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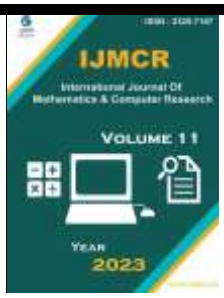

3D Hologram as Scientific Tool in Geometry Educational

Andi Kaharuddin[1], Prof. Nurdin Arsyad[2], Dr. Asdar[3]

[1]Student, Universitas Negeri Makassar, Indonesian

[2]Professor, Universitas Negeri Makassar, Indonesian

[3]Asst. Professor, Universitas Negeri Makassar, Indonesian

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Corresponding Author:
Andi Kaharuddin

ABSTRACT

Learning geometry must begin in a simple way from concrete to abstract, from an intuitive perspective to analysis, from exploration to long-term mastery. 3D Holograms are need to assist teachers and students in learning geometry. This research develops a valid, practical and effective 3D Hologram. Research and development used the ADDIE model. The 3D Hologram is validated by material and media experts and field tested. Data analysis used quantitative analysis. The results found 3D Hologram valid with a score of 75, practical with a score of 91, and effective with a score of 87. 3D Hologram as scientific tool in geometry education.

KEYWORDS: 3D Holograms; Scientific Tool; Geometry Educational

INTRODUCTION

The presence of technology in developed countries will make life easier by finding creative solutions to human needs [1]. One aspect of the curriculum in Indonesia is education that is integrated with technology. Technology is expected to be a solution to ever-changing human needs. Therefore, to create new designs in education, a combination of technology and elements of human psychology is used to train visual abilities, invention, creative thinking and critical thinking.

Geometry education in schools is expected to provide systematic attitudes and habits for students to be able to provide an overview of the relationships between geometric shapes and the classifications between these shapes. Students experience difficulties if the teacher does not provide stimulation to their senses because students do conceptual abstractions based on concrete characteristics, where their knowledge and experience is lacking [2].

1. WHY USED 3D HOLOGRAMS AT LEARNING?

Learning transformation from abstract to visual. At this stage, the 3D Hologram converts abstract shapes into visual shapes developed for smartphone use, providing considerable convenience for those who wish to use them. 3D holograms are seen as a future technology, capable of visualizing abstract shapes into visual shapes that resemble real objects. This 3D hologram was originally introduced in fiction genre films, but was only a concept film. Dennis Gabour was the first to find it and has been used to exhibit historic objects in the United States, in 2005 it was used to broadcast the first press conference in the United States.

2. PERSPECTIVE AT HOLOGRAMS

A hologram is a combination of two coherent light rays in microscopic form [3], [4]. The hologram acts as information storage of optical information, the optical information then forms an image, scene or scene [5], [6]. A hologram is an image of the latest information storage that can be in 3 dimensions [7], [8]. Holograms use the principles of diffraction and interference, which are part of the wave phenomena [9], [10]. The argument concluded that a hologram is a combination of coherent light rays that create an image as information storage from the original form to a 3-dimensional shape.

The characteristic of a hologram is that the light that reaches the observer's eye comes from a reconstructed image of a hologram and is similar to the original object. A person viewing a hologram image can see the depth, parallax and different perspectives that exist in the actual scene schematic. The hologram of a scattered object can be reconstructed from small holographic parts of a hologram broken into pieces, each part can be used to reproduce the whole image again [11], [12]. However, shrinking the size

of the hologram can cause a decrease in the perspective, resolution, and brightness of the image. Holograms are reconstructed from two types of images, usually real images and virtual images [13]–[15].

3. 3D HOLOGAMS AND GEOMETRY EDUCATION

Geometry education: cube and cuboid are abstract materials at the junior high school level. The abstraction in this material is shown in the concept mastery. Geometry education must begin in a simple way from concrete to abstract, from intuitive to analytical, from exploration to long-term mastery [16]–[18].

This 3D hologram is a scientific tool and facilitates students in understanding the concept of cube and cuboid, such as: sides, lines, points, side diagonals, space diagonals, diagonal areas, surface area and volume. The 3D Hologram design displays cube and cuboid in 3D and an observer can view them from any angle, as they are designed in 360 degrees, it will train visual abilities, invention, creative thinking and critical thinking.

As the utilization of the technology is new geometry education, conduction this research is very significant.

Besides, no study has been conducted to develop 3D Holograms in geometry education. This research is the first study to develop 3D Hologram application with 3D Hologram framework. Therefore, this research is expected to contribute to the literature in terms of developing 3D Holograms. The purpose of this research is to develop and test 3D Holograms as a scientific tool in geometry education.

METHODS

This study is research and development. The test subjects were junior high school students. Data collection techniques include questionnaires, observations and tests. The data analysis technique uses quantitative analysis. The research and development model used is Educational Research and Development with the ADDIE [19].

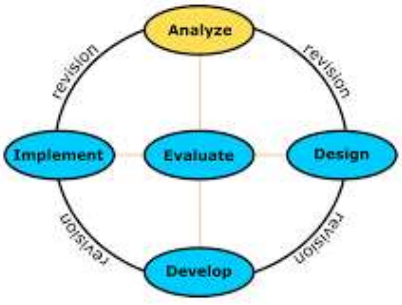

Figure 1. ADDIE model

(1) analysis: needs analysis activities, curriculum analysis, gap identification, task analysis, evaluation and revision; (2) design: material preparation, flowchart, visual design, evaluation and revision; (3) development: creating user interfaces, 3D object animation, dubbing, making 3D Hologram applications and holographic frames, validity test and revision; (4) implementation: field testing, evaluation and revision; (5) evaluation: practicality and effectiveness test.

RESULT

Preliminary studies show that teachers need geometry learning that is interesting and easy to use as well as technology-based, interesting assistance discovering students' difficulties understanding abstract geometry material, the needs of teachers and students require that the material be presented in the form of text, images, videos and 3D animation.

Design, compiling 3D Hologram materials consisting of elements, mesh, area of surface and volume of cube and cuboid, designing 3D Hologram orientations by integrating van Hiele geometry with a scientific approach, creating flowcharts and visual design.

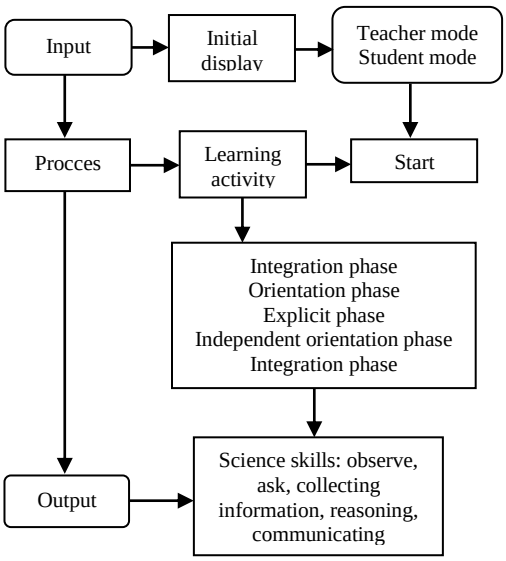

Figure 2. Flowchart 3D Hologram

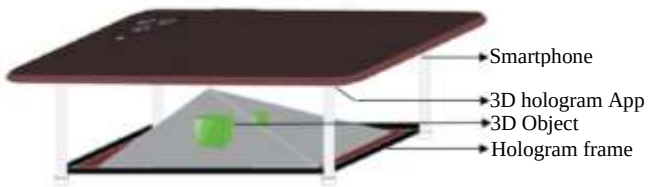

Figure 3. Visual Design 3D Hologram

Development, designing a 3D hologram user interface concept using the Figma program, creating assets and 3D object animation with the Blender program, importing 3D animation into video with the After Effects program, dubbing with the Adobe Podcast program, creating 3D holograms with the Unity program, creating frames hologram with black acrylic plastic, tape measure, hacksaw, drilling machine, plastic hose, bolts, mica plastic and validate with a score of 75 from the validation of media experts and revisions to the 3D Hologram that has been developed.

Figure 4. 3D Hologram

The implementation was carried out with two field trials, the first field trial was carried out in five meetings and obtained the result that the teacher using 3D holograms was in the good category, the activities of students while using 3D holograms were in the very active category, the response of teachers and students to 3D Holograms tend to be positive. After the field trial 1 ended, a revision was carried out based on the obstacles faced by the teacher and students including revisions to the sound recording that were not clear using the Adobe Podcast program in the sub-material section of the diagonal cube and cuboid. The next revision is the creation of hologram media to a larger size to facilitate teachers in teaching geometry material. The evaluation carried out was a practicality and effectiveness test on the results of field trials.

Table 1. Paracticality

No.	Indicator	Criteria	Achievement
1	Reasonableness	≥ 51	90
2	Teacher response	≥ 51	93

The practicality test obtained the result that the teacher using 3D holograms was in the very good category and the teacher's response to 3D holograms was in the positive category.

Table 2. Effectiveness

No.	Indicator	Criteria	Achievement
1	Student learning outcomes	≥ 75	84
2	Student activity	≥ 51	88
3	Student response	≥ 51	90

The effectiveness test of the first and second field trials was in the good category, where the learning outcomes of the students were in the good category, the activities of the students while using the 3D hologram were in the active category, and the students' responses to the 3D hologram were in the positive category.

DISCUSSION

The 3D Hologram eligibility criteria meet the eligibility criteria with a validity score of 75 from the indicators of language, ease of use and materials. This feasibility becomes an alternative that teachers can use in preparing teaching media in learning the topic of geometry. This is because learning geometry requires students to carry out conceptual abstraction processes in learning. The learning process in cognitive theory is a mental process and structure that occurs as a result of learning.

Practicality shows that 3D Holograms are practical and easy to use in learning geometry, based on trials using 3D Holograms and teacher responses.

3D Hologram integrates van Hiele geometry (information, orientation, explicitization, independent orientation and integration) which helps students learn geometry step by step. Material is presented in an organized manner so that the learning process of students is more directed and well structured. Testing the effectiveness of field trials to obtain effective criteria. This is because 3D Holograms are composed of sound/audio, text, video and 3-dimensional animation components with a scientific approach that accommodates differences in student learning styles and provides opportunities for students to observe, ask, collect information, reasoning, communicating.

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