



## **Development of E-Modules of Integrated Temperature and Heat with STEM-Contextual Approach of Papua**

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### **ABSTRACT**

This study intended to describe the results of the development of an e-module of integrated temperature and heat by using the STEM-contextual approach of Papua. This study was conducted at SMAS YPK. The subjects of this research were class X students of SMAS YPK Merauke who were used to test the product being developed. The research method used is Research and Development (R&D) with the ADDIE development model. The instruments used in the study were validation sheets, teacher and student response questionnaires, and essay tests. The results of this study are products in the form of STEM-based e-modules. Expert validation results were conducted and show the result 90.6% for material, 91.66% for media, and 85.5% for linguists' parts respectively. Besides, the results of the student response questionnaire were 86.25%, and the teacher's response questionnaire was 97.91%. Therefore, it can be concluded that the development of an e-module of integrated temperature and heat with a STEM-contextual approach of Papua is very appropriate to be used in the physics learning process.

**Keywords:** e-module, heat and temperature, STEM, contextual approach

### **INTRODUCTION**

The growth of science and technology, followed by changes in various social aspects, demands the creation of brilliant mindsets in individuals. The development of science and technology requires a mindset one step ahead to create an individual's advanced thinking (Henukh & Astra, 2021). For the current situation of the Covid-19 pandemic, learning during this challenging period requires much effort with the help of technology for sustaining the teaching and learning process. On March 24, 2020, the Ministry of Education and Culture Nadiem Anwar Makarim said in Circular Letter No. 4 of 2020, regarding the Implementation of Education in an Emergency Situation of the Spread of COVID, explained that the learning process should be carried out through online platform, however meaningful for students to achieve the lesson outcomes (Henukh et al., 2022; Rohmah et al., 2021).

To deal with this problem, learning innovation is required through E-modules so that students could understand better and lessons could be more interactive. Two previous studies reported that e-modules that have been implemented showed a good average result, thus these e-modules are suitable to be used in the teaching and learning process (Rahayu et al., 2015;

Resbiantoro & Cari, 2015; Rosyidah et al., 2015). STEM-based E-modules that are integrated with inquiry learning are feasible to be used with media experts and material experts' scores were quite decent (Henukh et al., 2021; Pujiati, 2019).

### **Problem of Research**

Implementing the STEM approach together with the Papuan contextual approach in the curriculum is demanded because these two approaches require students to be actively engaged in class, for both physical and mental activities. In addition, it is also applying the real-world situations of students' daily lives. The STEM approach at the high school level focuses on strengthening and enriching abilities through activities that expose STEM concepts at a higher level (Carin & Sund, 2016; Hapiziah et al., 2017). Thus, learning materials that focus on application in real-life situations are really necessary and demanding to be used.

### **Research Focus**

This study focuses on developing e-modules of integrated heat and temperature with a STEM-contextual Papuan approach. E-modules are independent learning materials that are arranged systematically and contain images, animations, audio, and video for students to experience in their learning. and. It is also used by the teacher to be given to the students that can be used independently.

Characteristics of the E-modules that the author has developed define basic competencies, indicators, and objectives. Learning material is packaged into small parts to make it easier to be used by the students that contain practice questions for students to answer and measure their level of mastery. The modules are also supported by a summary of the learning material, examples, and illustrations that support the clarity of the presentation of learning material and use language that students can easily understand. In this study, the e-modules that will be developed are integrated with the STEM-contextual approach of Papua. This integration aims to facilitate understanding the concept of the material for students learning.

Therefore, the development of E-Modules is required to be done to face the current pandemic challenges and also as supported learning resources for students to use in their learning process. Moreover, it is hoped that the modules could provide significant benefits to improve students' independent learning abilities.

## **METHODOLOGY OF RESEARCH**

### **General Background of Research**

The type of research used is research and development. This study used the ADDIE model as this model is usually used by researchers as guidance to produce instructional materials. The ADDIE research model involves five phases which are; analysis, design, development, implementation, and evaluation. The advantage of the ADDIE model, it

contains continuous evaluation at every phase and it is good for the validity and reliability of the materials to be produced (Henukh et al., 2019).

### Subject of Research

This study was conducted at SMAS YPK, Merauke Regency in June-November 2022. The subjects of this research were class X students of SMAS YPK Merauke who were used to test the product being developed.

### Instruments and Procedures

The data collection process is through the instruments, namely validation questionnaires and legibility test questionnaires, that consist of teacher and student responses through the given questionnaires. The validation questionnaire is used to indicate the level of validity or feasibility of the e-modules. Comments and suggestions obtained from the validation results will be used as a reference in improving the e-modules to be developed.

### Data Analysis

The results of the validation and the results of the readability test in the form of an average score for each statement item were then analyzed with the equation below:

$$\bar{X} = \frac{\sum x}{n}$$

Information:

$\bar{X}$  = average score

$n$  = Number of items

$\sum x$  = total score

The product quality criteria used are presented in table 1 below:

**Table 1.** Product quality criteria

Score Range	Quality Criteria
$\bar{X} \geq X_i + 1,8 Sb_i$	Very good
$X_i + 0,6Sb_i < \bar{X} \leq X_i + 1,8Sb_i$	Good
$X_i - 0,6Sb_i < \bar{X} \leq X_i + 0,6Sb_i$	Enough
$X_i - 1,8Sb_i < \bar{X} \leq X_i - 0,6Sb_i$	Less
$\bar{X} \leq X_i - 1,8 Sb_i$	Very poor

Information:

$\bar{X}$  = Average score

$X_i$  = Average ideal score

$= \frac{1}{2}$  (highest score + lowest score)

$Sb_i$  = Standard Deviation ideal score

$= \frac{1}{6}$  (highest score - lowest score)

## RESULTS AND DISCUSSION

The analysis was carried out from the gathered data in this study. The results of the needs analysis are presented in table 2.

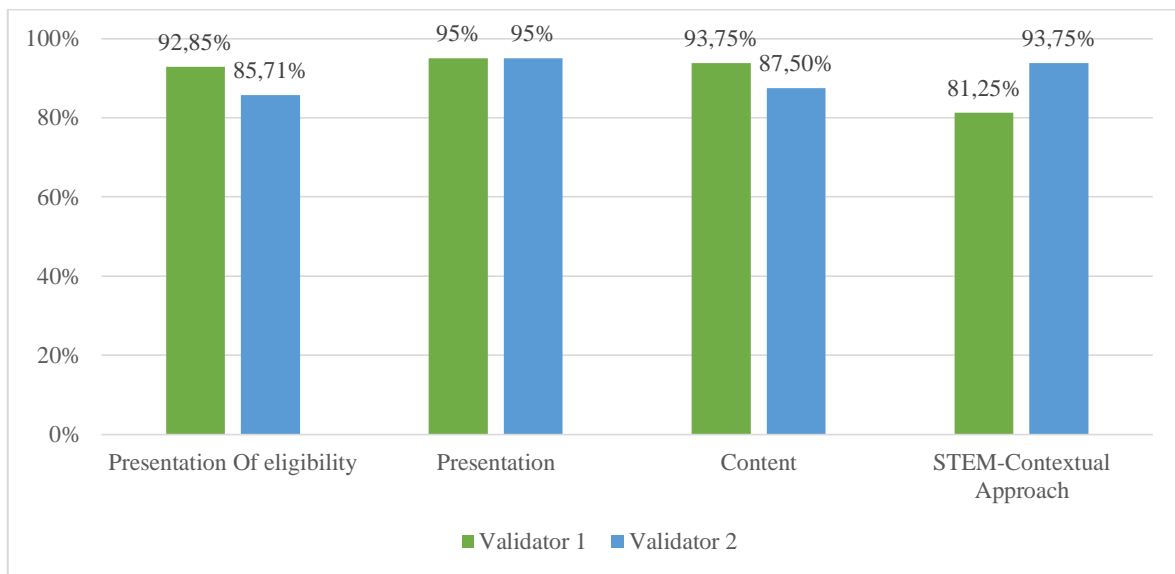
**Table 2.** Needs Analysis Results

Indicator	Results	Description
Current physics module ownership	34,6%	Already own
Interesting module	50%	Interesting enough
Illustrations/pictures on the available modules	46,2%	Interesting enough
Owned modules are presented in the form of E-modules	27,7%	Agree

Based on the results of the analysis that has been conducted it is known that the owner of the physics module is the owner of the module. Illustrations/pictures on the available modules and presentations in E-modules still need development and improvement to support online/online learning. In addition, the teachers also answered that learning media is in the form of E-modules.

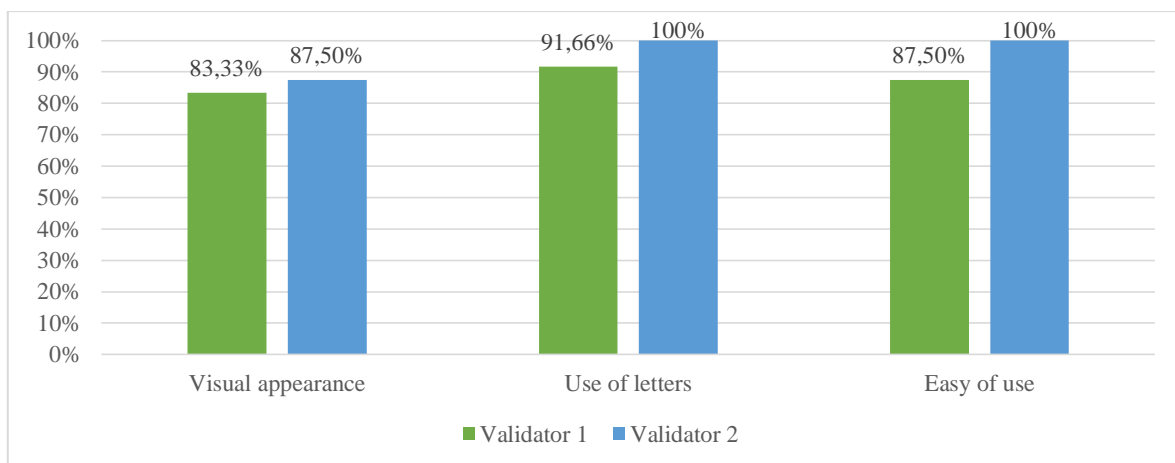
The second stage carried out in this research is to make the module design developed. The introductory section includes the cover, preamble, table of contents, list of tables, list of figures, instructions for use, explanation of the approach used, basic competencies, and concept maps. The contents of the E-module consist of heat material divided into several sub-chapters, namely, temperature, expansion of matter, heat, and heat transfer which includes four STEM aspects, namely science, technology, engineering, mathematics, and the Papuan context. Closing consists of a summary, competency test, bibliography, glossary, index, and competency test.

The third stage is to develop the product. Product development is done through product validation by material, media, and language experts. The results of product validation can be seen in the following figure.



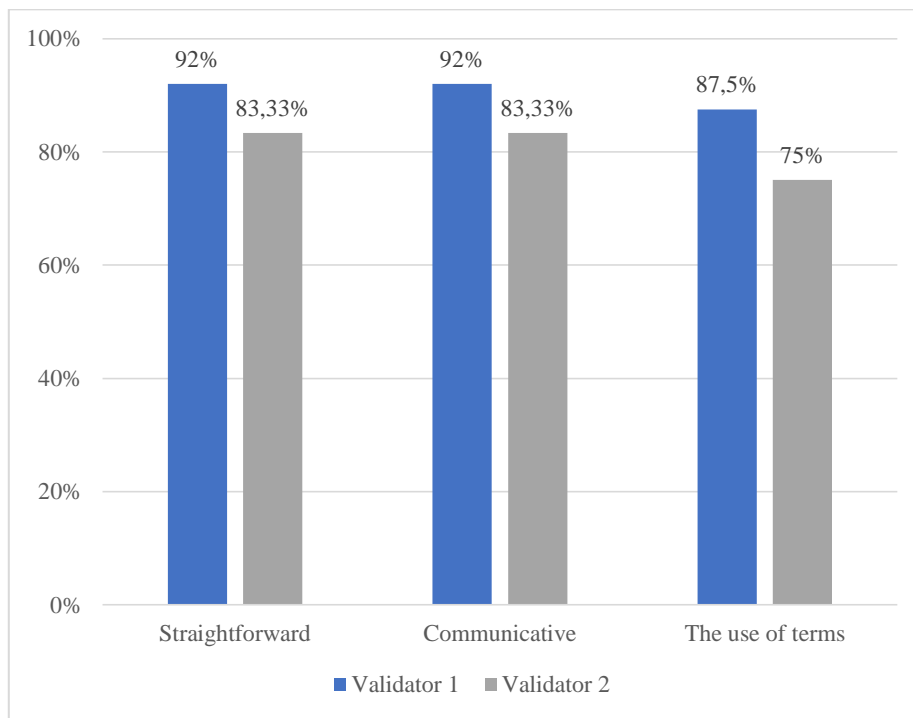
**Figure 1.** Material Expert Validation Results

Based on the picture above, the assessment given to the completeness aspect of the presentation obtained an average percentage of 89.28%, the presentation aspect was 95%, the content aspect was 90.62%, and the STEM approach aspect was 87.5%. The average assessment of material expert validation is 90.6%, with a very decent category. The results of media expert validation by two validators can be seen in the following figure.



**Figure 2.** Media Expert Validation Results

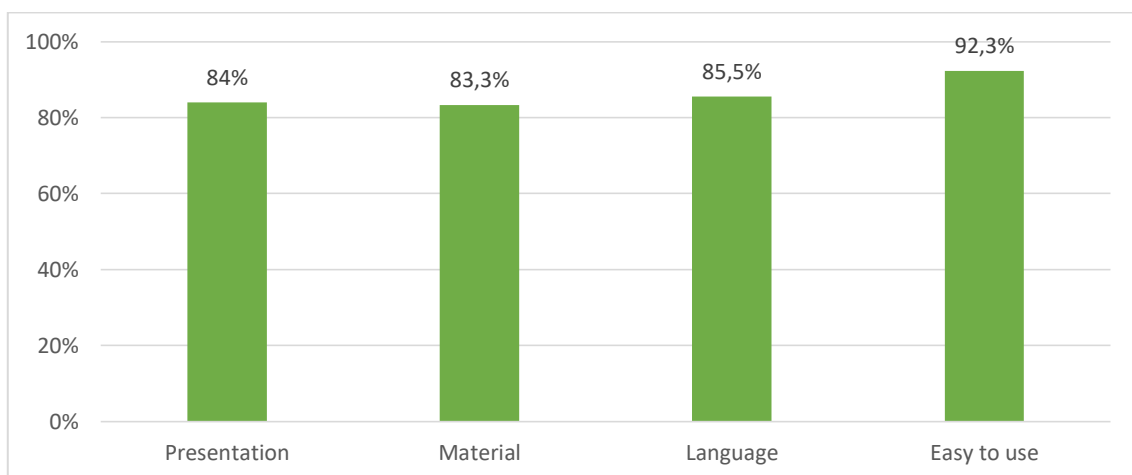
Based on the picture above, the average rating on visual appearance is 85.41%, the aspect of using letters is 95.83%, and the aspect of ease of use is 93.75%. Overall the results of the media expert validation average score of 91.66% with a very decent category.



**Figure 3.** Linguist Validation Results

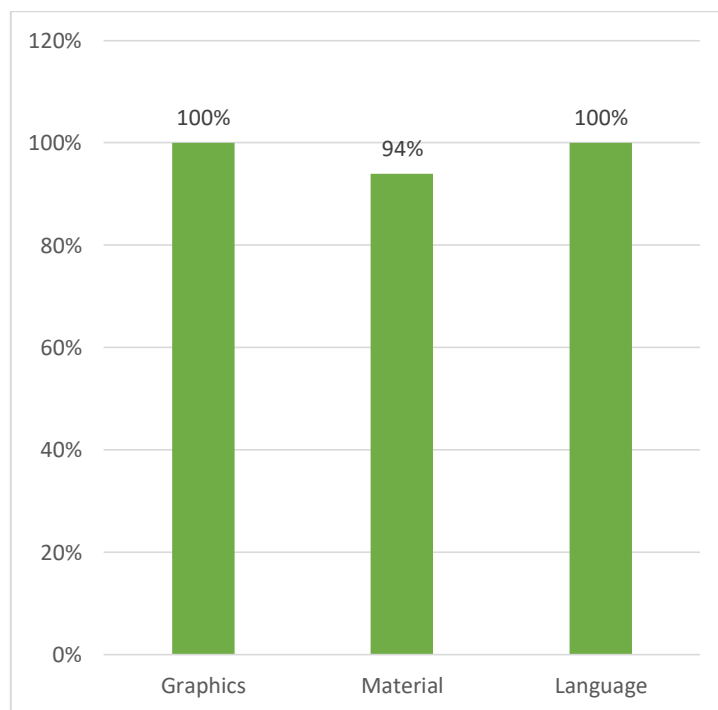
Based on the picture above, the validation assessment on specific aspects obtains an average percentage of 87.5%, 87.5% for communicative aspects, and 81.5% for aspects of using terms. The overall average rating obtained a percentage of 85.5% with a very decent category. After the validation, the next stage is design revision based on the experts' advice to distribute the developed product to students.

After the product is declared feasible or feasible by the validators, the next step is to apply it to students and teachers to find out the response to the E-module. The response test was conducted online with 30 students and 3 YPK Merauke high school teachers. The results of the response trials are presented in the following figure.



**Figure 4.** Student Response Test Results

The picture above is the result of the student response test conducted on 23 students. In the presentation aspect, the percentage is 84%, the material aspect is 83.3%, the language aspect is 85.5%, and the convenience aspect is 92.3%. The average percentage of the four aspects obtained is 86.25%, with a very good category. In addition, the results of the analysis of teacher response data can be seen in the following figure.



**Figure 5.** Teacher Participant Response Test Results

In the picture above, it can be seen from the graphical aspect that the percentage is 100%, the material aspect is 94%, and the language aspect is 100%. The average percentage of the three aspects is 98%, with a very good category.

The final stage is evaluation. The evaluation stage used is formative evaluation. Formative evaluation is carried out during product validation and revisions from experts who have provided suggestions and comments. Evaluation is also carried out by looking at the assessment of student and teacher responses. Formative evaluation is carried out at each stage of the ADDIE design. The last evaluation carried out in this study was the response from students and teachers. The results of the revision of each stage of the ADDIE model become the final product of an integrated heat and temperature E-module with an integrated STEM-Papua contextual approach.

The above results align with previous research, explaining that the analysis aims to gather the information necessary to develop media learning E-modules based on the STEM approach. In addition, using textbooks as learning media has not provided optimal results for students (Afriana et al., 2016; Apriyani et al., 2019; Nurkhalisa & Mastura, 2018).

Material, media, and language validation was carried out by two validators who assessed several indicators used in the study so that they were not biased. This research is in

line with previous research, which explains that good teaching materials with systematic and consistent concepts can make students more interested in student learning and make it easier to understand the material. It is the same as previous research that e-modules must meet material eligibility if they include conformity with the curriculum, sentence structure, actuality, and material flexibility. The E-module has been prepared with an attractive design and appearance and has undergone a material, media, and language validation process. As previously explained by researchers, the results of teacher and student response tests also show that STEM learning can provide impressive experiences that generate motivation and interest in learning (Hapiziah et al., 2017; Henukh et al., 2021; Purmadi & Surjono, 2016; Resbiantoro & Cari, 2015).

## CONCLUSIONS

Based on the research, it can be concluded that the results of developing the E-module temperature and heat integrated with the Papuan STEM-contextual approach are feasible with material validation results of 90.6%, media validation of 91.66%, and language validation of 85.5%. The assessment obtained from the results of the student response test obtained a percentage of 86.25%, and the teacher's response test obtained a percentage of 97.91% which was very suitable for learning. Based on the results of this study, large-scale trials and implementation of this research product are needed in the future so that students in learning activities can widely use this E-module product.

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