

# Observation of the Application of Guided Inquiry Learning Model on Plant Growth and Development Material to Improve Students Science Process Skills

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**Abstract:** The purpose of the study was to improve the science process skills of students who used the guided inquiry learning model on plant growth and development material. This type of research is quasi experimental in the form of Nonequivalent control group design. Population of all XII IPA classes. Samples of class XII IPA 1 (experimental) using guided inquiry learning model and class XII IPA 2 (control) with discovery learning model. Indicators of science process skills observed in this study consisted of aspects of observing, classifying, interpreting, predicting, asking questions, hypothesizing, using tools and materials, planning experiments, and communicating. The results of the study, science process skills in the experimental class the percentage is higher than the control class. In the experimental class, the aspect of observing was the highest aspect with a percentage of 88.39% while in the control class the highest aspect was the aspect of observing and asking questions with a percentage of 82.09% and 82.59%. The lowest percentage aspect is hypothesizing both experimental and control classes with a percentage of 80.36% and 58.04%. So the observation of the application of the guided inquiry learning model on plant growth and development material can improve students' science process skills.

**Keywords:** Guided inquiry; Science process skills

## Introduction

Education is a process that helps humans to develop themselves so that they are able to face all changes and problems with an open and creative attitude. Education is an effort made to create a learning atmosphere so that students can develop the potential that exists in themselves (Elvanisi et al., 2018). To achieve educational goals, an innovation or improvement in the learning process is needed.

The teaching and learning process is a process of interaction activities between teachers and students and mutual communication that takes place in an educational situation to achieve learning goals. In the teaching and learning process, students are able to identify, formulate problems, search, find facts, analyze and interpret and draw conclusions (Lestiawan et al.,

2018). The learning process at this time is only fixated on mastering concepts but does not train students to have process skills.

Science process skills are skills that involve all the abilities of students in obtaining knowledge based on phenomena. The ability of students in question is the skill of observing, classifying, interpreting, predicting, asking questions, hypothesizing, planning experiments, applying concepts, communicating and carrying out experiments (Wahyudi et al., 2015). According to Solikin et al. (2020) Science process skills (SPS) is a physical and mental skills associated with basic skills are mastered, owned, and applied in scientific activity so that the scientists managed to find something new.

Science process skills have an influence in science education because they help learners to develop intellectual skills, manual skills and social skills. Science

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learning is closely related to scientific performance which can be developed through hands on or direct experience with investigations and experiments to train science process skills resulting in minds on knowledge. According to Karim et al. (2021) Science process skills need to be trained and developed in science learning because science process skills have a very important role, namely helping students develop their minds and helping students learn science concepts. Furthermore, according to junior et al, (2020) There are eight indicators in SPS, namely: (1) Observing, (2) Classifying, (3) Inferring, (4) Predicting, (5) Constructing Hypotheses, (6) Experimenting, (7) Applying Concept and (8) Communicating.

Biology learning is one of the branches of science that studies living things. Biology learning should be applied in accordance with the nature of biology as science including minds on (cognitive), hearts on (affective) and hands on (psychomotor), namely the ability to use the mind to build concepts through direct experience accompanied by a scientific attitude (A. M. N. Hasan et al., 2018).

Growth and development material in plants is one of the materials in biology teaching that has the potential to develop students' science process skills, because according to Permendikbud No. 69 of 2013 concerning the SMA-MA Curriculum, the basic competencies in this material analyze the relationship between internal and external factors with the process of plant growth and development based on experiments. Analyzing and conducting experiments are activities that have the potential to develop students' science process skills. The material is not enough to just apply concepts to students but it is necessary to carry out treatment to prove existing concepts or theories so that students more easily understand the material being taught. How many problems often arise during the learning process, namely most students are more passive, afraid, and reluctant to be embarrassed to express their opinions, this will certainly affect the smooth learning and creativity of students during the learning process.

Based on the results of observations and interviews with class XII biology subject teachers at SMAN 1 Tapa, it was found that the psychomotor scores of students in biology subjects, especially in the material of growth and development in plants, had not shown satisfactory results. This can be seen from the presentation of the psychomotor scores of students who scored below the KKM standard of 75 or categorized as incomplete. In the learning process, the process skills activities (Psychomotor) of students are still lacking, students are still reluctant to express opinions, ask questions or answer questions. Students are still accustomed to the teacher-centered learning process so that the activity of

science process skills is not optimal. Some students still have difficulty in formulating problems, do not understand the instruments under study, and cannot find facts based on observations. Learners are also not yet active in communicating the results of learning either in the form of conclusions in a report or giving explanations in front of the class.

Based on how to develop students' science process skills, it is necessary to have a learning model that can support the emergence and improvement of students' science process skills, one of which is the inquiry learning model. According to Budiyo et al. (2016) the inquiry learning model requires students to be able to plan and conduct experiments, collect and analyze data and draw conclusions that are oriented towards solving problems. so that with this process students will be actively involved and have an increase in terms of understanding science, productive in creative thinking and have skills in obtaining and analyzing information. According to Apriliani et al. (2022) the guided inquiry learning model can encourage students to actively seek their knowledge so that students become independent individuals. Meanwhile, according to Aldahmash et al. (2016) Inquiry as a learning aim, pedagogy and curriculum reform is of utmost importance to science education.

The inquiry learning model is more centered on students, the teacher's role is only as a facilitator and guide. This inquiry learning model is one of the learning models that is suitable for teachers to apply in the century of knowledge. According to Hasan (2003) the learning approach used in the century of knowledge is a mixed approach, namely a combination of learning approaches from teachers, learning from other students, and learning on their own. Learning practices in the century of knowledge are teachers as facilitators, mentors, and consultants. Learning practices depend on modern knowledge tools, namely computers and telecommunications, but most of the characteristics of the Century of Knowledge can be achieved without utilizing modern tools.

## Method

This research was conducted in the odd semester of the 2022/2023 school year in class XII IPA SMA Negeri 1 Tapa. The type of research used is quantitative research using the quasi-experiment method. The population in this study were all XII science classes of SMA Negeri 1 Tapa. Adapaun sample in this study students of class XII IPA 1 as an experimental class and XII IPA 2 as a control class. Samples were selected by purposive sampling. The data collection techniques

used were observation sheets of students' science process skills and teacher activity sheets.

*Learner Observation Sheet Analysis*

Observation carried out in this study is to observe the science process skills carried out by students during the learning process as equation 1.

$$\% \text{ every aspect} = \frac{\text{score of each aspect achieved}}{\text{total score of each aspect}} \times 100\% \quad (1)$$

**Table 1.** Learner Activity Criteria (Trianto, 2010)

Activities (%)	Criteria
76-100	Very Good
51-75	Good
26-50	Not Good
≤ 25	No Good

*Teacher Activity Sheet Analysis*

The observation sheet used to determine the extent of learning implementation. Observations were carried out from the initial activities to the final activities and assisted by a teacher as an observer. In calculating the teacher activity observation sheet, the following formula is needed:

$$\% \text{ every aspect} = \frac{\text{score of each aspect achieved}}{\text{total score of each aspect}} \times 100\% \quad (2)$$

**Table 2.** Criteria for Learning Implementation (Prayudo et al., 2018)

Activites (%)	Criteria
86 < p	Very Good
71 < p ≤ 85	Good
51 ≤ p ≤ 70	Not Good
P ≤ 50	No Good

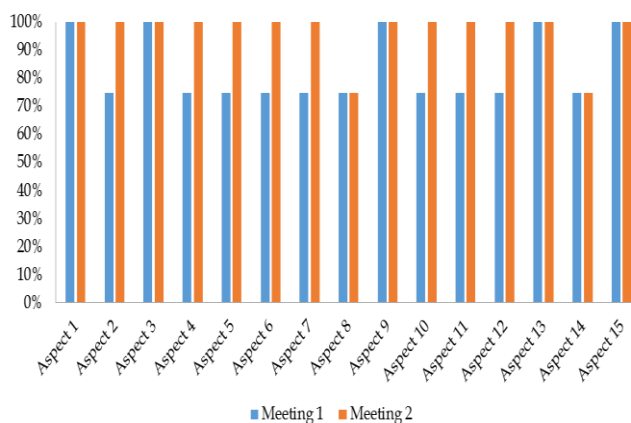
**Result and Discussion**

Based on the research conducted, the following results were obtained:

*Teacher Activity Observation Results*

*Experiment Class*

The results of the percentage of teacher activity during the learning process will be presented in Figure 1.

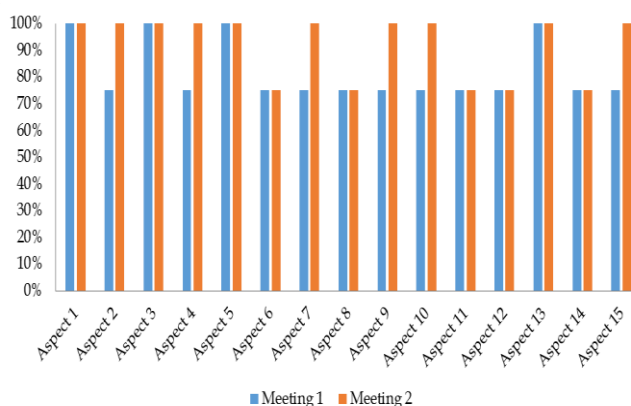


**Figure 1.** Experimental class teacher activity percentage

Teacher activities at meetings I and II each aspect obtained different scores. At meeting I, the teacher's activity obtained a score of 75%, namely in aspects (2,4,5,6,7,8,11,12,14) while the teacher's activity which obtained a score of 100% was in aspects (1,3,5,9,10,13,15). In meeting II, teacher activities that scored 75% were in aspects (8 and 14) while teacher activities that scored 100% were in aspects (1,2,3,4,5,6,7,9,10,11,12,13,15). According to Latjompoh et al. (2021) in addition to the use of learning media that can support the learning process, the teaching model can also support the implementation of learning activities that can affect the active participation of students and learning motivation so that it can help teachers to train students' skills.

*Control Class*

The results of the percentage of teacher activity during the learning process will be presented in Figure 2.



**Figure 2.** Control class teacher activity percentage

Teacher activities at meetings I and II each aspect obtained different scores. At meeting I, the teacher's activity obtained a score of 75%, namely in aspects (2,4,6,7,8,9,10,11,12,14,15) while the teacher's activity that obtained a score of 100% was in aspects (1,3,5,13).

At meeting II, the teacher's activity obtained a score of 75%, namely in aspects (6,8,11,12,14) while the teacher's activity that obtained a score of 100% was in aspects (1,2,3,4,5,7,9,10,13,15).

The average percentage of teacher activity in experimental and control classes both obtained two good and very good criteria. In the experimental class the first meeting obtained a score of 83% (Good) and the second meeting amounted to 97% (Very good). Whereas in the control class the first meeting obtained a value of 82% (Good) and the second meeting amounted to 92% (Very good). It can be seen that the percentage of learning implementation in the experimental class is higher than in the control class, but both have increased even though they have different percentage amounts. According to Suardika (2023), this guided inquiry learning model activity is designed to provide opportunities for students to fully participate in the learning process in the classroom. Students with their groups conduct discussions to formulate problems, with experimental activities to test hypotheses, draw conclusions based on the evidence found, and identify the causes of errors in problem-solving activities, and communicate the findings in front of the class. This can stimulate the development of student creativity in learning and the problems given can develop students' thinking skills, especially students' critical thinking skills and students' science process skills. Meanwhile, according to Cayvaz et al. (2020) Inquiry learning refers engaging students with scientific processes like orientation, developing hypothesis, designing and implementing experiment (s) to test the hypothesis, gathering and analyzing data and reaching conclusion to help them build their own knowledge and to use it in order to predict and explain the events in the natural world. According to Hasan et al. (2019) that in the industrial era 4.0 teachers must be creative and innovative in developing learning methods or finding solutions to learning problems, teachers in addition to being facilitators are also motivators and inspirators, and teachers must have the ability to analyze and write. According to Massie et al. (2021), a teacher must be able to recognize students and master their fields as well as be creative in using various learning methods so that students do not become bored.

*Student Observation Analysis Results*

Student's activities were observed during the learning process by giving the treatment of inquiry learning model as experimental class and discovery learning model as control class. The results of the first and second meetings in the experimental and control classes can be seen in Tables 3 and 4.

**Table 3.** Percentage Value of Observation of Science Process Skills at the First Meeting

Aspects of Science Process Skills	Experiment Class (%)	Control Class (%)
Observe	88.39	80.36
Categorize/Classify	84.82	81.25
Interpreting	85.71	73.21
Forecasting/Predicting	86.61	75.89
Asking Questions	82.14	81.25
Hypothesize	80.36	51.79
Planning an Experiment	86.61	-
Using Tools and Materials	82.14	-
Communicate	83.04	53.57

Based on Table 3 it can be seen that the experimental class shows the highest percentage of KPS indicators is in the aspect of observing with a percentage of 88.39%, while the lowest percentage is aimed at the hypothesizing aspect with a percentage of 80.36%. In the control class, the highest percentage of KPS indicators was the aspect of grouping and asking questions with a percentage of 81.25%, the lowest aspect was aimed at the hypothesizing indicator with a percentage of 51.79%, in the control class the indicators of planning experiments and using tools and materials did not appear because the learning process did not conduct experiments directly. So that the percentage of the control class is lower than the experimental class. According to Suryaningsih, (2017) students who are directly involved in doing and following a process of observing, analyzing, and proving about an object, then students can develop science process skills well.

**Table 4.** Percentage Value of Observation of Science Process Skills at the Second Meeting

Aspects of Science Process Skills	Experiment Class	Control Class
Observe	88.39	83.82
Categorize/Classify	86.61	81.25
Interpreting	87.50	85.71
Forecasting/Predicting	87.50	78.57
Asking Questions	84.82	83.93
Hypothesize	80.36	64.29
Planning an Experiment	84.82	75.89
Using Tools and Materials	85.71	72.32
Communicate	81.25	66.07

The experimental class shows that the highest percentage of KPS aspects is the aspect of observing with a percentage of 88.39%, while the lowest percentage is aimed at the hypothesizing aspect with a percentage value of 80.36%. In the control class, the highest percentage of the KPS aspect was interpreting with a percentage of 85.71%, while the lowest was aimed at the hypothesizing indicator with a percentage of 64.29%. In accordance with the results of research by Mahmudah et



al. (2019) showed that the science process skills of high school students in Bandung City were less skilled in the aspects of compiling hypotheses, determining variables, and compiling experimental procedures. As for the aspect of determining tools and materials, students are in the sufficient category. Science process skills are lacking because students are not trained to develop science process skills optimally in daily learning.

Based on the average results of the recapitulation of observations of students' science process skills for the first meeting and the second meeting both in the experimental class and in the control class, it can be summarized from Figure 3.

Figure 3 is the average result of the observation assessment of science process skills carried out by students in the process of learning activities. Science process skills between experimental and control classes look different from the results of the percentage of each aspect observed by the observer during learning activities, the experimental class obtained a higher percentage than the control class. In the experimental class, the aspect that has the highest percentage is the observation aspect, this is because in this aspect students are invited to directly observe the theory they get through direct experiments so that it can attract students' interest in learning. This aspect is a basic skill that is generally always carried out in learning activities. According to Putra et al. (2015) observing skills are activities to observe objects or phenomena as a stimulant to bring students to the material to be studied. control class which has the highest percentage is in the aspect of asking questions. The activity of students in the control class that has the highest percentage is in the aspect of asking questions. According to Eliyana (2020) observing skills are skills to gather information through application with the senses. According to Royani et al. (2014) asking questions is the same as showing one's mindset so that asking questions can encourage students' thinking skills.

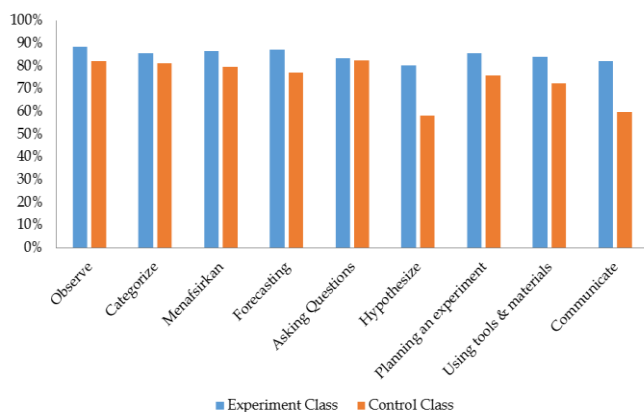


Figure 3. Average percentage of observation sheet

The hypothesizing aspect is the aspect that has the lowest percentage in both experimental and control classes. This is because students lack readiness before conducting experiments. In addition, students are not accustomed to proposing hypotheses in the learning process, because students are used to relying on the teacher in the learning process. According to Suryaningsih (2017) hypothesizing is realizing that an explanation needs to be tested in obtaining more evidence or solving problems. Furthermore, according to Rahmasiwi (2015) that low science process skills are caused by factors including low science background, guidebooks in learning, and lack of optimization of learning that involves the role of students. Learners who are less skilled and active in participating in the learning process tend to have low science process skills.

The aspect of grouping both obtained an increase in both control and experimental classes because the ability of students in terms of making observation tables properly and completely was good in the experimental class and quite good in the control class. This is because the experimental class is more focused on doing all the procedures that have been given because the inquiry learning model makes students actively involved in all learning activities. According to Hamidah (2022) Inquiry is a learning activity that maximally involves all students' abilities to search and investigate systematically, critically, logically, analytically, so that they can formulate their own findings. Inquiry learning is designed to invite students directly into the scientific process in a relatively short time. According to Baharom et al. (2020) An inquiry approach helps students think critically and build confidence in solving problems. Menurut Nurza et al. (2021) The inquiry learning model is a model that takes students to the scientific process, namely collecting and analyzing data, checking hypotheses, and theories, and reflecting the nature of knowledge formation. Science process skills are complex abilities to carry out scientific investigations into a series of learning processes.

The aspect of interpreting has increased because students are able to interpret or connect the results of observations with the concept of material correctly. According to Khairunnisa et al. (2019) in the aspect of interpreting data, students must have good observation skills first. With good observing skills, the skills in interpreting data will also be good. this is in accordance with the results of the study, namely based on the results of KPS research on the observing aspect which shows the "good" category and affects the results of the assessment of the KPS aspect of interpreting data, which also shows the "good" category.

The aspect of predicting has increased in both experimental and control classes, this is due to the use of

problem sheets given in the learning process, so that students will guess the possible results that will be obtained from the practicum and students will predict a certain situation that has never been observed directly based on the knowledge that has been obtained. Thus, students' science process skills in the aspect of predicting can be mastered well. According to Sitio et al. (2021), science process skills on predicting indicators can be trained with learning activities other than group discussions, namely with practicum activities.

The aspect of asking questions has increased in both experimental and control classes, this is because students are able to ask questions to ask for explanations about concepts that have not been understood or doubts about the practicum carried out. According to Yolanda (2019) The questions asked can ask for explanations, about what, why, how, or ask about the background so that concepts, magnetic electricity formulas, applications of subject matter in the context they experience. According to Lestari et al. (2020) States the relationship between the variables and verifies the expected results in the experiment or the problem to be solved. Student weaknesses in identifying research variables affect the ability to formulate problems. As a result, there are still many students who write incorrect problem statements.

The aspect of planning experiments has increased because students are able to plan experiments or are able to prepare tools and materials that will be used when conducting experiments. According to Rahayu (2020) planning an experiment is determining what will be measured, observed and recorded and determining what will be carried out in the form of work steps. According to Purnama et al. (2020) merencanakan percobaan, in this aspect students are required to be able to know the tools and materials in accordance with the experiment and can design work procedures to conduct experiments.

The aspect of using tools and materials has increased, this means that students are able to use tools and materials during the experiment. The skill of using tools and materials is one aspect of science process skills related to essential laboratory skills. Then the aspect of communicating has increased because students are able to explain the results of observations properly and systematically. According to Wahyuningsih et al. (2021) Communication skills possessed by students can train their ability to determine the results of learning. On the other hand, the activities of communicating skills can be in the form of presenting information data in oral and written form presented in the form of models, images, graphs, diagrams and tables. Meanwhile, according to Dewi et al. (2023) Changing the form of presentation, providing an overview of experimental data through

graphs, tables, or diagrams, compiling and submitting reports systematically, explaining experimental results, reading experimental results, discussing experimental results.

Learning activities in the experimental class that applied the inquiry learning model gave birth to more science process skills of students during the learning process, compared to the control class that used the Discovery Learning model. In accordance with the results of research conducted by Anam et al. (2015) that inquiry learning is significant for improving students' science process skills. The existence of significant differences in effectiveness between the Inquiry and Discovery Learning models also corresponds to research conducted by Solikhah (2017) that the Inquiry learning model is able to improve social studies learning outcomes higher than the Discovery learning model. Then according to Novitasari et al. (2017) that learning by using the inquiry learning model requires students to actively gather ideas to create knowledge by themselves and emphasize the maximum activity of students using all five senses of students to seek or find their own answers to something that is questioned so that students will be directly involved in solving the problems given by the teacher.

According to Putri SD et al. (2022) the inquiry method is one of the suitable learning models specifically in biology subjects, especially when viewed in terms of science process skills. This is because this method can instill the basics of scientific thinking. Meanwhile, according to Sole-Llussa et al. (2022) Science skills play a key role in performing scientific inquiries and, consequently, developing these skills is often considered as a learning objective in primary science education.

## Conclusion

Based on the results of the research and discussion that has been carried out, it can be concluded that the results of the observation of science process skills in the experimental class have a higher percentage than the control class. This means that observation of the application of the guided inquiry learning model on plant growth and development material can improve the science process skills of students at SMA Negeri 1 Tapa.

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## Author Contributions

Conceptualization, Ani M. Hasan, Jusna Ahmad.; data curation, Septia Yusuf; formal analysis, Septia Yusuf.; funding

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### Conflicts of Interests

The author declares no conflict of interest.

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