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Development of METAFORA (Temperature and Heat Interactive Learning Media for Senior High School) Using Lectora Inspire 18

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Abstract

This research aimed to develop physics interactive learning media (Lectora Inspire 18) based on temperature and heat. The development result was checked to determine the interactive learning media's validity, effectiveness, and students' responses. The research method uses Nieveen methods such as preliminary research, prototyping, and assessment phases. The interactive learning media were validated by 3 validators, including 2 expert validators and a user validator. Interactive learning media effectiveness and students' responses were analyzed by two trial activities (a limited trial including 10 students and a wide trial including 36 students). The development result is physics interactive learning media for senior high school (METAFORA) on heat and temperature, used with a PC and smartphone. Based on the evaluation of three validators, the validity score of interactive learning media is 4,74, and it is classified as valid. The N-Gain formula calculates interactive learning media from students' pre-test and post-test results. The interactive learning media effectiveness N-gain score is 0.60 (medium) based on a limited trial and 0.66 (medium) based on a large trial. The student's response was analyzed from the questionnaire given after implementing interactive learning media. In the limited trial, the student response percentage is 79.22%, which falls into the good category, and in the wide trial, it is 80.34 percent, which falls into the very good category. Based on the data analysis results, the physics interactive learning media Lectora Inspire 18 based on temperature and heat matter is valid, effective, and suitable as an alternative medium for physics learning.

Keywords: Interactive Learning Media; Lectora Inspire; Temperature and Heat

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INTRODUCTION

The development of science and technology is becoming increasingly rapid and inevitable as time passes. The sophistication of technology is related to the increasing number of innovations in various fields, including education. Educational technology combines learning activities, learning, developing, and managing technologies to solve educational problems (Akbar & Noviani, 2019).

Using technology-based learning media is a new way to use technology in

education. Learning media are a means of communication or a link between students and educators in order to achieve learning objectives. A quality learning process can be built through several aspects, including teaching, selecting appropriate learning methods, creating a comfortable learning environment, and using innovative learning media to assist learning activities (Astuti & Bhakti, 2018; Hartini et al., 2017; Zainuddin et al., 2019).

Learning physics requires understanding the relationships between the concepts because they are interconnected. This builds the view that physics is a subject considered difficult and saturating, so students seem passive in the physics learning process (Supardi et al. 2015). In addition, teachers frequently face challenges to demonstrate information to students, requiring the use of media that can help explain concepts in an interactive way (Jannah et al., 2019). Through technology in education, physics learning can be presented as a fun lesson, and innovative learning media can be tailored to the requirements of students in the classroom. New interactive learning media can create a more engaging, communicative, and interactive learning environment and enhance student comprehension of the material the teacher presents.

Interactive learning media is a tool that helps deliver learning materials and allows students and learning media to interact by acting on and reacting to each other (Yanto, 2019). Interactive learning media can be developed by utilizing several software programs, including Lectora Inspire 18. Lectora Inspire 18 allows teachers to add animation, images, text, video, and audio. Lectora Inspire 18 is widely used because it is relatively user-friendly without the need for sophisticated programming languages (Shalikhah, 2016). In Lectora Inspire 18, several components can combine flash, record audio, combine images, and capture screens. In addition, the templates provided by Lectora Inspire are more diverse and interesting; many quiz or test templates support e-learning needs. Another advantage is that Lectora Inspire can convert PowerPoint output into an e-learning format. Powerpoint output can only be converted into PDF format. Still, the output of Lectora Inspire is more diverse and can be adjusted to the needs of its users, consisting of single executable files (exe), CDROM, HTML, and SCROM (web-based) (Putri et al., 2016).

The subject matter of temperature and heat in physics is one of the materials taught to secondary-level students. Temperature and expansion, the relationship between heat and the temperature of objects and their form, the black principle, and heat transfer are all topics covered in the temperature and heat focus. The temperature and heat material were chosen because it is considered one of the most difficult materials for students. Research conducted by Azizah et al. (2015) mentioned some materials in physics subjects that are considered difficult by students along with the percentage of difficulty, namely 26% in temperature and heat, 25% in optics, 21% in a static fluid, 17% in elasticity and Hooke's Law, and 11% in kinematics.

Based on the results of an interview with one of the physics teachers at SMA Negeri 1 Tenggarang, the problems faced are that physics learning at school still uses learning media in the form of student handbooks, the student worksheets, or material with PowerPoint media. The teacher also said that technology-based media aren't used much in learning activities because teachers don't know how or help students use them. According to Hartawan et al. (2014), teachers in the teaching and learning process in the classroom in physics subjects still tend to be less creative and innovative in applying learning media. This is due to

the low ability of teachers to use and provide learning media technology (Wahid, 2018).

Based on the problems described, it is necessary to do development research entitled "Development of METAFORA (Temperature and Heat Interactive Learning Media for Senior High School) Using Lectora Inspire 18." The difference between this research and previous research is in the research subject, the subject matter used, and the data analysis method. This study aimed to find how well interactive learning media about temperature and heat helped by Lectora Inspire 18 worked, how valid they were, and how the students felt about using them (METAFORA).

METHOD

The research used a type of research and development using the Nieveen (2006) research model. The stages of Nieveen's development model are conducting preliminary research, the development or prototyping phase, and the assessment phase. The development steps in this study can be seen in Figure 1.

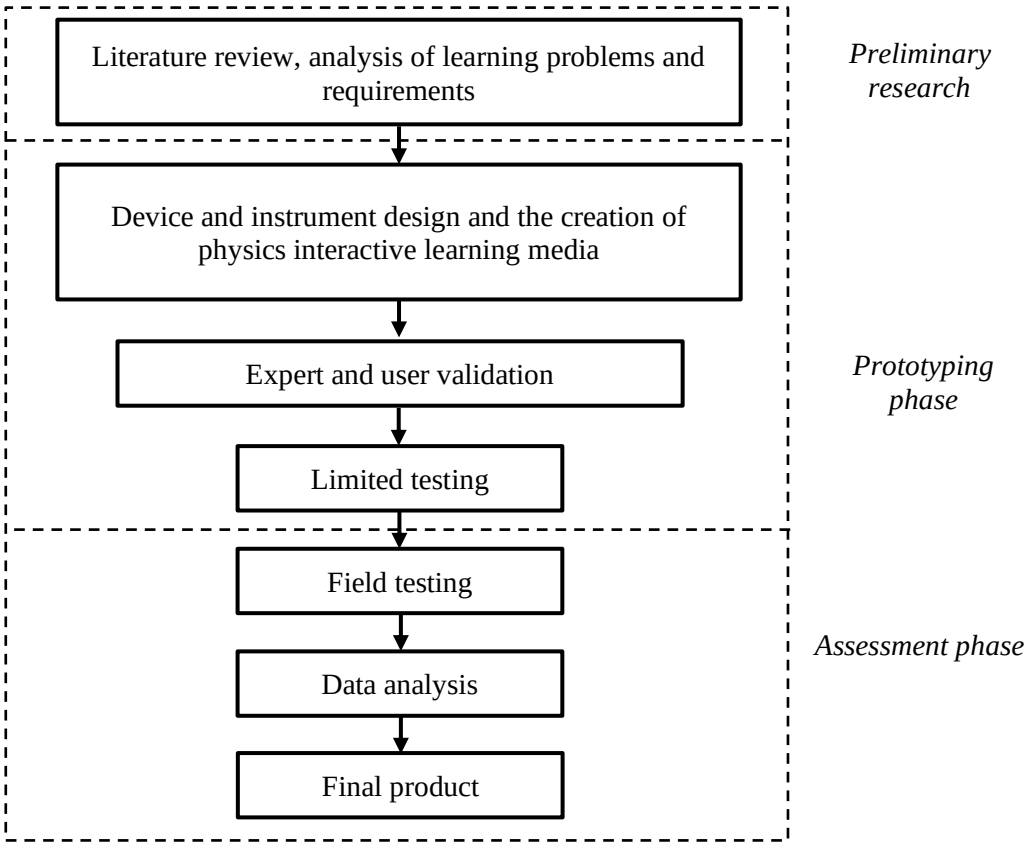


Figure 1 Research procedure modification of nieveen's development model

One of the public senior high schools in Bondowoso Regency was used for the testing phase. XI MIPA class students were the subjects of this study. The number of research subjects was adjusted for the trial stage. The limited trial was conducted on 10 students, and the broad trial was conducted on 36 students. The selection of the research site used the purposive sampling area method.

Research data were obtained from validation sheets, tests, and questionnaires. The analysis of the validity of interactive learning media is based on the acquisition of validation sheets. Validation was conducted by three validators: two expert validators and one

user validator. The data obtained through the validation sheet was then analyzed according to the following steps:

a. Recap assessment data, including aspects, indicators, and each indicator's value.
b. Calculating the average validity results from all validators for each indicator using the following equation (1)

$$I_i = \frac{\sum_{j=i}^{n} V_{ji}}{n} \text{.....(1)}$$

Description:
V_{ji} = j validator score data towards i indicator validator
n = the number of validators

c. Calculate the average validation score for each aspect using the following Equation (2)

$$A_i = \frac{\sum_{j=1}^{m} I_{ij}}{m} \text{.....(2)}$$

Description:
A_i = average score for i aspect
I_{ij} = average for aspect i of indicator j
m = number of indicators in aspect i

d. Calculate the total average value of all aspects using the following Equation (3).

$$V_a = \frac{\sum_{i=1}^{n} A_i}{n} \text{.....(3)}$$

Description:
V_a = total average score of all aspects
A_i = the average score for aspect i
n = the number of aspects

(Hobri, 2010:52-54)

e. To Adjust the total average value for all aspects obtained with the criteria as in Table 1 (Hobri, 2010).

Tabel 1 Validation coefficient interpretation category

Validity Coefficients	Interpretations
$V_a = 5$	Very Valid
$4 \leq V_a < 5$	Valid
$3 \leq V_a < 4$	Moderately Valid
$2 \leq V_a < 3$	Less Valid
$1 \leq V_a < 2$	Not Valid

The cognitive learning outcomes of students on pre-test and post-test scores are used to measure the effectiveness of learning media that Lectora Inspire helps. The N-gain equation will then be used to figure out what cognitive learning outcomes students have gained (Mellenia & Admoko, 2022). The N-Gain equation is mathematically written as in equation (4).

$$N - gain = \frac{S_f - S_i}{S_{max} - S_i} \text{.....(4)}$$

Description:
$N - gain$ = normalized gain
S_f = average post-test score
S_i = average *pre-test score*

(Hake 1998)

The N-gain score is then adjusted to the N-gain score criteria as in Table 2.

Tabel 2 N-gain score criteria

$N - gain$ score	Criteria
$N - gain \geq 0{,}7$	High
$0{,}30 \leq N - gain < 0{,}7)$	Medium
$N - gain < 0{,}30$	Low

In percent form, the division of categories for the acquisition of N-gain scores refers to the category of interpretation of N-gain effectiveness according to Arikunto (1999) as in Table 3.

Tabel 3 Effectiveness N-gain interpretation category

Percentages (%)	Criteria
>76	Effective
56-75	Moderately Effective
40-55	Less Effective
<40	Not Effective

Student response analysis was conducted as follows:

a. Recapitulate student response questionnaire data on each indicator and questionnaire answer value for each respondent.
b. Recapitulate the score based on the Likert scale.

c. Calculating the average response questionnaire answer using Equation (5).

$$I_i = \frac{\sum_{i=1}^{m} K_{ji}}{n} \text{.....(5)}$$

Description:
I_i = the average value of the results of the questionnaire answers from all respondents for each statement
K_{ji} = j respondent's score data on statement i
n = the number of respondents

d. Determining the percentage of questionnaire answers through Equation (6).

$$R = \frac{\sum_{i=1}^{n} I_i}{n} \text{.....(6)}$$

Description:
R = the average of total score
I_i = the average statement scores
n = maximum score

e. Substituting the total average score in percent form through Equation (7).

$$P = R \times 100\% \text{.....(7)}$$

Description:
P = the percentage of the average score of the student response questionnaire (%)
R = the average of total score.

The results of the student response analysis were adjusted to the student response criteria shown in Table 4 (Erhansyah dkk., 2012).

Tabel 4 Categories of student response

Interval	Criteria
80% ≤ P ≤ 100%	Very good
60% ≤ P < 80%	Good
40% ≤ P < 60%	Moderately Good
P < 40%	Not Good

RESULT AND DISCUSSION

The result of this research is the creation of a new product that has been tested to see how w ell it works and how people react to it. With the help of Lectora Inspire 18, the product that was made is an interactive learning tool for high school physics classes about temperature and heat. The development of learning media refers to the three stages of Nieveen's development research and design, namely the preliminary research, the design (the prototyping phase), and the assessment phase.

Preliminary research

During the first stage of this research, which was called "preliminary," there were a few steps: problem analysis, literature study, and needs analysis.

A problem analysis was conducted to obtain information related to problems in teaching activities at school. This stage was carried out through interviews with one of the physics educators and students of class XI MIPA.

Following the discovery of the problem, a literature review was carried out during the preliminary stage process. The literature study aims to examine the theory related to the problems encountered in the field. The goal was to get references related to the arguments made by researchers in carrying out the research.

Following the finding and collection of references to school problems, the next stage was analysis. At the stage of requirements analysis, researchers began to identify alternative solutions based on the results of analyzing the problems discovered by the literature review. Researchers also did a needs analysis based on the school curriculum to make sure that the media content fit with what was being taught at school.

Designing Stage (*prototyping phase*)

The design stage is the next step after the preliminary stage, where different solutions were found. At this stage, the media to be developed began to be compiled, validated, revised, and tested.

At the product design stage, the material begins to be compiled based on core competencies, basic competencies, indicators, and learning objectives. The

product design stage begins with designing media components, arranging the material to edit the material, and compiling evaluation questions. All media components are designed and arranged according to the storyline design. The developed physics interactive learning media consists of an opening page, an introductory page, navigation, a compilation team, and the ability to start learning.

The opening page was the initial page to enter the media. The second page, namely the introduction page, was a page with three menu components: navigation, starting learning, and the compilation team. On the start-learning page, there were competency standards, material, summaries, evaluations, and practicum pages. The material menu consists of several materials equipped with illustrations and images. The summary page contains the core of the entire material, summarized. The evaluation page contains 10 evaluation questions related to temperature and heat material, which were then used for post-test activities. The practicum page contains student worksheets, experimental simulation videos, and a long PhET simulation. The practicum menu accessed virtually was intended so students could find visual concepts of the material taught independently (Diraya & Umamah, 2022). In addition, research by Aprilia et al. (2022) showed that using PhET simulation can help improve student learning outcomes. The interactive learning media product design stage produces a Draft I ready to be validated.

During the validation stage of product development, learning media were tested to see if they could be used. Two expert validators, who were expert lecturers in physics education at the University of Jember, and one user validator, who is a high school physics teacher, validated the media. The average results of validation by three validators can be seen in Table 5.

Table 5 Recapitulation of validation results

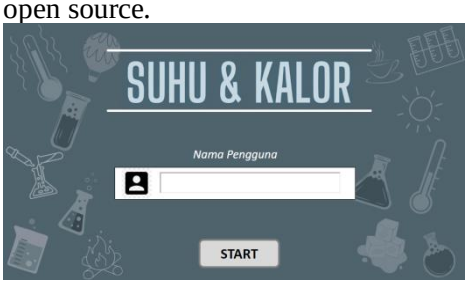
No.	Aspect	Average
1.	Presentation	4.89
2.	Language	4.56
3.	Contents	4.75
4.	Graphics	4.78
Total Average		**4.74**

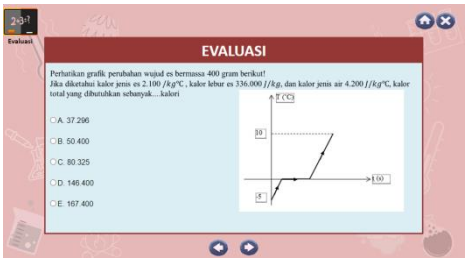
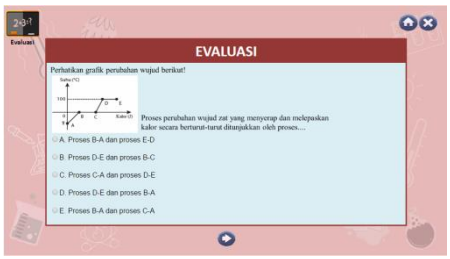
Based on Table 5 of the recapitulation of validation results, the average validation score was analyzed according to the validation coefficient interpretation category in Table 1. The presentation aspect presented the highest average score, with a value of 4.89 and was categorized as valid; the language aspect, with an average score of 4.56, was also included in the valid category. Meanwhile, the content aspect received an average validation score of 4.75 with a valid category, and the graphics obtained an average score of 4.78 with a valid category. The total validation average is 4.74, which falls into the valid category. The analysis results show that the interactive learning media for high school physics assisted by Lectora Inspire 18 on the subject of temperature and heat are feasible and can be used for learning in schools. Based on previous research, it is stated that interactive learning media based on Lectora Inspire on the subject of optical devices is declared valid because, from the content aspect, the material is in accordance with the content standards and syllabus of class XI physics. In the aspect of graphics, which includes media display components, color selection, text, audio, and the use of attractive images or simulations, it is stated that it can improve students' thinking and understanding (Irwandani et al., 2019).

Next came the evaluation and revision stage. In addition to providing scores on each validation aspect, validators were given space to provide input and suggestions for improving media. At this stage, revisions were made according to

the validator's directions, input, and suggestions on the validation sheet. Some of the improvements made can be seen in Table 6.

Table 6 Evaluation and Revision

No.	Revised Components	Revision Results
1.	Change the opening page display component to make it accessible to anyone (open source). 	Not using password components allows interactive learning media to be made open source. 
2.	Adjust learning objectives with Competency Achievement Indicators. 	The learning objectives are in accordance with the Competency Achievement Indicators. 
3.	Clarify media usage or navigation instructions by narrating them. 	Narrate media usage instructions on the navigation page.  

No.	Revised Components	Revision Results
4.	Adding evaluation questions from 5 questions to 10 questions.	The questions on the evaluation page have been added to 10 questions.
		
5.	Improving student worksheets in the practicum chapter.	The student worksheets has been adapted to practicum activities.
		

Based on Table 6 about evaluation and revision, five media components are recommended for improvement. The first part is to make the opening page look open source and doesn't need a password. The goal is to make developed media accessible to everyone. The second revision component displayed the learning objectives page, which was recommended to adjust to the Competency Achievement Indicator on the previous page. The third component was the display of the navigation page. The navigation page display was clarified by using narration so that the instructions for using the media were clearer. The fourth component was the evaluation; the number of questions was increased from five to ten. The fifth component was in the design of the experimental LKPD; the design of the experimental student worksheets was made more attractive and colorful.

The results of improving interactive learning media based on validator suggestions on the validation sheet were then tested on a limited basis on 10 students from Class XI MIPA. The result of the limited trial was Draft II, which was ready to be tested widely. The trial activities began with the AWA test (pre-test). Furthermore, students were allowed to learn and practice questions using Draft I of the learning medium. At the end of the meeting, students were again given a test question (post-test) as an evaluation and filled out a student response questionnaire sheet.

Using student test results, the N-gain test was used to determine the value of

media effectiveness. The N-gain score results are categorized based on Table 2, which describes the N-gain score criteria, and Table 3, which describes the N-gain effectiveness interpretation category. The N-gain score in the limited trial obtained a value of 0.60, which can be categorized as moderate. The acquisition of the N-gain score demonstrates that the developed interactive learning media are quite effective.

Student responses could be seen in the results of the student response questionnaire given after the learning process was complete. The results of student responses in the limited trial are listed in Table 7.

Tabel 7 Recapitulation of response result limited test students

No.	Aspect	Percentage of Indicators
1.	Student excitement	79.38 %
2.	Student comprehension	75.00 %
3.	Media clarity	80.64 %
4.	Student interest	81.88 %
	Average	79.22 %

Table 7 shows the recapitulation data of student response results in the limited test on each aspect. The results of student responses were then analyzed descriptively based on Table 4 regarding the categories of student responses. Student response on student excitement was 79.38% in the good category. Student understanding after using interactive learning media obtained a response of 75% in the "good" category. The media clarity aspect obtained a percentage of 80.64% with a "very good" category. Student interest in the media components obtained the highest percentage, with 81.88% in the very good category. The average student response results in the limited trial were 79.22%, which included the "good" category. The student response questionnaire had a suggestion column for media improvement before being used in a broad trial. Furthermore, the media were revised and improved according to the suggestions and input of students as users to produce Draft II, which was ready to be used on a wide-scale trial.

Assessment Phase

The final stage of this development research is the assessment stage. At the assessment stage, the revised Draft II of the limited scale trial was tested again with a wider scale. The broad trial stage was carried out on 36 students in MIPA class XI. At the assessment stage, the revised Draft II of the limited scale trial was tested again with a wider scale. The broad trial stage was carried out on 36 students in MIPA class XI. The implementation mechanism of the broad assessment stage was the same as the limited test stage. Students would first be given an initial test (pre-test) to determine the extent of their prior knowledge abilities. Afterwards, students will be given material and practice questions using Draft II of interactive learning media. The extensive trial is conducted in three 90-minute meetings. At the end of the learning process, students will be given a test in the form of 10 reasoned multiple-choice questions (a post-test) and a student response questionnaire.

The data from the pre-test and post-test would be used to determine how well the media worked. The effectiveness test uses learning outcome data, which was analyzed using the N-Gain equation as in Equation 4. The acquisition of the N-gain score in the broad trial was the same as that in the limited trial. Data on student learning outcomes tested by N-Gain showed a result of 0.66 with moderate criteria and was categorized as quite effective. The results of student responses to the broad test are shown in Table 8 .

Table 8 Extensive students test response

No.	Aspect	Percentage of Indicators
1.	Student excitement	80.73 %
2.	Student comprehension	77.43 %
3.	Media clarity	81.08 %
4.	Student interest	81.94 %
	Average	80.30 %

The average percentage data of student responses in the broad trial shown in Table 8 when analyzed regarding Table 4 is included in the "very good" category with acquisition of 80.30%. Student excitement obtained a percentage value of 80.73%, including the excellent category. In the aspect of student comprehension, it is categorized as good, with a percentage of 77.43%. Media clarity and student interest in media components were declared very good, with a percentage of 81.08% and 81.94%. Based on the results of the data analysis, it was found that students' responses to interactive learning media for high school physics assisted by Lectora Inspire 18 on the subject of temperature and heat were very good.

Lectora Inspire's validation of interactive learning media for high school physics showed an average score of 4.74 for a valid category. (Lukman et al., 2021) also found that learning materials made with Lectora Inspire software fall into a category that makes them very useful for learning. This is in line with Setyorini's research (2022), which found that interactive learning media assisted by Lectora Inspire software are valid and feasible for students and teachers to use in the learning process.

Through the validation stage and comparison with the results of relevant research, it was found that the interactive learning media for high school physics assisted by Lectora Inspire 18 on the subject of temperature and heat had advantages and disadvantages. The advantages of the developed media can be seen in its components, which are equipped with images, videos, illustrations, summaries, and complete experimental pages with experimental student worksheets. However, interactive learning media for high school physics, assisted by Lectora Inspire 18, on the subject of temperature and heat also has weaknesses, including no sound or direct explanation by the media maker to help students understand the material. The media also has several components that require internet access for their operation.

The effectiveness test of interactive learning media for high school physics assisted by Lectora Inspire showed quite effective results, so the media can support the learning process. The description of the increase in student learning outcomes after using interactive learning media is in accordance with the results of research previously conducted by Adoe (2022), which states that the average N-gain value of students after using interactive learning media assisted by Lectora Inspire is classified as effective. Similar research by Devega (2019) also states that the results of the analysis of the effectiveness of interactive learning media using Lectora Inspire, which is reviewed through the N-Gain score, were in the medium category.

The results of student responses in this study were comparable to students' cognitive learning outcomes, so the results of student responses supported the data on media effectiveness. The effectiveness of a media, model, or learning device can be seen based on the results of student responses to the media or model and the accumulated N-gain score (Nashiroh et al., 2020). Student responses showed that students were interested in the media components developed. Meanwhile, the clarity of the media also affects students' enjoyment of using interactive learning media, which impacts increasing student understanding. Increased student understanding of the

material impacts improving student learning outcomes.

Students' responses to interactive learning media with Lectora Inspire 18 were included in the "very good" category to be used as an alternative medium in classroom learning. The excellent student response as media users was supported by the validation results, which showed that the media presentation aspect was valid with the highest average score. This allows students to give very good responses because the media presentation was considered valid. Very good responses were also given based on the attractiveness of the media and media components developed. In addition, interactive learning media assisted by Lectora Inspire is new to SMA Negeri 1 Tenggarang students because similar research has never been done. The relationship between interest and acquiring the highest response is because the multimedia developed can attract interest in learning physics (Nuraini & Supriadi, 2018). Midroro et al. (2021) stated that the evaluation component in the media or module makes it easier for students to measure their abilities and is more practical when compared to written tests. This supports the practicality of the learning media developed because an evaluation page with 10 questions makes it easier for students to evaluate learning outcomes. The study's results are also in line with research conducted by Latifah (2020), which states that students' responses are very good to learning activities using interactive learning media assisted by Lectora Inspire.

Based on the results of data analysis related to high school physics learning media assisted by Lectora Inspire 18 on the subject of temperature and heat, it was declared valid based on the assessments of expert validators and users, effective and practical to support the learning process in terms of improving student learning outcomes, and likely to get a very good response from students.

CONCLUSION

Based on the results of the data analysis, it can be concluded that Metafora, as a result of its development, is declared feasible for use as an alternative medium in physics learning. The results of expert and user validation of interactive physics learning media assisted by Lectora Inspire 18 on temperature and heat obtained a result of 4.74 with a valid category. The N-gain test results were 0.60 with moderate criteria, and the broad trial also showed moderate effectiveness criteria with N-gain results of 0.66. Based on the N-Gain interpretation category, the results of media effectiveness in the limited trial were categorized as quite effective with a percentage of 60%, and in the broad trial, 66% were obtained with a fairly effective category. Students' responses to interactive learning of physics aided by Lectora Inspire 18 on the subject of temperature and heat in the limited trial were included in the good category with a percentage of 79.22%, while in the broad trial, they obtained a percentage of 80.34% with very good criteria.

The developed product can also be used as a reference for conducting further research in the form of quasi-experimental research to see students' learning interests, concept understanding, and critical thinking skills through the use of interactive learning media assisted by Lectora.

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