



Analysis of students' science process skills in human reflex practicum based on the guided inquiry learning



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ABSTRACT

Science process skills are essential abilities involving thinking, reasoning, and acting effectively to achieve scientific goals. While the Guided Inquiry Learning model has shown effectiveness in improving these skills, its application in the coordination system topic, particularly using human reflex practicum, remains under-researched. At SMAN 1 Tilango, Grade XI students learn the coordination system mainly through theoretical instruction, with limited practical activities. This reduces opportunities for students to develop science process skills such as observing, experimenting, and analyzing data. This study aimed to analyze learning implementation and students' science process skills through a human reflex practicum using the Guided Inquiry Learning model. Conducted in October 2024 at SMAN 1 Tilango, the research involved 20 Grade XI students and used a quantitative descriptive method. Data were collected via observation sheets focused on learning implementation and science process skills. The findings showed that all learning stages were implemented effectively, and students actively engaged in scientific activities. The highest achievement was in observation skills, with an average score of 87%, classified as very good. The Guided Inquiry model offered meaningful learning experiences and improved students' scientific understanding through direct involvement.

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INTRODUCTION

Education is a dynamic system that constantly evolves in line with the changing times. In practice, this development is reflected in the various innovations continuously introduced to improve the quality of education. The Commission on Education for the 21st Century identifies four key strategies to ensure the success of education in this era, one of which is learning to do, a



learning approach based on actions that encourage the generation of ideas related to science and technology. In schools, this strategy is implemented through meaningful learning experiences, where students construct their own knowledge using the skills they possess (Rifatul Mahmudah et al., 2019). One of the essential skills supporting this process is science process skills.

Science process skills include a set of physical, mental, and social abilities required to acquire, develop, and apply scientific concepts, laws, and theories (Matsna et al., 2023). These skills serve as a foundation for individuals to use reasoning, thinking, and actions effectively and efficiently to achieve learning goals (Elvanisi et al., 2018). By developing science process skills, students become more responsible for their learning and understand the importance of applying scientific methods. These skills involve activities such as observing, classifying, interpreting data, making predictions, formulating hypotheses, designing and conducting experiments, and communicating findings (Amita & Prasasti, 2017).

Based on interviews with the Biology teacher of grade XI at SMAN 1 Tilango, it was found that learning in the topic of the coordination system is still dominated by theoretical concept delivery. The learning process has not been balanced with the development of students' skills, particularly their science process skills. Practicum activities or experimental-based learning are still rarely conducted, limiting students' opportunities to explore concepts through direct experience. As a result, students' science process skills are underdeveloped; they are not yet accustomed to going through scientific stages systematically, such as observing, formulating problems, developing hypotheses, conducting experiments, and drawing conclusions based on data. Therefore, a learning model is needed that can actively engage students while also training their scientific skills. One such model is Guided Inquiry Learning, which, according to Ningrum et al. (2021), encourages students to actively engage in scientific inquiry, think critically, and construct concepts independently with guidance from the teacher.

The guided inquiry learning model enables students to act like young scientists, working in small groups to investigate problems and conduct experiments (Dewi, 2016). This approach fosters students' scientific abilities as they are directly involved in active learning processes. Knowledge gained through independent inquiry tends to be more meaningful and long-lasting because it is discovered systematically (Suwardani et al., 2021). In its application, the teacher serves as a facilitator who stimulates curiosity by presenting problems for students to solve. Students are then guided to find the best solutions independently, applying scientific methods, thinking analytically, and solving problems on their own (Anam, 2017). Thus, the application of Guided Inquiry Learning has strong potential to enhance students' science process skills.

Generally, inquiry learning is carried out through a series of structured learning stages. The first stage is orientation, where the teacher introduces the topic or problem and sparks students' interest. This is followed by problem formulation, hypothesis development based on prior knowledge, and data collection to support or refute the hypothesis. Students then test their hypotheses and conclude the findings. At each stage, the teacher provides guidance to help students draw logical, evidence-based conclusions. This approach not only increases student engagement but also helps them develop critical, creative, and systematic thinking in solving problems (Nurwahid et al., 2024).

Previous studies have discussed the effectiveness of the Guided Inquiry Learning model in improving students' science process skills. However, few studies have explored how this model is applied to the coordination system topic, which is characterized by its complexity. One such study was conducted by (Prasetyo Riyadi et al., 2015), who stated that the implementation of the Guided Inquiry Learning Model in the topic of the coordination system can enhance students' science process skills. The practicum conducted in that study involved an experiment on movements triggered by the brain and spinal cord when damaged, using frogs as experimental

subjects. To date, no research has specifically examined how this model is applied in the context of human reflex practicum, or to what extent its application can improve students' science process skills at the senior high school level. Human reflexes are a concrete and contextual topic that is highly relevant to be studied through practicum activities, as it involves physiological responses that can be directly observed. Unfortunately, school learning often presents this concept only theoretically, without providing students with exploratory experiences. As a result, students' science process skills—such as observing, formulating problems, hypothesizing, conducting experiments, and analyzing data—are not optimally developed.

This study aims to analyze students' science process skills in a human reflex practicum using the Guided Inquiry Learning model. It will examine the extent to which the learning process is implemented based on the syntax of the Guided Inquiry model and how students can develop science process skills such as observing, classifying, interpreting data, formulating hypotheses, as well as designing and conducting experiments. The results of this study are expected to provide insights into how students' science process skills are developed in the human reflex practicum through the application of the Guided Inquiry Learning model.

RESEARCH METHODS

Research Design

This research is a quantitative descriptive study. This approach was chosen to systematically and objectively describe the implementation of learning and students' science process skills during the use of the Guided Inquiry Learning model. The main focus of the study is to quantitatively illustrate the execution of the learning process and student involvement in various science process skill indicators. The research was conducted in October 2024 at SMAN I Tilango, Gorontalo Province.

Population and Samples

The population in this study consisted of all Grade XI students at SMAN I Tilango, totaling 43 students across two classes. However, the research sample was limited to only one class, consisting of 20 students. The selection of this class was based on the alignment between the Biology subject schedule and the researcher's availability. Therefore, purposive sampling was used to determine the sample, ensuring that the selected class allowed for optimal observation during Biology lessons within the research timeframe.

Instruments

The instruments used in this study consisted of two types of observation sheets. The first was the learning implementation observation sheet, which was used to assess the extent to which the learning process was carried out according to the syntax or stages of the Guided Inquiry Learning model. The second instrument was the science process skills (SPS) observation sheet, which was developed based on indicators proposed by (Rustaman, 2005). The assessment rubric for science process skills through observation can be seen in Table I.

Table I. The Assessment Rubric For Science Process Skills (SPS)

Observation Component	Score	Assessment Indicators
Observation (observing the reactions during the experiment)	5	Observation of human tendon movement is conducted accurately and thoroughly
	4	Observation of human tendon movement is conducted accurately but not thoroughly
	3	Observation of human tendon movement is conducted with less



		accuracy and thoroughness
	2	Observation of human tendon movement is conducted inaccurately and without thoroughness
	1	No observation conducted
Communication (clearly and systematically presenting discussion results)	5	Able to present the discussion results on human tendon movement systematically, clearly, and completely
	4	Able to present the discussion results on human tendon movement systematically and clearly, but less completely
	3	Able to present the discussion results on human tendon movement systematically, but unclearly and incompletely
	2	Able to present the discussion results on human tendon movement unsystematically, unclearly, and incompletely
	1	Unable to present the discussion results
Interpretation (recording and summarizing the experiment results and answering questions in the worksheet based on group discussion)	5	Able to record observation/experiment data, analyze the data, and correctly and accurately draw conclusions from the human tendon movement experiment
	4	Able to record observation/experiment data, analyze the data, and draw correct but less accurate conclusions
	3	Able to record and analyze data but unable to draw conclusions from the data obtained
	2	Able to record data, but unable to analyze and draw conclusions from the data obtained
	1	Unable to record, analyze, or draw conclusions from the data obtained
Hypothesis (understanding that there may be more than one explanation for a phenomenon)	5	Hypothesis is highly relevant, clear, and supported by strong scientific reasoning in line with the human tendon movement experiment
	4	Hypothesis is relevant and clear, but the scientific reasoning is not strong
	3	Hypothesis is present but vague and not supported by strong reasoning related to the research problem
	2	Hypothesis is very general or only slightly related to the research problem and is unclear
	1	No hypothesis or completely irrelevant to the research problem
Questioning (answering and asking questions and providing solutions or opinions during group discussions)	5	Accurately answers and asks questions, and provides solutions or opinions during group discussion
	4	Answers and asks questions but does not provide solutions or opinions during group discussion
	3	Either answers or asks questions accurately in group discussion
	2	Either answers or asks questions in group discussion, but not accurately
	1	Does not answer or ask any questions during group discussion

Procedures

Data collection was carried out through direct observation during the learning process. The observation was conducted over two meetings, in which students participated in learning activities using the Guided Inquiry Learning model. During these sessions, the observer documented both the implementation of the learning process and students' science process skills. The observation



focused on teacher and student activities across each stage of the guided inquiry model. Data were collected using previously prepared and validated observation sheets. This procedure aimed to capture a comprehensive picture of how the model was applied and how students demonstrated their science process skills during the lessons and practical activities. The research flow can be seen in Figure I.

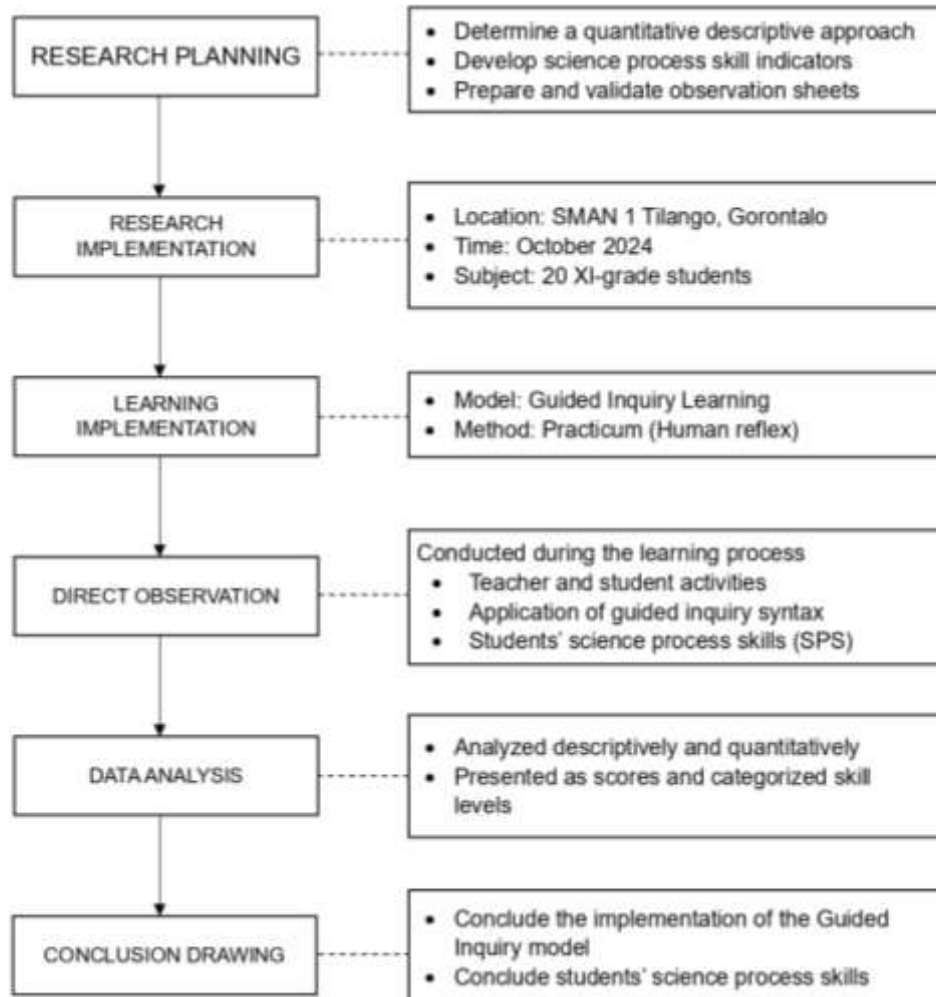


Figure I. The Research Flow

Data Analysis

The data obtained from the observations were analyzed using descriptive quantitative methods. The analysis involved calculating the percentage of learning implementation and science process skills for each observed indicator. These percentages were then categorized into levels of achievement. The categorization of students' science process skills can be seen in Table 2.

Table 2. The categorization of students' science process skills

Percentage of Science Process Skills (%)	Category
0 - 20	Very Poor
21 - 40	Poor
41 - 60	Fair
61 - 80	Good
81 - 100	Excellent

RESULTS

Learning Implementation Based on Guided Inquiry Learning

The observation of learning implementation was conducted by an observer involving 20 students. The observation focused on three main aspects of the learning activities: the introductory activities, the core activities, and the closing activities. The learning process followed the syntax of Guided Inquiry Learning, which consists of the following stages: orientation, formulating problems, formulating hypotheses, collecting data, testing hypotheses, and drawing conclusions. The observation was carried out over two meetings, and the percentage of implementation for each aspect is presented in Figure 2.

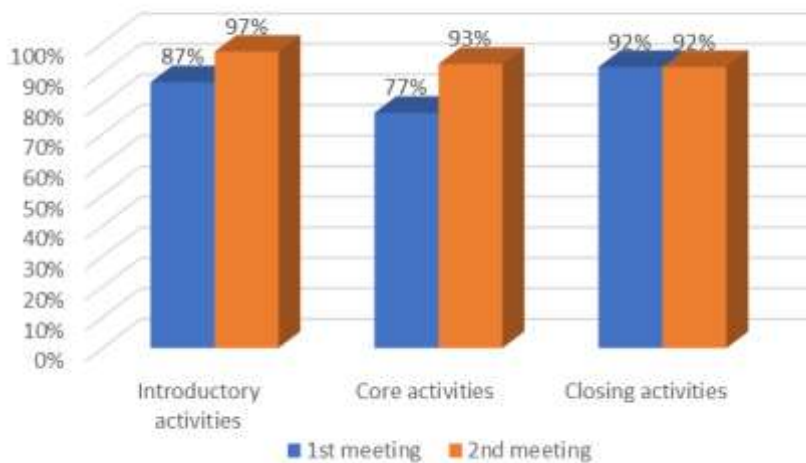


Figure 2. Diagram of learning implementation

Students' Science Process Skills

The observation of students' science process skills was conducted by an observer involving 20 students. The observation focused on five indicators of science process skills: observing, questioning, formulating hypotheses, interpreting data, and communicating results. The practicum carried out during this session was titled "Human Reflexes", in which students observed the leg's response when the knee was tapped using a reflex hammer (patellar reflex). The activity was carried out in groups, and students actively participated in each stage of the inquiry process. The results of the observation on science process skills are presented in Table 3.

Table 3. The results of the observation on students' science process skills

Indicators of Science Process Skills	Score	Category
Observing	87%	Very good
Questioning	77%	Good
Formulating Hypotheses	79%	Good
Interpreting Data	84%	Very good
Communicating Results	86%	Very good

DISCUSSION

Based on the results presented in Figure 1, the implementation of introductory activities increased from 87% to 97%. This improvement reflects the teacher's growing effectiveness in preparing students for learning, particularly through the delivery of learning objectives,

motivational prompts, and connecting the material to students' prior knowledge. According to Sanjaya (2010), introductory activities serve as a crucial stage to help guide students into meaningful learning contexts.

The most significant improvement occurred in the core activities, which increased from 77% to 93%. Core activities in guided inquiry learning represent the direct implementation of the inquiry process, which demands active student engagement in observing, formulating problems, hypothesizing, collecting and analyzing data, and drawing conclusions. This improvement indicates that the teacher was able to guide students effectively, aligning with the view of Pramana et al. (2024), who state that in guided inquiry, the teacher acts as a facilitator, providing only sufficient guidance to allow students to remain independent in their scientific thinking.

Meanwhile, the closing activities showed consistently high levels of implementation in both meetings, each at 92%. The teacher regularly conducted lesson reflections, reinforced key concepts, and provided appropriate follow-up. This stage is important to ensure that the results of the inquiry are well understood and contribute meaningfully to the students' knowledge. This is supported by Soda Betu & Viktoria (2025), who state that the final phase of a lesson should include the synthesis of knowledge and reflection on what has been learned. Overall, the implementation of learning using the guided inquiry learning approach falls into the "very good" category. All aspects of the learning process were carried out effectively and consistently.

The results of the study show that the observing indicator achieved the highest score, namely 87%, which falls into the "very good" category. In the practicum "Human Reflexes" involving knee tapping (patellar reflex), the ability to observe is crucial because students must directly examine the leg's reaction to stimulation on the lower part of the kneecap. This activity encourages students to focus on the spontaneous movement of the leg, identify the reaction time, and record its consistency. According to Suryaningsih (2017), Effective observation demands attention to detail and active involvement of the senses, which is reflected in this activity. (Mellyzar et al., 2022) stated that observation activities can create more meaningful learning experiences because students are directly involved in observing events occurring in their surroundings. Observational skills are a fundamental component of science learning and serve as the foundation for mastering other science process skills. Therefore, the ability to observe can be used as an initial basis for building and developing more complex science process skills.

The questioning indicator scored 77% and is categorized as "good." In this activity, students were challenged to develop scientific questions such as: "Why does the leg move involuntarily when the knee is tapped?" or "What causes the reflex not to occur in some individuals?" Such questions are vital in the inquiry process because they reflect curiosity and critical thinking. Rindiantika (2021) emphasizes the importance of open-ended questions that promote exploration. However, the lower score compared to other indicators indicates that students still tend to formulate descriptive rather than investigative questions. Providing stimuli in the form of surprising or unusual phenomena may help improve the quality of students' questions.

The ability to formulate hypotheses achieved a score of 79%, also in the "good" category. In the context of the patellar reflex, students made initial assumptions such as, "If the lower part of the knee is tapped, then the leg will move reflexively due to an automatic nerve response." Formulating such hypotheses requires understanding of the nervous system and the relationship between stimulus and response. Piaget's theory, as cited in Anas (2018), states that hypothesis formulation is part of the formal-operational stage of cognitive development, where individuals begin to think logically and abstractly. The guided inquiry model supports students in formulating hypotheses based on observations and group discussions.

The interpreting data indicator reached a score of 84%, which falls under the "very good" category. In this practicum, students recorded whether a reflex occurred, its intensity, and

compared responses between individuals. They were also able to relate their observations to physiological conditions such as fatigue or nerve disorders. The ability to analyze and draw conclusions shows that students were not only able to record data but also interpret it logically. Wulandari et al. (2021) state that interpretation skills are essential because students must connect observational results, identify patterns in a series of observations, and draw conclusions.

The communicating results indicator scored 86%, also in the “very good” category. After conducting observations and analyses, students were able to present their findings through group discussions, result presentations, and practicum reports. In the context of the patellar reflex, students explained the nerve mechanism, individual variations in results, and drew conclusions about the relationship between stimulus and bodily response. Atiaturrahmaniah et al. (2022) emphasize that scientific communication is crucial in developing scientific literacy, as it enables students to explain and defend their ideas logically. The guided inquiry model supports this by encouraging students to actively communicate their thought processes and research findings.

Overall, the implementation of the “Human Reflexes” practicum through the Guided Inquiry Learning approach has successfully encouraged active student involvement in the scientific process. This activity not only helped build a concrete understanding of concepts but also fostered skills in observation, critical thinking, and scientific communication. This aligns with the findings of (Nurfahzuni & Budiyanto, 2023), who reported that students’ science process skills can improve through the implementation of Guided Inquiry Learning, with the trained skills including problem formulation, hypothesis design, variable identification, data interpretation, and concluding.

CONCLUSION

Based on the results of the study titled “Analysis of Learning Implementation and Students’ Science Process Skills through the Application of the Guided Inquiry Learning Model at SMAN I Tilango”, it can be concluded that learning using the Guided Inquiry Learning model was carried out very well across all stages, including the introductory, core, and closing activities. Students were actively involved in the learning process and demonstrated their abilities in science process skills, including observing, formulating questions, developing hypotheses, interpreting data, and communicating results. Learning through the guided inquiry approach provided meaningful learning experiences and encouraged students’ direct engagement in understanding scientific concepts.

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