Journal of Educational Sciences
Journal homepage: https://jes.ejournal.unri.ac.id/index.php/JES

P-ISSN 2581-1657
E-ISSN 2581-2203

Effectiveness of Differentiates E-LKPD on Excretory System to Increase Student's Curiosity and Creative Thinking

Lailatul Farhani*, Wan Syafii , Darmadi
Department of Biology Education, Universitas Riau, Pekanbaru, 28293, Indonesia

ARTICLE INFO

Article history:

Received: 21 May 2025
Revised: 10 June 2025
Accepted: 11 June 2025
Published online: 05 July 2025

Keywords:

Curiosity,
Creative Thinking,
Effectiveness,
E-LKPD

* *Corresponding author:*

E-mail: lailatul.farhani6869@grad.unri.ac.id

Article Doi:

https://doi.org/10.31258/jes.9.4.p.1789-1798

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A B S T R A C T

This study aims to determine the effectiveness of E-LKPD Differentiation on the Excretory System material in increasing students' curiosity and creative thinking. The method used is a quasi-experimental design with a two-group pretest-posttest. The research sample was class XI.1 as the experimental class and XI.3 as the control class at SMAN 8 Pekanbaru. The instruments included questionnaires, curiosity observation sheets, and written creative thinking tests. Data analysis was carried out descriptively quantitatively. The results showed an increase in pretest and posttest scores. The independent sample t-test on curiosity showed a t-count value = 5.261 and t-table = 1.664, so H_0 was rejected and H_1 was accepted. This means that there is a significant difference between the curiosity of students in the experimental and control classes. The same test for creative thinking showed a t-count = 1.923 and t-table = 1.664, so H_0 was rejected again. This shows a significant difference between the creative thinking abilities of students in the experimental and control classes. Thus, Differentiated E-LKPD is effective in increasing students' curiosity and creative thinking skills.

1. Introduction

Information and Communication Technology (ICT) now plays a significant role in the development of education, serving as a means to improve its quality. The use of technology has become a catalyst for educational advancement and facilitates the achievement of learning goals. This aligns with the National Education System Law Number 20 of 2003, which states that education is a conscious and planned effort to create a learning atmosphere and process whereby students actively develop their potential to acquire spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, society, the nation, and the state (Megawati *et al*., 2022; Susdarwati & Puspitasari, 2019).

Based on Permendikbudristek Number 12 of 2024, the Independent Curriculum is designed with the principles of character development, flexibility, and a strong focus on essential content. According to Nurjanah & Mustofa (2024), the Independent Curriculum is a new paradigm solution that focuses on strengthening relevant competencies and character through learning plans based on the principle of differentiation. The differentiated learning approach provides students with the opportunity to engage in learning activities they enjoy, which also help them learn more effectively (Sarnoto, 2024). Herwina (2021) stated that the purpose of the differentiated learning approach is to ensure that all students have equal opportunities to learn and are appropriately challenged. The differentiated learning approach involves adapting classroom instruction to meet the diverse learning needs of students (Tomlinson, 2001). The differentiated learning approach is also defined as a method of identifying and teaching students based on their talents and learning styles (Morgan, 2014).

One of the factors that affects the success of student learning is the learning strategy implemented by teachers (Rahmasari, 2023). The differentiated learning approach is one of the most relevant learning strategies in today's educational landscape (Santika & Khoiriyah, 2023). (Marlina *et al*., 2019), stated that the differentiated learning approach is not personal or individual learning, but rather learning that accommodates students' strengths and needs through more flexible learning strategies. According to Lubis *et al*., (2023), the Independent Curriculum proposed by the Indonesian Ministry of Education and Culture provides freedom to differentiated students while emphasizing the development of 21st-century skills through use of contextual learning strategies and technology, giving students opportunities to enhance creativity, collaboration, and problem-solving skills.

Teachers play a key role in integrating science and technology into their teaching (Mutia *et al*., 2023). The development of science and technology in differentiated includes: 1) Technology provides access to various educational resources tailored to students' needs, such as e-books, E-LKPD, interactive simulations, online learning platforms, and videos. This allows teachers to present material in diverse styles and formats that can be adapted to learners' interests and needs. 2) Technology assists teachers in utilizing diverse, interactive, and dynamic tools and learning methods to support material adaptation. 3) Technology enables adaptive assessment, which automatically adjusts question types and difficulty levels according to students' abilities. By using these resources, educators can provide teaching materials tailored to the needs and interests of each student. One application of science and technology in the differentiated learning approach is the Student Worksheet in Electronic form (E-LKPD). Based on research by Minasari & Susanti (2023), educators must have the ability to prepare learning materials various media according to the mapping students' learning styles.

Regulations on curiosity are not explicitly mentioned in the Ministry of Education and Culture Regulation No. 262 of 2022. However, within the framework of the Independent Curriculum-which grants educational the freedom to design curricula according to the needs and characteristics of students' curiosity. With a more flexible and responsive approach to individual needs, the Independent Curriculum

is expected to foster increased student curiosity through more relevant and engaging learning experiences. In the 21st century, human quality can be enhanced by developing productivity and creativity based on knowledge and skills, particularly through creative thinking abilities. These skills are essential for workforce competitiveness. Teachers are encouraged to implement various innovative learning models that enable students to learn more independently according to their abilities and potential (Istiq'faroh *et al*., 2020).

The initial analysis of the learning process examined whether the differentiated learning approach has been implemented, which learning models and teaching materials are commonly used, and which have never been used in Biology learning at State High Schools in Pekanbaru City. The study found that 33% of schools use the Independent Curriculum, while 50% use both the Independent Curriculum and the 2013 Curriculum. Furthermore, 98% of respondents were aware of differentiated learning approaches, but 55.6% had not yet used differentiated teaching materials.

The above findings indicate limitations in the use of teaching materials to support the differentiated learning process in Pekanbaru. One of the teaching material that can be developed is Liveworksheet, a platform for creating E-LKPD type teaching materials. Suhaeri & Daud Firdaus (2022) stated that the use of media, such as E-LKPD presented through the effective application of a differentiated learning approach, can improve student learning initiatives and abilities, including creative thinking skills.

The ability to think creatively is the capacity to adapt to change and generate new ideas when facing problem (Putri *et al*., 2022). The ability to think creatively is essential for humans to face global challenges in the 21st century (Apriliana *et al*., 2018). The creative thinking ability of Indonesian students is still relatively low, as evidenced by the low PISA scores (Lestari & Ilhami, 2022). This is supported by research from Paryumi (2022), which states that students' creative thinking skills are still very lacking. This issue arises due to a lack of innovation in learning and is certainly a problem that must be addressed to prepare students for the challenges of the 21st century. One of the innovations in learning is the integration of E-LKPD, assisted by Liveworksheet, through a differentiated learning approach. This combination is expected to strongly enhance students' curiosity and creative thinking, preparing them to face the challenges of the 21st century.

2. Methodology

This research employed a quasi-experimental method using two-group pretest-posttest design. The study was conducted at SMAN 8 Pekanbaru in March 2025. The research sample consisted of class XI.1 as the experimental group and XI.3 as the control group. Data on curiosity were collected using questionnaires and observation sheets, while data on creative thinking were obtained through written tests. The design of quasi-experiment is presented in Table 1.

Table 1. Quasi-experiment Design

Class	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_3	-	O_4

The collected data will be analyzed using descriptive narrative methods and the Independent Sample t-Test the statistical method. The questionnaire used to measure students' curiosity levels was developed based on four indicators and employed a Likert scale, consisting of the response options: Always (SL), Often (SR), Rarely (JR), and Never (TP). The indicator and sub-indicator of curiosity are presented in Table 2.

Table 2. Indicator and Sub-indicator of Curiosity

Indicators	Sub-Indicators	Item Number		Total
		(+)	(-)	
Inquire about information or issues provided	1. Ask questions and respond to given problems	1	2	2
	2. Respond to questions asked	6	5	2
	3. Dare to ask questions	4	3	2
Enthusiasm/enthusiasm in learning or looking for answers and problem solving	1. Enthusiastic in conducting discussions	7	8	2
	2. Interested in the material provided	10	9	2
	3. Enthusiasm in solving the problems given	11	12	2
Searching for information from various sources	1. Read material related to the given issue	13	14	2
	2. Searching for relevant references related to the given issue	15	16	2
Try alternatives to troubleshooting	1. Trying to find a solution to the problem given	17	18	2
	2. Be passionate about finding alternatives to problem-solving from a variety of learning sources	19	20	2
Total Number of Statements		**10**	**10**	**20**

Students' creative thinking abilities were measured using multiple-choice tests. The indicator grid for the creative thinking variable is presented in Table 3.

Table 3. The Grid of Creative Thinking

No.	Indicators of Creative Thinking	Sub-Indicators of Creative Thinking	Question Number	Cognitive Level
1.	Fluency	1. Define multiple ideas, problem solving and answers	1,2,3,4	C4
		2. Provide suggestions from problems	5,6,7,8	C5
		3. Have relative answers according to the conditions faced	9,10,34,35	C4
2.	Flexible Thinking	1. Have a variety of questions or answers to be given	11,12,13,14	C4

No.	Indicators of Creative Thinking	Sub-Indicators of Creative Thinking	Question Number	Cognitive Level
		2. Have a different perspective on the problem	15,16	C4
		3. Able to change the way of thinking on the approach obtained	17,18	C4
3.	*Thinking Originality*	1. Able to form a unique and new expression	27,28	C5
		2. Giving the unexpected a way to express yourself	21,22	C4
		3. Able to update a combination of parts or certain elements	23,24	C4
		4. Able to solve problems in a modern way.	31,32	C5
		1. Developing, adding and enriching an idea	25,26	C4
4.	Elaboration	2. Detailing the details	19,20	C6
		3. Expanding an idea.	29,30	C4
		4. Connect details between concepts.	33	C4

3. Result and Discussion

Descriptive results of the students' curiosity questionnaire data are presented in Table 4.

Table 4. Questionnaire Results Curiosity Student

Elements	*Early Curiosity*		*Curiosity* Finals	
	Control Class	Experimental Classes	Control Class	Experimental Classes
Average score	77,9	79,9	78,0	86,8
Minimum Score	67,5	67,5	67,5	72,5
Maximum Score	93,8	91,3	93,8	100

Based on Table 4, it can be seen that the average pre-test scores students' curiosity in both the experimental and the control classes were below 81, which falls in to the "strong" category. After the treatment was given, the curiosity levels in both classes increased. However, the increase in the control class was minimal (less than 1 point), while in the experimental class showed a significant improvement. The post-test results in the experimental class showed an average score above 81, which is categorized as "very strong".This indicated that curiosity level in experimental class increased from strong to very strong. These findings suggest that the use Differentiated E-LKPD effectively improved studets' curiosity levels compared to the control class. Descriptive results of students' creative thinking skills in the pre-test and post-test for both the experimental and control groups are shown in Table 5.

Table 5. Results of Students' Creative Thinking Ability

Elements	Early Creative Thinking Skills		Final Creative Thinking Skills	
	Control Class	Experimental Classes	Control Class	Experimental Classes
Average score	38.14	36.58	77.33	82.89
Minimum Score	20	10	45	60
Maximum Score	65	65	100	100

Based on Table 5, it can be seen that the post-test results for creative thinking skills in the both the experimental and control classes showed improvement following the learning treatment. However, there was a noticeable difference in scores: the post-test results in the experimental class exceeded the Biology Learning Goal Achievement Criteria (KKTP), which was 80, while in the control class did not meet the KKTP. This indicates that the use of E-LKPD effectively enhanced the creative thinking skills of students in the experimental class, as evidenced by the comparison between pre-test and post-test scores and in contrast to the control class.

In addition to descriptive data analysis, in this study also conducted inferential analysis to support final decision-making. Prior to this, a normality test was performed on the primary data-namely, students' creative thinking ability and curiosity- as a prerequisite for conducting parametric inferential statistical tests. Parametric tests require that the sample data be normally distributed. After conducting a normality test using the Kolmogorov Smirnov test in SPSS 27, it was found that the significance values for students' curiosity's in both the experimental and control classes were ≥ 0.05. This indicates that the data normally distributed. Detailed results of the curiosity normality test are presented in Table 6.

Table 6. Normality Test Results of Students' Curiosity

Elements	*Curiosity*	
	Control Class	Experimental Classes
Df	38	38
Sig.	0.094	0.200

Furthermore, a normality test was also conducted on the data on students' creative thinking skills using the Kolmogorov-Smirnov test in SPSS 27. The analysis results showed that significance values for both the experimental and control classes were ≥ 0.05. This indicates that the data on students' creative thinking skills are normally distributed and can therefore be further analyzed using parametric statistical tests. Detailed results of the normality test are presented in Table 7 below.

Table 7. Normality Test Result of Students' Creative Thinking

Elements	*Curiosity*	
	Control Class	Experimental Classes
Df	38	38
Sig.	0.200	0.115

Based on the results, it can be stated, thus, that the data are normally distributed. Therefore, inferential analysis using parametric statistical methods can be conducted. Subsequently, the hypothesis was tested using the independent sample t-test, with the test results presented in Table 8.

Table 8. Results of Independent Sample t-Test Analysis of Student Curiosity in the Control Class and Experimental Class

	Eksperimen	**Kontrol**
Mean	86,81	78,44
Observations	38	38
Pooled Variance	47,9101	
Hypothesized Mean Difference	0,0000	
Df	74,0000	
t Stat	5,261	
t Critical one-tail	1,664	

Table 8 shows that the t-value (t Stat) is 5.261, while the critical t-value at a significance level with degrees of freedom (df) is approximately 1.664. Since the calculated t-value is greater than the critical value (5.261 > 1.664), the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted. This indicates a significant difference in students' curiosity levels between the experimental and control classes. The mean curiosity score in the experimental class was 86.7763, compared to 78.4083 in the control class, with a mean difference of 8.368. These results demonstrate that the use of Differentiated E-LKPD on the Excretory System material significantly increased students' curiosity in the experimental class compared to the control class.

The increase in curiosity occurred because the use of Differentiated E-LKPD in learning directs students to actively acquire information through structured learning steps that present problems designed to stimulate their curiosity. The activities in the E-LKPD encourage students to ask questions, seek additional information, and actively and independently respond to the problems presented. These findings align with the research conducted by Apriyantini & Sukendra (2023), which focused on the indicator of asking questions related to the given information or problems. Their study concluded that the implementation of E-LKPD in learning stimulates students to respond effectively to presented challenges, the results are presented in Table 9.

Table 9. Results of Independent Sample t-Test Analysis of Students' Creative Thinking Ability in the Control Class and Experimental Class

	Eksperiment	**Control**
Mean	83,03	77,63
Observations	38	38
Pooled Variance	153,0939	
Hypothesized Mean Difference	0,0000	
Df	74,0000	
t Stat	1,923	
t Critical one-tail	1,664	

Table 9 shows that the t count value (t Stat) is 1.923, while the t table value at a significance level of 5% with degrees of freedom (df) of 74 is approximately 1.664. Since the t count value is greater than the t table value (1.923 > 1.664), H_0 is rejected and H_1 is accepted. Thus, there is a significant difference in the creative thinking abilities of students between the experimental class and the control class.

Furthermore, Panjaitan *et al.*, (2023) explained that E-LKPD supports students in enhancing their willingness to engage in problem-solving. Similarly, Nisak & Susantini (2023) added that well-structured content in E-LKPD increases students' enthusiasm for completing tasks. This reinforces the notion that Differentiated E-LKPD not only improves learning outcomes but also fosters students' curiosity through structured exploratory and problem-solving activities. These results indicate that the use of Differentiated E-LKPD on the Excretory System material contributes to improving students' creative thinking skills in the experimental class. This improvement is attributed to the fact that students' creative thinking was specifically trained through the structured learning steps provided in the Differentiated E-LKPD.

According to Wismiati *et al*., (2025), learning media also play an important role in enhancing students' thinking abilities. Furthermore, Yustina & Putra (2022), stated that the use of E-LKPD can improve creative thinking skills, particularly in the aspect of flexible thinking. Research by Nazhifatin Khair & Soleh (2021)also revealed a positive correlation between the use of E-LKPD and the increase in students' self-confidence. In line with this, Astuti (2024) stated that the use of E-LKPD also promotes student discipline, which contributes to more systematic and detailed thinking.

4. Conclusion

This study concludes that the use of Differentiated E-LKPD on the Excretory System material is effective in enhancing students' curiosity and creative thinking skills. The application of differentiated learning strategies through E-LKPD allows learning to be more flexible and responsive to students' needs and learning styles. Through structured learning steps and engaging content, students are encouraged to explore, ask questions, and develop new ideas in solving problems. Overall, the integration of Differentiated E-LKPD serves as an innovative teaching approach that supports the goals of 21st-century education by fostering student engagement, independence, and the development of essential skills such as curiosity and creative thinking.

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How to cite this article:

Farhani, L., Syafii, W., & Darmadi. (2025). Effectiveness of Differentiates E-LKPD on Excretory System to Increase Student's Curiosity and Creative Thinking. *Journal of Educational Sciences*, *9(4)*, 1789-1798.