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Application of E-LKPD Based on Guided Inquiry to Science Process Skills, Cognitive Learning Results, and Learning Motivation of Excretory System Material

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Abstract

Science process skills include observing, formulating problems and hypotheses, designing and conducting experiments, and drawing conclusions. Based on observations at SMA Muhammadiyah 1 Semarang, the biology learning does not fully implement science process skills, which impacts cognitive learning outcomes and learning motivation. Teachers still rely on textbooks, so guided inquiry-based E-LKPD is needed to help improve science process skills. Guided inquiry-based E-LKPD facilitates scientific activities with more directed steps and keeps up with technological developments so that students are more motivated. This research aims to determine the application of guided inquiry-based E-LKPD on science process skills, cognitive learning outcomes, and student learning motivation in the excretory system material. This study is designed as a quantitative research with a one-shot case study design. The research sample was class XI A1 at SMA Muhammadiyah 1 Semarang, with a total sample of 32 students based on a purposive sampling technique. The instruments used to collect data were E-LKPD, pretest-posttest questions, observation sheets on the implementation of learning, student activities, and learning motivation. The data analysis used was descriptive presentation and N-gain. The results of the study showed an increase in science process skills by 17%, cognitive learning outcomes passing the KKM (97%), and learning motivation (100%). From these data, it can be concluded that inquiry-based guided E-LKPD is effective to apply, and if implemented gradually and continuously, it will maximize science process skills, cognitive learning outcomes, and learning motivation.

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INTRODUCTION

Science process skills are skills applied to solve problems scientifically through experimental activities to build and discover new knowledge, thereby being able to stimulate students to master concepts and theories scientifically (Sumaryani & Parmithi, 2021; Hartati *et al.*, 2022). Low student science process skills can be caused by learning activities that rarely involve science process skills, which impacts students' low learning outcomes, and vice versa (Abdillah *et al.*, 2017; Astuti *et al.*, 2019). Science process skills include observing, interpreting, classifying, formulating problems, developing hypotheses, using tools and materials, predicting, analyzing data, evaluating, writing data, preparing discussions, drawing conclusions, communicating, and applying concepts.

Cognitive learning outcomes are the mastery of the cognitive domain related to intellectual skills, knowledge, abilities, the application of methods, and a person's learning style based on the learning activities experienced (Pranyoto & Geli, 2020). Learning outcomes are defined as the final achievement results of students within the academic scope (Somayana, 2020). Student learning outcomes are related to learning motivation. Learning motivation is the drive within an individual to engage in activities to achieve a certain goal (Rahman, 2021). Students with high learning motivation tend to have high learning outcomes and achievements, whereas students with low learning motivation tend to have low learning outcomes and achievements.

The results of observations at SMA Muhammadiyah 1 Semarang obtained information that science process skills have not been fully implemented due to several reasons, such as practical activities that have not been carried out, learning that is still teacher- and textbook-centered, so that learning outcomes are not optimal, causing students to lose motivation as a result of monotonous learning. Based on these problems, a supporting teaching material can be presented, namely E-LKPD or digital LKPD. E-LKPD can be adjusted to learning achievements and objectives, then utilized to increase learning interest because it is already integrated with technology, thus providing a new learning atmosphere (Sari *et al.*, 2022; Okrul *et al.*, 2020).

The implementation of E-LKPD in learning will be more optimal if integrated with a learning model. The learning model that is identical to science process skill indicators is the inquiry learning model because its steps include activities that encourage students to observe, formulate problems, hypothesize, collect and analyze data, and draw conclusions (Saidaturrahmi *et al.*, 2020; Afidayani *et al.*, 2018). Based on the conditions above, the suitable inquiry learning is guided inquiry because it can be applied to students who have not yet had experience learning using the inquiry model (Fathurrohman, 2015). The guided inquiry learning model also strongly supports students who have varied learning abilities (Sumarni *et al.*, 2017). The combination of E-LKPD and guided inquiry model is very suitable because, in theory, it can facilitate the application of science process skills which will later impact learning outcomes and student motivation. Therefore, the implementation of guided inquiry-based E-LKPD is expected to effectively improve science process skills, cognitive learning outcomes, and student learning motivation at SMA Muhammadiyah 1 Semarang on the excretory system material.

RESEARCH METHOD

This study used a type of pre-experimental design research with a one-shot case study research design. This research was carried out at SMA Muhammadiyah 1 Semarang from January to February of the 2023/2024 academic year. The population in this study was all class XI students of SMA Muhammadiyah 1 Semarang, with a research sample of class XI-A1 with a total of 32 students. Sample determination in this study used purposive sampling techniques.

The research procedure is divided into 3 stages, namely preparation, implementation, and final. In the preparation stage, researchers compile all research instruments, including observation sheets of science process skills, observation sheets of learning motivation, learning implementation sheets, and observation sheets of learning activities. In addition, researchers compile learning tools that will be applied, such as making E-LKPD based on guided inquiry, teaching modules, and pretest – posttest questions. Pretest-

posttest questions are tested first and then analyzed using the Anates application to see the validity, reliability, level of difficulty of the questions, and the power of the different questions.

At the implementation stage, the activities carried out are applying E-LKPD based on guided inquiry of excretory system material in the sample class and measuring variables using instruments that have been prepared. The implementation of E-LKPD is carried out for 8 meetings, or equivalent to 13 hours of lessons (JP). After the guided inquiry-based E-LKPD is applied, the final stage is to analyze the data obtained during the application. The data collection techniques used are interviews, filling out observation sheets, working on pretest – posttest questions, and E-LKPD. Data on science process skills and learning motivation were analyzed using Microsoft Excel and explained in a quantitative descriptive manner. Cognitive learning outcome data were analyzed using the N-Gain test and described quantitatively.

RESULTS AND DISCUSSION

The discussion of the results of this research, E-LKPD based on guided inquiry on excretory system material, is obtained from data, namely (1) learning activities, (2) science process skills, (3) cognitive learning results (KKM 75), and (4) learning motivation.

The effect of using E-LKPD Guided Inquiry based on students' learning activities

Before the treatment was administered, the classroom learning activities remained teacher-centered. Students were not actively involved in answering and tended to engage in activities outside of learning, such as sleeping and playing on their phones or social media. This was due to monotonous, less interesting learning, and it occurred during vulnerable hours (close to breaks, after sports, or at dismissal time). After being given treatment using inquiry-based E-LKPD designed with the Canva application, which was popular among students at that time, it was able to increase learning activities, including visual, oral, and listening activities, although it was not yet stable in every meeting. Data on the development of learning activities in each meeting that were measured can be seen in Table 1.

Table 1. Student Learning Activities for Each Meeting

Meeting	Visual Activity		Oral Activity		Listening Activity	
	%	Category	%	Category	%	Category
P1	82	High	85	High	86	High
P2	85	High	87	High	89	High
P3	91	Very high	91	Very high	91	Very high
P4	52	Low	42	Low	47	Low
P5	91	Very high	92	Very high	91	Very high
P6	88	High	89	High	84	High
P7	66	Medium	82	High	67	Medium
P8	88	High	88	High	90	High
Mean	80	High	82	High	81	High

According to the observations and question-and-answer sessions by the observers, the increase in student learning activities is influenced by practicum-based learning and the provision of LKPD in a new form. The students were enthusiastic about participating in the practicum on the excretory system material because they had the opportunity to use laboratory equipment, learn to discover knowledge directly and independently, and gain enjoyable new learning experiences. This aligns with the research of Defianti *et al.*, (2021), Sinarma *et al.*, (2022) and Syafii, (2022), which stated that practicum activities affect student learning activities because practicum activities invite students to be actively involved, thereby creating activities that encourage students to understand the learning material. With the presence of practicum activities, visual learning activities (observing and monitoring), oral activities (discussing, designing, presenting results), and listening activities (listening to explanations) will be increasingly honed.

The effect of using E-LKPD Guided Inquiry based on Science process skills

The effect of guided inquiry-based E-LKPD on science process skills is seen through the assessment results by observers before treatment is given and after the treatment is provided during classroom learning, as well as the scores from completing the E-LKPD. Data on the results of measuring indicators of science process skills can be seen in Table 2.

Table 2. Learners' science process skills before and after research

KPS indicator	Before Research (%)	After Research (%)
Observe	67	67
Classify	64	63
Predict	86	99
Analyze Data	51	98
Evaluate	91	82
Communicate	34	91
Means	66%	83%

From the data above, it can be seen that the average science process skills measured after the study increased by 17%. The KPS indicators that experienced an increase are predicting, analyzing data, and communicating, while those that experienced a decrease are classifying and evaluating. The improvements in several indicators of science process skills are a new beginning for students to start adjusting themselves to become more active individuals. Students' ability to predict a case is a sign that they are thinking critically (Rima *et al.*, 2024). Good critical thinking skills will help students have the ability to communicate because they already have the knowledge to confidently express opinions and build cooperation. The improvement of KPS indicators is reinforced by the results of the recapitulation of the completion of guided inquiry-based E-LKPD, which can be seen in Table 3.

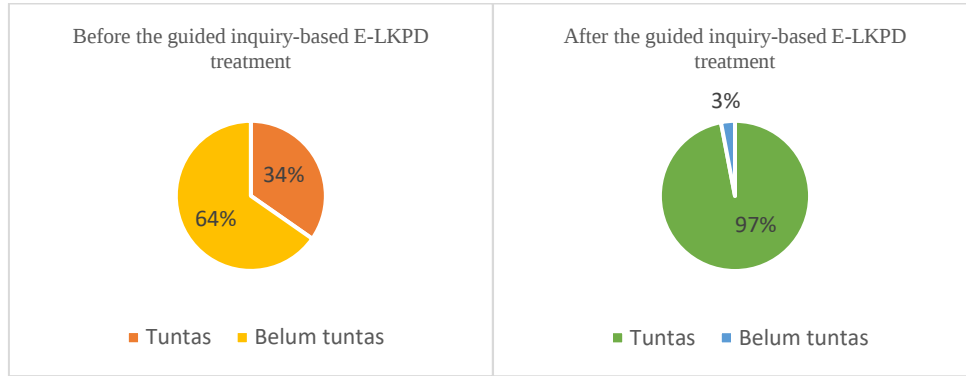
Tabel 3. Science process skills practicum activities on E-LKPD

KPS indicator	Kidney Organs		Lung organs	
	Score	Category	Score	Category
Formulate a Problem	100	Excellent	100	Excellent
Drawing up hypotheses	99	Excellent	100	Excellent
Using tools and materials	97	Excellent	-	-
Write down data	99	Excellent	100	Excellent
Discussion	98	Excellent	94	Excellent
Conclusion	100	Excellent	99	Excellent

Based on the data in Table 3, it can be seen that the science process skills possessed by students in practicum activities using inquiry-based E-LKPD are guided through the Canva application collaboratively in the very good category. The science process skills of students will be higher if students are more often involved in practicum activities (Anggraini *et al.*, 2016). Good science process skills are influenced by guided inquiry-based E-LKPD because the problems presented in it contain activities that invite students to process science. The results of research by Nuriantsyah *et al.*, (2023) and Hasanah & Agustini, (2023) stated that guided inquiry-based LKPD is effective in improving science process skills. This is in accordance with the results of the data above that E-LKPD based on guided inquiry is effective in improving science process skills.

The effect of using E-LKPD Guided Inquiry based on Cognitive Learning Results

The cognitive learning outcomes of students are analyzed based on the completion of pretest and posttest questions. The comparison of cognitive learning outcomes before and after the implementation of guided inquiry-based E-LKPD can be seen in the diagram.



Based on the diagram above, the completeness of cognitive learning outcomes in this study is based on the Minimum Competency Criteria (KKM) set by the school, which is a score of 70. The students' cognitive learning outcomes after being given treatment using inquiry-based E-LKPD showed an increase, with 97% of students meeting the KKM. Based on the percentage of completeness, this indicates that the use of guided inquiry-based E-LKPD can improve students' cognitive learning outcomes. Guided inquiry-based E-LKPD makes students active in learning activities, allowing them to explore information extensively and collect as well as independently verify the facts.

The improvement in students' cognitive learning outcomes was analyzed using the N-gain test. Based on the analysis using the N-Gain test, the average obtained was 0.77 in the high category. The results of the N-gain test calculation are shown in Table 4.

Table 4. N-Gain Analysis of Learners' Cognitive Learning Results

N-Gain score	Number of learners	Percentage (%)	Category
$g > 0,7$	19	59,4	High
$0,3 \leq g \leq 0,7$	12	37,5	Medium
$g < 0,3$	1	3,13	Low
N-Gain Mean Score		0,77	High
N-Gain Persen		77	Effective

The percentage indicates that the students' cognitive learning outcomes improved maximally. The N-Gain percentage obtained shows that inquiry-based guided e-LKPD is effective in improving cognitive learning outcomes. In accordance with the results of research conducted by Putri *et al.*, (2021); Rahmadayanti *et al.*, (2022), that guided inquiry-based E-LKPD is effective in improving the cognitive abilities of learners. Damopolii *et al.*, (2018) stated that improving science process skills makes student learning results better.

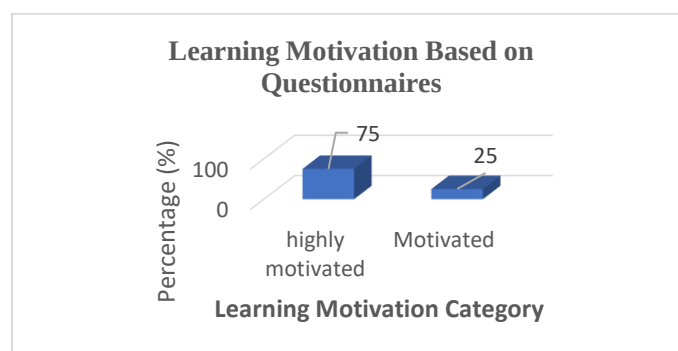
The effect of using E-LKPD Guided Inquiry based on Student Learning Motivation

Indicators of student learning motivation measured in this study are attention, intervention, confidence, and satisfaction. Data on the results of the assessment of student learning motivation can be seen in Table 5.

Table 5. Student Learning Motivation of Each Indicator Classically

Indicator	Percentage (%)	Category
Attention	71	Good
Relevance	76	Good
Confident	78	Good
Satisfaction	77	Good
Mean	75	Good

Based on the data in Table 5, it can be seen that student learning motivation, based on the 4 measured indicators, is classified as good. Students with good learning motivation will always strive to participate well in learning activities (Supriani *et al.*, 2020). Student learning motivation is also influenced by giving rewards in the form of additional points when they are active in carrying out learning activities. This creates competition among students in a positive scope. The results in the table are also supported by self-assessment through a questionnaire, which can be seen in the following bar chart.



The survey results on learning motivation show that 100% of students are motivated. Based on the survey responses filled out by the students, the E-LKPD is effective in increasing students' learning motivation. This increase is caused by the new learning model that presents digital learning tools and direct laboratory practicum activities, which stimulate students' enthusiasm to engage in learning activities that can enhance their learning motivation. The presence of enthusiasm and excitement that can boost learning motivation also affects the students' cognitive learning outcomes.

CONCLUSION

The conclusion of this research is that guided inquiry-based E-LKPD is effective to implement, as evidenced by science process skills in the very good category, improved cognitive learning outcomes with an average N-Gain score in the medium-high range, and good student learning motivation on the excretory system material.

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