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# Electronic Development of Student Worksheets Based on Science, Technology, Engineering, Art, and Mathematics to Improve Creative Thinking Ability of Class V Elementary School Students in Science Learning

**Kinanti Andartiani[1], Sri Sulistyorini[2], Yuli Kurniawati S Pranoto[3]**

[1]Master Program, Student of Primary Education, [2,3]Master Program, of Primary Education, Universitas Negeri Semarang, Semarang City, Indonesia

Corresponding Author: Kinanti Andartiani

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## ABSTRACT

This study aimed to analyze the validity, effectiveness, and practicality of the E-LKPD (Electronic Student Worksheet) to improve the creative thinking skills of fifth grade students at SDN 1 Kutoharjo and SDN 2 Kutoharjo after participating in STEAM-based learning (Science, Technology, Engineering, Art, and Mathematics). This study used research and development procedures with reference to the 4D model (Define, Design, Develop, and Disseminate) but this research was only up to the develop stage. The research design used was "One Groups Pretest-Posttest Design" with 72 students as research subjects. The research instrument used was observation sheet, interview sheet, expert validation test sheet, written test (pretest and posttest), and questionnaire sheet (questionnaire). The results of the research, it can be analyzed that the validity of the E-LKPD according to the material expert validator is 91.6 in the very valid category, the media expert validator was 75 in the valid category, and the language expert validator was 85 in the very valid category. The effectiveness of E-LKPD according to the results of the N-Gain test calculation of 0.61 was included in the category of quite effective and showed that there was a significant increase in creative thinking skills before and after using STEAM-based E-LKPD with 91% classical completeness results with complete criteria. STEAM-based E-LKPD was declared practical according to the results of teacher and student respondents which showed that teacher respondents scored 83 and 80 in the very attractive category and student respondents produced an average score of 81 in the very attractive category. The conclusion of the research was the development of STEAM-based E-LKPD was suitable for distance learning activities and can improve students' creative thinking skills.

***Keywords:*** *E-LKPD IPA, STEAM, Creative Thinking*

## INTRODUCTION

In the last two years, Indonesia has been attacked by a virus that has shaken the world, that was pandemic of Covid-19 in Indonesia. Provincial and local governments have formulated policies in the Education field to temporarily eliminate face-to-face learning at the school and university level. Elementary schools also use online/distance learning through parental guidance. Through online learning, students can learn by managing time flexibly and can study anytime, anywhere. Students can use various applications to interact with teachers, such as WhatsApp groups, classroom, telephone or live chat, video conferences, or via zoom.

The Student Worksheet (Permendikbud, 2013) is a comprehensive learning tool in the learning process. LKPD needs to be developed because it can help teachers deliver learning materials. Teachers need to develop their own LKPD to activate students' learning abilities, to improve creative thinking skills, and improve learning outcomes. This is in accordance with Prastowo which stated that LKPD can be made by teachers of related subjects, so it becomes more interesting and can be adapted to school situations and conditions.

In 21st century education, some people said that everyone should have three skills, there were: (1) life and professional skills, (2) learning and innovation skills, and (3) information media and technology skills. In terms of learning and innovation skills, students must have four abilities, there were: Communication, Collaboration, Critical Thinking, and Creativity (called 4C). The ability to think creatively in the 2013 curriculum is important for 21st century students as a thinking process that produces many possible ideas and wide and varied ways (Putra et al., 2017). The ability to think creatively can be said to be an important factor in learning objectives because in learning creative thinking can develop the attitudes and abilities of students in dealing with problems in the future (Permatasari. A., 2019).

Based on the results of interviews by researchers with grade 5 elementary school teachers, it was revealed that the existing LKPD still used the printed LKPD provided by the school. Currently in online learning, teachers gave assignments through WhatsApp Groups then will be collected within one week. Students will quickly feel bored and less active in the online learning process. It can be seen from the learning outcomes in science learning that have not been optimal and have not been trained to develop students' creative thinking processes. It can be seen in the results of the mid-semester 2 test on themes 6 & 7 of the 2020/2021 academic year, from the number of class 5 students as many as 80 students, only 42% of students completed the KKM 75.

One of the comprehensive learning tools in the learning process is the Student Worksheet (Permendikbud, 2013). LKPD needs to be developed because it is able to help teachers deliver the material to be taught through online learning. Teachers need to create their own LKPD that can be taught during a pandemic and can activate students in learning, improve creative thinking skills, and improve learning outcomes. The explanation of the LKPD in the form of definitions, examples, exercises, practice is very easy for the teacher but for students the stages in the LKPD are boring and difficult, thus affecting student learning outcomes (Yenilmez., 2008). Efforts made to overcome the above problems were through development in the form of Electronic-Student Worksheets (E-LKPD), because it adapted to the current learning process which was still using the online learning process.

Researchers inserted the STEAM approach (Science, Technology, Engineering, Arts, and Mathematics). The application of the model in the LKPD design can provide motivation and arouse the curiosity of students. STEAM was one of the 21st century learning models related to the development of soft skills that link the fields of science (science), technology, engineering, art, and mathematics, so that students are given a holistic understanding of the interrelationships of the fields of science through 21st century learning experiences (Hadinugrahaningsih et al., 2017). STEM learning also trained students to apply their knowledge in making designs as a form of solving problems related to the environment by utilizing technology (Permanasari, 2016). The learning process in the classroom is a very important part of education. The success of learning cannot be separated from the ability of teachers to develop models, methods, and learning media (Nugraha et al., 2017).

Most LKS contain brief material and questions that must be done by students,

although they can support students in learning, they were still not effective, seen from the low level of student activity and students have not shown their creative thinking skills (Putri & Mitarlis, 2015). LKPD generally contained practice questions or reviews of teaching materials for each topic, and contained a summary of the material. LKPD has not guided students to carry out learning activities that can help find their own concepts that were being taught. Teachers have never made their own worksheets to be used in online learning. Therefore, it needed to develop an E-LKPD (Electronic Student Worksheet) based on STEAM (Science, Technology, Engineering, Art, and Mathematics) to improve the creative thinking skills of fifth grade elementary school students in science learning.

## LITERATURE REVIEW

Based on a review of research related to STEAM-based E-LKPD, the student activity sheet was one of the learning media used during learning and considered to be one of the most preferred learning methods by students. Advances in technology and information make the development of learning media that can be used. One of the learning media that utilizes technological developments is E-Learning. E-Learning is the utilization of internet technology and web pages that aimed to create a learning experience (Horton et al., 2003). One of the uses of E-Learning was the development of student worksheets.

Haifaturrahmah's research showed that the STEAM-based worksheets developed were proper to be used as supporting learning resources in learning that applies integrated thematic learning to the 2013 curriculum (Haifaturrahmah et al., 2020). Agustina's research showed that the application of STEM-based learning can improve students' control of variables (Agustina et al., 2017).

Herro's research showed that it can increase teachers' understanding of STEAM to teach it as an effective first step to changing practice, citing the importance of collaboration between technologies that are directly integrated into the learning process (Herro & Quigley, 2017). Lee's research showed that the STEAM program with the theme 'earthquake' showed an effect on increasing students' self-efficacy in science subjects and their awareness of science-related work. Demonstrate statistical significance in increasing attitudes, work awareness, and continuing interest in science, technology, engineering, and mathematics. Can help students improve their scientific investigative skills as well as creative thinking skills and integrated thinking in schools (Lee et al., 2016).

Annisa's research can be concluded that there was a significant difference in students' creative thinking abilities with the STEAM-based PBL model on Acids and Bases (Annisa et al., 2018). Wiganingrum's research developed student electronic worksheets equipped with guided discovery-based animation videos which are expected to be able to help the physics learning process in schools and attract students' interest in physics (Wiganingrum et al., 2019).

## MATERIALS & METHODS

The method used in this research was the research and development method by adopting the Thiagarajan research method. 4D Models development research procedure proposed by Sivasailam Thiagarajan (1974). 4D Models have 4 main stages, there were defining, designing, developing, and disseminating, but this research only reached the develop stage due to limited research time.

At the definition stage, the researcher used the method of observation, interviews and documentation. Data derived from interviews, adjusted with data from observations and documentation results. Further, the data obtained will be more accurate (Suryandari et al., 2015).

At the Design stage, the researcher made a design of the content and appearance of the E-LKPD which will be

developed after getting input from the teachers. The E-LKPD that will be developed will include elements of STEAM which aimed to broaden their horizons and improve their creative thinking skills. The E-LKPD design has three main parts, namely the introduction/pre-content section, the core/content section, and the closing/post-content section.

At the development stage, it aimed to determine the validity, effectiveness and practicality of STEAM-based E-LKPD. After designing the content and appearance of the E-LKPD, the researchers tested its validity, effectiveness, and practicality by giving the developed E-LKPD to experts. These experts include material experts, media experts, and language experts.

In the trial phase, researchers conducted a limited test and a broad test to determine the effectiveness of the E-LKPD. Limited testing was carried out after the product has passed the validation stage and revised according to the suggestions and comments of the expert validators, the product is ready to be tested. This limited trial was conducted on the fifth-grade students of SDN 1 Kutoharjo with a total of 36 students. Suggestions and corrections to the results of the limited test are used as improvements to the STEAM-based E-LKPD that will be used in the broad test. Meanwhile, the extensive test uses test techniques (pretest and posttest) and questionnaires to test the practicality of the E-LKPD.

## RESULT AND DISCUSSION

### Analysis of STEAM-Based E-LKPD Validity

The results gained to analyze the developed E-LKPD in order to test its effectiveness, the researchers conducted limited trials and extensive trials. The E-LKPD consists of 10 descriptive questions. After being tested on a limited scale, the E-LKPD was analyzed to look for validity, reliability, differentiating power, and difficulty level tests. Valid questions are then used as a measure of student success.

The validity test uses the product moment correlation formula, which is to see the comparison of the product moment correlation ($r_{xy}$) of all items with prices $r_{tabel}$. If $r_{xy} > r_{tabel}$ then the item in question is declared valid, otherwise if $r_{xy} < r_{tabel}$ the item is declared invalid. The test questions were carried out with the number of test participants N = 36 and a significant level of 5% gained r table = 0.329. Items are said to be valid if r count > 0.329 (r count is bigger than 0.329).

**Table 1. Analysis of Item Validity**

| Item No | r count | Criteria |
|---|---|---|
| 1 | 0,39 | Valid |
| 2 | 0,58 | Valid |
| 3 | 0,72 | Valid |
| 4 | 0,74 | Valid |
| 5 | 0,53 | Valid |
| 6 | 0,69 | Valid |
| 7 | 0,60 | Valid |
| 8 | 0,53 | Valid |
| 9 | 0,66 | Valid |
| 10 | 0,69 | Valid |

In this testing, the researcher made 10 questions. After being tested, the validity of the questions was calculated and it was found that all 10 questions were valid. The results of the validity are shown in the table, indicating that the 10 items were declared valid because r count > 0.329. This means that all questions can be used as pretest and posttest evaluation questions in a wide-scale test. For valid questions, the questions will be used as pretest and posttest evaluation questions in a wide-scale test.

The results of quantitative analysis on a limited scale state that the level of reliability of the E-LKPD on 10 questions is 0.75, the reliability of 0.75 can be said to be reliable because it is greater than the r table, which is 0.329. With a reliability coefficient of as big as $0{,}6 < r_{xy} \leq 0{,}8$ it meant that the STEAM-based E-LKPD instrument by presenting 10 questions and being followed by 36 students has high reliability.

The results of the quantitative analysis for discriminatory power on a limited scale were obtained with 10 questions for grade V elementary school descriptions. In the analysis of the

differentiating power of 10 questions, there were "bad" criteria, there were 2 items, with "enough" criteria 4 items, and "good" criteria 4 items. The results of the analysis of the level of difficulty of the limited class stated that, 8 questions with moderate criteria and 2 questions with easy criteria.

In research (Annisa et al., 2018) there was a significant difference in students' creative thinking abilities which can be seen in the paired sample test with a significance value of 2-tailed 0.000 <0.05. Supported by research (Nurhikmayati, 2019) the validity of the learning device was in the valid category, the results of the CVI calculation are in the range 0-1 and are said to be in the reliable category with *r count* greater than *r table.*

## Analysis of STEAM-Based E-LKPD Effectiveness

The results gained to analyze the developed E-LKPD in order to test its validity, the researchers justified the E-LKPD developed with material, media, and language experts using the instruments and grids that have been provided. Validation was done by presenting several experienced experts to assess the designed product (Pratiwi, 2016). In addition, the researcher also validates the lesson plans (learning implementation plans) that will be used in the learning process to experts. The results of the justification of E-LKPD with experts are described as followed:

**Table 2. STEAM-based E-LKPD Validation Test Results**

| No | Scoring Aspect | Score | Criteria |
|---|---|---|---|
| 1 | Material Expert | 91,6 | Very Valid |
| 2 | Media Expert | 75 | Valid |
| 3 | Language Expert | 85 | Very Valid |
| 4 | RPP Expert | 82 | Valid |

Based on table 2, it can be seen that the results of the validity of the E-LKPD got results with valid and very valid categories. This proved that the validity test in each indicator of the assessment aspect has a good average of criteria. The results of the validation by material experts with a very valid category, which meant that the E-LKPD can be tested in learning at school. The results of the validation by media experts and RPP as a whole get a valid category. The validation test was used as an effort to make teaching materials before they were used into good and relevant teaching materials (Sistyarini & Nurtjahyani, 2017).

E-LKPD in this study was considered valid if the score from the validator or experts is in the appropriate or very proper category and got a positive response from teachers and students. This research was supported by research (Septiani et al., 2013), obtained a score of 96.87% with a very proper category on the properness of the material. The material presented was in accordance with the level of thinking of elementary school children and the exercises in the student worksheets play a role in measuring the results of learning activities. It was the same with research (Ardan, 2016), that in its development research, products such as Lesson Plans (RPP), tenth grade biology textbooks with local Timorese for teachers and students. Student Worksheets (LKS), learning media after being validated and tested turned out to be valid and practical.

## Improvement of Creative Thinking Ability

Increased creative thinking ability in students can be obtained from the pretest and posttest scores. The increase is calculated using the N-Gain formula. The results of the calculation of the increase in students were presented in table 3 below:

**Table 3. N-Gain Test Results**

| Average *Pretest* | Average *Posttest* | N-Gain | Criteria |
|---|---|---|---|
| 63 | 85 | 0,61 | Medium |

The results of the study analysis showed a significant increase between the results of the pretest and posttest. This was proved by the results of the N-Gain test which reached 0.6 with moderate criteria. The increase in pretest and posttest results showed that learning activities using STEAM-based E-LKPD can improve students' abilities (Febrianti et al., 2016).

This learning process shows that the abilities possessed by students are increasing.

Learning in class was declared successful if 75% of the number of students in the class have achieved classical completeness. The results of classical completeness are presented in table 4 below:

**Table 4. Classical Completeness Results**

| Number of students who completed | Total of students | Completed Percentage (%) | Criteria |
|---|---|---|---|
| 42 | 46 | 91% | Completed |

Based on table 4, the results of classical completeness after the posttest reached the criteria for completion. The classical mastery of students' learning provides information that students' understanding in general, relating to single substance and mixed substance material presented in STEAM-based E-LKPD, was very good. This showed that the developed E-LKPD can be understood by students well so as to improve creative thinking skills. The results of the study analysis showed a significant increase between the results of the pretest and posttest. This was proved by the results of the N-Gain test for creative thinking which reached 0.61 with moderate criteria and the N-Gain test results for creative thinking reached 0.68 with moderate criteria.

Based on the explanation above, it can be interpreted that STEAM-based E-LKPD can increase creative thinking skills. In accordance with the results of the research, STEAM-based E-LKPD was effective for improving creative thinking skills in the aspects of fluency, flexibility, originality, and elaboration.

## STEAM-Based E-LKPD Practical Analysis

The results gained to analyze the developed E-LKPD in order to test its practicality, the researchers gave a questionnaire to teachers and students of class V which aimed to find out what percentage of teacher and student interest in the developed E-LKPD. The questionnaire given to the teacher is called LARG (Teacher Response Questionnaire Sheet) and the questionnaire given to students is named LARPD (Student Response Questionnaire Sheet).

**Table 5. Results of Teacher Respondents**

| No | Name | Score | Value | Category |
|---|---|---|---|---|
| 1 | Bu Mening | 53 | 83 | Very Interesting |
| 2 | Pak Mulyono | 51 | 80 | Very Interesting |

**Table 6. Results of Student Respondents**

| Result | Score | Value | Category |
|---|---|---|---|
| Average | 49 | 81 | Very Interesting |
| Minimal | 26 | 43 | Quite interesting |
| Maximal | 59 | 98 | Very Interesting |

The results of the teacher's response got very interesting criteria in a whole, that was meant the teacher gave a very positive response to the developed E-LKPD. The material presented in teaching materials and pictures that were relevant in daily life make it easier for students to understand the material and can help teachers in the teaching and learning process to achieve learning goals (Nurrita, 2019). The used of simple language and the presentation of attractive images can lead students to understand the description of the material (Setyowati et al., 2013).

The results of student responses got very interesting criteria in a whole, that was meant students gave a positive response to STEAM-based E-LKPD. With an average score of 49 which was then analyzed with a maximum score of 59, the result obtained was a score of 98 which was included in the very interesting category, meaning that students gave a positive response to the STEAM-based E-LKPD for single substance and mixed substances. Teaching materials were said to be good if they get a positive response from students regarding the attractiveness aspect, the extent to which it can help students, and how easy it is for students to understand (Febrianti,et al., 2016).

Responded from students with learning using the developed E-LKPD can provide a new learning experience with E-LKPD using STEAM-based learning. This was because students were rarely involved

in science learning which is more active for students. E-LKPD received positive responses from students, then the developed E-LKPD can be used in large-scale trials.

This research was supported by research (Fitriani et al., 2016). about the development of problem-based LKPD to improve students' understanding of concepts and learning activities on the solution and buffer material, that the results of teacher and student responses to the development of this LKPD were 89.28% and 77.14% gave a positive response. Research (Payudi et al., 2017) on LKPD development was assisted by photoelectric effect interactive multimedia to build science process skills, that student learning outcomes worksheets have an attractiveness level with an average score of 3.27 or 81.74% in the attractive category. And research according to (Ratnawati, 2021) on improving learning achievement in online learning of electric motor installation using interactive LKPD, it stated that the practicality of use for daily tests results in 87.5% stating that can be understood and practical if used by students.

## CONCLUSION

STEAM-based E-LKPD was declared valid with validity according to material expert validators of 91.6 with very valid categories, media expert validators of 75 in valid categories, language expert validators of 85 with very valid categories.

STEAM-based E-LKPD was declared effective according to the results of the N-Gain calculation which showed that the N-Gain score of 0.61 is included in the quite effective category. Shows that there was a significant increase in creative thinking skills before and after using STEAM-based E-LKPD with 91% classical completeness results with complete criteria.

STEAM-based E-LKPD was declared practical according to the results of teacher and student respondents which showed that teacher respondents scored 83 and 80 in the very attractive category and student respondents produced an average score of 81 in the very attractive category.

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