Indonesian Journal of Educational Development (IJED)
Volume 6, Issue 3, 2025, pp. 1131-1144
ISSN: 2722-1059 (Online); ISSN: 2722-3671 (Print)
DOI: https://doi.org/10.59672/ijed.v6i3.5417

Android-based interactive ethnoscience E-LKPD containing science technology society models to improve critical thinking skills

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Article Info

Article history:
Received October 05, 2025
Revised October 11, 2025
Accepted October 19, 2025
Available online November 21, 2025

Keywords: Android-based, Critical thinking skills, E-LKPD development, Ethnoscience, Science technology society

Abstract. This research aims to develop an Android-based interactive E-LKPD with ethnoscience content and a Community Science and Technology model to improve students' critical thinking skills. The urgency is to provide innovative solutions for social studies learning by integrating Android-based science, technology, and local culture to increase interactivity and critical thinking in daily life. The method is Research and Development with the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The population is 1 classroom teacher, 18 students, and 4 experts. The sampling technique uses purposive sampling. Data collection techniques, observation, interviews, tests, response questionnaires, and documentation. There are three data analyses: needs analysis, validity analysis, and practicality analysis. Needs analysis, teachers, and students need developed products. The validity of the E-LKPD is rated very valid (89.23%), while its practicality is rated very practical (90.83%). It was concluded that this E-LKPD is feasible and useful for improving students' critical thinking skills. Based on the research results, it is recommended that teachers take advantage of the Android-based ethnoscience E-LKPD and that schools support the application of learning technology.

Introduction

Currently, technology has become a basic necessity for everyone. From children to adults to the general public, people use technology in all aspects of their lives (Salsabila & Agustin, 2021). Digital technology has drastically changed the dimensions of life and society (Area, 2017). The development of increasingly sophisticated technology will always change these events (Gabarda Méndez et al., 2025). Technology is developing rapidly, and its influence is inevitable, especially in the field of education. Technology plays an important role in creating an interesting and interactive learning experience (Area, 2017). Teachers, as educators, must be able to keep up with the trends and habits of using technology in the learning process (Kurniawati, 2018). Technology is very important in education, both now and in the future, to improve the quality of learning by identifying the challenges of integrating technology in schools (Kurniawati, 2018).

According to Stehle & Peters-Burton (2019), technology helps students adapt well to the ever-changing world in terms of 21st-century skills (Stehle & Peters-Burton, 2019). Fulfilling these 21st-century skills requires developing learning models, methods, and media, including the use of technology. Technology-based learning greatly facilitates teachers in the learning process (Arfadila et al., 2022). Technology can also influence students' critical thinking skills (Merta et al., 2023). Through technology, there are interactive features and challenge-based exercises that help students learn to think deeply, rather than passively receive material.

Critical thinking skills are important because they greatly support the analysis of information, problem-solving, and wise decision-making (Sodik et al., 2023; Widana et al., 2023). Elementary school is the initial stage of formal education because it is a crucial period for the formation of basic academic understanding and skills (Sodik et al., 2023). Therefore, it is important to develop students' critical thinking skills from an early age. Efforts to develop students' critical thinking skills require interactive classes, where students are thinkers rather than passive recipients of instruction, and teachers serve as facilitators, mediators, and motivators, helping students learn rather than teaching them (Karlina, Taena La, 2023).

Students' critical thinking skills can be developed through subjects such as Natural and Social Sciences (Purnadewi & Widana, 2023). The Merdeka Curriculum combines Natural Sciences and Social Sciences, which is then called IPAS. Natural and Social Sciences (IPAS) explains the interaction between living and non-living things in the universe, and describes human life as individuals and social beings who interact with their environment (Kemendikbud, 2022). In addition, natural and social sciences teach students to analyze their surroundings (Abshor, 2023). Natural and social sciences in elementary school play an important role in shaping children's scientific and logical thinking. The IPAS subject has a lot of memorization material, one of which is the fifth-grade ecosystem material, which includes analyzing the relationships between ecosystem components and food webs in the surrounding environment, the relationships between living things in the ecosystem, and ecosystem balance.

Based on data collected in March 2025 at SDN 01 Getasrabi, students find it challenging to understand the concept of ecosystem materials, as evidenced by their learning outcomes. In addition, students' passivity during learning stems from a sense of burden when analyzing ecosystem materials, leading to low critical thinking skills. Learning also still tends to be theoretical and less closely tied to local cultural realities and technological developments. Teachers have used a simple LKPD containing practical activities and practice questions, but have never used an electronic LKPD designed to develop critical thinking skills. The learning model has been used, but the LKPD used does not comply with it. From this problem, the researcher had the idea of developing an Android-based interactive ethnoscience E-LKPD loaded with community technology science models to improve the critical thinking skills of grade V elementary school students.

Student Worksheets (LKPD) are among the alternatives teachers use in the learning process. The LKPD is a learning support sheet that summarizes the material and assignments, helping students find key concepts (Ramadhani & Aufa, 2024). In the worksheet, students are shown the activities they perform and how they perform them (Kibar & Ayas, 2010). Student Worksheets can be considered learning media because they can be used alongside learning resources or other learning media (Raudoh, 2023). An interesting LKPD is an effective learning medium to improve students' critical thinking skills (Ramadhani & Aufa, 2024). LKPD can be developed by teachers according to the material and competencies to be achieved (Insanul Hikmah et al., 2023).

In the modern era, Android smartphones have become an indispensable tool in people's daily lives (Schnieder & Williams, 2023). Smartphones are easy to use without time restrictions and can be used with complementary media and communication such as audio, video, text, and photos (Shih & Mills, 2007). Android smartphones can be used to create engaging learning experiences, help identify students' abilities, encourage independent and collaborative learning, prevent boredom, and increase students' interest and confidence (Chindia & Wawire, 2024). The use of Android-based E-LKPD can increase student participation and learning outcomes (Supriyadi et al., 2021). Thus, the use of Android smartphones as a medium for E-LKPD ethnoscience not only facilitates flexible and interactive learning access but also serves as a means to improve the overall quality of the learning process.

This Android-based E-LKPD was developed by integrating the concept of ethnoscience to strengthen the connection between science and local wisdom (Jufrida et al., 2024). Ethnoscience is a contextual learning approach that involves the surrounding environment, promotes love for local culture, and trains science literacy skills (W et al., 2018). The Santhal community in India uses ethnoscience as knowledge about human understanding and behavior, and maintaining harmonious relationships with nature and their living environment, which has become part of their culture (Majumdar & Chatterjee, 2021). E-LKPD ethnoscience aims to introduce students to facts or events that develop in society that can be related to science (Haspen & Syafriani, 2020). This development aims to create Android-based interactive learning tools grounded in ethnoscience, enabling students to learn science concepts through local wisdom, deepen their appreciation of culture, and practice critical thinking to solve problems.

Integrating Android-based E-LKPD ethnoscience with the community science technology model can create learning that is interesting, relevant, modern, culture-based, and contextual (Hidayati & Julianto, 2025). Students have the opportunity to choose real-life issues or problems to investigate (B. Akcay & Akcay, 2015). In addition, they are also encouraged to find solutions to the problems they encounter (H. Akcay & Yager, 2010). Students are allowed to explore scientific phenomena around them, thereby improving their critical and creative thinking skills (Ariska, 2024; Evi Yupani & Widana, 2023). In addition, integrating ethnoscience can strengthen science literacy while instilling local wisdom values in students.

The novelty of this research lies in the use of Android to present interactive worksheets containing ethnoscience and Science Technology Society, which are specifically designed to improve students' critical thinking skills, an innovation that has not been widely implemented in research on the development of science learning tools. Nirwana et al. (2024) researched the development of an interactive E-LKPD assisted by Liveworksheets to improve students' critical thinking skills, resulting in a 93% practicality rating from student response questionnaires, categorized as very practical (Nirwana & Andriani, 2024). Nirwana et al.'s research used an existing online e-learning platform on Google called Liveworksheets. In this study, the researcher did not use an existing online e-learning platform on Google; instead, he designed it himself, starting with the material, converting it into a computer system, and then into an Android application.

In addition, research by Kiswanto et al. titled "Development of STEM-integrated E-LKPD containing Ethnoscience to improve students' critical thinking skills" produced a practical product that received positive student responses (Reftina Aysha Kiswanto et al., 2024). The difference in this study is the research material and subject. Furthermore, this research shares the same focus on integrating ethnoscience into the E-LKPD.

The researcher developed this Ethnoscience E-LKPD product to determine whether students' critical thinking skills increased after using it. With the existence of an Android-based ethnoscience

E-LKPD loaded with community technology science models, it is hoped that this tool will improve the critical thinking skills of elementary school grade V students. However, the researcher in this case limits the practicality of using this E-LKPD.

Method

The focus of this research is to develop an interactive ethnoscience E-LKPD in the form of an Android application, loaded with science, technology, and community models, with harmony materials, for the ecosystem of grade V elementary schools. This study uses the Research and Development (R&D) method, which involves developing products (Rachma et al., 2023). The product is an Android-based ethnoscience E-LKPD with a community science and technology model. This E-LKPD was developed using the ADDIE (Analyze, Design, Development, Implementation, Evaluation) model (Almelhi, 2021) because it offers a systematic, directed, transparent, and logical development process and is easy to apply (Cheung, 2016). ADDIE is a model that serves as a guideline in developing effective, dynamic, and supportive learning (Safitri & Aziz, 2022). However, in this case, the researcher limited the study to the implementation stage, namely, the practicality of using the E-LKPD Ethnoscience containing the science and technology community model.

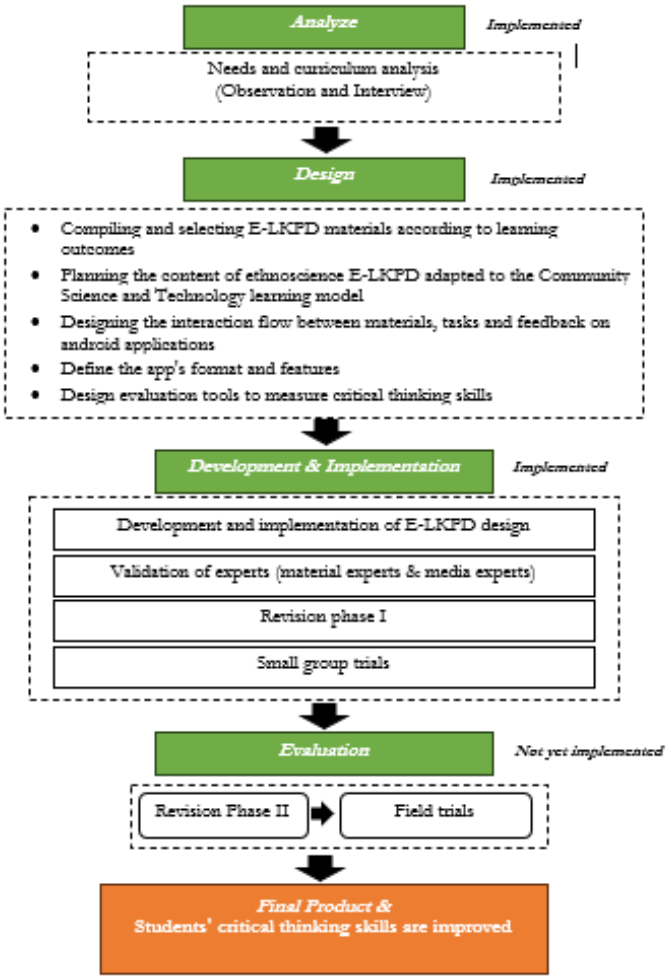

Image 1. Flowchart according to ADDIE theory

The population in this study is; 1 teacher; 18 students; 2 media members; and 2 material experts. The sampling technique uses purposive sampling. This study was piloted in a small group with 18

students, class V of SDN 01 Getasrabi located in Getasrabi Village RT 06/RW 01 Gebog District, Kudus Regency, Central Java Province. The data collection techniques are observation, interviews, tests, response questionnaires, and documentation. Data analysis techniques use needs, validity, and practicality analysis. Needs analysis data was obtained through initial observation and direct interviews with teachers and students. The data is used to identify relevant materials, student understanding levels, and the need for ethnoscience-based interactive application features loaded with science, technology, and community models. These findings form the basis for designing content, displays, and learning activities for products that align with students' characteristics and support the application of science, technology, and community models.

Meanwhile, data on the validity of Ethnoscience E-LKPD was obtained through expert judgement, namely, material experts and media, to evaluate products. The indicators and grids used to evaluate research products are as follows;

Table 1. Expert Judgement Indicator Aspects

No	Indicator Aspect
Subject Matter Expert	
1	Introduction
2	Content
3	Evaluation
4	Cover
Media Expert	
1	Application Introduction
2	Usage Control
3	Application Display
4	Application Support
5	End of Application
6	Multimedia design principles

The validated data was processed using the following validity formula (Nesri & Kristanto, 2020).

$$V=\frac{\sum x}{\sum xi} \text{ x } 100\%$$

V is explained as the percentage of product validity, while $\sum x$ is the total expert assessment and $\sum xi$ is the total ideal value. The level of product validity is then categorized based on the following criteria: highly valid (ranging from 85% to 100%), valid (ranging from 70% to 85%), less valid (ranging from 50% to 70%), and invalid (≤ 50%) (Nesri & Kristanto, 2020).

The practicality of E-LKPD is seen from the implementation of student activities while using E-LKPD. The practicality score is obtained from the student response questionnaire based on the Guttman scale, with "Yes" answers receiving a score of 1 and "No" answers receiving a score of 0. The data is processed using the following formula (Nesri & Kristanto, 2020);

$$P=\frac{\sum TSe}{\sum TSh} \text{ x } 100\%$$

P is explained as the practicality result, while $\sum TSe$ is the total score obtained and $\sum TSh$ is the maximum total score. From the practicality results obtained, it is then categorized based on practicality criteria, namely very practical, ranging from 80% to 100%, practical, ranging from 60%

to 80%, less practical ranging from 40% to 60%, impractical ranging from 20% to 40%, and very impractical ≤ 20% (Nesri & Kristanto, 2020).

Results and Discussion

This research produces an Android-based ethnoscience E-LKPD product containing science, technology, and society models to improve the critical thinking skills of grade V elementary school students. This product uses digital technology as an interactive medium to present learning materials integrated with local wisdom, enabling students to understand science concepts through real-world problems aligned with their culture. In this E-LKPD, using attractive colors and pictures helps students stay engaged and easily understand the material. The development of E-LKPD must be tailored to students' characteristics, levels of understanding, and language that is easy to understand (Kadek Aprilia Sri Wulandari & Putu Ari Dharmayanti, 2024). In addition to knowledge, students are given experience and are involved in the learning process. With this product, it is hoped that students will get better critical thinking skills.

This development research refers to the five stages in the ADDIE model. The ADDIE model is an approach that helps researchers, content developers, and teachers create teaching products that are effective, efficient, and usable in any environment (Aldoobie, 2015). The following are the details of the E-LKPD development:

Analyze

This stage consists of needs analysis and curriculum analysis. The E-LKPD needs analysis was carried out based on the results of interviews and direct observation (initial observation). Teachers have used simple LKPDs with practical activities and exercises, but have never used electronic LKPDs focused on critical thinking skills. During learning, teachers have used learning models, but the LKPDs used have not been integrated with them. In addition, students had difficulty understanding the concept of ecosystems, as evidenced by their learning outcomes. During the learning process, students felt burdened by analyzing ecosystem material, becoming passive, and developing low critical thinking skills.

In addition to the above issues, learning still tends to be theoretical. There is a lack of integration between learning and the realities of local culture, technological developments, and students' daily lives. However, this integration is important in shaping character and strengthening conceptual understanding through real-world contexts. According to El Widad et al. (2023), teachers are not optimal in explaining the material due to limited practical activities and relying solely on theory in books (El Widad et al., 2023). The lack of interactive media is also a problem. Therefore, there is a need to develop an Android-based E-LKPD ethnoscientific application using a community science technology model to improve students' critical thinking skills. This innovation has the potential to enrich students' learning experiences by combining technology, local wisdom, and a contextual scientific approach (Munandar et al., 2023). Meanwhile, the curriculum analysis includes learning outcomes, learning objectives adjusted to the independent curriculum, and material analysis. The researcher selected and analyzed the IPAS subject, namely Chapter 2: Harmony in the Ecosystem, for Grade 5, Semester I.

Design

This stage outlines the framework for developing E-LKPD based on the analysis results. The first step the researcher took was to compile and select E-LKPD materials based on the learning outcomes. then design the content of the ethnoscience E-LKPD adapted to the syntax of the Society's science and technology learning model. Here, the researcher is looking for local wisdom and ecosystem culture in the Kudus district, for example, living things on Mount Muria. Then the

researcher designed the flow of interaction among materials, tasks, and feedback in the application, which was also aligned with the Society's science and technology learning model. The syntax of the science and technology model of society includes 1) the invitation stage; 2) the exploration stage; 3) the explanatory stage; and 4) the follow-up stage (Jayadiningrat et al., 2022). After that, the researcher determines the format and features of the application (games and simulations). The next step is to look for images/animations, audio, and videos to complement the E-LKPD. And then the researcher designs the research instrument

This design stage also includes creating a screen layout and an application flowchart to clearly visualize the material presentation structure, menu navigation, and user interaction before the development process begins. In addition, the selection of colors, typography, and icons is developed in line with the principles of user-friendly interface design, making E-LKPD easy to access, visually appealing, and comfortable for student learning across various Android devices (Rani Chantika et al., 2025). All of these designs are then outlined in detailed design specifications that serve as guidelines for the development stage, ensuring that every content element, interactive feature, and application layout is realized consistently with the learning objectives.

Development

This stage involves implementing product design and expert validation. Initial activities include collecting and compiling materials, questions, and images into electronic LKPDs. The Android-based e-LKPD for ethnoscience, which incorporates a community science and technology model, features many design elements to provide students with a wealth of learning experiences. This stage also includes a limited trial process to ensure the suitability of the material and the effectiveness of the display, so that the resulting product is not only visually appealing but also supports the improvement of critical thinking skills in elementary school students. The following is a display of the Android-based e-LKPD for ethnoscience, which incorporates a community science and technology model.

Table 2. Table E-LKPD Etnosains Description

No.	Appearance	Description
1.		The following is an initial look at the E-LKPD. If you want to start using E-LKPD, click the start interaction button.
2.		The ethnoscience E-LKPD menu display, Harmony in the Ecosystem, consists of 6 navigation buttons, namely instructions for use, topic A, topic B, topic C, evaluation, and profile. The topic navigation buttons A, B, and C include several features: interactive conversations, material summaries, and interactive worksheets in the form of games.

3.		The following is a user guide containing instructions for using the E-LKPD ethnoscience.
4.	 	The following is an interactive conversation between several characters discussing an ecosystem event.
5.	 	The following is a summary of each topic, complete with YouTube links. In addition, there is an audio feature that explains the material.
6.	 	The following is what the game looks like. This educational game consists of three games with different game concepts.
7.	 	The evaluation display consists of ten questions. Students answer the question by pressing the correct answer option.

The E-LKPD above was then validated through expert judgment, namely, subject matter experts and media experts. There were four expert validators, namely two subject matter experts and two

media experts. The aspects assessed in terms of subject matter consisted of the introduction, content, evaluation, and conclusion. Meanwhile, the media aspects assessed include application introduction, usage control, application display, application help, application ending, and multimedia design principles. The results of the validation by these experts are then analyzed to obtain input and suggestions for improvement, so that the developed E-LKPD ethnoscience can meet the categories in terms of material and media before being tested on students. The validation results are presented in the following table;

Table 3. E-LKPD Validation Results

No.	Information	Precentage (%)	Category
1.	Subject Matter Expert 1	93.75%	
2.	Subject Matter Expert 2	86.25%	
Average score of subject matter expert		90%	Very Valid
3	Media Expert 1	93.27%	
4	Media Expert 2	83.65%	
Average score of Media expert		88.46%	Very Valid
Overall average		89.23%	Very Valid

This validation was conducted to determine whether E-LKPD is suitable for use in learning. Based on the validation results in Table 2, the overall average percentage was 89,23%, which is categorized as highly valid. In conclusion, the Android-based E-LKPD for ethnoscience with a community science and technology model is highly suitable for use. There are several requirements for E-LKPD to be considered good, namely attention to its structure, didactic requirements, construction requirements, and technical requirements (Afrianti, 2022).

In addition to the validation results above, there are also several criticisms and suggestions from subject matter experts and media experts, namely: 1) Providing a bibliography; 2) adding cultural elements and local wisdom related to daily life; 3) improving sentences that are not operational; 4) there are several navigation buttons that need to be improved. Experts also recommend adding more detailed instructions for use, adjusting font sizes for easier reading, and enhancing visual elements such as colors and illustrations to increase student motivation and enrich the interactive experience in electronic worksheets.

Implementation

After revising the product, the next stage is implementation. This stage involves testing the Android-based E-LKPD ethnoscience, which incorporates a community science and technology model, in small groups to assess the E-LKPD's practicality. The practicality of the E-LKPD is assessed by the feasibility of its use during the trial. It was carried out using a student response questionnaire with 18 fifth-grade elementary school students and 20 questions. Several aspects of the practicality assessment were 1) appearance (visual design, attractiveness); 2) ease of use (accessibility, navigation); 3) suitability of content with learning objectives; and 4) benefits for critical thinking.

The students' performance during the practical test showed they used the electronic worksheets effectively, as evidenced by their ability to navigate each menu and understand the instructions without much assistance. Most students were attracted to the appealing visual display and interactive design, which motivated them to complete all learning activities. It also encouraged students to think critically. Easy access and straightforward navigation helped students focus on the material rather than on how to operate the system. Content aligned with the learning objectives encouraged active engagement, making students more focused on developing critical thinking skills

through discussion, analysis, and problem-solving. The results of the practical use of E-LKPD by students are presented in the following table:

Table 4. Practical Results of E-LKPD

No.	Aspects	Precentage (%)	Category
1.	Display (visual design, attractiveness)	93.33%	Very practical
2.	Ease of use (accessibility, navigation)	91.11%	Very practical
3.	Fit of the content with the learning objectives	90.00%	Very practical
4	Benefits for critical thinking	88.89%	Very practical
Overall average		90.83%	Very practical

The above activities were carried out in groups, where learning through peer guidance can help students identify, design, and solve problems (Smith, 2010). Based on the practicality results in Table 3, the average percentage was 90.83% in the very practical category. In conclusion, the Android-based E-LKPD ethnoscience, which incorporates the science, technology, and society model, is very practical for students. Learning tools can be considered practical if they are designed attractively, stimulate learning, and can be used as a learning resource (Tunnisa et al., 2022).

Evaluation

This stage provides value to the development of the E-LKPD that has been tested. The data in this stage are in the form of increases in students' critical thinking skills, as measured by pre-tests, post-tests, and student responses. However, the researchers in developing this E-LKPD only reached the implementation stage.

The novelty of this research lies in the resulting product: the interactive ethnoscience E-LKPD, loaded with science, technology, and society models. Fitriani's 2024 research, entitled "Development of Ethnoscience-based E-LKPD in Ecosystem Learning in Class V," uses the ADDIE Model. The results of Fitriani's research validation indicate that the product is highly feasible, with a value above 89%. The same is true for this study, which produced 89.23% and is very feasible. The similarity with this research is the development of an ethnoscience-based E-LKPD and the selection of ecosystem materials. The difference is that it is Android-based and adds a community technology science model to improve students' critical thinking skills (Ida Fitriani, 2024).

In addition, Fitriyah's research in 2021, entitled Development of Android-based E-LKPD with a Problem-Based Learning (PBL) Learning Model to Improve Students' Critical Thinking. The study found an increase in critical thinking after participants were given an Android-based E-LKPD using the PBL model. Similarly, this study achieved a practicality of 90.83% and was highly effective in improving students' critical thinking skills. The similarities with this study are the development of an Android-based E-LKPD and the improvement of critical thinking. The difference in this study lies in the science, technology, society, and control variables models, where the researcher chose grade V SD (Fitriyah & Ghofur, 2021).

Conclusion

The development of an Android-based ethnoscience E-LKPD loaded with science, technology, and community models is urgently needed, highly valid (average validity score of 89,23%), and highly practical (average practicality score of 90,83%). This E-LKPD is suitable for use in the learning process of Natural and Social Sciences (IPAS) subjects. In addition, through the practical results of E-LKPD use, Ethnosains can improve elementary school students' grade V critical thinking skills in science subjects. Therefore, the researcher suggests that teachers start integrating

ethnoscience in digital media as an alternative to interactive learning, and educational technology developers can expand local culture-based content to make learning more contextual and relevant.

Acknowledgements

The research is funded by the Ministry of Higher Education, Science, Technology (Kemendiktisaintek) Directorate General of Research and Development with the number SK 0419/C3/DT.05.00/2025. The researcher expressed his gratitude to the rector and LPPM of the University of Muhammadiyah Kudus for providing the opportunity for the researcher to carry out this research. Not to forget, the researcher would like to thank all parties who have helped. It is hoped that the researcher will be able to use it as a reference for further research and be useful for the community, especially for the author.

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