Mutmainnah et al. (2019) and Safahi et al. (2020) showed that students need a lot of practice in the process of interpreting scientific events around them. The lack of conceptual understanding of students causes the interpretation process to be less than optimal.

The skill indicator of applying concepts with a percentage of 54% is categorized as less skilled, in this indicator students are seen how the skills in applying the theoretical concepts learned with practicum activities to be carried out both verbally and text in the practicum report. The results of observations show that students have been able to convey the concept of theory in the practicum report but not maximally verbally in the process of practicum experiments, some of the students also need to be given pressure and lure the value of new activeness to convey the theory that the practicum assistant wants. Based on observations, it was also found that practicum activities were sometimes carried out before the theory taught by the lecturer, so this became a problem for students in finding new concepts in practicum.

This indicator needs to be trained by understanding the concept through making a practicum topic journal with every after practicum or before practicum uploaded via google drive and given the name of each practitioner so that the concept of theory that has been learned can still be understood by students even though it is not fully understood by students. Attention needs to be paid to the delivery of material during theory so that students pay attention to understanding it and can be carried out to new activities such as practicum (Anggereini et al., 2023; Khairunnisa et al., 2019). The skill of applying concepts if students can use them in new situations, and new experiences in the delivery process that will occur both verbally and textually is still lacking so it needs to be trained in each process. This is also explained by Guan et al. (2016), Lepiyanto (2014), and Mutmainnah et al. (2019) that students have been able to use the concepts they have understood to solve the problems that are happening. Over time, some students have been able to apply between theory and practicum so that it needs a process in finding the student's KPS.

Communication skills obtained a percentage of 68% with a skilled category. Based on direct observation, students at the beginning of the practicum still tend to be passive both verbally and textually in the practicum process in presenting the conclusion of practicum activities. After the beginning, with frequent interactions between students, some students began to dare to convey conclusions correctly and precisely, although there were still many students who were passive or silent in conveying the conclusions requested by the practicum assistant. In the context of practicum reports, students have begun to be skilled in conveying the results in writing which contains the findings, literature sources and concludes practicum activities, this is because students are getting used to writing and getting information properly and correctly according to the sources they get. And this communication is a KPS which can be a process of sharing information, emotions, thoughts, and experiences using scientific language (Hunegnaw & Melesse, 2023; Samitra & Kristiawan, 2021; Ulmiah et al., 2013).

During the process of direct observation and interviews as well as analysis of student activity documentation, practicum activities still have a less skilled category on several KPS indicators, with the results of these findings students must be able to develop these science process skills as future teachers, because affective abilities alone have not been able to develop themselves must be combined with developing psychomotor skills. This is in accordance with the nature of science as prospective science teachers where the way to obtain science is by doing scientific work through the process of scientific experiments that require these process skills.

In order for student development to occur, it is necessary to facilitate and design a suitable learning to train the science process skills of Biology Education students, especially on several KPS indicators such as classification, prediction, interpretation and applying concepts, so that students do not only focus on making reports, it is necessary to make process assessment instruments during the practicum. Some learning designs that can help the development of KPS with project-based learning or inquiry. In the process of assessing students can be with performance assessment and students are asked to be able to demonstrate performance and also the ability to do tasks.

Conclusions

Based on the results of the study, it can be concluded that in the practicum of animal physiology, Biology Education students of FKIP Jambi University with 10 practicum topics analyzed with 10 indicators of science process skills are skills in planning experiments, asking questions, using tools and materials, observation, hypothesizing and communication in the skilled category. While less skilled indicators include

classification, prediction, interpretation and applying concepts, this is because these indicators are interrelated with the theoretical concepts that have been learned, if students' understanding of the concept is lacking then these indicators will appear not optimally.

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Conceptualization, methodology, formal analysis, investigation, writing original draft preparation, visualization, M.T.; software, resources, project administration, validation, data curation, supervision, writing review and editing, A.H. and W.S. All authors have read and agreed to the published version of the manuscript.

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All author declares that there is no conflict of interest.

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