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## THE DEVELOPMENT OF ETHNOPHYSICS BASED ENRICHMENT BOOK ON THE PROCESS OF MAKING BRICKS IN MUARO JAMBI REGENCY

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### **Abstract**

*This study aims to develop an ethnophysics-based enrichment book on the brick-making process in Muaro Jambi Regency in order to improve students' cognitive abilities. The research method used is Research and Development and refers to the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation). The research subjects were material experts, media experts, and students of class XII Science at SMAN 7 Kota Jambi. The research instruments used were interview guidelines, student characteristic questionnaires, observation sheets, expert validation sheets, and perception trial questionnaires. The data obtained were in the form of qualitative data which was analyzed continuously and intensively and quantitative data which were analyzed using descriptive statistics. This enrichment book is written in communicative language equipped with interesting pictures, data, and factual information on bricks in Muaro Jambi Regency. The results of the feasibility test by the material expert validators and the media experts in the first stage were 76% in the good category and in the second stage, it was 97% with the very good category. The results of the student's perception test showed that the ethnophysics-based high school physics enrichment book in the brick-making process in Muaro Jambi Regency was feasible to use with a percentage of 83% which was included in the very good category.*

**Keywords:** Bricks-making Process, Enrichment Book, Ethnophysics

### **1. INTRODUCTION**

Physics is a natural science that is closely related to natural phenomena and their applications in everyday life. According to Fadilah (2019), in the environment around students, there are also many conceptual and contextual examples, conceptual and contextual questions that can be used to guide students in gaining conceptual understanding and good learning outcomes. In addition, the purpose of learning physics is to master the concepts of physics and be able to solve problems in the environment by applying the concepts of physics in it. According to Muslimin, et al (2018), achieving learning objectives can be classified into Bloom's taxonomy. The cognitive domain or abilities related to aspects of knowledge, reasoning, or thinking in Bloom's taxonomy can be divided into 6 levels, they are knowledgeability (C1), comprehension ability (C2), application

ability (C3), analytical ability (C4), evaluation ability (C5).), and the ability to create (C6).

The application of Bloom's taxonomy in learning in schools can be supported by a large number of student learning resources. Learning resources that can support students to improve cognitive abilities at school can be in the form of enrichment books. Enrichment books are an additional learning resource that has a knowledge add-on function such as increasing the reader's knowledge and increasing readers' insight into science, technology, and art (Rofiah, 2015). This book is not mandatory for students to use but it is useful for students who have difficulty understanding certain subjects in the main textbooks (Sitepu 2012).

Enrichment books are grouped into three groups, they are knowledge enrichment books, skills enrichment books,

and personality enrichment books (Desnita, et al, 2016). Knowledge enrichment books are books that can develop students' knowledge (knowledge development). By having this knowledge enrichment book, students can get new knowledge that is not obtained from textbooks because the information in knowledge enrichment books is broader or deeper. Knowledge enrichment books have different characteristics, they are presenting material that is factual, developing reading material that is based on science, and developing various knowledge such as factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge.

In its presentation, enrichment books can be linked to local wisdom because the use of learning resources in the context of local wisdom is considered effective to improve students' analytical skills. This is in line with research conducted by Jufrida, Basuki, & Rahma (2018) which examines the local wisdom of the Merangin geopark which has the potentiality to be used as a source of learning science at the junior high school level. Rosyidah (2013) also states that local wisdom-based learning can improve learning outcomes with student activity for about 84.37% and a very active category of 15.63%.

Ethnoscience is the activity of transforming original science which consists of all knowledge about the facts of society that comes from hereditary beliefs and still contains myths (Lia, et al., 2016). Ethnoscience consists of ethnophysics, ethnochemistry, ethnobiology, ethnomathematics, and ethnomedicine (Battiste, 2005). Ethnophysics is a field of study that has emerged slowly from ethnomathematics research (Lins et al., 2019). The advantages of ethnophysics in learning are (1) meaningful learning experiences, (2) developing student skills, (3) collaborating and interacting with learning, (4) communication, (5) critical and reflective thinking, (6) self-confidence and argumentation skills, (7) Creativity (Derlina et al., 2019). One culture that has been passed down from generation to generation in Muaro Jambi Regency is the process of making red bricks.

Brick is one of the basic materials used to make a building that is made of soil with or without a mixture of other materials (Suhendra, 2015). One of the world cultural heritages in Jambi is Muaro Jambi Regency Temple. This temple is estimated to have been built in the 9-12 century AD. The temple building is made of red bricks called the menopo (Meilania & Febrianti, 2019). Besides Muaro Jambi Regency Temple, another temple was also found in Muaro Jambi Regency, precisely in Pematang Jering Village, which was also made of red bricks. This shows that since ancient times the people of Jambi have been able to master simple techniques for making bricks. Public knowledge about the process of making bricks can be reconstructed into scientific knowledge that can be used as a source of learning physics. Therefore, the local culture of making bricks can be used as an alternative activity to add insight and knowledge to teachers and students.

Based on the results of student diagnostic tests that have been carried out at SMAN 8 Muaro Jambi and SMAN 7 Kota Jambi, it is known that 78.69% of students still find it difficult to connect physics with the surrounding environment, especially in the aspect of local wisdom in making bricks in Muaro Jambi Regency. Based on the results of diagnostic tests for the cognitive domain in Bloom's taxonomy, only 21.31% of students have the ability to apply (C3) and analyze (C4). According to (Annuuru, et al., 2017), students' ability to analyze is low because when a diagnostic test is given to the students, they have not been able to distinguish or break down the material into more specific parts and determine the relationship between parts and the overall concept.

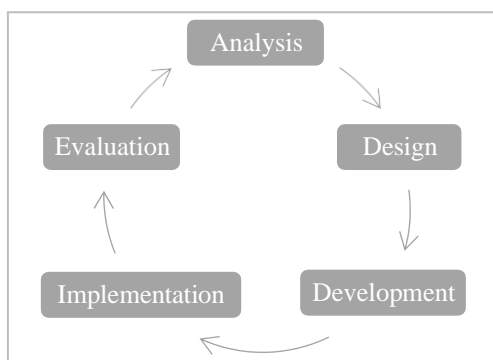
In addition, based on the results of interviews with teachers at SMAN 8 Muaro Jambi and SMAN 7 Kota Jambi, it is also known that 100% of schools do not have enrichment books and 100% of schools do not have learning resources that are integrated with local wisdom. Whereas, based on the results of the questionnaire on student characteristics, it was known that students were very interested in learning

physics with an average score of 77.78% in the good category.

Based on these problems, the solution that can be done is to develop an ethnophysics-based enrichment book on the brick-making process in Muaro Jambi Regency. This study aims to produce an ethnophysics-based high school physics enrichment book on the brick-making process in Muaro Jambi Regency in order to improve students' cognitive abilities.

## 2. RESEARCH METHOD

This research uses the type of development R & D (Research and Development) with the ADDIE model development type. According to Rusdi (2018), the implementation of the steps at each stage of ADDIE is guided by research methods that are in accordance with the types of main stages, objectives, and characteristics of each stage. The five stages in the development of the ADDIE model can be seen in the following Figure 1:



**Figure 1. ADDIE Development Model Framework**

Source: Rusdi (2018)

In its implementation, this research was only carried out in 3 stages, they are the first, analyzing stage which consists of needs analysis, student characteristic analysis, prerequisite abilities and initial abilities analysis, and learning environment analysis. The second is a design stage, that consists of seven steps, they are determining the development team, determining the required resources, compiling a development schedule, selecting and determining the scope, structure, and sequence of materials or learning messages, making storyboards,

determining product specifications, and making prototypes product. The third is a development stage which consists of the validation of material experts and media experts as well as validation of practitioners in the form of students' perceptions of the enrichment book being developed. The subjects of this study were material experts, media experts, and students of class XII Science at SMAN 7 Kota Jambi. The instruments used in this study were:

1. interview guidelines, which contained a list of questions to teachers at SMAN 8 Muaro Jambi and SMAN 7 Kota Jambi. The questions were about the learning environment of students in schools and to the brick crafts community about brick processing to get information about the community's original knowledge.
2. Questionnaire, this questionnaire sheet aims to find complete information about the problems faced by being asked questions. The questionnaire used was a questionnaire for analyzing student characteristics.
3. Observation sheet, this sheet is in the form of a diagnostic test. The distribution of this observation sheet is given to students to find out the weaknesses of students in understanding physics material.
4. Expert Validation Sheet, which is a sheet of corrected results from media experts and material experts used to determine the relevance of the enrichment book to the expected competencies.
5. Perception Trial Questionnaire, this questionnaire aims to see student responses regarding the enrichment book that has been developed whether it is in accordance with the material being taught or not.

The data obtained in this development research are qualitative and quantitative data. Qualitative data were obtained from the input and comments of the validators and students which contained answers to the questionnaire in the form of suggestions for improving the enrichment book material and media. Qualitative data analysis was carried out continuously and intensively. While the

quantitative data of this development research was obtained from scoring validation questionnaires and testing students regarding the assessment of enrichment books that had been made. Furthermore, the data were analyzed using a Likert scale. According to Helmi, et al. (2016) the Likert scale is a scale that can be used to measure the opinion or perception of a person or group.

To calculate the product eligibility percentage, the interpretation of the score is calculated based on the acquisition value of each item as follows:

$$I = \frac{\sum \text{acquisition score}}{\sum \text{maximum score}} \times 100\% \quad (1.1)$$

Description:

I = Interpretation of the percentage shore of the assesment

for the interpretation criteria of the score on the product assessment can be seen in the following table:

**Table 1. Interpretation Criteria**

Percentage	
Percentage	Criteria
0 – 20%	Very Bad
21 - 40%	Bad
41 – 60%	Good enough
61 – 80%	Good
81 – 100%	Very Good

(Source: Riduwan & Sunarto, 2010)

Based on the above criteria, the enrichment book product is said to be feasible if the assessment is in the range (61-80%) or (81-100%) in the good and very good categories.

### 3. RESULT AND DISCUSSION

The results of this development focused on developing a high school physics enrichment book on the brick-making process in Muaro Jambi Regency. The purpose of this development is to improve students 'cognitive abilities and increase students' insight into local wisdom in Jambi. The process of developing this enrichment book is carried out in a structured manner according to the ADDIE development model according to Rusdi (2018) which starts from

Analysis, Design, and Development. The following is an explanation of the results of the development that has been carried out:

#### A. Analysis

At this stage, the researcher conducts 4 analyzes including needs analysis, student characteristic analysis, prerequisite and initial ability analysis, and learning environment analysis. The needs analysis was carried out by conducting interviews with brick craftsmen in Muaro Jambi Regency and science experts whose aim was to assist researchers in the process of reconstructing the community's original knowledge into scientific concepts, especially the concepts of physics material circular motion, measurement, pressure, heat transfer, and work. This needs analysis is carried out to ensure that the enrichment book is developed according to the needs.

The second analysis is the analysis of student characteristics. In this analysis, the researcher distributed a questionnaire on student characteristics to see the students' interest in learning physics at school. The results of the analysis showed that 77.78% of students were interested in learning physics with good categories.

The third analysis is the analysis of the prerequisite skills and initial abilities. In this analysis, the researcher gave a diagnostic test to 42 students at SMAN 8 Muaro Jambi and SMAN 7 Kota Jambi. The researchers conducted this analysis aimed to determine the initial abilities of students, in this case regarding the brick-making process related to the concept of physics and to find out the student's ability to analyze (C4) the questions given. From the results obtained, there are 21.31% of students have the ability to apply (C3) and analyze (C4). This shows that the students' ability to apply (C3) and analyze (C4) is still low because students still do not know the process of making bricks in Muaro Jambi Regency and have not been able to explain the relationship between the physics concepts that exist in each of these brick-making processes.

The last analysis is the analysis of the learning environment. In this analysis, interviews were conducted with physics teachers at SMAN 8 Muaro Jambi and

SMAN 7 Kota Jambi. This analysis aims to determine the learning environment in the school, in this case in terms of facilities and infrastructure. Based on the results of interviews that have been conducted, it showed that the teachers and the students are using learning resources in the form of textbooks such as books published by Marthen Kanginan and Grafindo for their teaching and learning processes. In addition, there are no enrichment books that is used for their learning process, especially physics enrichment books that are integrated with local cultural wisdom.

### B. Design

The design stage is the stage where the researcher carries out the process of designing the enrichment book that is being developed. The design of this enrichment book is based on the storyboard and specifications of the enrichment book product. Specifications can include paper size, color, font size, font, layout, format, illustration figures and tables. The enrichment book developed measures 148 mm x 210 mm (A5). There are several variations of typeface used, but the focus is on the content in the enrichment book, namely the "Andalus" typeface. Other font variations are used in book cover designs, both cover and chapter covers.

Furthermore, the researcher determines the scope of the material to be published in the enrichment book. The material contained in high school students in the process of making bricks is circular motion material, measurement, pressure, heat transfer by radiation, convection and conduction, and also business materials. The purpose of determining the scope of this material is to facilitate researchers in developing products and provide additional insight to readers, especially students.

Moreover, the researcher also determines the development team, supporting resources and the development schedule. The existence of this determination in the design stage serves to ensure that the product development process can be carried out properly.

### C. Development

The development of an ethnophysics-based high school physics enrichment book in the brick-making process starts from the beginning of the book, the contents, and the end of the book. The following are the results of the development of the enrichment book in each section:

#### 1. Beginning of the Book

##### a. Book Cover

Book cover is made based on the title of the book being developed. The book cover is divided into three parts, they are the front cover, the spine, and the back cover. The front cover of the book contains a logo, type of book, book title, author and contains a picture of a house on stilts in Muaro Jambi made of bricks, the process of making bricks, and bricks. On the spine of the book contains the logo, type of book, book title, and author. And on the back cover of the book contains a description of the book, the type of book, the title of the book, and a picture of the brick drying process. For more details, it can be seen in Figure 2.

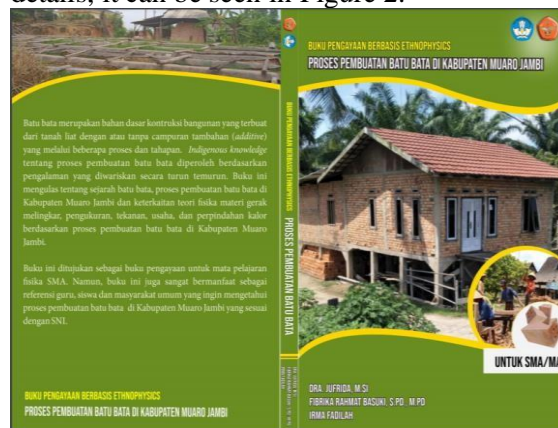


Figure 2. Book Cover Design

##### b. Chapter Cover

Cover Chapters are made to make it easier for readers to understand the material discussed in the chapter. Chapter covers contain chapter descriptions, chapter titles, and an introduction that is containing the topics discussed. In addition, the chapter cover also contains images that are in accordance with the topics discussed. An example of a chapter cover made in an enrichment book can be seen in Figure 3.

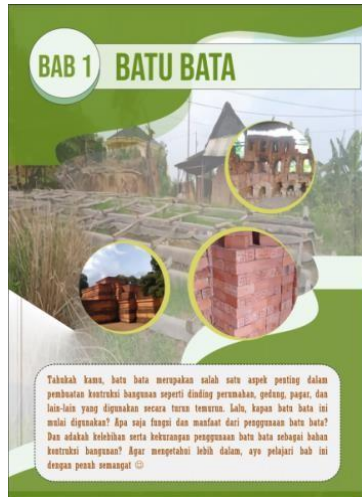


Figure 3. Example of Chapter Cover Design

c. Preface

The preface contains the author's thanksgiving sentence to God Almighty, a brief description of the book, and the author's expectations for criticism and suggestions from readers.



Figure 4. Book Preface

d. Table of Contents

The table of contents contains the parts of the book that can make it easier for readers to find the topic they want to read.

Figure 5. Book Table of Contents

e. List of Figures and List of Tables

The list of figures contains captions of images that can make it easier for readers to find images to be viewed, and the list of tables contains table descriptions that can make it easier for readers to find the table to be seen.

Figure 6. a) The list of Figures and b) The list of Tables

f. Book Guideline

Book guideline contains sections that describe the contents of the book. It give the easiness for the readers to study the book.



Figure 7. Book Guideline

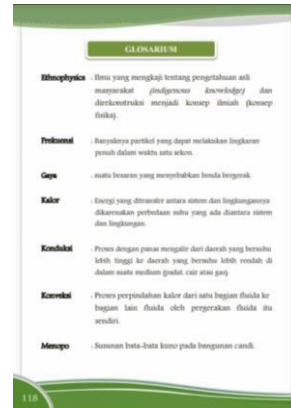


Figure 9. Example of Book Glossary

2. Contents

The contents contains a collection of materials related to bricks such as the history of bricks, functions, advantages and disadvantages of bricks, and also the concept of physics in each brick-making process in Muaro Jambi Regency. The physics concepts contained in each process are circular motion, measurement, pressure, heat transfer by radiation, convection and conduction, and work material.

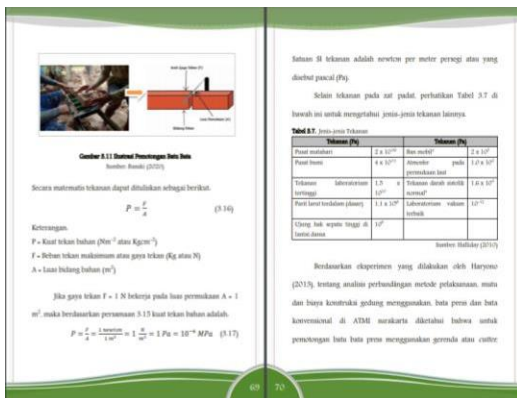


Figure 8. Example of Book Content

b. Bibliography

The bibliography contains the sources of books and journals used in making material in the enrichment book being developed.



Gambar 10. Example of Book Bibliography

c. Author's Profile

Author's profile contains the author's bio, the author's educational history, and the purpose of the book being developed.

3. End of the Book

a. Glossary

The glossary contains a list of terms contained in the contents of the book, which is accompanied by definitions for these terms.



Gambar 11. Author's Profile

The finished enrichment book product will be continued at the validation stage of both the material and the media. This validation is carried out to determine the feasibility level of the product being developed. In addition, validation is also carried out to receive suggestions from the validator so that the product being developed has a better quality. The validation was carried out by three validators and carried out twice for each validator. The results of the validation in the first stage can be seen in Table 2.

**Table 2. First Validation Results**

Validator	Pernyataan																									
	Komponen Materi						Komponen Penyajian										Komponen Bahasa				Komponen Grafika					
	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	5	6
1	3	4	4	4	3	4	4	3	3	4	4	4	3	4	4	4	4	4	4	4	3	3	4	4	4	
2	5	4	4	4	4	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
3	4	4	4	3	4	4	4	3	3	4	4	3	3	4	4	4	4	4	3	4	3	4	3	4	3	
Total Skor	12	12	12	11	12	10	11	10	10	11	12	11	11	11	12	12	12	12	12	11	11	10	12	11	12	11
Total Skor tiap Komponen	80						112										46				68					
Persentase Skor	76%						75%										77%				76%					

Based on Table 2, the results of material validation were obtained with the percentage of the material/content feasibility component of 76% and the material/content presentation component of 75%. Meanwhile, the results of media validation was obtained the percentage of language components by 77% and graphic components by 76%. From the results of the first validation, suggestions were obtained from each validator so that there were several parts of the product display that had to be revised. The results of the revisions that have been made based on suggestions from the validator can be seen in detail in Table 3.

**Table 3. List of Revision Result in the Enrichment Book**

Before Revision	After Revision
- The front cover of the book has no mention of the complete title	- The cover of the book is added with the complete title "Proses Pembuatan Batu Bata di Kabupaten Muaro Jambi"
- The back cover of the book contains a concise synopsis, the title in complete	- The back cover of the book contains a brief, concise, and

Before Revision	After Revision
	clear synopsis of the book and the title is added complet as the front cover.
- The table of contents, the list of figures, and the list of tables, they are not neat	- Fixing the table of contents, the list of figures, and the list of tables by leaving spaces between dots and page numbering..
- The writing of tables and figures in chapter 3 does not have clarity and completeness of information.	- Add caption to figures and tables for each figure and table.
- There is no introduction before displaying the image.	- The addition of an introductory psentence before displaying the image.
- In chapter 1. The image of the tampples are seperated	- The image of the type of Muaro Jambi temples are put into one picture frame.
- there are no images of the type of bricks that are commanly used by community.	- add pictures on the mentions of the types of bricks.
In chapter 2, it is better to discuss about the bricks in Muaro Jambi, not only about the process of making bricks in general	The addition of sub-topics to discuss the history of bricks in Muaro Jambi Regency.
In chapter 3, it discusses the relationship between the concept of the physics with the note that the material presented does not show the value of indogenous knowledge that exists in each bricks-making process.	Added the indogeneous knowledge first before reviewing the physics concept contained in it



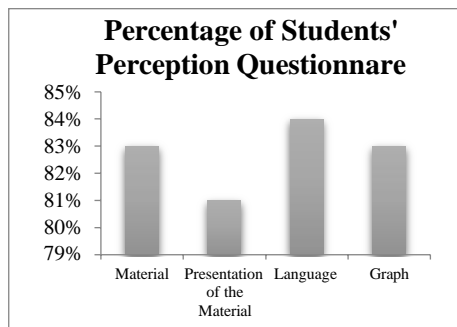
The results of the revisions in the first validation are validated again by the validator in the second validation. Here are the results of the second validation.

**Table 4. Second Validation Result**

Validator	Pernyataan																									
	Komponen Materi						Komponen Penyajian										Komponen Bahasa				Komponen Grafika					
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	5
1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
2	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4										
3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Total Skor	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	10	10	10	10	10	10	10	10	10	10
Total Skor tiap Komponen	99						140										40				60					
Persentase Skor	94%						93%										100%				100%					

Based on Table 4, the results of the material validation were obtained from the three validators with the percentage of the material/content feasibility component of 94% and the material/content presentation component of 93%. Meanwhile, the results of media validation was obtained a percentage of the two validators for the language component of 100% and the graphics component of 100%. So, the average percentage of all components in the material and media is 97% with the very good category. After passing the validation stage, the next step to take is the practicality test.

The practicality test was carried out by distributing student perception questionnaires. The test subjects in this practicality test were students of grade 12 science at SMAN 7 Kota Jambi. The student perception questionnaire contains 20 statement items consisting of 4 components, they are the feasibility of the material/content, the presentation of the material/content, language and graphics. Based on the results of distributing questionnaires conducted via Google Form, data were obtained as many as 27 students who filled out the questionnaire. The results of the student perception questionnaire can be seen in Figure 12.



**Figure 12. Bar Chart of Students Perceptions Results**

Based on Figure 12. It can be seen that the student's perceptions of the enrichment book that were made were in a very good category. The highest percentage order is obtained in the language component with a percentage of 84%. The second place is in the material/content and graphic feasibility component with a percentage of 83%. And the last order is the component of the presentation of the material/content with a percentage of 81%.

#### 4. CONCLUSION

Based on the results of the development and discussion that have been described, it can be concluded that:

1. The development of ethnophysics-based high school physics enrichment book products in the brick-making process in Muaro Jambi Regency is carried out in three stages, namely: first, analysis. At this stage, a content needs analysis was carried out, an analysis of the characteristics of students' interest in learning physics, an analysis of the prerequisite abilities and initial abilities carried out by distributing diagnostic test questions to students, and an analysis of the student's learning environment by conducting interviews with physics teachers at school; second, design. It is done by determining the resources needed in the manufacture of the product, product specifications, and designing the content by collecting physical materials in accordance with the brick-making process in Muaro Jambi Regency; and third, development. It is carried out by

validating material experts and media experts to determine the feasibility of the enrichment book being developed.

2. The ethnophysics-based high school physics enrichment book on the brick-making process in Muaro Jambi Regency which was developed got the average percentage of student perception test results with 27 students as respondents were 83% with the very good category.

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