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STEM-Based e-LKPD Development in Islamic Context to Enhance Creative Thinking in Digestive Studies

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Abstract: This study aims to produce teaching materials in Electronic Student Worksheets (E-LKPD) based on STEM in an Islamic context to improve creative thinking skills in the human digestive system. The development process involved validity testing by six experts, readability testing by 18 students, and field trials by one biology teacher and 36 students. The study results indicate that the developed E-LKPD is highly valid and effective. The E-LKPD achieved an average validity rating of 90.87%, classified as feasible. Regarding readability, it scored an average of 98.84%, indicating it is highly appropriate for users. Furthermore, field trials revealed positive feedback from teachers and students, with feasibility ratings of 91.26% and 98.49%, respectively, confirming that the E-LKPD is very well-received and effective in practical use. There is an increase in the average ability to think creatively as measured through test instruments. The study significantly enhances students' creative thinking abilities by implementing E-LKPD. Before using E-LKPD, the average creative thinking score was 34.86, which increased to 72.08 after implementation, with an N-Gain of 0.55, categorized as medium. These results demonstrate that E-LKPD is highly suitable for learning activities and effectively improves students' creative thinking skills.

Abstrak: *Penelitian ini bertujuan untuk menghasilkan bahan ajar Lembar Kerja Siswa Elektronik (E-LKPD) berbasis STEM dalam konteks Islam untuk meningkatkan keterampilan berpikir kreatif pada sistem pencernaan manusia. Proses pengembangannya melalui uji validitas oleh enam ahli, uji keterbacaan oleh 18 siswa, dan uji coba lapangan oleh satu guru biologi dan 36 siswa. Hasil penelitian menunjukkan bahwa E-LKPD yang dikembangkan sangat valid dan efektif. E-LKPD mencapai rata-rata tingkat validitas sebesar 90,87% tergolong layak. Mengenai keterbacaan, skornya rata-rata 98,84%, yang berarti sangat sesuai bagi pengguna. Selain itu, uji coba lapangan menunjukkan tanggapan positif dari guru dan siswa, dengan peringkat kelayakan masing-masing sebesar 91,26% dan 98,49%, yang menegaskan bahwa E-LKPD diterima dengan sangat baik dan efektif dalam penggunaan praktis. Terdapat peningkatan rata-rata kemampuan berpikir kreatif yang diukur melalui instrumen tes. Penelitian secara signifikan meningkatkan kemampuan berpikir kreatif siswa dengan penerapan E-LKPD. Sebelum menggunakan E-LKPD, rata-rata skor berpikir kreatif sebesar 34,86 meningkat menjadi 72,08 setelah penerapan,*

dengan N-Gain sebesar 0,55 dikategorikan sedang. Hasil tersebut menunjukkan bahwa E-LKPD sangat cocok untuk kegiatan pembelajaran dan efektif meningkatkan kemampuan berpikir kreatif siswa.

Keywords: *Concept of the Human Digestive System, Creative Thinking Ability, Electronic Student Worksheets, Islamic Context, STEM.*

INTRODUCTION

Education aims to develop a person's potential through teaching, enhancing the quality of human resources. In the Industrial Revolution 4.0 era, digitalization in education is crucial for maintaining relevance and competitiveness (Ependi et al., 2023; Jelantik, 2021). This period emphasizes 21st-century learning, which equips students with high-level skills necessary for long-term progress and global competitiveness (Widyawati et al., 2021; Ricky Ardiansah & Zulfiani, 2023). Teachers must meet 21st-century competency requirements by fostering 4C skills: Critical Thinking, Communication, Collaboration, and Creativity. The 4C aspect is included in a type of soft skill implemented in everyday life and is much more helpful than just strengthening hard skills. Therefore, it is essential to integrate 4C skills in learning, especially creative thinking skills (Sholikha & Fitrayati, 2021; Darise, 2019). Data from The Global Creativity Index shows that Indonesian people's creativity level is ranked 85th out of 129 countries (Wahyuni et al., 2021). This means that creativity in Indonesia still needs to improve. The lack of teaching materials oriented towards developing creative thinking abilities is the main factor in the low level of creativity of students in Indonesia (Hasanah et al., 2023). This deficiency predominantly stems from the need for teaching materials tailored to cultivate creative thinking skills. Consequently, a pressing demand exists for innovative educational approaches to bolster students' creativity.

Teachers need to develop the ability to select appropriate models, approaches, and strategies for the learning process. One highly recommended approach for the era of Industrial Revolution 4.0 is STEM (Science, Technology, Engineering, Mathematics), which integrates these disciplines into the learning process and focuses on solving real-world problems in daily and professional life. The STEM approach addresses educational challenges and meets the urgent demand for preparing graduates who can compete globally (Davidi et al., 2021; Parmin et al., 2020). However, STEM education in Indonesia is still underutilized due to a lack of teacher knowledge and skills (Rahmawati et al., 2022). Despite this, the government provides training and support through the teacher mobilization program. STEM is particularly effective in developing 21st-century skills, including creative thinking, which is crucial for understanding and applying biological concepts to solve daily life problems (Vistara et al., 2022; Rahmawati et al., 2022). By emphasizing knowledge construction and real-world problem-solving, STEM encourages students to understand scientific concepts and think creatively to devise solutions (Herak & Lamanepa, 2019).

Recent research has highlighted the importance of 21st-century skills, especially creative thinking, in modern education. Studies have shown that STEM approaches significantly improve students' creative thinking abilities (Clara Aldila et al., 2017; Lou, 2017). Additionally, STEM-based learning contributes to a substantial increase in creative thinking, with an effect size score of 0.663 (Iskandar et al., 2020). Despite these benefits, STEM learning in Indonesia still needs to be utilized due to a lack of teacher knowledge and skills (Rahmawati et al., 2022).

This study introduces a novel approach by integrating STEM-based learning with Islamic values in developing electronic student worksheets (e-LKPD). Unlike previous studies, this research aims to embed Islamic values directly into the teaching

materials, providing a holistic educational experience that encompasses both intellectual and ethical development. This integration is expected to enhance students' creative thinking skills while maintaining their moral and ethical grounding. Additionally, Ricky Ardiansah and Zulfiani highlight the potential of e-LKPD to support technology-based learning and improve student engagement (Ricky Ardiansah & Zulfiani, 2023).

This study aims to create STEM-focused Electronic Learning and Teaching Materials (e-LKPD) within an Islamic framework designed to enhance creative thinking in studying the human digestive system. Furthermore, this study seeks to evaluate both teachers' and students' reactions to the newly developed e-LKPD, providing valuable insights into its efficacy and applicability in educational settings. Therefore, the Author must conduct research titled "Development STEM-Based e-LKPD in an Islamic Context to Enhance Creative Thinking Skills in Digestive Studies."

METHOD

This research was carried out at MAN A Bekasi City in May-October of the 2023/2024 academic year. The population in this study was all class XI students, while the sample used in this research was class XI MIPA 7. Sampling was carried out using a purposive sampling technique. Researchers have considered choosing classes that represent the expected characteristics of the population (having heterogeneous mastery of biology) and are also based on the recommendations of the class XI biology teacher.

This study is development research using the Research and Development (R&D) method. The development model used is the 4-D model. This model consists of four stages: define, design, develop, and disseminate. However, this research was only carried out up to the 3-D stage. The dissemination stage was not carried out due to technical obstacles to licensing and limited research time. The following is the procedure for developing a 4-D model:

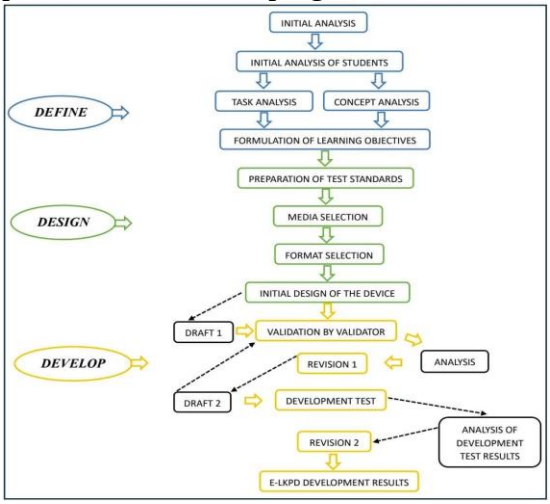

Figure 1. Development Procedure

Three stages must be carried out. The first stage is the definition stage. The definition stage consists of five activities: front-end analysis, student analysis, concept analysis, task analysis, and learning objective analysis (Permana & Puspasari, 2020).

The design stage aims to prepare a STEM-based E-LKPD prototype in an Islamic context to be developed. This stage consists of four activities: preparing test standards, media selection, format selection, and initial device design according to the format and analysis that has been carried out.

The development stage consists of two activities, namely expert validation and product testing (Inelda Yunita, 2017). The validation process involved six validators with different expertise: material experts, learning experts, media and design experts, language experts, Islamic Religious Education (PAI) experts, and education practitioners. After going through the validation stage by experts, an E-LKPD readability test was carried out, limited to 18 students. Then, the E-LKPD was revised based on expert advice and student assessments. Finally, field trials were conducted on all class XI MIPA 7 members, totalling 36 students. At this stage, teachers and students were asked for responses to using the E-LKPD being developed.

Data collection was carried out using tests, questionnaires, and interviews. Data

processing in this research uses two main techniques: the Guttman and Likert scales. Data processed using the Guttman scale includes the E-LKPD checklist results and the E-LKPD readability test results. Meanwhile, data processed using a Likert scale includes the results of the E-LKPD validity test and the results of teacher and student response questionnaires.

Table 1. Guttman Scale Criteria

Criteria	Score
Yes	1
No	0

(Wahdan Najib Habiby, 2017).

Table 2. Likert Scale Criteria

Criteria	Score
Strongly disagree	1
Do not agree	2
Agree	3
Strongly agree	4

(Hidayat, 2021).

After the data processing process, an interpretation will be obtained to describe a group of data, which will then be carried out in the data analysis process. This data analysis includes the E-LKPD feasibility test results and N-Gain analysis. Analysis of the E-LKPD feasibility test results consists of analysis of validation sheets by experts, readability level, and responses from teachers and students to the E-LKPD used during the learning process. The data obtained was analyzed using a Likert scale and Guttman scale. The scale measurement level uses intervals, and intervals can be analyzed on the instrument for each item using a percentage formula:

$$PS = \frac{S}{N} X100\%$$

PS: percentage
S : the number of respondents' answers in 1 item
N: the number of ideal values in an item

Next, the data is internalized and interpreted into eligibility criteria. The development of E-LKPD will be declared theoretically feasible if the feasibility percentage is 61% - 80% (Astuti & Ismail, 2021).

Table 3. Eligibility Criteria

Percentage %	Predicate
80% - 100%	Very worthy
61% - 81%	Worthy
41% - 60%	Decent enough
20% - 40 %	Not worth it
≤20%	Very inadequate

The effectiveness of E-LKPD can be seen from the results of students' abilities before being given treatment (pretest) and after being given treatment (posttest) to think creatively. The data results from the test were analyzed using N-gain analysis adapted from Hake (1998) in the equation: (Ulfah et al., 2016).

$$<g> = \frac{\% < Spost > - \% < Spre >}{100 - \% < Spre >}$$

<g> = N-gain score (average)
<Spre> = pretest average
<Spost> = posttest average

Table 4. N-Gain value category

N-Gain Value	Category
g>0.7	High
$0.3 \leq g \leq 0.7$	Currently
g<0.3	Low

RESULTS AND DISCUSSION

Potential & Problems

The development research has produced STEM-based E-LKPD in an Islamic context to improve creative thinking skills on the human digestive system for class XI SMA/MA level. The E-LKPD development stage includes three stages: define, design and develop.

The definition stage begins with interviews with teachers and students and observing the LKPD currently used in schools. At this stage, facts and solution options are produced, which are then used to formulate initial steps related to development. Apart from that, conducting student interviews aims to understand the characteristics and preferences of students, which is one of the essential requirements in preparing E-LKPD, which is referred to as didactic requirements. The use of LKPD must pay attention to the absence of individual differences so that a good LKPD can be used by both slow, medium and clever students (Abrar, 2021).

The results of observations and interviews with teachers revealed several main problems, namely that E-LKPD with an Islamic or STEM context has not been implemented in schools, there is a gap in students' creative thinking abilities, which is characterized by the need for additional stimulus so that participants can produce creative ideas that are "out of the box", LKPD in schools is still a simple format with a limited display in black and white. The LKPD used is still limited to presenting questions without adopting a particular learning model as its basis. On the other hand, in line with the results of teacher interviews, students stated that they often felt complex and constrained, especially when applying biological concepts in situations requiring creative thinking.

Product Design Development

After completing the front-end, back-end, and student analyses, the researcher can proceed with task analysis, concept analysis, and formulation of learning objectives for each student. The results from the defined stage activities reinforce the research's background. All problems identified at the research location are references for developing the e-LKPD according to field needs.

The second stage of the 4-D model is design. This stage is divided into four activities. The first activity begins with preparing an E-LKPD reference test based on STEM indicators by following the Laboy-Rush stages of reflection, research, discovery, application and communication. Each of these steps is loaded into the E-LKPD through a series of activities that are related to each other. Next, these steps are combined into a grid with an assessment rubric. The learning objectives that have been set are also used as a reference in preparing E-LKPD to meet the needs of students.

The second activity of the design stage is media selection. The author developed electronic-based LKPD motivated by digitalization, which has penetrated various aspects of life in the 21st century, including the field of education, which ultimately encouraged the transformation of teaching materials from print to electronic. While preparing the E-LKPD, researchers have used several applications, including Canva, IbisPaint X, and Heyzine.

The third activity of the design stage is format selection, divided into product design and colour selection. Graphic suitability of teaching materials must be prepared by considering book size, colour, type and size of letters (Ningtyas & Rahmawati, 2023). The E-LKPD in this research was designed according to the BNSP size standard, namely ISO A4 (210mm X 297mm). Apart from that, E-LKPD is designed to contain text, graphic media (images/banners/videos), and animated characters that can attract students' attention to learning. The following is the E-LKPD design that was developed:

Picture 1. Front Cover

Picture 2. List of Contents

Picture 3. Instructions for Using E-LKPD

Picture 4. Concept maps

Picture 5. Islamic Context

Picture 6. STEM Analysis

Picture 7. Activity Sheet

Picture 8. Back Cover of E-LKPD

Compared with Previous Research

Previous research has highlighted the importance of 21st-century skills, especially creative thinking, in modern education. Studies have shown that STEM significantly improves students' creative thinking abilities (Clara Aldila et al., 2017; Lou, 2017). In addition, STEM-based learning contributes to a significant increase in creative thinking, with an effect size score of 0.663 (Iskandar et al., 2020). However, this research adds new value by incorporating an Islamic context in developing STEM-based e-LKPD. This provides an additional dimension not explored in previous research, namely how Islamic values can be integrated into STEM-based teaching materials to improve students' creative thinking skills.

Validation

The final stage in this research is the development stage because the dissemination stage still needs to be carried out. The development stage consists of several activities: validation by experts, readability testing, and large-scale field trials. E-LKPD, designed at the design stage, will be validated by several experts. The purpose of expert validation is to evaluate product designs so that they can produce feasible products that can be used in the learning process.

Validation was carried out by six experts divided into material experts, learning experts, media and design experts, language experts, practitioner experts and PAI experts. In this study, aspects of the Islamic context were not measured/tested, but PAI experts still carried out validation. The Islamic context in this research is included in the E-LKPD and creative thinking test questions. The following is the validation data:

Table 5. Validation Results

Validator	Percentage (%)	Criteria
Materials Expert	97.17	Very Feasible
Media and Design Expert	81,59	Very Feasible
Linguist	95	Very Feasible
PAI Expert	87,49	Very Feasible
Learning Expert	87,24	Very Feasible
Educational Practitioner Expert	96.72	Very Feasible
Percentage and Criteria for Total E-LKPD	**90,87**	**Very Feasible**

Based on data from validation results that have been carried out by various validators, including material experts, media and design experts, language experts, PAI experts, learning experts, and educational practitioner experts, it can be concluded that overall, this E-LKPD has received the "very feasible" criteria. These consistent results reflect the high quality of E-LKPD. Validity can reflect the level of consistency in each part of the E-LKPD developed, starting from objectives and materials to assessment (Trimunarti, 2015). Therefore, E-LKPD is reliable teaching material that supports an effective learning process.

After going through the revision stage, which is the result of suggestions from the validators, the researcher will then carry out a readability test on a small (limited) scale. Readability testing was carried out on 18 students in class XI MIPA 7, half the total number of students in one class. The following is an overview of the readability test results:

Table 6. Readability Test Results

Indicator	Percentage (%)	Criteria
Graphics	100	Very Feasible
Practicality	100	Very Feasible
Presentation	98,14	Very Feasible
Language	97,22	Very Feasible
Indicator Average Percentage	**98,84**	**Very Feasible**

Table 6 shows that the E-LKPD readability test results reached a percentage of 98.84%, with the criteria "very feasible". The input from students was through a readability test, namely a request to provide a download navigation feature on the

flipbook so that students could download offline when the internet signal was interrupted. The assessment above shows that E-LKPD has received very decent acceptance from students, and the suggestions provided can be used to improve the user experience in terms of accessibility, mainly when problems occur with internet connectivity.

The final activity in this research is conducting field trials on a large scale. This field testing aims to determine the effectiveness of E-LKPD in increasing students' creative thinking, as well as knowing the response of teachers and students to E-LKPD developed and used in learning. The results of the analysis of teacher responses can be seen in the following table:

Table 7. Results of Teacher Response Analysis

Aspect	Percentage (%)	Criteria
Practicality	87,5	Very Feasible
Material Feasibility	93,05	Very Feasible
Graphics	92,85	Very Feasible
Language	91,66	Very Feasible
Percentage and Criteria for Total E-LKPD	**91,26**	**Very Feasible**

Based on the teacher response questionnaire analysis results, an average percentage of 91.26% was obtained with the criteria "very feasible". The material feasibility component occupies the highest percentage at 93.05%. Meanwhile, the practicality component got the lowest percentage at 87.5%. Even though the practical aspect is smaller than others, the criteria obtained are still classified as very feasible. This indicates that the E-LKPD being developed still meets the standards and needs required in the learning context. Practicality, in this case, can refer to the ease of use of E-LKPD, the availability of resources, or its accessibility. Thus, E-LKPD can still be considered a practical resource supporting the learning process.

Table 8. Results of Student Response Analysis

Aspect	Percentage (%)	Criteria
Practicality	98,43	Very Feasible
Material Feasibility	96,36	Very Feasible
Graphics	99,44	Very Feasible
Language	99,76	Very Feasible
Percentage and Criteria for Total E-LKPD	**98,49**	**Very Feasible**

Meanwhile, the responses given to 36 students obtained an average percentage of 98.49% with the criteria "very feasible". The assessment shows that all material content and activities contained in the E-LKPD are by curriculum standards, the language used is appropriate to the level of student ability, and conformity to graphic aspects.

Finally, the results of the analysis were conducted to determine the increase in students' creative thinking abilities using the N-gain formula. In this context, testing involves using creative thinking ability tests as a form of evaluation prepared by researchers. Four indicators of creative thinking are used in preparing test questions. According to Munandar, these indicators refer to indicators of creative thinking, which consist of fluency, flexibility, originality, and elaboration. All test questions have gone through the validity and reliability testing stages. A summary of the results of the N-Gain analysis can be seen in the following table:

Table 9. Summary of N-Gain Test Results

Normalized Gain (g)	Criteria
0,55	Currently

The results of the pre-test and post-test show an increase in students' creative thinking abilities. This can be determined through the N-gain test. The N-Gain score obtained by researchers was 0.55, indicating that the improvement in student learning outcomes was in the medium category. This

means that the effect of using STEM-based E-LKPD to improve creative thinking skills on the human digestive system material is significant. In other words, this approach has proven to be effective in increasing students' understanding and achievement regarding the material.

However, researchers realized that the increase in students' creative thinking abilities after learning using E-LKPD had yet to reach the expected significance level. Creative thinking is included in the category of higher-order thinking abilities. High-level thinking abilities require continuous practice and honing (Suryandari & Sajidan, 2019). Therefore, further and continuous efforts are needed in training students to develop creative thinking abilities so that learning outcomes can be more optimal, and there is an increase in students' creative thinking abilities until they reach a high level of significance (expected).

Meaning of Findings and Recommendations for Further Research

These findings indicate that the development of STEM-based e-LKPD in an Islamic context improves students' creative thinking skills and meets pedagogical needs that are more inclusive and relevant to students' Islamic context. This indicates the importance of developing contextual and digital-based teaching materials based on Islamic values in modern education.

For further research, exploring the application of Islamic STEM-based e-LKPD in other subjects and at different educational levels is recommended. In addition, further research can examine the long-term effectiveness of using e-LKPD on creative thinking skills and overall student learning outcomes. Further research could also consider implementing the disseminating stage to see the acceptance of e-LKPD in various schools and regions.

You can access the following link for more information on the developed E-LKPD: https://drive.google.com/drive/folders/1dfDvrTyK8PUC-qoo3rjpMZCRJe3XZ69K

CONCLUSION

Based on the research that has been carried out, it can be concluded that the final product has been produced in the form of a STEM-based E-LKPD based on Islamic context material on the human digestive system with very appropriate criteria based on expert validity tests and readability tests. The resulting e-LKPD is a flipbook comprising five STEM approach syntaxes containing three main activities. Apart from that, this research has also identified teacher responses and student responses to the final product of the developed E-LKPD. Teacher responses have an average percentage value of 91.26% with very appropriate criteria, and student responses have an average percentage value of 98.49% with very appropriate criteria. Based on the research results, E-LKPD, implemented in learning with a STEM approach, has improved students' creative thinking abilities by increasing creative thinking abilities based on a normalized gain test of 0.55 with medium criteria. Based on the research results that have been obtained, the conclusion obtained is that E-LKPD is very suitable for use in the learning process.

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