

# The Development of Electronic Student Worksheet to Improving Higher Order Thinking Skills in Temperature and Heat Material

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**Abstract:** This research aims to determine the validity, practicality and effectiveness of e-worksheet using the *liveworksheet* website. This research used method R&D which referred ADDIE model which consisted n five stages, Analysis, Design, Development, Implementation, Evaluation. Data collection techniques are validation sheets, student response questionnaires, interviews, observations, tests and documentation. The results showed that the developed media had met the following criteria: very valid (aspects of graphics, content, language) based on feasibility tests by expert groups who obtained an average percentage of 91%, Practical, based on the implementation sheet provided by three observers during the learning process using Electronic Student Worksheet products which get an average percentage of 95%, Effective, based on the results of pretest and postes used to determine HOTS thinking skills and use student response questionnaires after using the product. The result of the *N-gain* value obtained was 0.71 with a high category and a response questionnaire obtained of 90%. So that the development of an Electronic Student Worksheet is feasible to be used in the learning process because it has met the criteria of validity, feasibility and ease of use.

**Keywords:** E-worksheet; HOTS; *liveworksheet*; Temperature and Heat

## Introduction

Science is one application of science that contains material about related natural events, which are then applied in everyday life (Maulidiyah et al., 2022). According to Wahyuni et al. (2022), science learning aims to build a HOTS ability in solving problems in daily activities through teaching and learning activities that can stimulate students' HOTS abilities. Science focus on efforts to equip, guide and in still positive values in students (Doyan et al., 2018) Science explains the search for knowledge in such a way that in learning and educational activities, science focuses more on the production of direct experience in the form of explanations related to concepts (Astalini & Kurniawan, 2019).

In the 21st century, all fields have experienced very rapid development, especially the field of ICT. In the era

of the industrial revolution, 4.0 has affected the world of education (Hidayah & Kuntjoro, 2022). The field of education is required to always adapted and innovate along with the development of technology in the era of revolution 4.0 (Octaviana et al., 2022) 21st-century skills are also called 4C skills which consist of creativity, critical thinking, communication, and collaboration. These 21st-century skills are among the Higher Order Thinking Skills students need to prepare for global challenges Junedi et al. (2020), *Higher Order Thinking Skill* (HOTS) is a higher-order thinking ability that includes thinking critically and creatively (Noprinda & Soleh, 2019).

In fact, in Indonesia, learning at this time is still not oriented to the ability of HOTS. This is evidenced by the research of Kurniawati et al. (2021), obtained data that the Higher Order Thinking Skill (HOTS) of junior high school students in Jember Regency with a sample of 30

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students showed that there were no students with high HOTS. Where 18 students with the medium HOTS category and 12 students with the low HOTS category. Based on Nurwahidah's research (2018) on science learning in Semarang, obtaining data on students' HOTS abilities is at a low level. In addition, the ability of students who are not trained and accustomed to applying reasoning activities and solving a problem in learning. This is in line with research conducted by Fanani (2018), stating that the ability of HOTS, especially in the cognitive domains of C4, C5, and C6 obtained a score below 50%. The use of media and teaching materials during the learning process is considered unable to improve students' HOTS abilities (Azhari, 2022) Teaching materials commonly used in learning activities are student worksheet.

Worksheet is a medium that allows supporting the teaching and learning process (Wahyuni et al., 2022). student worksheet is printed teaching material that students can use to learn independently, and it is suspected that students are more active during the learning process (Novitasari & Puspitawati, 2020). (Kalifah & Nugraheni, 2021) explained that student worksheet is a student worksheet in which there are stages of problem-solving to develop students' way of thinking through existing exercises. Arsana and Sujana (2021), stated that the student worksheet also included several materials or summaries in detail following basic competencies and indicators. According to Maulidiyah et al. (2022), stated that the use of media and teaching materials during the learning process is considered incapable in the process of improving students' HOTS abilities. Given the progress of science and technology that continues to grow, student worksheets are very important to be compiled, developed, and modified according to needs as a way to improve student HOTS (Kholifahtus et al., 2021).

The learning process with the use of digital-based Student Worksheet can make the atmosphere when learning is not easily boring and learning becomes more interesting and efficient. This is because learning will not be monotonous and it is expected that students will be more active. E-Student Worksheet means a student worksheet in the form of a soft file that can be used in various conditions which in the end can be of effective value by using electronic devices in the form of gadgets, laptops, and computers (Kurniawati et al., 2021). According to (Kholifahtus et al., 2022) stated that E-Student Worksheet is a learning tool that uses internet assistance which is systematically arranged and then packaged in electronic format. According to (Prastika & Masniladevi, 2021) stated that E-Student Worksheet is a media that integrates with technology in which there are several features such as images, videos, and animations so that they can attract students' attention so that

students are not bored and more active during learning activities.

Software liveworksheet is an application to convert traditional worksheets printed in the form of documents, pdfs, and jpg into interactive online exercises because it can contain several features such as video, images, and audio. According to Fauzi et al. (2021), stated that liveworksheet is a platform in the form of a website that provides services to educators to make student worksheet more interactive and educators can use the E- student worksheet that is already available. (Prastika & Masniladevi, 2021) states that the questions contained in the E-Student Worksheet can be multiple choice, tick column-shaped questions, matchmaking, and drawing lines. (Prastika & Masniladevi, 2021) stated that liveworksheets have several advantages, including being able to create their own interactive E- Student Worksheet which has ease of operation. Students can directly work on the activities contained in the E- Student Worksheet and do not need to download or register in the liveworksheet first.

Student Worksheet innovation using liveworksheet software can improve Higher Order Thinking Skills (HOTS). According to Kholifahtus et al. (2022), the development of student worksheet teaching materials can improve the HOTS ability of students. This is because E- Student Worksheet presents HOTS-based questions that can stimulate the process of interpreting and analyzing information. The use of electronic teaching materials has the advantage of being more interesting, and varied and can make students enthusiastic about learning and not feel bored. The previous statement can be reinforced by research conducted by (Puspita & Dewi, 2021) which confirmed that high-level reasoning skills increased by 86.7% after using E- Student Worksheet, with an initial average of 30.76 increasing to 74.09. The purpose of this research is to know about the validity, practicality, and effectiveness of Electronic Student Worksheet in learning science.

## Method

The type of research that researchers use is research and development. The development research design used is the ADDIE development design. The product developed in this development research is Electronic Student Worksheet which aims to improve the Higher Order Thinking Skill (HOTS) of junior high school students in learning science material temperature, heat, and expansion. Excuse research uses this model because the steps in the ADDIE development model have several logical sequences in the process of developing Electronic Student Worksheet. The step of ADDIE model shown in the Figure 1.

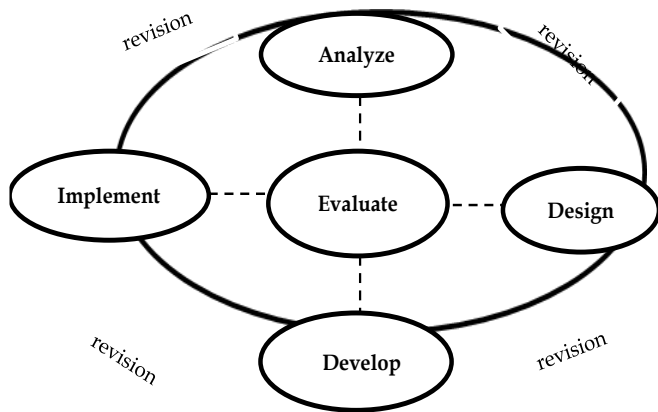


Figure 1. ADDIE Development Model Scheme

Fannani, (2018) states that HOTS is a Higher Order Thinking ability that is part of Bloom's Taxonomy which consists of operational verbs namely analyze (C4), evaluate (C5), and create (C6)

Table 1. Indicators of HOTS

Indicators	Explanation
C4 -Analyze	The process of describing the explanation of the material is then linked as a whole
C5- Evaluate	Activities by making a decision based on predetermined criteria and standards
C6- Created	Find a solution or something new from a process so that it can determine various existing elements.

(Anderson dan Krathwohl, 2001)

The independent variable used is Electronic Student Worksheet, defined as electronic teaching materials containing several tasks and arranged by the Higher Order Thinking Skill (HOTS) indicator. This research implementation in 2 Maesan Junior High School. The population of this research is seven class of junior high school students. Total of participant is 28 students. Electronic Student Worksheet are implementation in 4 activities on science subject.

The data analysis method used a equation of validity, practically and effectivity of Electronic Student Worksheet. To know validity of Electronic Student Worksheet was measured using validation sheets filled out by three science teachers at SMP 2 Maesan. The validity of Electronic Student Worksheet was obtained through implementation.

$$V = \frac{Tse}{Tsh} \tag{1}$$

- V = Validity
- TSe = Total score of validity
- TSh = Score maximum

The average total validation value that will be obtained will be referenced based on the criteria of values on a certain scale can be found in table 2.

Table 2. Category of validity

Percentage (%)	Category
86-100	Very Valid
71-85	Valid
56-70	Valid Enough
41-55	Less Valid

(Sari et al., 2022)

Practical data analysis is seen from the observation sheet of learning implementation when using Electronic Student Worksheet products. To find out the practicality of a product can be calculated using equation 2.

$$Percentage = \frac{score\ obtain}{score\ maximum} \times 100\% \tag{2}$$

The criteria for participation in the learning process using liveworksheet based E-LKPD can be seen in table 3.

Table 3. Criteria of practically

Criteria of practically	Criteria
76-100	Very Practical
51-75	Practical
26-50	Practical Enough

(Rochman et al., 2021)

Analysis of effectiveness data seen from test results and student response questionnaires. In this development research using the N-gain test. The N-gain test is conducted to determine the results of improving students' Higher Order Thinking Skills. The N-gain test can later be calculated using equation 3.

$$\langle g \rangle = \frac{\langle S_f \rangle - \langle S_t \rangle}{100 - \langle S_t \rangle} \tag{3}$$

- $\langle g \rangle$  : n gain
- $\langle S_f \rangle$  : score of posttest
- $\langle S_t \rangle$  : score of pretest

The results of these calculations are then compared with the criteria contained in table 4.

Table 4. Criteria N-gain

N-gain	Category
$g > 0.70$	High
$0.30 \leq g \leq 0.70$	Medium
$g < 0.30$	Low

(Hake, 1998)

The survey results given after being processed with Electronic Student Worksheet was immediately collected so that the percentage of student responses was obtained after using direct liveworksheet based E-Student Worksheet. The results of student responses can be calculated using the formula.

$$Percentage = \frac{Score\ obtain}{Score\ maximum} \times 100\% \quad (4)$$

After knowing the percentage value, the student response criteria can be seen in the table 5.

**Table 5.** Criteria of student respond

Percentage (%)	Criteria
76 - 100	Excellent
51 - 75	Good
26 - 50	Average
≤ 25	Poor

(Fitriasih et al., 2019)

### Result and Discussion

This development research uses the ADDIE model with five stages of analysis, design, development, implementation, and evaluation. Data on the results of each step of research and development are as follows:

#### Analyze Phase

This stage is the analysis stage by looking for various references and conducting interview activities. Based on the results of the analysis, it is known that the LKPD used is still in printed form. In addition, based on the results of interviews conducted with science teachers of SMPN 2 Maesan, it was revealed that the school only used teaching materials in the form of modules or printed books. In addition, students' HOTS skills are still not reflected in learning activities, making learning less interesting. Students' HOTS abilities still need to be guided one by one and students are still waiting for instructors from the teacher. The development of Electronic Student Worksheet aims to train students' HOTS thinking in the learning process in which there are daily problems with the aim that students can find material and solve problems independently.

#### Design Phase

Making E- Student Worksheet consists of making covers, compiling contents, and uploading HOTS-based E- Student Worksheet on the liveworksheet website. At this stage, product design is carried out through power points. This design was created to create student worksheets containing study instructions and practice questions arranged based on HOTS skill indicators and converted into PDF form for use in electronic student

worksheet using liveworksheet software. Making liveworksheet based E- student worksheet covers is designed using the help of Canva software. This Electronic Student Worksheet cover is designed as attractive as possible by choosing a color background that adjusts to the sub-material to be taught. The creation of Electronic Student Worksheet content is aligned with the student worksheet structure consisting of student identity, instructions for use, learning outcomes, introduction, and learning activities which consist of HOTS thinking ability indicators, namely: (1) analyzing, (2) evaluating, (3) creating. The cover page and contents of the E- Student Worksheet that have been created will be converted first into pdf format. After being converted into pdf format, student worksheet products are uploaded to the liveworksheet website and researchers add learning videos from youtube. The creation of the contents of E- Student Worksheet can be seen in Figure 2.



**Figure 2.** The parts of E- Student Worksheet consist of covers, and HOTS indicators that are part of analyze, evaluation, and create

#### Develop Phase

The next stage is validation activities. The validator from teacher in SMPN 2 Maesan. The results of the validation data analysis filled in by the three validators are as Table 6.

**Table 6.** Electronic Student Worksheet 1 validation results

Assessment Aspect	Percentage of Validators (%)			Percentage (%)	Category
	1	2	3		
Graphic Aspect	89	89	91	90	Very Valid
Content Aspect	84	96	84	88	Very Valid
Language Aspect	83	83	100	89	Very Valid
Average	85	89	92	89	Very Valid

Based on the results of Table 6, the validity of Electronic Student Worksheet 1 showed the average percentage obtained was 89% with a very valid category. The assessment results from expert validators in each aspect also reached the very valid category with a percentage category in the graphic aspect of 90%, the content aspect of 88%, and the language aspect of 89%.

**Table 7.** Electronic Student Worksheet 2 validation results based on liveworksheet

Assessment Aspect	Percentage of Validators (%)			Percentage (%)	Category
	1	2	3		
Graphic Aspect	91	91	94	92	Very Valid
Content Aspect	84	100	80	88	Very Valid
Language Aspect	89	86	100	91	Very Valid
Average	88	92	91	91	Very Valid

Based on the results of Table 7, the validity of Electronic Student Worksheet 2 showed the average percentage obtained was 91% with a very valid category. The assessment results from expert validators in each aspect also reached a very valid category with a percentage category in the graphic aspect of 92%, the content aspect of 88%, and the language aspect of 91%.

**Table 8.** Electronic Student Worksheet 3 validation results based on liveworksheet

Assessment Aspect	Percentage of Validators (%)			Percentage (%)	Category
	1	2	3		
Graphic Aspect	89	91	86	89	Very Valid
Content Aspect	92	88	84	88	Very Valid
Language Aspect	94	91	97	94	Very Valid
Average	92	90	89	90	Very Valid

Based on the results of table 8, the validity of Electronic Student Worksheet 3 showed the average percentage obtained was 90% with a very valid category. The assessment results from expert validators in each aspect also reached the very valid category with

a percentage category in the graphic aspect of 89%, the content aspect of 88%, and the language aspect of 94%.

Based on the results of table 9, the validity of Electronic Student Worksheet 4 showed the results that the average percentage of 92% with the category was very valid. The assessment results from expert validators in each aspect also reached the very valid category with a percentage category in the graphic aspect of 90%, the content aspect of 89%, and the language aspect of 96%. The assessment results from the validation of the four E-LKPD products received an average percentage of 91% with a very valid category. This shows that the entire Electronic Student Worksheet gets a very valid category so that the E-LKPD product is worthy of use with a few revisions.

**Table 9.** Electronic Student Worksheet 4 validation results based on liveworksheet

Assessment Aspect	Percentage of Validators (%)			Percentage (%)	Category
	1	2	3		
Graphic Aspect	89	91	91	90	Very Valid
Content Aspect	84	92	92	89	Very Valid
Language Aspect	97	91	100	96	Very Valid
Average	90	92	94	92	Very Valid

*Implementation Phase*

This stage is the product trial stage in learning after the product is said to be valid. In this trial stage, learning implementation data was produced using Electronic Student Worksheet, practical analysis data. The data was obtained based on observations filled in by three observers during the learning activity. The practical data of Electronic Student Worksheet obtained can be seen in Table 10.

Based on Table 10, the analysis of learning implementation using an Electronic Student Worksheet shows an average percentage of 95% in the very practical category. Learning activities carried out during 5 meetings can achieve practical criteria in all activities such as introduction get an average percentage of 91% In the very practical category, the core activities get an average percentage of 96% with the very practical category and the closing activities get an average percentage of 97% with the very practical category. So it can be concluded that the implementation of learning activities using Electronic Student Worksheets has a significant effect on learning objectives. However, in learning activities, there are several obstacles and suggestions from the three observers during learning activities. The suggestions given by the observer can be used to improve the learning process at the next meeting. Some obstacles and solutions while using Electronic Student Worksheet can be seen in Table 11.

**Table 10.** Result in E- Student Worksheet learning outcomes

Learning Activity	Activity to					Category	
	1	2	3	4	5		
Introduction	92	88	92	90	96	91	Very Practical
Main Activity							
Give stimulants accordingly	92	100	92	92	100	95	Very Practical
E-Student Worksheet							
Students watch a video	92	100	92	-	-	95	Very Practical
Students discuss to identify a problem	92	92	92	-	100	94	Very Practical
Students answer the result of discuss	92	100	92	100	100	97	Very Practical
Students show the result of discuss	92	92	100	100	100	97	Very Practical
Students show conclusions on E-Student Worksheet	100	92	100	100	100	98	Very Practical
Concluding	92	96	96	100	100	97	Very Practical
Average	93	95	94	97	98	95	Very Practical

**Table 11.** Obstacles and solutions during learning using E- Student Worksheet

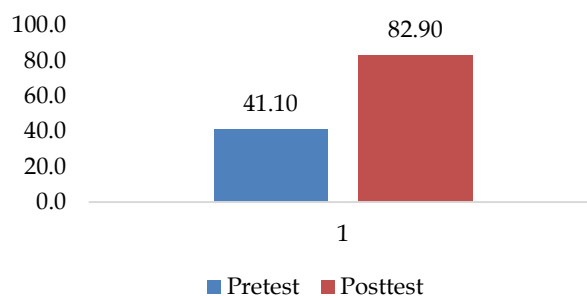
Obstacle	Solution
At the time of accessing E-Student Worksheet, there were still many students who had difficulty changing the language on the liveworksheet website	Assist students in the process of using E-Student Worksheet on the liveworksheet display in detail
Answers in E-LKPD disappear when students open other applications	During the process of working on E-LKPD, you should not open other applications on Android so that the answers done by students are not lost

*Evaluate Phase*

The evaluation stage is used as a stage that aims to measure the effectiveness of the Electronic Student Worksheet on learning science material temperature, heat, and expansion. The effectiveness results were obtained from pretest and posttest activities which were used to determine the improvement of students' HOTS thinking skills which were carried out through evaluation in the form of N-gain tests and using student response questionnaires to determine student responses after using Electronic Student Worksheet products. The results of the HOTS ability test are assessed from formative tests in the form of pretest and posttest assessments given to students. The results of the analysis of students' HOTS abilities can be seen after being given or taught using Electronic Student Worksheet products. The average score of the student HOTS ability test can be seen in Figure 3.

Figure 3 is the result of the average pretest and posttest values which show that there is a difference which means that the value is obtained before and after using the product developed, which is in the form of an Electronic Student Worksheet. The average pretest score obtained by students before using Electronic Student Worksheet was 41.1%. Then, after learning activities using Electronic Student Worksheet, a value of 82.9% was obtained. So, students' HOTS thinking skills have

improved after using Electronic Student Worksheet products. Then, after learning activities using Electronic Student Worksheet, a value of 82.9% was obtained. So it can be concluded from the average results obtained that HOTS thinking skills have increased after using Electronic Student Worksheet products.



**Figure 3.** Average of Pretest and Posttest Score

Table 12 shows the N-gain value of grade VII B students of 0.71. this value means that there is an increase in HOTS thinking skills after using Electronic Student Worksheet with high categories. That is, the increase that occurred was quite good and followed the expected criteria. In addition, effectiveness data is also analyzed based on indicators to determine the improvement of students' HOTS thinking skills. The

average results of the test score and N-gain of HOTS thinking ability on each indicator can be presented in Table 13.

**Table 12.** Effectiveness of HOTS ability

Component	VIII B Class		N-gain <g>	Category
	Pretest	Posttest		
Number of Students		28		
Lowest Score	30	70	0.71	High
Highest Score	50	90		

**Table 13.** Results of achievement of HOTS thinking ability indicators

Indicator	N Pretest	N Postets	N-Gain	Category
Analyze	43.75	81.25	0.66	Medium
Evaluate	38.75	84.29	0.75	High
Create	39.29	75	0.59	Medium

Based on Table 13, shows an increase in HOTS thinking skills in grade VII B students after using the Electronic Student Worksheet which is based on 3 indicators of HOTS ability with different N-gain results on each indicator. In each indicator of thinking ability, HOTS displays that each indicator does not fall into the low category. From the table above, it can be concluded that the lowest increase in the N-gain value is found in the creating indicator with a result of 0.59 in the medium category.

The effectiveness results, based on the pretest and post-test assessments, are also obtained from student responses based on student response questionnaires given after Electronic Student Worksheet treatment. Response questionnaires are given to assess student responses related to products used during learning activities.

**Table 14.** Results of student response questionnaire analysis

Aspect	Percentage (%)	Category
Interest	91	Very Good
Motivation	86	Very Good
Feedback	93	Very Good
Average	90	Very Good

Based on Table 14, the analysis of student response questionnaires after using Electronic Student Worksheet products from 28 students showed an average percentage of 90% in the very good category. Each aspect observed in the student response questionnaire achieved very good criteria with an average percentage of interest aspects of 91%, motivation aspects of 86%, and response aspects of 93%.

## Conclusion

The results of the research and discussion that have been described can be concluded that the Electronic Student Worksheet product on temperature, heat, and expansion material is very valid for use in learning based on aspects of graphics, language, and content. Based on the validity test conducted, the average percentage is 91% with a very valid category. Electronic Student Worksheet products meet the practicality aspect. This is based on observations of the implementation of learning that has been carried out to get an average percentage of 95%. with very practical categories. Electronic Student Worksheet products on temperature, heat, and expansion materials have met the effective criteria because there is an increase in students' HOTS abilities after using the product. This can be seen from the N-gain value which gets an average percentage of 0.71. The product can be said to be effective Then the average student response in the very good category showed a percentage of 89% and received a positive response from students. While the average results of student responses show a percentage of 90% with very good categories, so Electronic Student Worksheet products are effective and can be used in the science learning process. The development of Electronic Student Worksheet products in future research is expected to be developed for other science materials, as well as the development of more interactive and innovative Electronic Student Worksheet products.

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## Authors Contributions

Conceptualization: Elly Fathur Prayogi, data curation: Elly Fathur, funding acquisition Zainur Rasyid Ridlo, methodology: Sri Wahyuni, visualization: Zainur Rasyid Ridlo, writing-original draft: Elly Fathur Prayogi, writing-review & editing: Sri Wahyuni.

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## Conflicts of Interest

No Conflicts of interest.

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