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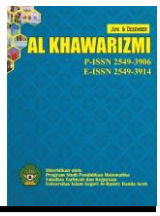

Ethnomathematics Learning Media Based on Augmented Reality in Geometry to Improve Numeracy Skills

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Abstrak

The purpose of this research is to describe the validity of the learning media that have been developed for mathematical learning. The learning media developed were based on augmented reality to improve numeracy skills. This media also contains elements of ethnomathematics. This research is a development research using the Plomp design research model. As for one of the media criteria, it is considered eligible if it meets the valid criteria. The results of the research showed that the media expert rating showed very good classification with an average score of 50. The material expert rating indicated good classification with an average rating of 30.5, so the learning media was declared valid. It can be concluded that ethnomathematics learning media based on augmented reality can be used in mathematics learning.

INTRODUCTION

Numeracy skills are knowledge and skills related to basic mathematics, such as using numbers and symbols for solving issues related to everyday situations, analyzing data of many forms, and interpreting the outcomes of analysis to predict making conclusions (Kementerian Pendidikan dan Kebudayaan, 2017). Various problems and high-level skills require numeracy skills (Inovasi, 2019). In addition, in Indonesia, the Minimum Competence Assessment evaluates student numeracy skills. Therefore, numeracy skills are one of the important skills that major students develop through school learning.

However, the numeracy skills of students in Indonesia are still poor. It is based on PISA Indonesia results from 2015 and 2018. For numeration, Indonesia achieved an average score of 386 out of an average of 490 per country in 2015 (OECD, 2016). However, in 2018, Indonesia's numeration score dropped to 379, with an average rating of 487 (OECD, 2019). Out of 79 countries, Indonesia was ranked 73rd. The educators must find a solution to this problem.

Developing augmented reality-based ethnomathematics learning media is one of the proposed solutions to improve student numeracy skills. Ethnomathematics learning media have several advantages (Richardo, 2017). Some of the advantages of using ethnomatematic learning media are as follows: giving students the opportunity to combine mathematical concepts with what they already know from their own environment; providing a learning environment that nurtures strong and enjoyable motivation; and fostering appreciation, nationalism, and pride in their own culture. Augmented reality media also has some advantages (Mustaqim & Kurniawan, 2017), among others, being more interactive, effective use, being able to be used in a variety of media, simple object modeling, being affordable, and being easy to use.

Apart from that, students still have difficulties in learning geometry, such as difficulties in using principles and concepts, difficulties in processing skills, and difficulties in drawing conclusions (Fauzi & Arisetyawan, 2020; Mahdayani, 2016). Ethnomathematics learning media based on augmented reality can also help students in learning geometry. Geometry can be well taught through ethnomatematics, which incorporates local cultural context (Verner, Massarwe, & Bshouty, 2019). In addition, there is a possibility that the use of augmented reality in geometry learning can improve students' mathematical skills (Koparan, Dinar, Koparan, & Haldan, 2023).

Furthermore, several studies show that ethnomathematics-based augmented reality learning media can facilitate the development of students' numeracy skills. Research conducted by Khaerani, Nensi, Prasani, Nirwana, & Assagaf (2023) shows that combining culture and Augmented Reality technology can effectively improve students' numeracy skills by embedding mathematical concepts in the context of traditional games. Similar media, according to research by Romadon & Kartika (2024), can also be used in mathematics classrooms to aid student understanding, particularly in geometry topics. In research conducted by Sudirman, Yaniawati, Melawaty, & Indrawan (2020), it was found that using augmented reality as an ethnomathematical learning tool could enhance student learning activities and improve their understanding of mathematical concepts. Later, interactive learning that incorporates local context can help students master numeracy skills (Salsabila, Baidowi, Azmi, & Lu'luilmaknun, 2022b, 2022a).

Thus, it can be said that augmented reality-based ethnomathematics learning media can help students learn mathematics, in particular by improving their numeracy skills. Therefore, this media needs to be developed by fulfilling several feasibility factors, one of which is the feasibility aspect of validity. The aim of this research is to describe the validity of the ethnomathematics learning media based on augmented reality.

METHOD

This developmental research aims to develop an augmented reality-based media that will enhance the numeracy skills of junior high school students through learning

ethnomathematics on geometry topic. This research uses design research developed by (Plomp, 2013). This development model has three phases that researchers need to undertake, namely the preliminary research phase, the prototyping phase, and the assessment phase.

Here is an overview of each phase of the Plomp (2013) model that will be implemented in this research.

1. Preliminary research phase, consisting of identification of problems and analysis of needs, review of literature, develop conceptual or theoretical framework (initial framework) for the development of products such as augmented reality-based ethnomathematics learning media on geometry topic to improve numeracy skills of junior high school students
2. Prototyping phase, development of a product prototype to be tested using iteration based on small cycles with formative evaluation as the basis for completing the developed product. Included in this evaluation is testing the validity, practicality, and effectiveness of the product. Once the data is saturated and ready for testing on a wider subject, the evaluation process will be stopped.
3. Assessment phase as the final stage (sumative evaluation), used to evaluate and conclude whether the development product has met the specified specifications based on user assessments with wider coverage.

As a note, the goal of this research is to reach the second phase (prototyping phase) mainly the validity test phase of the product prototype on the formative evaluation (end of the development phase), and the entire remaining phase will be continued in the years to come. It's because of the time constraints of this research.

Validity is a standard to be met by a developed learning medium (Nieveen, 1999). The developed media is deemed to meet this standard if it has the ability to measure what should be measured according to the purpose of its creation (Allen & Yen, 1979). The ethnomathematics learning media based on augmented reality media developed needs to be tested for validity.

To determine the validity of the media developed, non-test techniques were used, using a questionnaire instrument in the form of a learning media validation sheet. The validity of the media was assessed by experts consisting of two people. The two validators are material experts and media experts. The evaluation results on the validation sheet are used as a reference for improving media quality. The following is a validity measurement classification table.

Table 1
The Classification of Validity Measurement

Media Expert	Material Expert	Classification
$X > 47.6$	$X > 30.6$	Very Good
$39.2 < X \leq 47.6$	$25.2 < X \leq 30.6$	Good
$30.8 < X \leq 39.2$	$19.8 < X \leq 25.2$	Moderate
$22.4 < X \leq 30.8$	$14.4 < X \leq 19.8$	Poor
$X \leq 22.4$	$X \leq 14.4$	Very Poor

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RESULT AND DISCUSSION

The media that has been created is validated by experts. Here's an introduction dispaly of the Geometry Etnomathematics application. In the introduction display there are several menus, namely **Instructions**, **Information**, **Play**, **Exercise**, and **Exit**.

Figure 1
The Introduction Display on Ethnomathematics Geometry Application

The Instructions menu displays instructions on how to use the application. The Information menu shows information related to the Etnomathematics Geometry application and the developer. The Exercise Question menu shows some examples of exercises related to cuboid and cylinder. The Exit menu is used to exit the app. Here's a display of the instructions, information, exercise, and exit on the app.

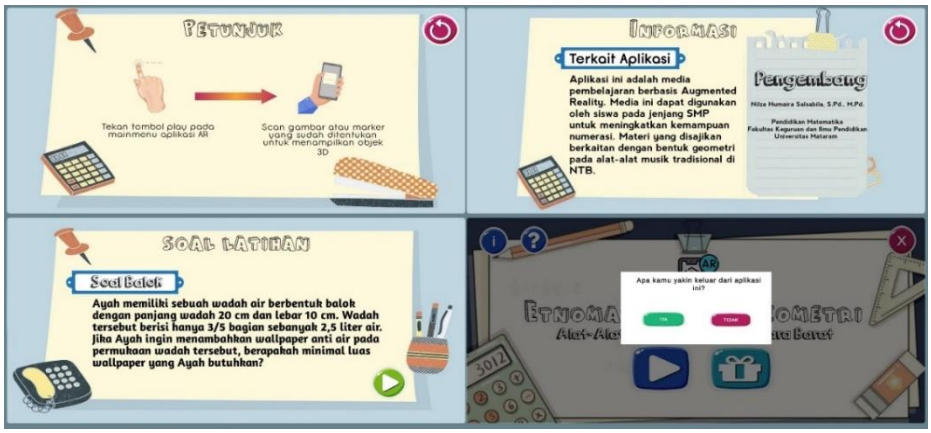

Figure 2
The Instructions, Information, Exercise, And Exit on The App

In the Play menu, the user needs to scan the marker that has been created. The markers represent the traditional musical instruments of West Nusa Tenggara. The traditional musical instruments available in the app are Palompong, Gendang Beleq, and Rebana Gending. The markers can be printed for scanning or scanned through a digital

screen. Here's a display of the third marker of traditional West Nusa Tenggara musical instruments.

Figure 3
The Display of Markers Ethnomathematics Geometry App

An application that scans the marker will display 3D geometric objects on the phone screen. The Palompong musical instrument represents the cuboid geometry object. The Gendang Beleq musical instrument represented the cylinder geometric object. The Rebana Gending musical instrument represented the sharpened cone geometric object. After the geometry object appears, the Info and Back submenus appear. The Info submenu displays the material related to the surface area formula and the volume of the geometric object, as well as the information relating to the scanned musical instrument. Here is the 3D object display and the Info submenu.

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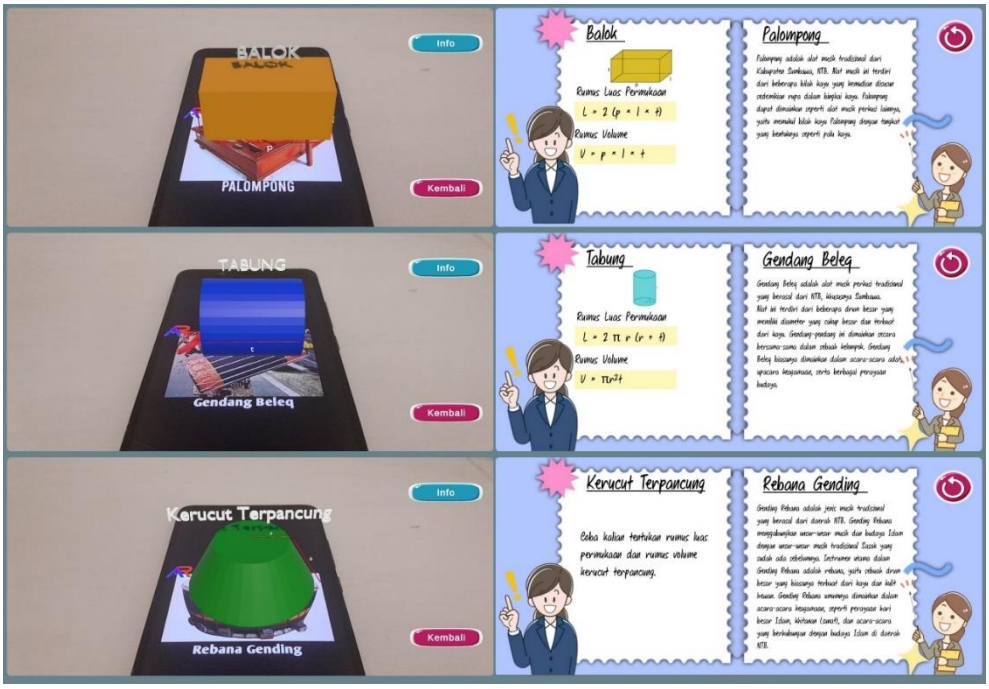

Figure 4
The Display of Geometric Objects and Materials in Applications

The Ethnomathematics Geometry Application as a learning media is evaluated for its validity by media experts and material experts. The expert assessment shows that the media in this research is declared to be valid. The media validation result is shown in the table below.

Table 2
The Media Validation Result by Experts

No.	Description	Media Experts	Material Experts
1	Number of Item	14	9
2	Validator 1 Score	51	32
3	Validator 2 Score	49	29
Mean Score		50	30.5
Classification		Very Good	Good

The above table shows that the developed media gets a very good classification assessment and the material expert gives a good classification assessment of the media's validity. Based on the assessment, media meets valid criteria and deserves to be used as a media of mathematical learning.

The final product of this research is an augmented reality-based learning media. The media is focused on the mathematics numeracy skills of junior high school students. The learning topic taught in the media is geometry at the junior high school level. The development research is based on Plomp (2013) design research.

Previous research has demonstrated that ethnomathematics in learning media plays a significant effect in media credibility in mathematics learning. Ethnomathematics can provide students with a multicultural perspective on mathematics, hence increasing their interest in the subject (Brandt & Chernoff, 2015). The local context used in mathematics learning can help students learn in the classroom (Harahap, Lubis, & Nurmalina, 2018; Yustinaningrum, 2017). Topic activities using local contexts or situations related to students's everyday activities may enhance their numeracy skills (Kurniawan, Budiarto, & Ekawati, 2022).

Furthermore, the use of augmented reality in geometry learning can improve students' mathematical learning results (Koparan et al., 2023). Sudirman et al. (2020) revealed that augmented reality-based ethnomathematical learning media can enhance student learning activity and understanding of mathematical concepts. Students could accept learning geometry through augmented reality, and that utilizing AR-enhanced instructional methods positively impacted students' learning achievements.

CONCLUSION

Based on the results of research and discussion, it was concluded that the ethnomathematics learning media product based on augmented reality on geometric material to improve the numeracy skills meets valid criteria. The validity of the product lies in an very good classification based on the judgment of the media expert and good classification is based on a judgement of the material expert. It can be said that ethnomathematics learning media based on augmented reality can be implemented in mathematics learning.

The media development in this research is limited to the local cultural context in the form of traditional West Nusa Tenggara musical instruments. Apart from that, the musical instruments presented in this media are still limited. Future research can take a broader local context to broaden students' insight into ethnomathematics and improve their mathematical abilities.

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