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The Influence of Science Process Skills-Based e-LKPD on Learning Outcomes, Learning Motivation, and Metacognitive Abilities of Class XI High School Students

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Abstract

Background: This research is a quasi-experiment whose research design is a posttest-only control group design. This study aims to see the effect of e-LKPD based on science process skills in terms of learning outcomes, learning motivation, and students' metacognitive. All students in class XI MIPA SMAN 14 Makassar from five classes make up the population. **Method:** Random sampling is used to take samples for this research. There were 28 students of class MIPA 2 and 28 students of XI MIPA 4 who became the control action as a sample. The test instrument is in the form of multiple choice to assess the ability of learning outcomes and the use of questionnaires in measuring learning motivation and questionnaires to measure students' metacognitive skills. This study's data analysis technique is a descriptive and inferential statistical analysis using non-parametric tests (Mann Whitney). The descriptive analysis results illustrate that using e-LKPD based on science process skills (KPS) for students has learning outcomes in the high category, a very high category in learning motivation, and metacognitive abilities in the high category. **Results:** The results of the inferential analysis illustrate significant differences in learning outcomes, learning motivation, and metacognitive skills of students using KPS-based e-LKD in the experimental class, with the mean rank value in the practical class being higher than the control class. **Conclusion:** The results of the KPS-based e-LKPD research significantly influence learning outcomes, learning motivation, and students' metacognitive abilities in biology learning at SMA Negeri 14 Makassar.

Keywords: e-LKPD; Learning outcomes; Metacognitive; Motivation to learn; Science process skills

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Introduction

Competency standards for graduate students in the 2013 curriculum learning are expected to be based on competencies in the 21st century. The competencies in question are soft skills, including "The 4C Skills" (Permendikbud No. 21, 2016). (Sugiyarti et al., 2018) revealed that the implementation of 4C in the 2013 curriculum learning, when implemented in schools, can have an extraordinary effect on the next generation in facing the obstacles of 21st-century life.

Implementing TPACK in education provides a renewable framework to improve learning processes and outcomes, especially for educators. TPACK is a framework that can collaborate in the areas of skills in using technology, pedagogy, and content as a whole and comprehensively. So that it can trigger a new mindset toward the three learning domains.

Therefore, implementing the three TPACK domains in learning can provide various learning nuances (Nurdiana, 2016). The types of educator pedagogic skills that need to be mastered are developing teaching materials like student worksheets (LKPD).

LKPD is a set of pages covering various student activities that can make students play an active and authentic role in the objects and problems studied (Prastowo, 2014). LKPD can be interpreted as a printed form of teaching material with sheets containing content and assignment instructions oriented to the demands of essential competencies. LKPD is a student learning guide that makes teachers more practical when learning (Katriani, 2016).

Putriyana, Auliandari, & Kholillah (2020) revealed that e-LKPD is a practical guide that can make students understand learning content integrated with desktops, smartphones, notebooks, or cellphones. This can be seen from the integration of technology as a Moodle platform where parts of the system and the learning process are utilized from the Learning Management System (LMS) side. The LMS is integrated with the KPS-based e-LKPD.

KPS is all the skills that can be applied in obtaining a principle or concept and theory to develop existing ideas and deny previous findings (Nurhayati, 2011). Ongowo & Indoshi (2013) revealed that KPS is a skill that has components that include observation, measurement, inference, communication, classification, and prediction. Then integrated process skills include controlling variables, determining operational definitions of variables, formulating hypotheses, data analysis, and assembling experiments. KPS has various benefits.

Tawil (2014) states that KPS can increase students' ability, activity, process, and understanding of the nature and results of science. KPS can be described in the learning process based on cognitive, affective, and psychomotor development. Aqsan, Nurhayati, & Karim (2018) The use of KPS needs to be mastered by students in the learning process. It emphasizes the teacher developing teaching materials that can spur the dominance of student activity in class. View Rakhmi, Yuliati, & Harjana (2017) KPS-based LKPD can be a teaching material as well as the LKPD can spur students' process skills in carrying out learning activities. Atiyah, Wahidin, & Roviati (2016) revealed that using KPS-based LKPD encourages students to increase their scientific knowledge.

This study measures the ability of student learning outcomes Agustanti (2012) holds that learning outcomes are patterns of behavior change in a person. Learning outcomes can be in the form of test results points on learning material. Imamah (2012) expresses learning outcomes as a student learning outcome regarding the theme tested through a written test. Adnan *et al.* (2021) concerning the scientific literacy skills of students at the junior high school level regarding Biology learning in the South Sulawesi region, which is still relatively low. Based on this, it explained that activities in Biology learning could not be linked to a concrete world context and do not start from actual problems. Learning that has a scientific nuance in class is still classified as deviating from learning content, learning needs, and learning objectives.

Mulda (2019) states that implementing KPS-based LKPD is effective in the learning process because it can spur an increase in conceptual understanding, interest in learning, and learning outcomes. The research results of Rahmatillah., Halim, A., & Hasan (2017) use of KPS-based worksheets can improve student learning outcomes. Adnan, Faisal, & Marliyah (2012) revealed that students need to pay attention to the importance of learning motivation which is a tendency to consider academic activities meaningful and to try to obtain the desired benefits. Adnan & Bahri (2018) explained that guided scientific inquiry-based learning spurred increased motivation and encouraged the development of intelligent and motivated behavior in submitting ideas to teachers. Then the research results of Rahmatillah., Halim, A., & Hasan (2017) explained that implementing KPS-based worksheets is proven to spur increased understanding of concepts and provide motivation for learning in students. Adnan, Saenab, & Muis (2017) state that constructivist theory is a learning personality that can encourage students' freedom in understanding the material according to their way. This is because students are more flexible in doing assignments.

According to Riyadi (2015), metacognition describes the state of personal knowledge regarding one's knowledge, mental resources, and self-awareness of what needs to be done. Metacognitive abilities play an important role in developing students' independence in learning. Metacognitive skills can increase students' abilities to manage to learn management, plan and select strategies, monitor learning improvements, turn mistakes into good ones, reason how effective and efficient methods are used, and change habits or strategies if desired. This ability can make someone independent in self-assessment and self-regulation (Rivers, 2001). Furthermore, Howard (2004) explained that metacognitive skills are essential in each student's cognitive activity: attention, understanding, communication, memory, and problem-solving. Therefore, students with good metacognitive abilities can indicate good learning outcomes. This study aimed to determine e-LKPD based on science process skills on learning outcomes and learning motivation of Class XI SMA/MA SMAN 14 Makassar.

Methods

This research is classified as quantitative research with quasi-experimental research. This study aimed to determine the effect of the KPS-based e-LKPD on learning outcomes, learning motivation, and metacognitive abilities at SMAN 14 Makassar. This study has a design in the form of a posttest-only control group design. The location of this research is SMAN 14 Makassar from October to December 2021. This study has a population of all class XI MIPA study groups at SMAN 14 Makassar in the academic year 2020/2021 in 5 classes. Furthermore, samples were taken by random sampling so that 28 students in class XI MIPA 2 were selected to act as the experimental class and class XI MIPA 3 as the control class.

Data collection techniques in this study were (a) multiple-choice tests aimed at measuring learning outcomes, (b) and questionnaires whose development was based on the ARCS component (Attention, Relevance, Confidence, and Satisfaction) to measure student learning motivation using an instrument in the form of a questionnaire.. (c) measuring metacognitive abilities using a questionnaire instrument. Data analysis was descriptive and inferential statistical analysis and non-parametric tests with Mann Whitney using SPSS 25.0.

Result

Based on Table 1, the average value of the learning outcomes obtained by students in the experimental class has a higher value than the control class. The average value of the practical class learning outcomes in the posttest was 83.42, while students in the control class were 63.93. This shows that the difference in the average value of the two types is 13.49. The highest score obtained by students in the experimental category in the posttest was 92, while in the control class, it was 76. Then the standard deviation value for the practical course was 4,582, while for the control class, it was 5,975.

The value of the ability of learning outcomes is then classified. The grouping can be based on the grouping table of student learning outcomes. To see the distribution of frequencies and the percentage of student learning outcomes in the experimental and control classes can be shown in Table 2.

Table 1. Descriptive statistics on learning outcomes in the experimental and control classes

No.	Statistics	Experiment class Posttest	Control class Posttest
1	Number of samples	28	28
2	Average	83,42	63.93
3	The highest score	92	76
4	Lowest value	76	56
5	Standard deviation	4,582	5,975

Table 2. Frequency distribution and percentage of learning outcomes in experimental and control classes.

No.	Statistics	Experiment class Posttest		Control class Posttest	
		F	%	F	%
1	Shallow X < 63	0	0	12	43
2	Less 63 ≤ X < 72	0	0	15	54
3	Enough 72 ≤ X < 81	10	36	1	4
4	Fine 81≤ X < 90	16	57	0	0
5	Very good 90 ≤ X ≤ 100	2	7	0	0

The value of the ability to study biology material I of class XI SMAN obtained from students in table 2 illustrates that in the experimental class, there were 2 (7%) students who got excellent grades and 16 (38%) students with good abilities. So, the number of students with exceptional skills is 18 (64%). In the control class, only 1 (4%) scored on sufficient knowledge, and 15 (54%) had less power. Therefore, the total number of students with less than adequate abilities is 16 (58%).

Table 3. Descriptive statistics on students' learning motivation in the experimental class and the control class.

No.	Statistics	Experiment class Posttest	Control class Posttest
1	Number of samples	28	28
2	Average	82	57
3	The highest score	92	69
4	Lowest value	65	45
5	Standard deviation	6.107	6.197

The value of the ability to learn motivation is shown in table 3 in the experimental class in the posttest is higher than the value of the control class. The average posttest learning motivation in the practical lesson is 82, compared to the control, which is 57. Therefore, it shows the difference in the second average, 25. The highest motivation score is obtained in the experimental class in the posttest, with a value of 92, while the control class is 69. Then the standard deviation value for the practical lesson is 6.107, while for the control class, it is 6.197.

The value of motivation is then carried out by categorizing activities. Categorization can be based on the learning motivation grouping table. The following is a description of the frequency and percentage of learning motivation in the experimental and control classes, which can be seen in Table 4.

Table 4. The distribution of frequency and percentage of students' learning motivation in the experimental and control classes.

No.	Statistics	Experiment class Posttest		Control class Posttest	
		F	%	F	%
1	Shallow X < 50	0	0	6	21
2	Low 50 ≤ X < 59.99	0	0	14	50
3	Moderate 60 ≤ X < 69.99	1	3	8	29
4	Height 70≤ X < 79	12	43	0	0
5	Very high 80 ≤ X ≤ 100	15	54	0	0

The value of learning motivation generated by students in Table 4, which describes the experimental class students in the posttest, shows that the practical class has 15 (54%) with very high abilities and 12 (43%) with high skills. So, the number in the high and high groups is 27 (93%). Only 8 (29%) had moderate abilities in the control class, and 14 (50%) had low skills. Therefore, the number of students with medium and low abilities is 16 (79%).

Table 5. Metacognitive descriptive statistics of students in the experimental and control classes.

No.	Statistics	Experiment class Posttest	Control class Posttest
1	Number of samples	28	28
2	Average	84	59
3	The highest score	93	69
4	Lowest value	68	40
5	Standard deviation	7.814	7.608

Table 5 illustrates an average metacognitive score produced by experimental class students in the posttest of 84, compared to 59 in the control class. This demonstrates that the difference in the average scores of the two types is 25. Metacognitive scores in the experimental course in the posttest are 93, while the control class is 69. The standard deviation in the practical lesson is 7,814, while in the control class is 7,608.

The value of students' metacognitive abilities is then categorized. The categorization is based on the metacognitive grouping table. The following describes the frequency and metacognitive percentage of students in the experimental and control classes shown in Table 5.

Table 6. Frequency Distribution and Percentage of Students' metacognitive abilities in the Experiment and Control Class.

No.	Statistics	Experiment class Posttest		Control class Posttest	
		F	%	F	%
1	Very less X < 40	0	0	0	0
2	Less 40≤ X < 63	0	0	19	68
3	Enough 64 ≤ X < 74	3	10	9	32
4	Height 75≤ X < 84	10	36	0	0
5	Very high 85 ≤ X ≤ 100	15	54	0	0

The students' metacognitive values are obtained based on Table 6. It illustrates that the posttest scores are in the high category, 15 (54%) and 10 (36%) tall. So, the number of students classified as very high and high is 25 (90%). As for the control class, only 9 (32%) students scored in the excellent category, and 19 (68%) students in the less category. Therefore, the number of students in sufficient and fewer categories is 28 people (100%)

The prerequisite test is carried out as a normality test to review whether the sample distribution is normal. The results obtained are in the form of information on the probability values of Kolmogorov-Smirnov and Shapiro-Wilk. In the control and experimental classes, the value is small than 0.05. Therefore, it can be concluded that each sample is not normally distributed. Thus, the inferential statistical analysis used is non-parametric (Mann Whitney).

Table 7. Mean Rank Pretest and Posttest learning outcomes and learning motivation.

	Group	*N*	*Mean rank*	*Sum of rank*
Posttest Learning Outcomes	Experiment	28	42.43	1188.00
	Control	28	14.57	408.00
Posttest Motivation	Experiment	28	42.41	1187.50
	Control	28	14.59	408.50
Posttest Metacognitive	Experiment	28	42.21	1182.00
	Control	28	14.79	414.00

Table 8. Non-Parametric Test (Mann Whitney)

	Posttest Learning Outcomes	Posttest Motivation	Posttest Metacognitive
Mann-Whitney U	2.000	2.500	8.00
Wilcoxon W	408.00	408.50	414.00
Z	-6.43	-6.39	-6.31
Asymp. sig.(2-tailed)	0.00	0.00	0.00

Based on Tables 7 and Tables 8 illustrates that there are differences in learning outcomes in the experimental and control classes. It is proven in Asymp. Sig. (2-tailed) reviewed in the study results, which illustrate that (0.00<0.005) and the mean rank of the experimental class is higher than the control (42.43>14.57). Therefore, there is an influence of KPS-based e-LKPD on learning outcomes. Review from the side of learning motivation in the experiment and control Shows differences in student motivation in the experimental and control classes. This is proven in Asymp. Sig. (2-tailed) review of learning motivation shows that (0.00<0.005) and the mean rank in the experimental class has a higher value than the control class (42.41> 14.59). Therefore, KPS-based e-LKPD influences student motivation—a review of metacognitive abilities in the experimental and control classes. There are differences in the metacognitive skills of experimental and control class students. The Asymp proves this.sig value. (2-tailed) which is reviewed on metacognitive knowledge, shows that (0.00<0.005) and the mean rank in the experimental class is higher than the control (42.21> 14.79). Therefore, there is an influence of KPS-based e-LKPD on students' metacognitive abilities.

Discussion

Learning outcomes

There is an effect of implementing KPS-based e-LKPD due to the advantages of KPS-based e-LKPD. The researcher made various KPS patterns. Such as observation, inference, and prediction (OIP), compliance, classification, inference or OKI, identification of variables, operational definition of variables, formulating problems, determining hypotheses, and interpreting data or IDM3. It is intended for students after making observations. Furthermore, students carry out inference and prediction activities with

other KPS patterns. Therefore, KPS patterns are formed that allow students to work on assignments that are not only completed in one stage but can continue to the next. Students actively build their knowledge base to obtain meaningful learning. It is hoped that students will discuss and share ideas in completing assignments on the KPS-based e-LKPD. So that patterns of interaction between colleagues are formed, which will encourage their cognitive development.

Through KPS learning, students can develop skills, including giving nuance to students regarding the nature of scientific knowledge. Carrying out KPS-based learning activities can be a space for students to engage in scientific knowledge. KPS is described in learning activities that review essential things such as attitudes, values, and scientific skills (Tawil, 2014). LKPD that uses a KPS approach can answer the 2013 Curriculum problem, which encourages KPS to be imbued by students in the learning process and emphasizes teachers be able to develop teaching materials to encourage students to play an active role in class (Aqsan et al., 2015).

Table 1 reviews the descriptive analysis of student learning outcomes. Describes students' learning outcomes in the experimental class, which are higher than in the control class. Therefore, it is assumed that the two types have differences in learning outcomes. The experimental class's highest learning outcomes differ significantly from the control class. It means that there is maximum learning achievement in the practical course. Review the experimental class standard deviation value that is small from the control. This means that the width of the data variation in the experimental class is smaller than the control.

The results in Table 2 review the frequency distribution and percentage of student learning outcomes and describe the experimental class belonging to the sound and excellent categories higher than the control. This is due to the existence of learning activities that further increase the acquisition of student learning outcomes. Learning activities can be in the form of KPS patterns consisting of OIP, OKI, and IDM3.

Based on Table 7, the mean rank of the experimental class is higher than that of the control class (42.43>14.57). The mean rank difference is 27.86. Table 8 Asymp. Sig values. (2-tailed) in terms of learning outcomes illustrates that (0.00 <0.005). It has a meaning in the form of significant differences in learning outcomes between the experimental and control classes. So, there is an influence of KPS-based e-LKPD on learning outcomes. In line with this, based on Mulda's (2019) results regarding implementing KPS-based worksheets that are effective in the learning process. Because it can improve aspects of understanding concepts, learning interests, and student learning outcomes. In line with previous research (Rahmatillah., Halim, A., & Hasan, 2017), KPS-based worksheets can improve student learning outcomes.

Learning Motivation

There is an effect of implementing the KPS-based e-LKPD on student learning motivation which is influenced by the existence of KPS-based e-LKPD teaching materials that use the Learning management system (LMS) platform. As a tool that can make it easier for students to work on KPS-based e-LKPD. So that it can increase student activity in learning and inter-group collaboration, which can affect student learning outcomes, and it is closely related to student learning motivation. In general, if students' learning motivation is high, it can give a tendency for their cognitive abilities to be also increased, and vice versa. In line with the opinion of Sukirman (2011), revealed that there is a positive relationship between learning motivation and students' cognitive abilities. Adnan, Faisal, & Marliyah (2012) students should pay attention to the importance of learning motivation as a student need to understand that academic activities are meaningful and valuable and seek to obtain the desired educational benefits. Learning motivation can be interpreted as a general trait (universal meaning) or situation-specific state (specific conditions).

Table 3 displays a descriptive analysis of students' learning motivation. Shows that the average learning motivation of the experimental class is higher than the control. So it can be assumed that there are differences in learning motivation. The highest learning

motivation score was obtained in the experimental class. This was very different from the experimental type. It contains the meaning of getting the maximum value of learning motivation in the experimental category. Based on a review of the practical class's standard deviation value on the learning motivation, it is smaller than the control. Therefore, it can be proven that the width of the data variation in the experimental class is smaller than that of the control class.

Based on Table 4 displays the description of the frequency and percentage of student learning motivation. Shows that the frequency and rate of students in the experimental class in the high and very high categories are higher than the control. This is due to the implementation of the KPS-assisted e-LKPD with the help of LMS. Learning activities using the LMS platform contain student management features, class management, learning resources, and learning activities. These features can provide an increase in student learning motivation.

The implementation of the KPS-based e-LKPD on semester I material in class XI has an impact on student learning motivation. Based on Table 7, the mean rank of the experimental class is higher than that of the control class (42.41>14.59). The mean rank difference is 27.82. Table 8 contains the Asymp.sig values. (2-tailed) viewed through learning motivation explains that (0.00 <0.005). It means that there are significant differences between the experimental and control classes. Therefore, there is an influence of the KPS-based e-LKPD on semester I material in class XI. In line with this, based on the research results of Rahmatillah., Halim, A., & Hasan (2017), the use of KPS-based worksheets is proven to spur conceptual understanding and student motivation in the learning process. The same is true of the research results of Hanim, Suyanti, & Fauziyah (2018), which explain that there is a significant effect of the KPS LKPD on student learning motivation.

Metacognitive learning

There is an effect of implementing the KPS-based e-LKPD on students' metacognitive abilities. Through these abilities, students can utilize strategies for monitoring learning progress, student awareness of thought processes while studying, problem-solving, self-reflection, self-motivation, learning goals, and analyzing self-intellectual abilities. In line with this (Pierce, 2003) stated that students' awareness in

Thinking activities when studying can spur trained students such as controlling things in the form of goals, attention, and motivation. So that it can prompt students to be able to plan learning objectives, study sequences, regulate the learning process, and carry out evaluation activities of learning activities so that maximum learning results can be achieved.

Table 5 displays a descriptive analysis of students' metacognitive abilities. Describes that the metacognitive knowledge of the experimental class is higher than the control. Therefore it can be interpreted that there are differences in metacognitive skills between the two types. Acquisition of the highest metacognitive ability scores in the experimental class differs significantly from the practical course. It contains the meaning in the form of a more optimal purchase of metacognitive abilities in the experimental type. The results of the review of the standard deviation value on the metacognitive skills of the practical class are smaller than the controls, which illustrates that the width of the data variation in the experimental type is smaller than in the control class.

Based on table 6 describes the results of the description of the frequency and percentage of students' metacognitive abilities. The frequency and percentage of students in the experimental class in the high and very high categories are more significant than in the control class. This is due to the implementation of KPS-based e-LKPD. Encouraging students to know the strategies used to learn, think, and solve problems.

Table 7. The mean rank of the experimental class is higher than that of the control class (42.21>14.79). The mean rank difference is 27.42. Table 8 shows the acquisition of Symp. sig numbers. (2-tailed) in terms of metacognitive ability shows that (0.00 <0.005).

There are significant differences in metacognitive abilities between the experimental and control classes. So, there is an influence of the KPS-based e-LKPD on learning outcomes. One of the KPS-based LKPD domains that have been developed is that students are trained in problem-solving process activities. The study's results (Ramdoniati et al., 2018) concluded that problem-solving-based worksheets influence students' metacognitive abilities. Another dimension of KPS-based LKPD is the inquiry process. The results of a similar study conducted by Jianto L, Anita & Boisandi (2020) concluded that guided inquiry-based worksheets significantly affected students' metacognitive abilities.

KPS-based e-LKPD can increase students' ability to control learning personally, think about and determine a strategy, monitor learning progress, revise mistakes, analyze the effectiveness of using methods and change habits or strategies when needed. These skills make an independent person a self-assessment and self-manager (Rivers, 2001). Howard (2004) revealed that metacognitive abilities could be necessary for students' cognitive activities such as understanding, communicating, memory, attention, and problem-solving.

Conclusions

A conclusion can be drawn based on the description of the results and discussion of the research. KPS-based e-LKPD on semester I material for class XI SMA/MA affects students' learning outcomes, motivation, and metacognitive. The average value of students' learning outcomes, reason, and metacognitive abilities taught using the KPS-based e-LKPD was higher in the experimental class than in the control class.

Declaration statement

The authors reported no potential conflict of interest

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