Riemann: *Research of Mathematics and Mathematics Education*
Volume 7, Issue 1, 78-87, April 2025
e-ISSN: 2721-883X | p-ISSN: 2721-8848
https://journal.sanagustin.ac.id/index.php/reimann

Development of Learning Modules on Circles Using Augmented Reality for Eighth-Grade Students

Diana Sefti[1*], Dodik Mulyono[2], Nur Fitriyana[3]

[1*,2,3]Mathematics Education, Universitas PGRI Silampari, Lubuklinggau
dianasefti02@gmail.com

*Corresponding author

Received: Juli, 2024 | Revised: Januari, 2025| Accepted: Februari, 2025|
Published: April, 2025

***Abstract*:**
This research aims to develop an augmented reality-assisted circle learning module for 8th-grade students at SMP Negeri 4 Lubuklinggau that is valid, practical, and has potential effects. The study employs the 4-D development model (define, design, develop, and disseminate). The augmented reality-assisted circle learning module is deemed valid based on language validator scoring 0.85, media validator scoring 0.87, and content validator scoring 0.86. The summary of validator test results shows high scores with an average of 0.88. Practicality results from teachers show 89.33 and from small group student practicality are 92.85, indicating that the module scores high with an average of 86.26, thus deemed very practical. The learning module demonstrates potential effects on student learning outcomes, where 30 students successfully completed with a percentage of 93.75, categorized as successfully completing the Minimum Completion Criteria (KKM) set at 70.

Keywords: Development; Circle; Augmented Reality; Mathematics, Modules.

Introduction

Education is an effort to prepare the younger generation to welcome and face the development of the era in the global era. Education must be implemented as well as possible in producing best education quality and improving the quality of human resources. Learning is not just an effort to provide knowledge that is oriented towards the target of mastering the material (students memorize more than mastering skills) given by their teachers, but also provides a guide to life that will be useful for themselves and other humans, learning also provides entertainment to students. So, they can carry out learning activities with pleasure not because of coercion (Ngubadillah & Kartadie, 2018).

Mathematics is a science taught at every level of education (Septian et al., 2021). The abstract characteristics of mathematics require high concentration and seriousness to understand, even taking a long time, full of symbols that are sometimes difficult to understand (Alyusfitri et al., 2020; Septian et al., 2021). Students' understanding of the subject matter is the main goal of the learning process. Therefore, the use of interactive

multimedia is needed as an innovation in today's learning media. The technology-based learning media commonly used is computers (Wulandari et al., 2019).

Among the Android-based learning media that can be designed is Augmented Reality (AR). According to Atmaja (2017), Augmented Reality (AR) is a synthesis of real and virtual analogies. Furthermore, Pambudi et al (2018) stated that AR technology is a visual technology that combines virtual objects into real objects at the same time.

Modules are teaching materials used for independent learning because the modules contain learning instructions that allow students to learn on their own without the help of teachers (Suastika & Rahmawati, 2019). Modules contain materials that are arranged systematically and made as interesting as possible to attract students' interest in learning (Susrini, 2021). With this kind of learning, learning becomes more meaningful because students can build and shape knowledge.

Based on the results of initial observations, the author obtained information from several students in 8th grade, where students need more interesting learning media that is equipped with clear text examples so that students can easily understand and can help students in learning. Not only that, students also need learning media that has a non-monotonous design. It is supported by images that attract students' attention. So, they are interested in studying the material, especially in the circle material.

Research Methods

This study uses the Research and Development (R&D) method which aims to produce a particular product and test its feasibility (Sugiyono, 2019). This study is also a study that refers to the 4D (four-D) research and development model. The 4D development model consists of 4 stages, namely the define, design , develop , and disseminate stages .

This study produces learning products/teaching materials in the form of a circle learning module assisted by augmented reality, and uses a 4D model approach. The results of this learning device are said to be good if they meet the criteria of being valid, practical and having potential effects. The subjects of this study involved all students 8th Grade C of SMP Negeri 4 Lubuklinggau, totaling 32 students and 1 mathematics subject teacher.

The stages carried out in planning the development of the Module Augmented reality assisted learning according to the 4D model is as follows:

Define Stage

define stage is the initial stage to determine and define the requirements needed in the development of learning. Before the research is conducted, observations are first conducted at school. At this stage, researchers conduct interviews with teachers to find out what obstacles are faced by students in the learning process.

The purpose of this stage is to determine and define learning needs by analyzing the objectives and limitations of the material. Similarly, according to Arkandiantika et

. al ., (2019) explains that the definition stage is useful for determining and defining the requirements needed in the learning process. This activity stage is divided into several steps, namely:

1. **Front-end Analysis**
   The analysis was conducted to determine the basic problems in media development, which underlies the need for module development. At this stage, the researcher conducted observations and interviews with one of the teachers at SMP Negeri 4 Lubuklinggau regarding the learning of mathematics on circle material.
2. **Learner Analysis (Learner Analysis)**
   Student analysis is very important to be done at the beginning of planning. Student analysis is done to find out the characteristics of students that are in accordance with the 2013 curriculum teaching module. This analysis is done by considering the characteristics, abilities, and experiences of students, both as groups and individuals.
3. **Task Analysis**
   Task analysis is the identification of the main tasks or skills that students perform during learning. Then analyzing them into a more specific sub-skill framework.
4. **Concept Analysis**
   Concept analysis aims to identify, detail and systematically organize relevant concepts to be taught based on initial analysis.
5. **Specifying Instructional Objectives (Formulating Learning Objectives)**
   This stage is carried out to formulate the results of task analysis and concept analysis to determine learning objectives. The results of the formulation of learning objectives will be the basis for compiling teaching modules.

Design stage (Design)

The design stage is the second stage in the 4D development model, namely a design. This design stage aims to design a medium that can be used in mathematics learning. This design stage includes:

1. **Constructing Criterion-Refenced Test (Test Construction)**
   The preparation of tests based on the preparation of learning objectives that are the benchmark for student abilities. At this stage, researchers analyze test items or use instruments that become an activity that must be carried out. Augmented reality- assisted modules which is developed will carry out a trial phase by conducting limited group testing only.
2. **Media Selection**
   The selection of media is carried out to identify learning media that are relevant to the characteristics of the material and in accordance with the needs of students. The selection of learning media that will be designed to support augmented reality- assisted learning modules includes 3D designs containing circle material .

Students can observe or see directly the 3D design about during learning guided by the use of the module.

3. **Format Selection (Format Selection)**
   Format selection is done so that the selected format is in accordance with the learning material. Format selection in development is intended to design learning content, selection of approaches, learning resources, organizing and designing media content, and creating media designs.
4. **Initial Design**
   Initial Design is a design of the entire media that has been created before testing is carried out.

Develop Stage

This development stage aims to produce a development product through a validation test stage by language validator experts, material validators, and media validators. At the development stage, the design that has been made is realized in real form (Purnamasari, 2020). The stages carried out are:

1. **Expert Appraisal (Expert Validation)**
   At this stage, validation of the product content is carried out by language experts, material experts, and media experts. The experts are asked to validate the product in the form of a module that is produced. The results of the validation are used to determine the feasibility of a module that will be reviewed from the validity aspect as a decision-making process whether the module is worthy of being tested.
2. **Revision I**
   After validation by linguists, material experts, and media experts, the next step is revision and evaluation according to the suggestions and comments given by the experts. The results of the next revision will be used for small group trials .
3. **Small Group (Small Group)**
   The revised learning media based on the validator's suggestions were then tested in learning. Small group trials were conducted to determine the shortcomings of the revised module (Sari et al., 2021). The small group test will be conducted in 8th grade I of SMP Negeri 4 Lubuklinggau with 6 students as respondents to see the level of practicality of the product that has been developed.
4. **Revision II**
   small group trial, deficiencies and weaknesses of the learning media that have been created and tested will be found. These deficiencies and weaknesses are corrected in revision II. The results of stages a, b, and c are used as a reference for revision and re-evaluation for a new product that is better and ready to be tested on a large group (field test).
5. **Field Test (Large Group)**
   Then at this stage, the revised learning media will be tested on a large group (field test). The purpose of conducting a large group test (field test) is to determine the feasibility of a developed module, seen from the practicality and potential effects of the module.

Disseminate Stage (Spread)

After revisions are made at the development stage, at this stage the dissemination of the learning media that has been produced is carried out. According to Arkadiantika et al (2019), the learning media that has been developed must be disseminated and socialized to a wide audience outside the scope of the development itself.

Results and Discussions

The final product results in this development obtained a circle learning module assisted by augmented reality for 8th grade students. Based on the results of teacher interviews and the results of student needs analysis, information was obtained that the school had limited teaching materials and a lack of student interest in learning because they only relied on textbooks. Then, the curriculum used refers to students so that they can develop their own potential, therefore it is necessary to update independent learning media for students.

Data Analysis

The data analysis in this study was analyzed qualitatively and descriptively. This analysis aims to determine the quality of the product developed, namely in the form of an augmented reality- assisted module based on aspects of validity, practicality and potential effects. The data analysis techniques used in this study are as follows:

Validity Analysis

Augmented reality- assisted circle learning module that has been created at the design stage and developed, will then enter the evaluation stage in the form of a validation test by language experts, media experts and material experts. After calculating the sum of the validator's answers, the next step is to calculate the percentage validity index of the assessment score that will be carried out by the validator. Validity classification from the interpretation of the validity index. After the validation sheet is filled in by the validator, the next step is to calculate the average assessment score that is started by each validator with the following formula:

$$\frac{\sum s}{n(c-1)}$$

Source: Lestari et al., 2021

Information :

V : Validity

S : Score = r –lo

lo : The lowest validity assessment number

c : The highest validity assessment number

r: The number given by the appraiser

n : Many Question Points

Next, each expert's value is averaged. The validation data will then be classified into the classification in table 1.

Table 1 Validity level criteria

Interval	Category
$0.80 < V \leq 0.10$	Very Valid
$0.60 < V \leq 0.80$	Valid
$0.40 < V \leq 0.60$	Quite Valid
$0.20 < V \leq 0.40$	Less Valid
$0 < V \leq 20$	Invalid

Modification (Anshary & Edidas, 2018)

So it can be concluded that the augmented reality assisted module is said to be valid if the Aiken'V value obtained is more than 0.60.

Practicality Analysis

After knowing the results of the module that has been tested for validity, the next step will be to find the value of the product's practicality test. The formula for analyzing the value of the practicality test can be done by using the following percentage formula:

$$P = \frac{\sum X}{X} \; x\, 100\%$$

Information:

P : Percentage of product practicality

X : ideal maximum total score

$\sum$ x : Number of answers given by students and teachers

After getting the results of the practicality index, next we will look for the average value of the research subjects. The average value data of the practicality test results will be classified into classifications in table 2.

Table 2 Practicality Level Criteria

Percentage (%)	Level of Practicality
$81 > 100$	Very Practical
$61 > 80$	Practical
$41 > 60$	Quite Practical
$21 > 40$	Less practical
$0 > 20$	Not Practical

(Sriwijayanti, et al., 2020)

The results of the presentation in Table 3.2 show that the module assisted by augmented reality is said to be practical if the percentage obtained is ≥61.

Effectiveness Analysis

According to Erawati, et al ., (2017), potential effects are a condition where there is a match between previously set goals and objectives with the results achieved. Thus, potential effects emphasize more on how the desired results are achieved according to the predetermined plan. The data obtained from the results of working on the questions are analyzed with the following steps:

1. Calculate the score from the students' answers
2. Calculating the number of students who completed or achieved the KKM (Minimum Completion Criteria) test results of ≥70 according to the KKM for mathematics subjects at SMP Negeri 4 Lubuklinggau.

$$P = \frac{\sum X}{X} \; x\, 100\%$$

3. Calculate the percentage of completion using the following formula:

$$P = \frac{T}{n}\, x\, 100\%$$

(Norsanty & Chairani, 2016)

Information:
P = Percentage of Classical Completion
T = Number of Students Completed
N = Number of Students

4. Changing the percentage of completion to qualitative. Augmented reality assisted module It can be said that it is feasible to be seen from the aspect of potential effects if the percentage of classical completeness is categorized as good and very good. The classical completeness category can be seen in Table 3.

Table 3. Categories of Classical Potential Effect Completeness

Interval (%)	Category
P ≤80	Very good
70 ≤P < 80	Good
60 ≤P < 70	Pretty good
50 ≤P < 60	Not good
P < 50	Not good

(Norsanty & Chairani, 2016)

So, from the table that can be seen above, it can be concluded that the module teaching material can be said to be feasible if from the potential aspect, the classical completion percentage reaches 70%.

Results and Discussion

The results of the trial that has been applied to students will then be used to investigate the validity, practicality and effectiveness of the augmented reality - assisted circle learning module . The following data analysis stages will be carried out:

Validity Test

Validity analysis is taken from data obtained from validity tests on material experts, media experts and language experts. The results of the analysis of the validity test can be seen in Table 4.

Table 4 Results of Validation Questionnaire Assessment

NO	Validation	Percentage (%)	Category
1	Language Validation	85%	Very Valid

2	Media Validation	87%	Very Valid
3	Material Validation	86%	Very Valid

Based on table 3.4, the assessment of the validation module by language experts was 85%, media experts were 87%, and material experts were 0.86 with a very valid category. This shows that the developed module is valid and feasible to be tested without revision and can be used.

Practicality Analysis

At this practicality test stage, a response questionnaire was given to teachers and students with different questions. The following are the results of the analysis of the practicality test on teachers and students (small groups):

Table 5 practical results for teachers and students (small groups)

NO	Trials	Percentage (%)	Category
1	Teacher	89.33%	Very Practical
2	Small Group	92.85%	Very Practical

Based on the results of the calculation of the practicality questionnaire of teachers and small group students, teachers showed a positive response to the augmented reality- assisted learning module with the criteria of very practical and a percentage value of 89.33%, and students (small group) also showed a positive response to the augmented reality- assisted learning module with the criteria of very practical and a percentage value of 92.86%.

Effectiveness Analysis

This analysis was conducted in 8th grade C of SMP Negeri 4 Lubuklinggau, totaling 32 students. Analysis of the effectiveness of augmented reality -assisted learning modules on 8th grade students, a comparison of student learning outcomes was carried out using the developed module. Based on the learning outcomes of 32 students against the developed module, the student learning outcome data can be seen in table 6.

Table 6 Student Learning Outcomes

Value Range	Number of Students	Presentation	Category
$70 - 100$	30	93.75%	Completed
> 60	2	6.25%	Not finished
Amount	32	100%	-

Based on the table above, it can be seen that the learning outcomes of 32 students, on the developed module have a potential effect on student learning outcomes with a percentage of 93.75, namely 30 students completed and 2 students (6.25%) did not complete, so it can be concluded that the augmented reality- assisted learning module has a potential effect on student learning outcomes with a percentage of values with the KKM benchmark determined by the school, namely 70.

Conclusions and Suggestions

Based on results development module learning circle assisted augmented reality on student 8th grade 4 Lubuklinggau so writer take conclusion that material teach

module learning circle assisted augmented reality connect materials related to technology that combines cyberspace three dimensions to the real world. The author uses this model which there is augmented reality so that become module Which dance.

The validation results show that the validation of each, namely: (1) language experts got a score of 0.85; (2) media experts 0.87; and (3) material experts 0.86. So it was obtained that the development of a circle learning module assisted by augmented reality for 8th grade students of SMP Negeri 4 Lubuklinggau was categorized as very valid.

The practicality test conducted by giving a questionnaire to teachers got a score of 92.85% and students got a score of 93.85%. Based on the values obtained, the average acquisition was 91.09%. Thus, the development of a circle learning module assisted by augmented reality for 8th grade students of SMP Negeri 4 Lubuklinggau has been categorized as very practical.

augmented reality -assisted circle learning module have a potential effect on student learning outcomes. Based on the Minimum Passing Criteria (KKM) set by the school, as many as 30 students reached the complete category with a score of 93.75% and there were 2 students who had not reached completion with a score of 6.25%. Thus, the results of the potential effect test on the augmented reality -assisted circle learning module can be said to be feasible to use. So it can be concluded that this augmented reality-assisted circle learning module is valid, practical and effective for use in the learning process.

References

Anshary, I., & Edidas. (2018). Pengembangan Trainer Mikrokontroler Sebagai Media Pembelajaran dengan Metode Fault-Finding. Jurnal Vokasional Teknik Elektronika & Informatika, 6 (2), 1-5.

Atmaja, D. (2017). Implementasi Augmented Reality untuk Pembelajaran Interaktif. Jurnal Ilmiah Ilkom. 9(2).

Erawati, I., Darwis, M., & Nasrullah, M. (2017). Efektivitas Kinerja Pegawai pada Kantor Kecematan Palangga Kabupaten Gowa. Jurnal Office, 3(1), 13-18.

Hamzah, A. (2019). Metode Penelitian & Pengembangan. Malang: Literasi Nusantara.

Hastuti, F. W., Kesumawati, N., & Surmilasari, N. (2021). Pengembangan E- Modul Berbasis PAKEM Pada Pokok Bahasan KPK dan FPB Untuk Siswa Kelas IV SD. INNOVATIVE, 1(2), 647-653.

Lestari, Fida et al. (2021). Pengembangan Bahan Ajar Matematika Berbasis Problem Based Learning Pada Siswa Sekolah Dasar. Jurnal Basiedu. Vol. 05, No. 1. Hal. 398.

Ngubadillah, A., & Kartadie, R. (2018). Pengaruh Media Visual Menggunakan Aplikasi Lectora Inspire Terhadap Hasil Belajar Peserta Didik. Jurnal Penelitian Pendidikan, Vol. 35.

Pambudi, K.H.B., Buchori, A., Aini, A.N. (2018) Pengembangan Media Pembelajaran Berbasis Android Menggunakan Augmented Reality Pada Materi Bangun Ruang Sisi Datar. Jurnal Pendidikan Matematika dan Sains. 6(1).

Septian, A., Inayah, S., & Pelani, J. I. (2021). Pengembangan Multimedia Pembelajaran Berbasis Macromedia Flash Pada Materi Bangun Datar. RANGE: Jurnal Pendidikan Matematika, 2(2), 97-107. https://doi.org/10.32938/jpm.v2i2.697.

Sriwijayanti, R. P., Qomariyah, R. S., & Nurma, I. F. (2020). Pengembangan Media Adobe Flash Berbasis Pakem Di Sekolah Dasar. Pedagogy: Jurnal Ilmiah Ilmu Pendidikan, 7(2), 92-105.

Suastika, I. K., & Rahmawati, A. (2019). Pengembangan Modul Pembelajaran Matematika Dengan Pendekatan Kontekstual. Jpmi (Jurnal Pendidikan Matematika Indonesia).

Suastika, I. ketut, & Rahmawati, A. (2019). Pengembangan Modul Pembelajaran Matematika Dengan Pendekatan Kontekstual. JPMI (Jurnal Pendidikan Matematika Indonesia), 4(2), 58. https://doi.org/10.26737/jpmi.v4i2.1230.

Sugiono. (2019). Metode Penelitian Kualitatif dan R&D. Bandung: Alfabeta.

Susrini, E. (2021). Pengaruh Bahan Ajar Dan Minat Terhadap Prestasi Belajar (Studi Eksperimen pada Mata Pelajaran Kimia Siswa Kelas XII IPA di SMA Negeri 1 Pagar Alam). Diadik: Jurnal Ilmiah Teknologi Pendidikan, 11(1), 110-120.

Wulandari, T. J., Siagian, S., & Sibuea, A. M. (2019). Pengembangan Media Pembelajaran Dengan Aplikasi Macromedia Flash Pada Mata Pelajaran Matematika. Jurnal Teknologi Informasi & Komunikasi Dalam Pendidikan, 5(2),195–210. https://doi.org/10.24114/jtikp.v5i2.12598.