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Innovative Mathematics Learning : Designing Student Worksheet with Augmented Reality with Lempok Durian Context

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Abstrak

Pemanfaatan Augmented Reality (AR) dalam pembelajaran dapat memberikan pengalaman belajar yang interaktif sehingga dapat meningkatkan keterlibatan siswa. Tujuan dari penelitian ini untuk menghasilkan bahan ajar matematika materi perbandingan menggunakan konteks makanan khas Sumatera Selatan yaitu lempok durian yang valid, praktis, dan memiliki efek potensial terhadap ketuntasan hasil belajar peserta didik kelas VII SMP di Palembang. Penelitian ini merupakan penelitian pengembangan (*research and development*) dengan model ADDIE (*Analysis, Design, Development, Implementation, and Evaluation*). Data dikumpulkan melalui angket, wawancara, dan tes yang dianalisis secara kuantitatif dan kualitatif. Hasil penelitian menunjukkan bahan ajar matematika materi perbandingan menggunakan konteks lempok durian valid berdasarkan penilaian validator dengan nilai kevalidan sebesar 0,89 termasuk kategori validitas tinggi, praktis berdasarkan angket respon peserta didik dengan nilai kepraktisan sebesar 4,13 termasuk kategori sangat praktis, dan memiliki efek potensial berdasarkan hasil belajar peserta didik dengan persentase efek potensial sebesar 82,6% termasuk kategori sangat tinggi. Dengan demikian, bahan ajar dengan Augmented Reality dapat digunakan sebagai media pendukung dalam pembelajaran matematika untuk meningkatkan hasil belajar dan motivasi siswa.

Kata kunci: Perbandingan, Lempok Durian, *Augmented Reality*

Abstract

The use of Augmented Reality (AR) in learning can provide an interactive learning experience that can enhance student engagement. This research aims to produce mathematics worksheet using the context of South Sumatra's typical food namely lempok durian in ratio, which is valid, practical, and has a potential effect on the accuracy of the learning outcomes of seventh-grade students in Palembang. This research is research and development with the ADDIE model. (Analysis, Design, Development, Implementation, and Evaluation). Data is collected through lifts, interviews, and quantitatively and qualitatively analyzed tests. The results of the study showed ratio mathematical material using the lempok durians context is valid based on validator assessment with a validity rating of 0.89 including the high validity category, practical based on the elevation of student response with a practicality rating of 4.13 including very practical category, and has potential effects based on learning results of students with a percentage of the potential effect of 82.6% including the very high category. The development of worksheets with Augmented Reality can be implied by being used as a supporting medium in mathematics learning in an effort to improve learning outcomes and student motivation

Keywords: *Ratio, Lempok Durian, Augmented Reality*

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INTRODUCTION

To achieve quality education, efforts can be made to synergize all aspects of education to the maximum, so that the interaction process between students and learning resources can run according to learning objectives (Cahyadi, 2019). The main component in the world of education is the teacher. A teacher is always required to be able to keep up with and even surpass scientific developments (Putra et al., 2022). Interesting, effective, and efficient learning is currently very necessary so that teachers can make students more active and have a high interest in the learning process. The use of innovative worksheet also has the potential to encourage students' motivation and enthusiasm in the learning process(Perawati et al., 2020). Thus, to meet students' needs, teachers must have creativity in preparing innovative, interesting, and contextual worksheet.

Currently, it is often found that the worksheet used by educators are instant or just-use worksheet such as textbooks, textbooks donated by the government, and worksheets purchased through distributors who come to schools (Zuriah et al., 2016). The worksheet used are good, but the worksheet are still less interesting and monotonous, so they do not suit the needs of students. Because the worksheet used are still in printed form or textbooks, they do not use the help of technology. Thus, if learning in schools is still limited to using printed worksheet or similar, it means that education has not kept up with educational developments in the 5.0 era (Gunawijaya, 2021). In line with this, it is necessary to develop worksheet that can increase students' interest in the learning process by utilizing technology that continues to develop. For this reason, one of the appropriate worksheet that can make students interested, especially in learning mathematics, is worksheet that involve technology, one of which is currently widely used, namely Augmented Reality technology. By using Augmented Reality-based worksheet, learning becomes less monotonous (Alzahrani, 2020). Through the intermediary of a camera, Augmented Reality is a virtual reality that can be presented in the real world (Bulut & Ferri, 2023; Korkmaz & Morali, 2022; Wulandari et al., 2022). Augmented Reality enhances perception and interaction with the real world by placing virtual information around the user (Jabar et al., 2022; Lai & Cheong, 2022).

One of the criteria for good worksheet is paying attention to the characteristics of students and the material presented, as well as being close to the students' learning environment (Widiastuti, 2020). Mathematical problems that are contextual or close to students' learning environment make students better able to understand abstract mathematical concepts so that student's interest and learning achievement can continue to increase (Hartatiana et al., 2023; Lisnani et al., 2020; Mashuri et al., 2019). Augmented reality technology can provide concrete

learning experiences in mathematics learning (Pahmi et al., 2023; Cahyaningrum & Hadi, 2023). Augmented Reality can also increase student motivation and learning outcomes (Oktina Harini & Pujiriyanto, 2022; Salinas et al., 2013; Wu et al., 2015).

Research on AR has been carried out on different materials, 3D shapes (Sari et al., 2022; Yulia et al., 2022). in this research the cultural context is used in this case using lempok durian as a typical food as a starting point in introducing the concept ratio. Cultural context makes mathematics learning meaningful (Nizar & Rahmawati, 2024; Noprisa et al., 2024). Based on the description above, this research aims to produce a worksheet using the context of lempok durian with Augmented Reality technology that is valid, practical, and has a potential effect on student learning outcomes.

METHOD

This research uses the ADDIE (Analysis, Design, Development, Implementation and Evaluation) development model.

Analysis

The analysis stage aims to obtain information on needs and problems in the form of relevant materials, worksheet and curriculum used to develop worksheet.

Design

At the design stage, several activities will be carried out, including formulating learning objectives, determining the material to be studied, then preparing worksheet systematically that have been adapted to student needs.

Development

In the development stage, what is done is starting from making worksheet in the form of Student Worksheets. The resulting is validated by experts, namely material experts and media experts, to provide comments and suggestions as a guide for making revisions. After the revisions have been completed, the product is tested on students, namely in field trials, resulting in improved worksheet based on validation by experts and practicality by students.

The data collection techniques used were questionnaires, interviews and tests. The questionnaires used in the research were product validation questionnaires by experts and student response questionnaires.

Implementation

At the implementation stage after the worksheet is declared valid and practical, worksheets are given to teachers to be used in classroom learning.

Evaluation

Assess quality instructional products and process, both before and after application.

RESULTS

The development of worksheet using the context of lempok durians with Augmented Reality technology aims to produce worksheet that are valid, practical and have potential effects. Based on the results of data analysis which refers to the ADDIE model. The first stage is the analysis stage, at this stage curriculum analysis, needs analysis and material analysis are carried out. A summary of the researcher and teacher interviews is as follows

Researcher	*: what worksheet the teacher uses when teaching in class?*
Teacher	*: I use books, worksheets, power point slides*
Researcher	*: What kind of worksheet?*
Teacher	*: Worksheets generally contain short material and questions, but of the three they more often use books to explain the material.*

Based on the results of interviews with teachers, it is known that the worksheet used in schools, especially in mathematics learning, are printed books. The printed book uses context related to everyday life and the questions that are usually worked on are also based on contextual problems. This indicates that students are used to working on questions with various problems, meaning that students' basic abilities are relatively good. However, when given practice questions that are not the same as the questions they usually do, students experience difficulties. This means that students do not understand the concept of the question or material. Mathematics learning is delivered to students in an informative manner, meaning that students only get information from the teacher so that students' understanding is not optimal (Fauzi & Arisetyawan, 2020). Because the worksheet used in schools are still in printed form, one learning innovation that can be used in accordance with current technological developments is the development of worksheet using Augmented Reality technology. Worksheet with Augmented Reality technology has advantages, including having an attractive appearance that can increase students' interest in learning and the application used is more interactive (Mursyidah & Saputra, 2022). The use of worksheet with Augmented Reality technology can be used as a medium to create interesting and efficient learning (Aditama et al., 2019).

After going through the analysis stage, the next step is the design or drafting stage. At the design stage, the researcher carried out a material review, the material discussed in the worksheet being developed was comparative material for seventh grade students in the odd semester. This material was designed using the context of a typical South Sumatran food, namely lempok durian, and with the help of Augmented Reality (AR) technology, namely using the Blender and Spark AR applications. Designing the worksheet using the Canva application,

starting from designing the cover, learning objectives, learning activities, practice questions and evaluation questions. At this stage the researcher also prepared instruments that would be used to assess the worksheet being developed, such as validation sheets for expert validators and student response questionnaires for data on the practicality of the worksheet being developed.

Next is the development stage, this stage is the validation and revision stage of the worksheet which is developed based on comments and suggestions from the validator. The validation process is a measure that shows the level of validity of a product or learning tool that has been developed by referring to several assessment aspects (Fitria et al., 2017). In the process of validating worksheets by material experts and media experts, there are several aspects of assessment of the worksheet being developed, for assessing material aspects including material content, appearance, language, and usefulness. The assessment of media aspects is system quality, display design, and Augmented Reality. The following is a partial display of the worksheet

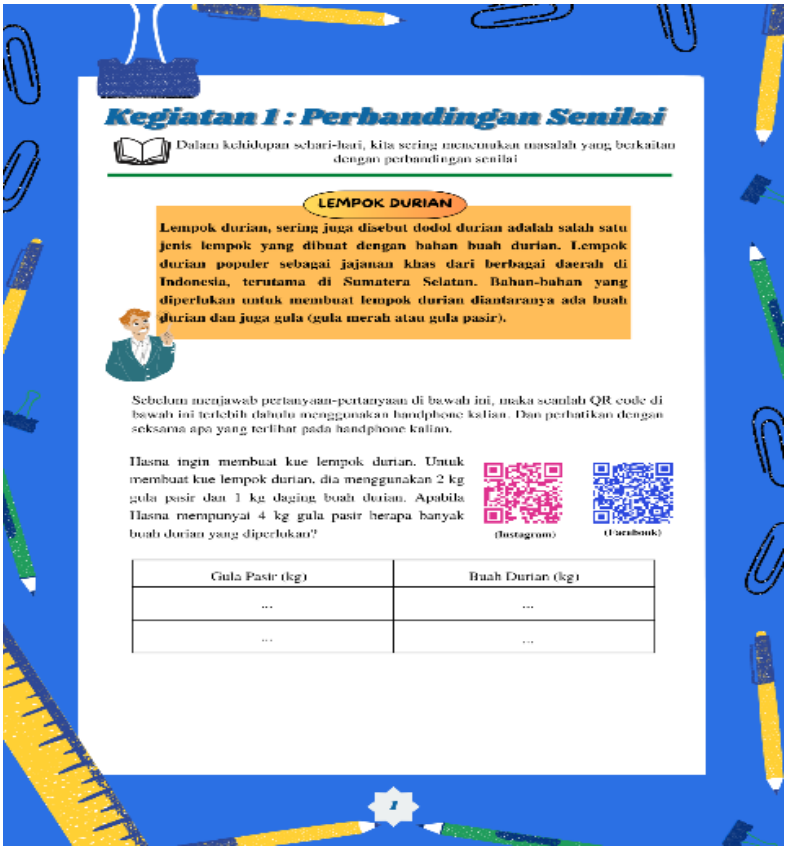

Figure 1. Student's Activity

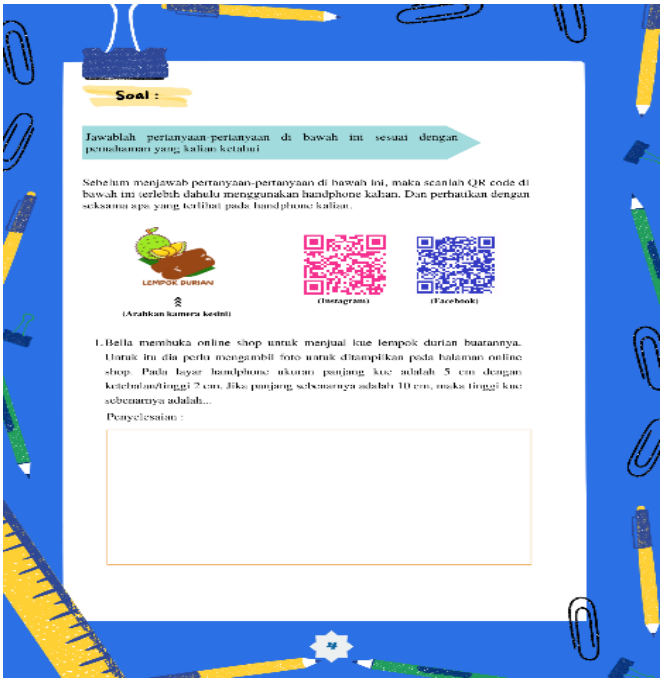

Figure 2. practice question sheet

Figure 1 is a student activity to discover the concept of ratio. Before filling in the table, students are asked to scan the QR code first. Figure 2 is a student activity for solving problems related to ratio. Students are asked to scan the QR code to get an idea of the problem in this activity. Student worksheets can be accessed at Worksheet AR.

Table 1. Worksheet Validity

	Aspect	Validity	Category
Content	Content	0.89	High
	Appearance	0.92	High
	Usefulness	0.84	High
	Language	0.84	High
Media	System Quality	0.83	High
	display design	0.92	High
	AR	1	High
Average		0.89	High

Table 2. Worksheet Practicality

	Practicality	Category
One to one	3.75	very practical
Small Group	3.95	very practical
Field Test	4.13	very practical
Average	3.94	very practical

Based on Table 1 and 2 above it can be conclude that worksheet has high validity and very practical category.

DISCUSSION

Based on the validation results of the worksheet assessed by the three validators, the level of material validity is 0.87 in the "High Validity" category and the level of media validity is 0.92 in the "High Validity" category. Thus, overall the worksheet developed have a high level of validity with a validity level value of 0.89. The designed worksheet have fulfilled the validity aspects in terms of content, appearance, usefulness and language. In the content aspect, the material presented with the help of augmented reality is in accordance with basic competencies, learning objectives, comparative concepts presented through augmented reality are appropriate and can be used by students. Augmented reality provides an interactive learning medium for students to investigate abstract mathematical concepts in a real environment and contributes to extraordinary results in understanding concepts and supports enjoyment in the learning environment (Özçakır & Özdemir, 2022). The context used also helps students understand the concept of comparison. Cultural context helps build awareness of the role of mathematical knowledge in the context of mathematical society and culture (Rosa & Gavarrete, 2017).

The results of the student response questionnaire showed that the worksheet developed was very practical at average 3.94 . Students are very interested in augmented reality-based worksheet with the context of lempok durian, because it is easy to use and can be applied to mathematics learning to help students understand the ratio. The cultural context also contains positive values and attracts students' interest in learning (Ratriana et al., 2021; S. A. M. M et al., 2020).

Next, researchers conducted tests on 23 seventh grade students. This test is carried out by providing 5 evaluation test questions. The learning outcomes test aims to determine the potential effects of worksheet Based on the results of the analysis of the average value of student learning outcomes of 82.6 which is included in the high category. Based on the results obtained from working on evaluation questions, it can be seen that the worksheet being developed can have a potential effect on student learning outcomes at ratio. The ratio learning that uses augmented reality with the context of lempok durian helps students understand the concepts given, because the context used is close to students, and is presented as real. Students can see how the comparison of two quantities is presented in the activity of observing the comparison of sizes of lempok durian through augmented reality. Next, students are trained through questions on comparative material by applying the concepts they already understand. Augmented reality assisted learning has higher efficiency (Yip et al., 2019). Increase students'

learning motivation and have an impact on their learning outcomes (Bantining Ngastiti et al., 2022; Hanafi et al., 2017). Learning with Augmented Reality can also improve students' spatial abilities, problem solving and motivation (Guntur et al., 2020).

In this section, the research findings are discussed clearly, in detail, and are linked to theories and previous research results, thereby revealing whether the findings contradict or support the theories or previous research results. The discussion does not repeat the explanations provided in the research findings section. Moreover, this discussion highlights the novelty of the research findings compared to previous studies, whether they align with or contradict previous research findings.

CONCLUSION

Based on the research results, it can be concluded that the worksheet using the context of the typical South Sumatran food lempok durian with Augmented Reality technology is declared valid and practical and has potential effects. The development of worksheet with Augmented Reality can be implied by being used as a supporting medium in mathematics learning as an effort to improve learning outcomes, student motivation, and student involvement.

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