JPPIPA 10(8) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Validity of Project Model Science Learning Tools Assisted by *Augmented Reality* to Improve Students' Literacy and Creative Thinking Abilities

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Received: July 4, 2024
Revised: August 5, 2024
Accepted: August 25, 2024
Published: August 31, 2024

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DOI: 10.29303/jppipa.v10i8.8373

Abstract: The development of project model science learning tools assisted by augmented reality has been carried out to improve students' literacy and creative thinking abilities. This development research aims to produce a valid product and describe the results of the validation of the learning device so that it is suitable for use in the learning process. This type of research is research and development with 4D model design which consists of the definition, design, development and dissemination stages. Validation of learning tools was carried out by three competent expert validators at Mataram University. The development of augmented reality-assisted project model science learning tools developed consists of a syllabus, lesson plans, teaching materials, LKPD, augmented reality media as well as scientific literacy test instruments and creative thinking ability test instruments. The results of the research show that the project model science learning tools assisted by augmented reality have very valid and reliable criteria so that they are suitable for use in the science learning process in schools to improve students' scientific literacy and creative thinking abilities.

Keywords: Augmented Reality; Creative Thinking Ability; Learning Tools; Project Model; Scientific Literacy

Introduction

The world development of the 21st Century is marked by the use of information and communication technology in various life activities which will of course also have an impact on the world of education. Education has a very important role in producing quality Human Resources (HR) to be able to keep up with developments and competition in the current era of globalization. So to deal with this, adaptation or adjustments need to be made in the educational process (Prihatmojo et al., 2019). Dewi et al. (2022) stated that several skills needed to face the developments that occur include creativity, entrepreneurship, literacy, communication, problem solving, critical thinking and working together. Thus, students need to be prepared to have good competencies including the ability to think logically, critically and creatively, being able to communicate and collaborate as well as the ability to master technology and scientific literacy.

Scientific literacy is a person's ability to apply their scientific knowledge in identifying a problem and drawing conclusions based on scientific evidence in order to make decisions regarding human activities towards nature (Hadiprayitno et al., 2020). The facts from the PISA survey results from 2000 to 2018 show that Indonesia is one of the countries with a relatively low scientific literacy ranking. This shows that there is a gap in the applied science learning (Narut & Supardi, 2019). Apart from scientific literacy skills, the 4C skills that are important to develop are creativity, including the ability to think creatively. Creative thinking is a thinking process to get a new relationship from various things that is done through receiving, remembering and

How to Cite:
Naf'atuzzahrah, N., Hadiprayitno, G., & Harjono, A. (2024). Validity of Project Model Science Learning Tools Assisted by Augmented Reality to Improve Students' Literacy and Creative Thinking Abilities. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 5837–5843. https://doi.org/10.29303/jppipa.v10i8.8373

analyzing activities so that the results can be used to solve problems (Ananda, 2019). It is very important to hone creative thinking skills because it can train and familiarize students with solving problems in various ways that suit their thinking (Trimawati et al., 2020). The 2015 Global Creativity Index (GCI) data shows that Indonesia's level of creativity is still low and is ranked 115th out of 139 countries, which indirectly shows that the ability to think creatively is also still relatively low (Yulaikah et al., 2022).

Based on observations and interviews conducted at one of the MTs in West Lombok, information was obtained that the science learning process implemented had not directed students to train their thinking skills and solve problems scientifically. Learning resources and media in science learning are still very limited and have not been integrated with the use of technology. The problem that is the main focus is the limitations of teachers in preparing learning tools, especially those oriented towards growing and improving scientific literacy and students' creative thinking abilities. Therefore, innovation or new ideas are needed through the development of learning tools to serve as a reference for implementing active, creative and fun learning using a model that can support and facilitate the development of students' scientific literacy and creative thinking abilities. The learning model used is the project based learning model.

Project based learning is a learning model that produces a project, where in the project students will create a product and are given the freedom to determine the product that will be created and presented. This PjBL model can help students train critical and creative thinking skills to produce quality products (Elisabet et al., 2019). In using learning models, it is very good if combined with the use of learning media (Ulfa et al., 2022). This is closely related to the use of information and communication technology (ICT) which is integrated in learning. ICT-based learning is very important to apply, especially to science learning (Muzaki et al., 2022). One technology-based media that can be used in science learning is Augmented Reality (AR). AR is a technology that combines two-dimensional or three-dimensional virtual objects into a real environment which is then displayed or projected in real time (Setyawan et al., 2019). The benefit is that it can help students to understand objects in science learning more realistically with flexible time and impressive experience, thereby fostering students' interest and motivation to learn and can train their thinking abilities (Sudarmayana et al., 2021; Vari, 2022). Based on the description above, it is necessary to develop science learning tools with a project model assisted by augmented reality to improve students' literacy and creative thinking abilities. This research aims to produce a scientific learning device with a project model assisted by augmented reality that is valid to be applied in the learning process. In line with research by Putra et al., (2018) which states that the learning tools developed need to be validated to ensure their quality. A learning device is declared suitable for use if the validation results show a high validity and reliability category. This is a reference for researchers to carry out validation tests of project model science learning devices assisted by augmented reality to improve students' scientific literacy and creative thinking abilities before implementing them in the learning process at school.

Method

This type of research is research and development. The research design used is the 4D model. Thiagarajan in (Sugiyono, 2019) revealed that 4D model research consists of four steps, namely Define, Design, Development and Dissemination. Define is an activity to analyze and define a problem, weakness or condition which is the basis for the importance of carrying out development. Design is the stage of making plans in the form of designs related to the product that has been determined. Development is the activity of creating and developing a design into a product and carrying out product validation tests so that results are obtained in accordance with previously determined specifications. Dissemination is the activity of spreading products that have been tested so that they can be used by other people. To facilitate the research process, a research and development flow has been arranged with stages or procedures as in Figure 1.

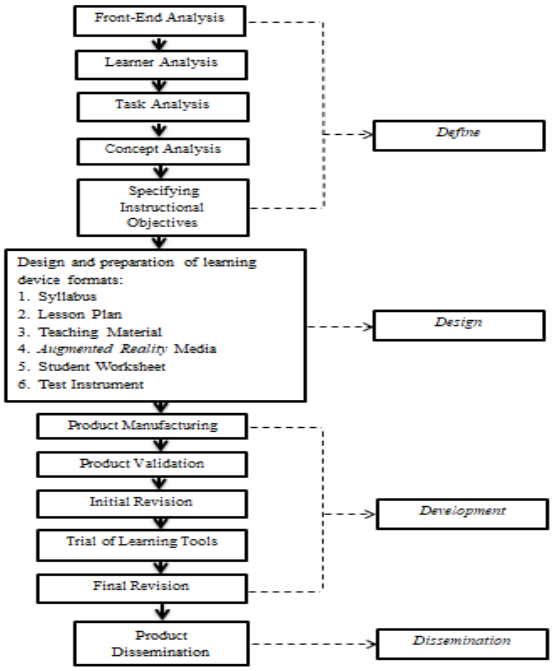

Figure 1. 4D Research Procedures

The type of data obtained in this research is qualitative and quantitative data. Qualitative data is obtained from expert validators' suggestions and input on learning tools that have been developed to serve as a basis and reference for making revisions or improvements. Meanwhile, quantitative data was obtained from validation results by expert validators in the form of learning device validation questionnaire scores on a scale of 1 to 4. The formula used to calculate the validity of the learning device products that have been developed is as stated in Equation 1.

$$\% \text{ validation} = \frac{\text{Validator score}}{\text{Maximum score}} \times 100\% \quad (1)$$

The percentage data on validity results that have been obtained can then be matched according to the validity criteria as stated in Table 1.

Table 1. Learning Device Validity Criteria

Percentage (%)	Score
85,01 – 100,00	Very valid
70,01 – 85,00	Valid
50,01 – 70,00	Less valid
01,00 – 50,00	Invalid

(Akbar in Arifuddin et al., 2022)

Apart from validity testing, reliability testing of learning device products is also carried out. In this research, the calculation of the reliability of learning tools uses the Borich method, known as Percentage Agreement (PA), which is the percentage of agreement between assessors which is a percentage of agreement between the first assessor and the second assessor using the formula stated in equation 2.

$$Percentage\ Agreement\ (\text{PA}) = \left(1 - \frac{\text{A}-\text{B}}{\text{A}+\text{B}}\right) \times 100\% \quad (2)$$

With A being a larger assessor's score and B being a smaller assessing score. The larger score (A) is always subtracted from the smaller score (B). Learning tools are said to be reliable if the percentage agreement value is more or equal to 75% (Makhrus et al., 2020).

Result and Discussion

This research is a type of research and development with a 4D model design. The 4D development model consists of 4 stages, namely definition, design, development and dissemination (Rajagukguk et al., 2021). This research is limited to the development stage, namely product validity testing. This research aims to produce a product in the form of a project model science learning device assisted by augmented reality.

Define is an activity to analyze and define a problem, weakness or condition which is the basis for the importance of carrying out development (Gogahu & Prasetyo, 2020). At this stage there are several activities carried out including beginning-to-end analysis, student analysis, task analysis, concept analysis and specification of learning objectives (Amali et al., 2019). The results of the initial and final analysis show that science learning has not directed students to train their thinking skills and solve problems scientifically, science learning media and resources are still very limited, there is no integration of technology in science learning and the available learning tools are incomplete and lacking adequate. Furthermore, the results of the student analysis show that the level of literacy and creative thinking abilities of students is still relatively low because they are rarely trained and have not yet become accustomed to it. Students become more motivated when learning is integrated with the use of technology. The students involved in this research were class VIII MTs students in West Lombok. Task analysis contains a collection of procedures for determining the content in a learning plan which includes Core Competencies (known with KI) and Basic Competencies (known with KD) in accordance with the applicable 2013 curriculum (Purwasi & Fitriyana, 2020). The basic competencies used as a reference in the development of this learning tool are KD 3.8 (Understanding substance pressure and its application in everyday life, including blood pressure, osmosis and capillarity of transport tissue in plants) and 4.8 (Presenting the results of testing the application of the concept of substance pressure in everyday life). Concept analysis is carried out by identifying main concepts and systematically arranging the main concepts to be taught. Detailing and systematic preparation of the material was carried out to form a concept map, which in this case is material about pressure of substances and its application in daily life for class VIII SMP/MTs. Specification of learning objectives, namely the formulation of learning objectives in more detail based on KI and KD which are adjusted to the main indicators of learning objectives (Kristianto & Rahayu, 2020), namely measuring students' scientific literacy and creative thinking abilities.

Design is the stage of making plans in the form of designs related to products that have been determined (Hafidh & Lena, 2023). Next, an initial draft or prototype of the augmented reality-assisted project model learning device was prepared, which was developed including syllabus, lesson plans, worksheet, teaching materials, augmented reality media and scientific literacy test instruments and students' creative thinking abilities. The syllabus created in this research refers to Minister of Education and Culture Regulation No. 22 of 2016 and was developed in the form of learning activities in

accordance with the stages or steps of the project model to improve students' scientific literacy and creative thinking abilities. The Learning Implementation Plan (RPP) is made in accordance with the project model syntax which contains school identity, KI, KD, IPK (known with Competency Achievement Indicators), instructional objectives, materials, models, methods, learning media, learning resources, learning and assessment steps to improve students' scientific literacy and creative thinking abilities. Teaching materials are prepared based on the 2013 SMP/MTs Curriculum on Substance Pressure and its Application in Daily Life. The content in the teaching materials is designed to be integrated with augmented reality media. Student Worksheets (LKPD) are designed in the form of activities with project model stages to improve students' scientific literacy and creative thinking abilities. Augmented reality media is Android-based media designed to display science learning objects in three dimensions. This media was designed using the Unity, Vuforia and Blender applications. The AR media developed is an application that can be installed on Android versions 7 to 12. The test instrument was created to measure students' scientific literacy and creative thinking abilities. The test instruments developed are in accordance with indicators of scientific literacy and creative thinking abilities. At this stage a validation sheet is also designed which will be used by the validator as a reference to provide an assessment of the product being developed.

Development is the activity of creating and developing a design into a product and carrying out product validation tests so that results are obtained in accordance with previously determined specifications (F. Fitri & Ardipal, 2021). Validated products include syllabus, lesson plans, student worksheets, teaching materials, augmented reality media and scientific literacy test instruments and students' creative thinking abilities. Validation was carried out by expert validators, namely three lecturers from the Master of Science Education study program, Mataram University. The data on the validity and reliability of learning devices can be seen in Table 2.

Table 2. Validity and Reliability Test Results of Learning Devices

Learning Tools	Validity Test Results (%)	Category	Reliablity Tes Results (%)	Category
Syllabus	96.15	Very Valid	96.40	Reliable
Lesson Plans	95.24	Very Valid	94.70	Reliable
Teaching Materials	94.17	Very Valid	94.40	Reliable
Student Worksheet	93.75	Very Valid	94.60	Reliable
*Augmented Reality*Media	93.23	Very Valid	93.60	Reliable
Scientific Literacy Test Instrument	91.67	Very Valid	94.40	Reliable
Creative Thinking Ability Test Instrument	91.67	Very Valid	94.40	Reliable

The results of expert validation are one of the criteria that serve as a reference that the learning device products developed can be used or applied in the learning process in schools. Based on the data in Table 2, it shows that each product consisting of syllabus, lesson plans, teaching materials, student worksheet, augmented reality media, scientific literacy test instruments and creative thinking skills has very valid categories or criteria. This is in line with the statement (Fitri et al., 2020) explain that learning tools that already have very valid criteria can be applied or tested in schools after making revisions based on input and suggestions from expert validators.

The syllabus developed refers to KD 3.8 and 4.8 material on pressure of substances and its application in everyday life. The average assessment result of the syllabus by expert validators is 96.15% with a very valid category and the average value of percentage agreement (PA) is 96.40% with reliable category. The syllabus developed already contains the complete components that must be included in the syllabus (Yulianingsih et al., 2022).

The RPP developed consists of three meetings and is structured based on the syntax or learning steps of the project model. The average assessment results of the RPP by expert validators were 95.24% in the very valid category and the average percentage agreement (PA) value was 94.70% in the reliable category. The improvements made were based on input and suggestions from the validator, namely explaining the apperception section more clearly and in detail and refining the learning objectives that will be measured during the research. (Wati, 2021) states that lesson plans that have a valid category can be applied in learning.

The teaching materials developed contain material about pressure of substances and its application in daily life for class VIII SMP/MTs. This teaching material is integrated with augmented reality (AR) media which is also being developed, which includes markers that can be scanned using the AR application. The average assessment results of teaching materials by expert

validators were 94.17% in the very valid category and the average percentage agreement (PA) value was 94.40% in the reliable category. Improvements made include adjusting the colors and including the source of the image and adding numbering to the writing of the equation. In line with the results of other research which shows that teaching materials assisted by augmented reality have valid criteria as a learning resource for computer systems informatics (Alimka et al., 2024).

The developed LKPD is prepared based on the project model. The initial part of the LKPD contains basic questions related to the material topic, sections for preparing project activity schedules, project design plans, project creation procedures (tools, materials and project creation steps), as well as tables of progress, obstacles and solutions in the project creation process. The average assessment results of the LKPD by expert validators were 93.75% in the very valid category and the average percentage agreement (PA) value was 94.60% in the reliable category. Improvements made include adding images to make them more attractive and complemented by the source. This is in line with research by (Murni & Yasin, 2021) which states that LKPD based on project models is valid, practical and effective for use in Water Cycle Science material.

The augmented reality media developed is an application that can be installed on Android versions 7 to 12 with the available menus, namely developer info, application info, AR camera menu and quiz. The average assessment result of AR media by expert validators was 93.23% in the very valid category and the average percentage agreement (PA) value was 93.60% in the reliable category. The improvements made were adjusting the image display. In line with Hidayat (2024) research which states that science learning media regarding the solar system using augmented reality applications can increase students' learning motivation. Apart from that, Vari (2022) stated that the use of augmented reality in science learning can train 21st century thinking skills depending on the learning activities taking place.

The test instrument developed consists of 8 questions with details of 4 questions to measure scientific literacy abilities and 4 questions to measure creative thinking abilities. These questions are prepared based on indicators of scientific literacy and creative thinking abilities. The average assessment results of scientific literacy and creative thinking ability test instruments by expert validators were 91.67% in the very valid category and the average percentage agreement (PA) value was 94.40% in the reliable category. Improvements made include checking and readjusting the question script with the indicators. In line with research of Putri (2020) which explains that scientific literacy test instruments in science learning that have been validated and have valid and reliable criteria can be used by teachers to measure the level of students' scientific literacy abilities. The research results of (Trimawati et al., 2020) stated that science assessment instruments in project-based learning which have very valid and reliable criteria require the implementation of learning in an efficient time to improve students' creative thinking abilities.

Dissemination is the activity of spreading products that have been tested so that they can be used by other people (Insani & Rossa, 2024). At this stage, research products will be disseminated in the form of science learning tools with augmented reality-assisted project models that have been developed. Dissemination activities will be carried out after limited-scale and wide-scale trial activities to obtain data on the product's practicality and effectiveness. Next, the final product that has been improved is given to the school where the research was carried out and one other school.

Conclusion

The learning tools developed in this research consist of a syllabus, RPP, LKPD, teaching materials, augmented reality learning media, scientific literacy test instruments and creative thinking abilities. Expert validators have provided a validation assessment of the learning tools to ensure their quality before being implemented in learning activities. Based on the validation data obtained, the science learning tools developed using a project model assisted by augmented reality to increase students' scientific literacy and creative thinking abilities have very valid and reliable criteria so they are suitable for use in the science learning process in schools (SMP/MTs).

Acknowledgments
We would like to thank all parties involved in this research.

Author Contributions
Author contributions to this article, N: data collection, data analysis, writing article draft, GH. and AH: focused on methodology and reviewed the paper.

Funding
This research was funded by Ristekdikti Master's Thesis Research 060/E5/PG.02.00.PL/2024

Conflicts of Interest
The authors of this article declare no conflicts of interest.

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