

Design and Validity of Augmented Reality-Based Student Worksheets Integrated with Acehese Culture

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Abstract. *This research aims to design and validate student worksheets based on Augmented Reality integrated with Acehese culture. This research is development research using the Plomp model. This research is limited to two stages, namely preliminary research (preliminary research) and the development phase (prototyping phase). The instrument used is a student worksheet validation sheet consisting of aspects of material, presentation, language, and integration with the Augmented Reality application. Validation was carried out by 3 expert validators. Based on the problems in the initial research, the student worksheet design is integrated with Acehese culture where Acehese cultural ornaments become markers that will be visualized into 3D shapes. The results of the research show that the design of student worksheets based on augmented reality integrated with Acehese culture is in the best condition with a valid category.*

Keywords: *Design, validity, student worksheets, augmented reality, Acehese culture*

1. Introduction

Education plays a crucial role in life that differentiates humans from other living creatures. Any experience that causes change and learning in an individual, whether through the guidance of others or independent learning, can be considered a form of education.

Education is an effort to develop an individual's human dimensions throughout his life through knowledge that is conveyed in stages. This teaching process is the responsibility of parents and the community. The function of national education is to expand abilities and form honorable character and culture to increase the intelligence of the nation's life, by optimizing the potential of students to become individuals who are faithful, obedient, virtuous, knowledgeable, creative, independent, and become democratic citizens and responsible (Anugrah Cahya Dewi et al., 2020). Mathematics is one of the school subjects that can develop this character. Because good mathematics education not only teaches concepts and formulas but also inspires curiosity, exploration and problem-solving (Hasibuan, 2016).

Efforts to improve students' mathematical abilities during classroom learning involve the use of various learning resources. Apart from innovative teaching methods, adequate learning resources are an important component in forming students' understanding and interest in mathematics (Nainggolan, 2023). Learning sources are everything (objects, data, facts, ideas, people and so on) that can lead to a learning process. Examples of learning resources include textbooks, modules, worksheets, realia, models, models, banks, museums, zoos and markets. (Prastowo, 2018). Teaching materials are a form of learning resource that can support the learning process (Yayuk, 2019).

Teaching materials are all materials that support teachers in the teaching process. This includes various learning tools consisting of materials, methods, guides and evaluations designed in a structured and interesting manner to achieve learning objectives, namely meeting competencies and sub-competencies in all their complexity (Suprihatin & Manik, 2020). Learning materials have great significance for both parties, teachers and students, in the teaching and learning process. If there are no learning materials, teachers will experience difficulties in increasing learning effectiveness. Likewise, students without learning materials, will have difficulty adjusting when the teacher teaches material they don't understand.

One of the teaching materials that teachers can use in teaching mathematics in class is student worksheets. According to the Ministry of National Education (Gusmiro et al., 2017), student worksheets are a series of assignments given to students to complete. Usually contains instructions and steps to complete a related task. The tasks requested in the student worksheets must lead to the achievement of clear basic competencies. The benefit of having student worksheets is that it makes it easier for teachers in the learning process, while for students, student worksheets allow independent learning as well as understanding and carrying out written assignments.

Many teachers still use conventional worksheets at school, namely worksheets that are simple, instant, and just bought without planning, preparation or compiling them themselves. In fact, teachers are aware that the worksheets they use often do not match the basic competencies and existing indicators (Diani, 2016). Factors that cause difficulties for teachers in developing student worksheets are a lack of understanding about how to create and develop lesson materials, a lack of training from relevant agencies regarding student worksheets development, and a lack of teacher understanding of the benefits of creating or developing student worksheets, especially developing student worksheets that utilize technology.

The teacher is an important actor in the learning process in the classroom, so worksheets should be designed by the teacher. The role of a teacher today demands more than just imparting conceptual knowledge; It also requires an understanding of interactions with a generation highly skilled in information and communication technology. Teachers are not only expected to stop studying after graduating as a Bachelor of Education, but also must continue to follow the ever-changing developments in technology, information and communication. One of the technological developments that is currently popular is augment reality (AR). Augmented Reality (AR) technology is a technology that combines objects from the real environment with information or virtual objects, so that virtual objects appear to be present and interact in real space directly and in real time (Ervana & Martini, 2019). The trend of applying AR in learning is believed to have the ability to increase student motivation because it is able to inspire students, attract their interest, and encourage exploration using new technology (Diegmann et al., 2015). Using AR can increase students' understanding of the texture and structure of an object (Alfitriani et al., 2021) and also create effective and more interesting learning activities for students (Nurmaena & Gumindari, 2022). Augmented reality (AR) has the advantage that it can be used to help visualize abstract concepts for understanding and structure of an object model. Currently AR is widely used in the fields of gaming, medicine and image processing, while in the field of education it is still rarely used (Mustaqim, 2016). So, making AR-based worksheets can provide students with technological skills in utilizing technology and using devices in learning.

2. Method

This type of research is development research (R & D) to produce a product (Student Worksheet) and validate it so that it is suitable for use. This research uses the Plomp model consisting of 3 stages (Puspasari, 2017). However, this research uses 2 research stages, namely preliminary research (initial research) and prototyping phase (development phase).

The preliminary research carried out was a needs and context analysis as well as a literature review. Needs and situation analysis is an initial study to obtain data in the form of phenomena of problems for educators and students that occur through initial observations and interviews with mathematics teachers at SMPN 4 Langsa. Literature studies are carried out to find solutions to problems. The literature review includes a study of appropriate learning media or resources to improve the problem of students' low mathematical abilities, motivation and self-confidence.

The prototyping phase begins with designing a prototype of the Student Worksheet based on Augmented Reality (AR). Next, the prototype is evaluated and revised until a valid LKS prototype is obtained. The LKS prototype that has been designed undergoes a self-evaluation carried out by the researcher himself to see the completeness of the LKS and any visible errors. After revisions were made, the prototype was then validated by a team of experts consisting of two mathematics lecturers and one senior teacher (expert review). Then revisions are made to the prototype according to the validator's suggestions so that the product prototype is declared valid by the expert. This research reports the results of the expert review which can be seen in the Tessmer diagram in Figure 1.

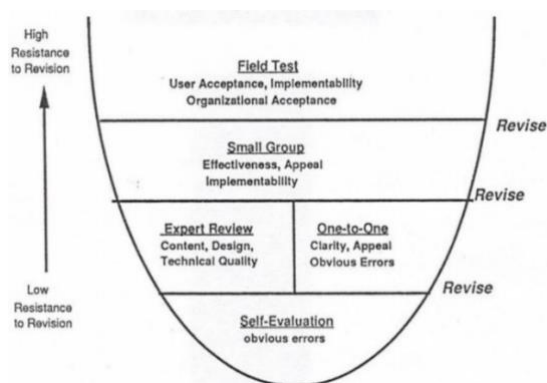


Figure 1. The formative evaluation (Plomp & Nieveen, 2013)

The instruments at the self-evaluation and expert review stages are in the form of questionnaires using a Likert scale. Self-evaluation was analyzed using percentage techniques, while the validity questionnaire sheet was carried out by three experts. Validity is analyzed by the total mean (V_a) of the validity assessment data with criteria (Azis, 2019) on Tabel 1.

Table 1. Validity level

Validity level	Interpretation
$1 \leq V_a < 2$	Invalid
$2 \leq V_a < 3$	Less Valid
$3 \leq V_a < 4$	Valid
$4 \leq V_a < 5$	Very Valid

3. Results and Discussions

The results obtained from this research include the results of the preliminary research phase and the Prototyping Phase. At the preliminary research stage, it was found that the learning carried out had not implemented student-centered learning, the teacher had never designed learning resources, student learning motivation was low, geometry lessons were considered difficult by the majority of students, low learning persistence, and low student self-confidence. This makes it difficult for students to manage and the learning process in class is less conducive. Based on this problem, researchers together with mathematics teachers designed a learning resource in the form of Student Worksheets based on Augmented Reality (AR) with the hope that students will be interested in learning so that they can foster enthusiasm for learning and improve students' mathematical abilities.

The next stage is the prototyping phase, namely designing a product based on Augmented Reality (AR). The Worksheets design can be seen in Figure 2.

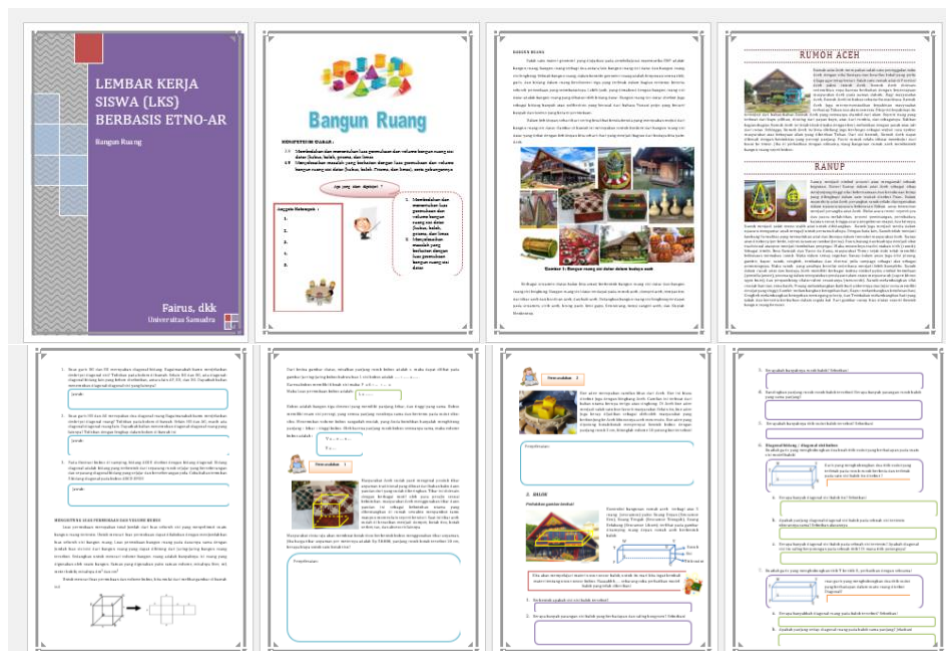


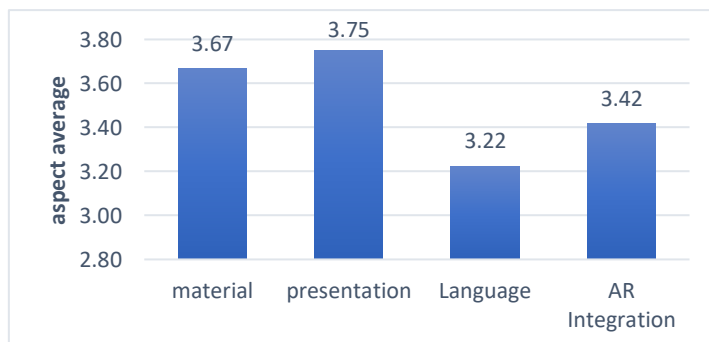
Figure 2. Design of student worksheets based on Augmented Reality (AR)

The worksheet design is then carried out in a series of tests at the development stage (prototyping phase), which begins with a self-evaluation. The researcher read and checked the completeness of each prototype, corrected any errors and added parts that were deemed lacking. The results of the self-evaluation test by the researcher himself showed that the Worksheets prototype design was complete. Next, a validity test of the AR-based Worksheets was carried out on experts, namely two mathematics lecturers and one senior mathematics teacher. Validity assessment includes four aspects, namely material, presentation, language and integration with Augmented Reality Applications. The results of the validation of Student Worksheets by validators are presented in Table 1.

From table 1, it can be seen that the average overall worksheet validation result is 3.49 or in the valid category. The average for the material aspect is 3.67 (valid), presentation 3.75 (valid), language 3.22 (valid), and Integration with Augmented Reality Applications 3.42 (valid).

Table 1. Student worksheet validation results

No	Rated aspect	Evaluation			X	K
		V1	V2	V3		
I	Material aspect					
	1 The main material of the worksheet is in accordance with the indicators	4	4	5	4,33	Very Valid
	2 The facts, concepts, and illustrations submitted are accurate	4	4	4	4,00	Very Valid
	3 The material presented is suitable for the abilities of class VIII SMP students	3	4	3	3,33	Valid
	4 The material in teaching materials can support improving student learning outcomes	3	3	3	3,00	Valid
	5 The material is presented systematically	3	4	4	3,67	Valid
II	Presentation aspect					
	1 The concepts presented are coherent and balanced from beginning to end	4	4	4	4,00	Valid
	2 The layout of text, images, tables and graphs is presented harmoniously	4	3	4	3,67	Valid
	3 The presentation of material is student-centered and can motivate	4	4	4	4,00	Very Valid
	4 Students to learn independently	3	4	3	3,33	Valid
III	language aspect					
	1 The language used is appropriate to the student's level of development	3	3	4	3,33	Valid
	2 Presented in interesting language so that it motivates students to learn	4	4	4	4,00	Very Valid
	3 Grammar is in accordance with Improved Spelling	3	3	3	3,00	Valid
	4 The sentences used are clear and do not cause misunderstandings	3	3	3	3,00	Valid
	5 Standard use of terms and symbols	3	3	3	3,00	Valid
	6 Integrity of meaning in chapters, sub-chapters and paragraphs	3	3	3	3,00	Valid
IV	Integration with Augmented Reality Applications					
	1 There are instructions for using worksheets and augment reality applications.	3	3	3	3,00	Valid
	2 Images used as targets for augmented reality applications can be scanned and display objects that match the material	3	4	4	3,67	Valid
	3 Images used as targets support augmented reality applications delivery of material	4	4	4	4,00	Very Valid
	4 There is a link that can be used to download the augment reality application	3	3	3	3,00	Valid
Average		3,37	3,53	3,58	3,49	Valid

**Figure 3.** Average results for each validation aspect

Based on Figure 3, the average value for each aspect of Student Worksheet validation is within the valid criteria ($3 \leq Va < 4$). The highest validation is in the Worksheet presentation aspect and the lowest validation value is in the language aspect.

4. Conclusions

Based on the research results, a student worksheet design based on augmented reality integrated with Acehese culture has been obtained in the best condition. Student worksheets are valid in four aspects, namely material, presentation, language, and integration with Augmented Reality applications are in the valid category

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