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# Bruner's theory on the development of e-book traditional snacks ethnomathematics for mathematical understanding ability

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***Abstract*:**
This study aims to make traditional books that were packaged electronically with an ethnomathematics approach to traditional snacks, which was adapted from Bruner's theory by presenting three stages of Bruner's theory as enactive, iconic, and symbolic by incorporating elements of traditional snacks as an ethnomathematics approach as an effort to build students' mathematical understanding abilities. The method used the 4-D concept by using questionnaires and test instruments so that this media was valid and suitable for use as a medium in learning mathematics. The results showed a score of 3.86 for material experts and 3.74 for media experts, with 82% eligibility criteria to improve students' mathematical understanding abilities. The response to the ethnomathematics-based e-book was 91% with the "Very Eligible" criteria. It can be concluded that this e-book was developed to meet valid criteria and is practical and effective in use.

**Keywords:** Bruner's Theory, Comprehension Ability, Ethnomathematics, Javanese Traditional Snacks.

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## Introduction

In the era of globalization, science and technology are growing very fast (Inganah et al., 2023; Kim et al., 2019; Yoshikawa & Kabay, 2015). It makes a difference, especially in education, to get knowledge and develop students' character and soft skills (Darmayanti, Sugianto, et al., 2022; Kai et al., 2021; ND Safitri et al., 2023; Wisshak & Hochholdinger, 2020). Mathematics education is often called the mother of all science

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because so crucial for studying (Yeh, 2019). Studying mathematics is full of meaning and awareness about what is going on, understood or not (Bossé et al., 2021; Khoiriyah et al., 2022). To understand concepts and procedures, students need to understand facts, ideas, relationships, and procedures mathematics for complete problem mathematics (Russell et al., 2020; Widya Rizky Zakinah et al., 2022).

A function is a draft important in the development field of mathematics like algebra, calculus, calculus and geometry, econometrics, and statistics (García-García & Dolores-Flores, 2021; Sugianto et al., 2022). Even development engineering, technology, and information from development knowledge apply draft function because of that draft, this is urgent and necessary to correct by students in mathematics in Century front (Sugianto et al., 2022; Tokgoz et al., 2021). Function-late life is defined as linking rules of every domain element with an appropriate one-element codomain. In the era of globalization, science, and technology is g function-late life is defined as linking rules of every domain element with an appropriate one-element codomain. Many relationships Among phenomena daily could be declared as functions. For example, the application draft functional is the relationship between the car's speed, distance traveled, and distance goes ingredient burned. The function is not accessible material to understand students (Merona & Santi, 2018). Student often experiences confusion in differentiating Between relationships and processes. Also, I have no innovative express role in the correct form, so I cannot complete problems correctly. Failures and difficulties often make errors in students (Permatasari & Marlina, 2022; Yusdiana & Hidayat, 2018)— difficulties and mistakes sourced from low-ability students in understanding draft relationships and function.

Based on the results of observation class VIII at Assyfa Learning Center Foundation Pasuruan, several students have difficulty studying Theory functions. It showed that with results test students who get scores above the KKM, only 32.4 %, meaning around 67.6 students still are under KKM value. The results Interview supported this with one of the Mathematics teachers at YALC Pasuruan, who said that in Theory learning function, method study was usually conducted by a group or individual. Learning media used to support gift Theory function only with LKS or identical book packages with dark color. Difficulties encountered in the learning process are that students dislike reading and do not understand the concept. In addition, students have difficulty illustrating something from the abstract to the concrete and vice versa, and students still have difficulty understanding a story problem by applying a concept. To overcome student difficulties and obstacles faced by teachers in an understanding of concepts, one possible effort can be made by utilizing learning theory. Bunner's theory states how the learning process goes according to the student's perception of a particular situation to obtain a relative and lasting change. On the other hand, math e-books could be used by teachers as a tool to help teach (Cábyová et al., 2020; Fedorov & Mikhaleva, 2020; Humaidi et al., 2022).

They have required innovation in learning, such as more learning media innovation attractive, including e-books, to increase results study students (Asyrofi et al., 2018; Fadillah et al., 2021; Gorghiu et al., 2011). E-books help students understand Theory and, as a tool for giving information-related eye lessons one direction, develop the potency of students as learners (Kumbhar, 2018). E-books are book electronics containing text and image information, allowing teachers to include audio and video. E-books are digital for display on a screen, computer, or mobile device (Gorghiu et al., 2011; Raynaudo & Peralta, 2019). Moreover, the e-book works as an environmental

study with a multimedia document database application. Various sources of education arrange a multimedia presentation about topics discussed in the book. The advantages of e-books are their compact size so that users can easily carry their quality permanently and bring to anywhere (Kristensen & Lüders, 2021). Besides that, students could develop productive skills by making digital books that the teacher can easily create and share.

Furthermore, e-books improve teacher-student interaction, making the learning process exciting and not tiring, easy for a student with characteristics different from understanding mathematics (Cábyová et al., 2020). Ethnomathematics is also suitable for making learning more meaningful by showing a real connection Between cultural environment and mathematics in learning (Husna et al., 2021). As related material directly to the culture local public because of essential to integrate e-books with ethnomathematics for students to love the culture local in the era of globalization (Fouze, 2018; Ju, 2016; Rubio, 2016).

Ethnomathematical studies developed in LKS teaching materials with distinct typical culture Tegal, Java middle in increase connection mathematical students on the material algebra (Darmayanti, Effendi, et al., 2022). In understanding challenging algebraic ideas by students, reminiscent of operations subtraction and addition algebra with presenting theory designed algebra with outside learning class to produce experience valuable, authentic character culture Dayeuhluhur. "Nambungan" community in Cilacap, Central Java (Yulianto & Arumsari, 2016). Learning material algebra could be overcome by constructing characters for student internalization of Islamic culture and religion in mathematics learning (Bahadir, 2021; Richardo, 2020). Many results have been obtained in ethnomathematical studies that require more profound insight into its application and classroom problems.

Innovation in the learning process, such as selecting learning models, is needed to minimize mistakes and difficulties in understanding draft relational and functional (Stachová, 2019). Iskandar & Zulela MS (2021) stated that selecting appropriate and impactful learning models significant to the results study is a must-have innovation for the teacher (Hapsari & Fatimah, 2021). The alternative is learning with Bruner's model can use to help students understand draft relationships and function. A characteristic typical Brunner model when learning functional theory is syntax training. This could be achieved by introducing the draft function through real students' context life. After students have grasped the fundamental concepts of relationships and functions, they progress to representational functions in tables and graphs. These activities correspond to symbolic steps in Bruner's theory. After students have grasped the fundamental concepts of relationships and functions, they progress to representational functions in tables and graphs. These activities correspond to symbolic steps in Bruner's theory (Metsämuuronen, 2018; Pinheiro, 2019).

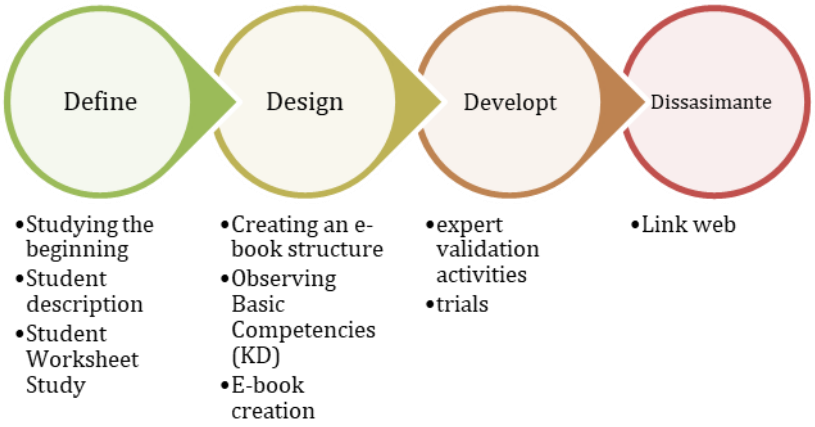
Research results previously developed e-books as learning media to increase draft students' understanding Hadi et al., (2021) with e-books based on interactive material expansion and solar system and not on learning math (Hadi, Ahmad Niamul., Priandini, Astrida Bela., W. Wikhdatul Unni Khairatul., Ju'subaidi., & Cahyani, 2021). Bayani (2019) developed e-books based on problems with material cubes and blocks. Anggraini (2020) used novel-based e-books on temporal statistics (Anggraini, 2020). Suprapto et al. (2019) developed e-books based on animation for vocational students with algebra theory. It was growing stem-based e-books on the material ecosystem, not in learning math, and developing e-books based on conservation in learning biology (Andaresta &

Rachmadiarti, 2021). As well as the research conducted by Fitrianna et al. (2021) creating e-books based on learning inductive material algebra.

According to previous research, there is an effort to increase student understanding by developing e-book media based on ethnomathematics with the brunch learning model design. As a result, the brunch learning model is being used to develop e-book-based ethnomathematics learning media to increase students' understanding of function material. Developed media in the study is the highlight element of culture in the scenario. Flow in e-book media is about acculturation, interpretation of material, and interactive answers with the user. The acculturation used in the e-book is a variety of traditional snacks designed to introduce students to local culture. The ethnomathematics e-book is designed with a leisurely brunch learning design that students can use in the teaching and learning process as an intermediary method for interpreting material theory related to functions with everyday life in the form of materials used to make various snacks and various traditional snacks in domain recognition using illustrative examples. Draft interpret theory by deductive, especially by explaining related things with life every day, then served in form sentence mathematical for stimulating conceptual understanding. This medium introduced materials that apply function with diversity. Traditional snacks such as *onde-onde*, *bikang*, steamed buns, *lemper*, *lapis*, *boiled lontong*, or snacks with various traditional snacks are presented in an enticing, iconic, and symbolic manner because The destination of the study is an update on previous research that describes the development process of e-book as a digital learning media based on ethnomathematics on student's understand ability as response and results in study student after use that medium.

## Research Methods

This study was research and development. The development model used the 4D model (Thiagarajan, 1974), consisting of 4 stages (Maydiantoro, 2021): definition, design, development, and dissemination. Developed e-book media tested in class VIII Assyfa Learning Center Foundation. Following the description, the 4-D effect is described in Figure 1.




**Picture 1**. 4-D Development Stages

Making an e-book as a learning medium started with observation using stages 4D by Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel. The background behind the use of stage observation is in tune with references in journals and observations previously that 4-D stages match used in making e-books as means of learning. Then the process that will be conducted is: (1) define (formation process which includes observation beginning and end, observation teaching materials, observations material, observation students, and formulation destination learning), (2) design (the process of forming, namely the design process synchronous e-books with function material in the 2013 curriculum with based ethnomathematics, (3) develop (the manufacturing process which includes validation experts and trials). The last process was disseminated through online web links.

Through data with the descriptive technique after using ethnomathematics e-book for device learning response students through sheet questionnaire and test results study through sheet test. Response sheet students and sheets test given to 32 students from class VIII of the Assyfa Learning Center Foundation, which later quantified to get the results in the form of numbers who will be measured to make ethnomathematics e-book as teaching materials. Ethnomathematics e-book media that has been revised based on results validation next will test 32 students who have ability mathematics different in class VIII Assyfa Foundation Learning Center.

*Validation Theory*

Two validators who carried out Validation Theory are two lecturers in math. Validators do an investigation with fill-in sheet verification Theory using the Likert scale four choices (4 = very good, 3 = good, 2 = average, 1 = little).

**Table 1.** Grid validation Theory

| Num | Corner look | Instruction | Unit |
|---|---|---|---|
| 1 | Presentation | Destination | 1, 2 |
| | | Relevance | 3, 4 |
| | | Collapse | 5, 6 |
| 2 | Appropriateness | Quality contents Theory | 7, 8 |
| | | Scope Theory | 9, 10, 11 |
| | | Depth Theory | 12, 13, 14 |
| 3 | Language and writing | Truth language | 15, 16 |
| | | Suitability with EYD | 17, 18 |

(Darmayanti, Effendi, et al., 2022)

*Cultural Expert Validation*

Table validation expert culture is as follows:

**Table 2.** Grid Validation Expert Culture

| Aspect | Component | Unit |
|---|---|---|
| **Culture** | History of traditional snacks, ingredients, miscellaneous maker snacks | 1, 2, 3, 4, 5 |

(Darmayanti, Effendi, et al., 2022)

*Media Validation*

Table validation teaching material is as follows:

**Table 3.** Grid Validation Teaching Materials

| Num | Corner look | Instruction | Unit |
|---|---|---|---|
| 1 | Contents | Theory | 1, 2, 3, 4, 5 |
| 2 | Language | Language Compilation | 6, 7, 8, 9, 10 |
| 3 | Presentation | Carrier Theory | 11, 12, 13 |
| 4 | Appearance | Appearance e-books | 14, 15 |

(Darmayanti, Effendi, et al., 2022)

*Response Student*

The questionnaire response to the student is as follows:

**Table 4.** Grid Questionnaire Student Response

| Number | Corner look | Unit |
|---|---|---|
| 1 | Usefulness | 1, 2, 3, 4 |
| 2 | Convenience | 5, 6, 7, 8, 9 |
| 3 | Appearance | 10, 11, 12, 13, 14, 15 |
| 4 | Attractiveness | 16, 17, 18, 19, 20 |
| 5 | Ethnomathematics | 21, 22, 23 |

(Darmayanti, Effendi, et al., 2022)

*Test Results*

A questionnaire was used to see the results development of students after using the ethnomathematics e-book as means of learning. A questionnaire containing two questions containing instruction ability understanding and given separated from the ethnomathematics e-book next will be measured based on the Polya solution step.

**Table 5.** Grid Ability Understanding student

| Aspect | Indicator | Item |
|---|---|---|
| Understanding Mathematical | Restate the concept | 1, 2 |
| | Presenting concepts in various forms of mathematical representation | |
| | Using thoughts or algorithms in solving math problems | |

(Darmayanti, Effendi, et al., 2022)

Below is Polya's problem-solving, used to see students' understanding of mathematics with Bruner's theory on e-book traditional snacks ethnomathematics.

**Table 6.** Classification of Polya Stages

| Num | Indicator | Description |
|---|---|---|
| 1 | Understanding the Problem | Students to work on problems must first have the initial ability to understand the situation to determine the strategy to solve the problem. |
| 2 | Planning a Plan | Students can use the ability to make plans or strategies by choosing the formula to be used through reasoning in selecting and sorting out which procedure to use. |
| 3 | Executing the Plan | A student could do the plans arranged in stages by performing calculations through a predetermined formula. |
| 4 | Reviewing Results | Students could review the return results written on the sheet answer by making a conclusion or re-evidence that is useful to check whether what has been done is correct. |

## Results and Discussions

*Definition*

Stage first in development, this e-book is designed to identify later determining how condition learning, such as how destination learning you want to be achieved, and constraint Theory found in education (Irawan et al., 2018). Five steps must be conducted in stages. The fifth step results from introduction analyses, students and concepts analysis, following analysis tasks, and destination learning. Study shows that teaching materials used by the student are module student for curriculum 2013 activities designed to lift and strengthen problem fundamentals in learning middle school math about function. According to researchers, teaching materials used by students During this load Theory function found several shortcomings, especially from the side language and contents of a book. More continue if reviewed from contents from the book that, obtained only give practice question in the form of abstract. At the same time, Theory algebra is frequent material our find and happen in real life (no there is an application concept).

Because of the lack of appropriate mathematics teaching materials to increase student potential, YALC Pasuruan does not have modules related to ethnomathematics. Students also struggle to understand mathematical theory because they are served by independence. Books in school nor YALC, yet have Theory education like a module that can help students reach the 2013 curriculum that is created a generation of intelligent Muslim intellectuals and spiritual. Especially modules that can be accessed through

technology that is digitally based. Thus, researchers need to develop additional teaching materials, such as e-books, with the help of app book creators.

Researching student characteristics in reaching destination learning is a Step from the analysis of students. Knowledge and skills, as well as attitude beginning student in learning addressed based on Next core competence, obtained information about characteristics students, especially for eye lesson less math enthusiastic and understanding to the material presented, and students enjoy the problem presented in form life every day.

Analysis Duty is a set procedure for determining the contents of teaching materials. Describe how to structure from contents of teaching materials, how must step conduct students in learning material, and how to describe information obtained. The findings obtained through the are something future problems will face with served in obtained teaching materials from the internet and supporting media other.

Analysis draft is the stage where conducted activity with destination To describe several concepts discovered and learned by a student from teaching materials that will be used. This exercise aims to understand theoretical problems in e-books by discussing theoretical functions in ethnomathematics-based book-making applications. The beginning of developing a product involves determining more formerly potential problems from the studies field and collecting information related to potential in school. Obtained that learning in the class at YALC Pasuruan does not yet provide device learning with use advantages from progress technology, for example, LCDs and projectors, so learning media Becomes more varied, but only a bit of appropriate learning media with the 2013 curriculum.

Previously, print-outs, books printed in packages, and worksheets from school made condition objectives at YLAC Pasuruan. Schools this not yet using the e-book on the app book creator, especially in learning class VIII, and there is no combination of eye lesson mathematics with values ethnomathematics in printed textbooks because the long book this used only discusses knowledge generally. As a result, only a little from educators at YALC provide understanding about ethnomathematics, and no discussion or application to learn based on theory brunch. E-book teaching materials on the application book creator-based ethnomathematics are still seldom found, and some extensive available printed teaching materials are still packed by general. Therefore, researchers are trying to develop an ethnomathematics e-book to increase student understanding.

*Design*

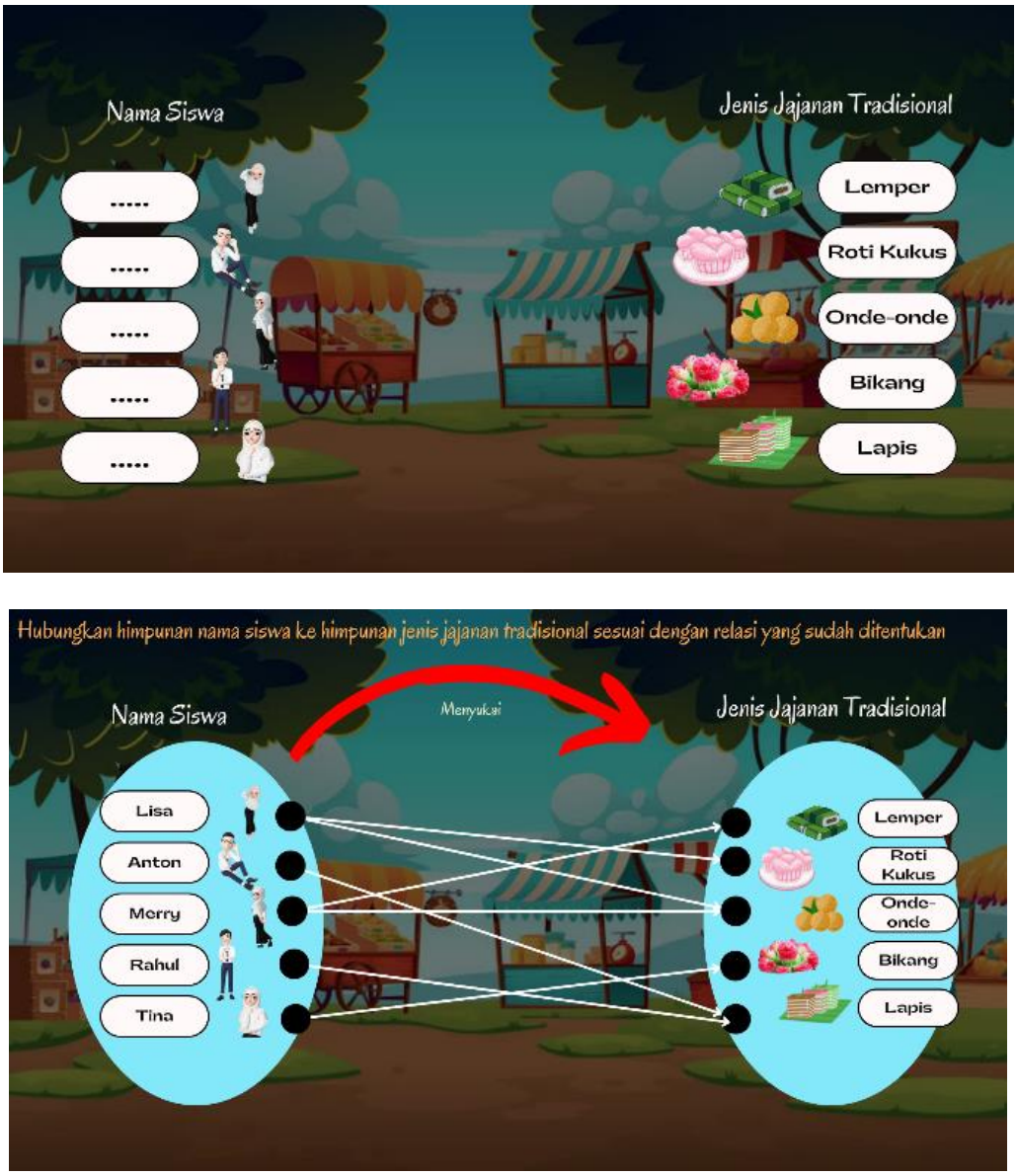
Several necessary things are carried out in the design e-book development context of ethnomathematics on material function in class VIII. E-books will arrange with adapt Core Competencies and Basic Competencies in Curriculum 2013. E-books are constructed using stages of Bruner learning and loading values ethnomathematics. The design begins from the e-book cover, as follows:


**Picture 2.** E-book Cover

Math e-Books were designed with the use help application Canva. On the cover containing the title "Learn Function Based on Ethnomathematics and Bruner's Theory," the content includes the book, level class, and name author. Destination writing the valuable title to (a) attract the attention reader, (b) describe the book the content, (c) trigger for reading the book, (d) is the very beginning of a book, (e) can summarize the contents of the book, and (f) can describe topics books (Fadillah et al., 2021; Sugianto et al., 2022).

Developed e-book complete with Basic Competencies (KD), Indicators of Achievement Competence, and destination learning. Understanding the destination from learning this. The competence base used in this e-book is KD 3.3 class VIII SMP in the 2013 curriculum, which is "to describe and state" relations and functions with the use make up representations (words, tables, graphs, and diagrams)." However, in this e-book, the author restricts learning to just the material connection function to foster links regarding inverse functions. KD, IKP, and Goals then show on the Learning page.

Exposure Theory constructed uses stages learning Bruner, namely enactive, iconic, and symbolic (Purnomo, 2022; Sundari & Fauziati, 2021). Before using learning media, a teacher must give correct perception (enactive phase) so that students follow what is contained in the press. In the activity, the teacher invites students to study through something deed or related actions with learning media. During the active phase, student experience direct what they know, which can increase interest in the study. A study by Agustina et al. (2020) found that learning with action immediately offers significant benefits for the ongoing learning process. Besides conveying an accurate-world picture, something objects and behavior in life allow students to study being independent, involved, and active in the learning process, improve their spirit and motivation to learn, and, in the end, have likely increased results learning (Pramudita et al., 2019).




**Picture 3.** Exploration of the Iconic Phase

Learning media have Step exploration shown in form life real in Figure 3. This refers to the material provided by the teacher in the perception at the beginning of learning (stage symbolic). Student To does the same thing as in the phase activity but learns media through the image. Setting symbolic allows students to build draft basics that must be mastered before continuing to Step symbolic. According to research by (Yuniarti & Trisna, 2022), the benefits of general learning with pictures are simplifying and clarifying what is important or what the teacher wants to say to students.


**Picture 4.** Symbolic Phase Exploration

Symbol level refers to the usual symbol used in mathematics, primarily material relational and functional (Ningsih et al., 2020), as shown in Figure 4. According to (M. P. Ariyanto & Purwaningrum, 2022), with the use of three example representative of Bruner's theory, students can remember, understand, process, and express complete knowledge about concepts that can be used to solve problems (P. Ariyanto & Purwaningrum, 2022).

Research and development of designed e-books, validated by a panel of experts: Mrs. Niken Bi Safitri, S.Pd., class VIII junior high school teacher at YALC Pasuruan, and Yus Mochamad Cholily, M.Si lecturer at University Of Muhammadiyah Malang. Validation is essential to get input, opinions, and suggestions and evaluate the developed e-book. Validation of expert material, media expert, expert language, and practitioners in the field of expert material. The validator investigated with a Likert scale of four choices (4 = very good, 3 = good, 2 = regular, 1 = little) are presented in Table 7.

**Table 7.** Results of Validation Data Analysis Theory

| Expert | Aspect | Average score | Information |
|---|---|---|---|
| **Theory** | Presentation | | Very good |
| | Appropriateness | | Very good |
| | Language and writing | | Very good |
| | **Total Average Score** | | **Very good** |

The results of the Cultural Validation Data Analysis are as follows:

**Table 8.** Results of Validation Data Analysis Culture

| Expert | Component | Information |
|---|---|---|
| **Culture** | History of traditional snacks, ingredients, miscellaneous maker snacks | Very good |

Overall, the overall average validation material and culture in the table above are 3.73 and 3.86, which are very useful (very valid) categories. In short, ethnomathematics e-book media contains quality and decent material for testing.

**Table 9.** Results of Media Validation Data Analysis

| Corner look | Information |
|---|---|
| Contents | Very valid |
| Language | Very valid |
| Presentation | Very valid |
| Appearance | Very valid |
| Amount score | Very Valid |

From the table above, the average total media validation is 3.72 with the excellent category (very valid), which means ethnomathematics e-book media is already worthy of testing.

After revising with suggestions and criticism from the validator, the next stage is the trial stage. The product trial being developed is the ethnomathematics e-book media. The trial product includes media trials based on design implementation learning for 32 students in class VII at YALC Pasuruan. The ethnomathematics e-book media is the product trial being developed.

**Table 10.** Analysis results from student's response

| Num | Aspect | Category |
|---|---|---|
| 1 | Usefulness | Practical |
| 2 | Convenience | Very Practical |
| 3 | Appearance | Very Practical |
| 4 | attractiveness | Practical |
| 5 | Ethnomathematics | Very Practical |

Based on Table 10, the calculation produces a score end practicality of 3.62. According to (Mauluah & Marsigit, 2019), traditional snacks, ethnomathematics, and e-book media With a score of 3.62, ethnomathematics is extremely practical. Ethnomathematics e-book media about traditional snacks ethnomathematics easy to

use, with clear language, illustrations, and accessible material understood, and expand knowledge student about traditional snacks ethnomathematics. This is seen in the average obtained of 3.65 in the category of practicality good. Media with score practicality tall easily used and valuable for students. The student's response after using media is to know the results of the study students after using that medium. Test results meant for learning ethnomathematics e-book media efficacy in traditional snacks ethnomathematics. This stage occurs in the ethnomathematics e-book traditional snacks ethnomathematics is valid for testing by giving test understanding draft students.

**Table 11.** Test results understanding draft

| Indicator | Category |
|---|---|
| Understanding the Problem | Very Good |
| Planning a Plan | Very Good |
| Executing the Plan | Well |
| Reviewing Results | Well |
| **Average Score** | Very Good |

Based on these data, the student's conceptual understanding test results were obtained after learning ethnomathematics e-book media for traditional snacks and increasing conceptual understanding because all students got more points than the scores obtained. This is in line with (Hasanah et al., 2021), showing that there is ethnomathematics in the form of traditional snacks in the village of Kemiren, Banyuwangi, typical of the Osing tribe, namely the concept of fractions and integers, the concept of algebra and comparison, the flat shapes and space concept, the transformation concept, the congruence and congruence concept. The social arithmetic concept provides benefits for contextual learning and is used as an example of the use of mathematical concepts around us (Hasanah et al., 2021; Huda, 2018). KKM determined 73, with the presentation completeness study at 82%. After the data is collected, the next is analyzed to produce results. The validity, practicality, and effectiveness of ethnomathematics e-book media in traditional snacks ethnomathematics used to evaluate eligibility. Based on the analysis of validity tests conducted by (media experts, expert materials, and experts' culture), a practical test is carried out by the student.

## Conclusions and Suggestions

Contextual ethnomathematics mathematics e-book was developed to support the urgency of cultivating and enhancing student culture through learning and a culture of values. The development is carried out with a 4D model. The math ebook was designed with the help of the Canva application. The designed product is then tested for feasibility using validity and product tests to determine the attractiveness of e-book-based ethnomathematics media on relations and functions. A score of 3.86 for material experts and 3.74 for media experts with eligibility criteria of 82% to improve students' mathematical understanding abilities. The results of the response to the ethnomathematics-based e-book were 3.62 or 91% with "Very Eligible" requirements. It can be concluded that this e-book was developed to meet valid criteria and be practical and effective in use. This shows that the e-book developed by the researcher has an

attractive standard. The study is expected to be carried out on a larger scale at the trial stage, testing the feasibility and effectiveness of Bruner's theory on e-book traditional snacks ethnomathematics for the mathematical understanding ability.

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