Designing Instructional Multimedia of Curved Three-Dimensional Shapes in Junior High Schools Through out Gorontalo Province

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Abstract. Development of instructional technologies gives rise to high demand, including math learning, that can be attained by the involvement of information and communication technology through instructional multimedia. Instructional multimedia are presentation media that combine the whole media elements, such as text, audio, video, animation, and graph. An appropriate and innovative design of instructional multimedia will indubitably provide an effective learning process to students, which then later positively contributing to their learning outcomes. The objective of this study was to develop character-based instructional multimedia of curved three-dimensional shapes in the ninth grade of junior high schools throughout Gorontalo province. The development model referred to the 4-D Model (Define, Design, Develop and Disseminate) proposed by Thiagarajan, Semmel and Semmel. It was shown that the developed interactive multimedia of curved three-dimensional shapes were valid and feasible according to experts, as well as being practical and bettering students' responses during the lesson. Additionally, learning implementation by employing the multimedia arrived at excellent criteria and could improve students' activities and learning outcomes. Based on the observation result, their activities reached excellent criteria. Student learning outcomes also gave classical mastery data with excellent criteria. All in all, instructional multimedia being developed were valid, practical, and effective to apply in the math learning process in the ninth grade of junior high school
Keywords: Instructional Multimedia, Curved Three-Dimensional Shapes

1. Introduction

Math learning serves as a process that is designed and emphasized on exploration and investigation to familiarize students to use science in solving problems. The students are prepared to become competitive, adaptive, and self-contained human resources. Accordingly, it is essential to enhance learning quality, relevance, renewal, and innovation in a planned, directed, and sustainable manner.

Innovations in math learning are attempted through the utilization of information and communication technology (ICT). Multimedia are among the forms of ICT apps employed in the learning process. Multimedia refer to the combination of two or more elements, including text, graph,

audio, visual, or animation [1]. In the same tune, [2] mention the characteristics of instructional multimedia, as follows:

1. Featuring more than one convergent media, e.g., bringing together the audio and visual elements.
2. Having an interactive quality and capability of accommodating user response.
3. Being autonomous, user-friendly, and content-complete in such a way that the user can use the media single-handedly.

Utilizing instructional multimedia enables students to be more engaged in the classroom, making the teachers not become the only learning source. Animation in multimedia makes it attractive and able to increase student learning outcomes.

The benefits of instructional multimedia, according to Newby, Stepich, Lehman, and Russell [3], consist of (1) realistic, in which students can listen to actual events as what has been received; (2) motivating students to better their positive attitude; (3) effective for all types of learning; (4) interactive, multimedia are able to present information, feedback, and evaluation; (5) consistent, all students can carry out the procedures and stages; (6) controlled, every student can use the multimedia; (7) personal, each student is able to control the learning process as in accordance with their level of understanding; (8) making the lesson more fascinating; (9) suitable for various learning types. For such reasons, the math learning process gets more interactive, interesting, and great fun.

Using multimedia in the classroom will create a significant learning condition as the students take different opportunities of learning with the designed multimedia that are relevant to learning objectives.

Several previous studies show that interactive multimedia are capable of increasing student learning outcomes at all levels of education. Computer-based multimedia presentation is more successful than the conventional method [4]. Further, [5] points out that a traditional approach prepares students only to sit passively while looking forward to the information; thus, they lack motivation. If teachers present a substantial and unique learning environment, the students will find the lesson easier and more efficacious. Learning topics can be adjusted to students' characteristics and give opportunities for them to study with their own styles and comprehensions. [6] investigates the effect of multimedia apps supported by instructional software; it reveals that using multimedia apps contributes to students' learning process and positively affects their behavior towards science. On top of that, a study conducted by [7] concludes that multimedia-based teaching and learning process can change students' behavior. Such a process is more organized and understandable. As multimedia are useful tools for teaching, those previous studies come to the conclusion that the multimedia-based learning process is more working than the conventional one. [8], in her study, discovers that the use of multimedia is more worthwhile compared to the traditional method at the level of knowledge, understanding, and application. Multimedia also make an enormous contribution to mathematics learning outcomes in the topic of geometry [9].

2. Research Methodology

This development study was conducted in junior high schools throughout Gorontalo Province, i.e., SMP Negeri 1 Tapa Bone Bolango Regency, MTs Negeri 2 Boalemo Regency, SMP Negeri 1 Duhiadaa Pohuwato Regency, MTs Al Khairaat Kwandang North Gorontalo Regency, SMP Negeri 2 Gorontalo, and MTs Negeri 2 Gorontalo Regency in the academic year of 2019/2020 (second semester). The development model referred to Four-D Model proposed by [10] that comprised Define, Design, Develop, and Disseminate stages. The developed product was instructional multimedia of curved three-dimensional shapes.

The following instruments were utilized in this research: 1) a questionnaire to obtain data of students' interest and motivation regarding the application of instructional multimedia of curved three-dimensional shapes; 2) an observation sheet of learning implementation by relying on curved three-dimensional shapes multimedia; 3) an observation sheet of students' activities; 4) learning outcome test.

Data analysis was elaborated below.

1) Analysis of Validity
Expert validation was analyzed by referring to the validity criteria presented in table 1.

Table 1. Validity Criteria.

Mean	Validity Criteria
4.00 - 3.75	Highly Valid
3.75 - 3.00	Valid
3.00 - 2.25	Quite Valid
2.25 - 1.50	Less Valid

The above table illustrates that interactive multimedia in the learning process could be applied if it met the 'valid' or 'highly valid' criteria based on expert assessment.

2) Analysis of Students' Responses and the Implementation of the Learning Process
Students' responses were obtained from the result of the questionnaire, in which the data were then analyzed, and the result of every indicator was concluded. Assessing the learning implementation was performed by matching the average total score given with the following criteria:

Table 2. Learning Implementation Criteria

Range	Interpretation
86% - 100%	Excellent
76% - 85%	Good
66% - 75%	Fair
56% - 65%	Poor
0% - 55%	Bad

3) Analysis of Student Learning Outcomes
Student learning outcomes were analyzed by referring to 80% individual mastery and 85% classical mastery of students reaching minimum mastery criteria.

3. Results and Discussion

This present work produces a product, i.e., interactive multimedia of "coordinate system", for the ninth-grade students. The development followed the Four-D model, as follows:

Define

The results of observation and interview with teachers and students indicate that the utilization of instructional multimedia is limited. Hence, the development of such multimedia, particularly in the topic of curved three-dimensional shapes, is highly required. The multimedia are designed to give an interactive effect on students to absorb the concept of curved three-dimensional shapes. Moreover, interactive multimedia can help to in still positive characters to the students, namely self-reliant, responsible, honest, confident, determined, and cooperative.

Design

This stage comprises the preparation of character-based multimedia of curved three-dimensional shapes. There are also multimedia validity sheets, questionnaires to obtain data of students' interest and motivation, observation sheets of learning implementation, observation sheets of students' activities, and learning outcome tests being developed.

The presentation of interactive multimedia of curved three-dimensional shapes has some functions, which are:

1. Tutoring
Interactive multimedia-based learning materials are presented by tutoring. Information containing the concept explanation is provided in the form of text, audio, image, animation, and graph. The stages of curved three-dimensional shapes tutoring generally involve introduction,

information/topic presentation, basic examples and problem-solving, questions and responses, and conclusions. In tutoring interaction, information and knowledge are communicated in such a way as the teacher presents the topic to the students. Here are a few tutoring examples of curved three-dimensional shapes multimedia.

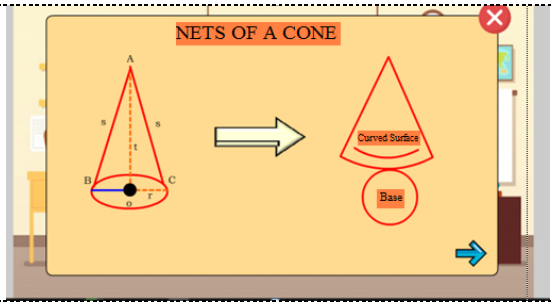

Figure 1. tutoring design of multimedia.

2. Drill

This format is intended to train the students to acquire skills or sharpen the concept of curved three-dimensional shapes. The program provides a series of multiple-choice questions displayed in a structured manner, along with the correct answers. At the end of the program, students can see their final score as an indicator to measure the level of their success in addressing the questions.

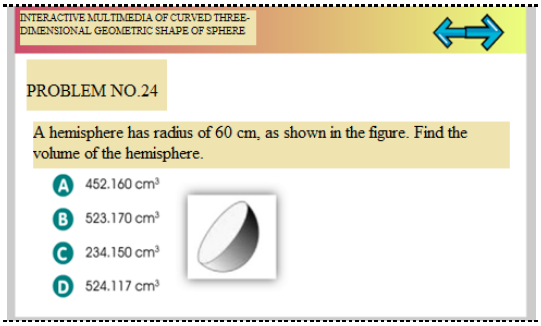

Figure 2 drill design of multimedia.

3. Simulation

Instructional multimedia with this format are attempted to resemble a dynamic process taking place in reality, e.g., simulating the finding of the surface area of a cone by cutting out the apothem to form the following cone nets.

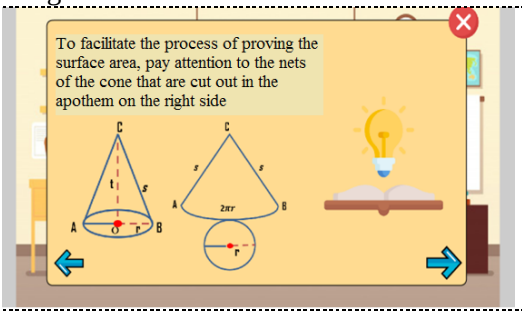

Figure 3 simulation design of multimedia.

Develop

Expert Validation

The validity of instructional multimedia of curved three-dimensional shapes comprises many assessment parameters, including material/topic (content, language, and legibility) and design. Validity results revolve around qualitative suggestions and assessment sheets. Qualitative suggestions are treated as a reference to revise the instructional multimedia.

Based on the result of expert validation involving teachers and lecturers, the achievement percentage arrives at 90.88% with an excellent qualification (revision is unnecessary). Accordingly, the content, language, and legibility of the curved three-dimensional shapes multimedia can be applied in the learning process.

From the assessment of the design expert, the developed multimedia fall under an excellent qualification, as proven by the percentage of the achievement of curved three-dimensional shapes multimedia by 92.22%. On that ground, the multimedia feature the first-class design in terms of display and interactivity and are applicable in the classroom.

Instructional multimedia draw students' attention to study better rather than the traditional method of teaching [11]. Koehnert's theory brings out the fact that the more senses involved in the learning process, the more successful the process itself. Once students stand in an effective situation to study and involve more senses to absorb information, it will be much easier for them to grasp the lesson.

Product Trial

1. The response and implementation of the learning process utilizing the multimedia of curved three-dimensional shapes.

It is shown in the observation result regarding learning implementation with instructional multimedia that the interactive multimedia of curved three-dimensional shapes are practical to use.

Table 3 Analysis of Learning Implementation by Employing Curved Three-Dimensional Shapes Multimedia

Junior High Schools	**Percentage of Learning Implementation (%)**	**Criteria**
SMPN 1 Duhiadaa	89.73%	Excellent
SMPN 2 Gorontalo	93.82%	Excellent
SMPN 1 Tapa	91.40%	Excellent
MTsN 2 Gorontalo Regency	90.22%	Excellent
MTsN 2 Boalemo	90.18%	Excellent
MTs Alkhairaat North Gorontalo Regency	91.72%	Excellent

Drew on the analysis result of learning implementation in the site area, the multimedia of curved three-dimensional shapes can help teachers perform the lesson and achieve learning objectives. It has something to do with the fact that the learning process is much more enticing, interactive, and time-saving. Teachers play a role as a facilitator in the learning process, guiding group activities, and offering feedback towards learning evaluation that is designed in the multimedia.

Provided in Table 4 are students' responses to interactive multimedia encompassing the aspects of motivation, interest, practicality, and clarity.

Table 4. Average Percentage of Students' Responses

Classes	Students' Responses (%)	Criteria
SMPN 1 Duhiadaa	85.29%	Excellent
SMPN 2 Gorontalo	89.12%	Excellent
SMPN 1 Tapa	85.00%	Excellent
MTsN 2 Gorontalo Regency	87.52%	Excellent
MTsN 2 Boalemo	85.15%	Excellent
MTs Alkhairaat North Gorontalo Regency	85.22%	Excellent

Table 4 indicates that students' responses to the interactive multimedia of curved three-dimensional shapes fall under excellent criteria. Simply put, they respond positively to the application of multimedia in the classroom. The students are very keen to study, as shown by their interest and attention during the lesson because the multimedia are attractive, user-friendly, and clear for them.

This is in line with a study conducted by [12] on the linkage between media and computer technology towards students' learning motivation. It is found that learning motivation is of major importance in the learning process. Computer-based technology and media are able to drive the students to study effectively and even to study independently.

Similarly, [3] claim the benefits of instructional multimedia, including (1) realistic, in which students can listen to real events as what has been received; (2) motivating students to better their positive attitude; (3) effective for all types of learning; (4) interactive, multimedia are able to present information, feedback of materials, and evaluation; (5) consistent, the procedures and stages can be carried out by all students; (6) controlled, every student can use the multimedia; (7) personal, each student is able to control the learning process as in accordance with their level of understanding; (8) making the lesson more fascinating.

In addition, the test of cognitive learning outcomes obtains the following data.

Table 5. Average Percentage of Student Learning Outcomes

Classes	classical outcome mastery (%)	Criteria
SMPN 1 Duhiadaa	85.19%	Excellent
SMPN 2 Gorontalo	87.22%	Excellent
SMPN 1 Tapa	85.88%	Excellent
MTsN 2 Gorontalo Regency	85.60%	Excellent
MTsN 2 Boalemo	85.44%	Excellent
MTs Alkhairaat North Gorontalo Regency	85.12%	Excellent

Table 5 illustrates that student learning outcomes reach excellent criteria, meaning that the application of curved three-dimensional shapes multimedia positively contributes to increasing their learning outcomes. The aforementioned multimedia facilitate the students to comprehend math concepts. Interactive multimedia-based learning process can help students improve conceptual understanding. Furthermore, [9], in their study, sum up that multimedia have a huge impact on mathematics learning outcomes, and the delivery of geometry topic becomes more actual and is able to influence students' memory. Clement *et al.* 1989 and Ulfa *et al*. 2018 also strengthens this idea, in which studying geometry through multimedia can motivate students to overcome abstract and complicated problems and concepts [13-15].

Disseminate

The dissemination process is undertaken by relying on the interactive multimedia of mathematics in a more extensive learning process, i.e., distributing the multimedia of curved three-dimensional shapes to several junior high schools in the city/regencies throughout Gorontalo Province.

4. Conclusion

This study concludes that: (1) the multimedia of curved three-dimensional geometric shapes are valid under the expert assessment, so that it is feasible to apply in the learning process; (2) the multimedia of curved three-dimensional shapes are practical, as the result of the interview with teachers and students reveals that the multimedia are easy to use and able to improve students' responses in the classroom. Besides, learning implementation with multimedia of curved three-dimensional shapes falls under excellent criteria; (3) such multimedia are effectively employed in the learning process. Students' activities also achieve excellent criteria. Finally, the learning outcome test shows that students' classical mastery arrives at excellent criteria.

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