Analysis Teacher and Student Responses Related Learning Media Development *Augmented Reality* (AR)-3D on Atmospheric Material for Students Class X in Surabaya

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Abstract. Study This aim For developing learning media based on Augmented Reality (AR)-3D and analyzing teacher and student responses related to the media it develops . Development of learning media This done with method research and development (R&D) which refers to the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. Stage analysis involve identification need learning and characteristics student . At stage design , designed relevant AR-3D content and features with material atmosphere . Development done with creating AR-3D media using application . Implementation involve application of media in the learning process at school intermediate over the country in Surabaya. Evaluation media effectiveness is carried out through trials field and analysis of result data Study student before and after using AR-3D media. Research result show that teacher and student responses at all area Surabaya school show positive . AR-3D learning media can increase understanding draft atmosphere students , interesting interest learn , and give experience interactive and fun learning . Study This give contribution significant to innovation learning based technology in the field education geography.

Keywords: Augmented Reality, AR-3D, learning media , materials atmosphere

1 Introduction

Augmented Reality (AR) technology has be one innovation in field learning that can be done give atmosphere interactive and fun learning in learning . In some year finally, the use of AR in learning can increase understanding and involvement students [1]. Many teachers welcome positive AR use in learning Because considered capable introduce innovation that makes material more interesting and easy understood[2].

Implementation of AR learning media in the classroom give experience learn more deep and concrete , esp For nature of material abstract like atmosphere . Based on response from the teachers, the use of AR was viewed as the innovation makes it easier in understand material lesson . Majority the teacher stated that AR helps explain complex concept with a more visual and interactive way , so makes it easier student For understand material. AR use in learning science can increase understanding concept and motivate student For Study [3]. Teachers feel that AR learning media is effective tool For explain draft abstract in material atmosphere , like structure layer atmosphere and phenomena weather .

One geography teacher in Surabaya said , " with using AR, you can explain layers atmosphere with more clear . Student Can see direct How every layer different and how every layer can seen works . This matter Far more effective compared to with only use two- dimensional image. AR can increase results Study student with provide experience learn more real and effective [4].

A number of study show response from students are also very positive . student state that AR use in learning make material more interesting and easy understood . AR can increase motivation Study student as well as give experience learn more fun and interactive [5]. One of student class X in Surabaya stated that " learning with AR media to make it more interested and active in learning . Student can see direct How atmosphere it works , doesn't it? only imagine from text or picture ."

Research that has been done previously also supported statement such as , for example, research by Özdemir et al. (2020) shows that AR is in education science can increase involvement students and provide more understanding Good about the concepts taught [6] . In addition , research by Yoon et al. (2022) concluded that AR can help student overcome difficulty Study with method provide more visualization clear and concrete from complex material [7] .

Although Lots study show positive results However In fact, the majority of teachers in Surabaya Not yet implementing 3D AR media in the learning . This matter found in all area school intermediate on country in Surabaya, good center , north , south , east and west. The majority of teachers Still use images and text in power point inside convey material atmosphere . This matter Of course will influence the situation Study which is lacking fun , learning not enough Interesting , students not enough active and creative in the end can influence results Study .

Majority survey results student expect the existence of learning media specifically For abstract material For makes it easier understanding material . Atmospheric material is one of material that needs innovative and involving learning media interactive student . Students studying with AR media shows comprehension and retention more material Good compared to with method learning traditional [8] .

From the results of the survey conducted to teachers and students , the need held study For analyze related teacher responses development of 3D AR learning media for material atmosphere at school intermediate over the land of Surabaya. Study This aim For developing effective and analyzing AR-3D learning media teacher and student responses related development of augment reality learning media for material atmosphere .

2   Research Method

This study use method purposeful research and development (R&D). For develop and analyze teacher and student responses related to Augmented Reality (AR)-3D learning media in the material atmosphere For student class X in Surabaya. Study This done with using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model.

2.1   Type of Research

Types of research This is study development (R&D) which refers to the ADDIE model. The ADDIE model consists of of five stages :
   - Analysis: Identify need learning and characteristics student .
   - Design: Designing relevant AR-3D content and features with material atmosphere.
   - Development: Create AR-3D media using device soft special .
   - Implementation: Applying media in the learning process in several ways school intermediate above in Surabaya.
   - Evaluation: Evaluate media effectiveness through trials field and analysis of result data Study student .

2.2   Population and Sample

- Population : All student class X at SMAN Surabaya, which consists of from five regions .
- Sample: Determination sample use purposive sampling technique , with criteria schools that have facility supporter AR technology . Deep sample study This customized with distribution area , that is area center represented by SMAN 6 class X.7 with total 28 students , area north which is represented by SMAN 19 class X.12 with total 29 students , area east represented by SMAN 16 class X. 3 with total 28 students , area south which is represented by SMAN 18 class X.1 with the number of 34 students and the western region represented by SMAN 13 class X. 8 with total 34 students . Following is spread amount students in all Surabaya areas.

Table 1. Table of Related Teacher Responses Development of AR-3D Learning Media

Variable	Information
Design	Interesting , current , complete can help imagination student in Study material atmosphere
Material	Complete covers all discussion atmosphere
Language	Easy , clear , simple and appropriate with age student
Benefit	Motivating student For creative , giving variation with innovation , yes describe material atmosphere

Variable	Information
Innovation	Interactive , interesting specifically in lesson geography
Critics	Not all smartphones can do it used to install
Reason not yet implementing AR 3D teaching media	Teacher too Lots task so that not enough time For develop yourself , need facilitated school , need it motivation from school .
Design	Interesting , current , complete can help imagination student in Study material atmosphere

Fig. 1. Distribution of School Origin Students in Surabaya

Asal sekolah
153 responses

- ● SMAN 13 Surabaya
- ● SMAN 16 Surabaya
- ● SMAN 18 Surabaya
- ● SMAN 19 Surabaya
- ● SMAN 6 Surabaya
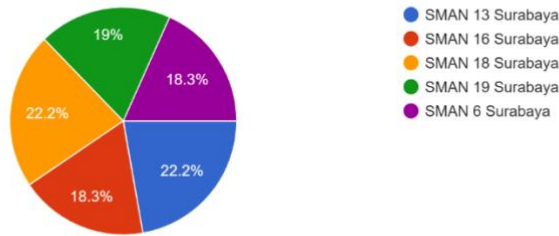
3   Data Type

3.1   Primary Data and Secondary Data

Primary Data.
Data obtained direct from response student to use of AR 3D learning media with use googleform , and teacher responses to use of AR-3D media with using research instruments.

Secondary Data.
Data obtained from documentation school and relevant literature with this study.

3.2   Data Collection Technique

Observation.
   Observing the learning process using AR-3D media.

Documentation.
View teacher and student responses related to AR-3D learning media.

Questionnaire.
Collect teacher and student responses towards the learning media developed through googleforms and sheets question.

3.3   Data Analysis Technique

Data analysis techniques used in study This is analysis descriptive with the percentage that describes results teacher and student responses accompanied with criticism and suggestions from teachers and student . Size used For response student with use scale likert range 1-4. 1 is very negative, 2 is negative , 3 is positive and 4 is very positive . Negative has the meaning difficult , ugly , whereas positive means easy , good . Furthermore For determine value , 3 criteria are made , namely 1-2 criteria bad , 2-3 criteria moderate and 3-4 criteria Good .

4   Research Result

Study This aim For develop and implement 3D Augmented Reality (AR) based teaching materials on the material atmosphere for student class X in Surabaya. Following is results research obtained from development and implementation the teaching materials.

4.1   Development of 3D AR Teaching Materials

Stage development 3D AR teaching materials are carried out with following the ADDIE model. This process involve a number of step key :

Analysis.
Done identification need learning and characteristics student class X. Analysis results show that Lots student experience difficulty understand draft abstract about atmosphere use method conventional .

Design.

3D AR content and features are designed For covers visualization layer atmosphere , phenomenon weather , and interactions between component atmosphere . Display Design in learning media This consists from

    a.   Opening Page

   b.   Material display form text , AR images for modeling 3 Dimensional design Atmosphere .

Fig 2. Application Initial Display Image: **Fig 3.** Application Menu Display

In stages this, researcher designing fill material in learning media This with gather information about atmosphere from various relevant sources . Source content obtained through studies literature that can accountable . Material about atmosphere Then summarized and adjusted with need material taught in high school. Collection results material furthermore consulted with geography lecturer and teacher For review suggestions and criticism To use renew application this.Story Board.

Fig 4. Stage Making Storyboards
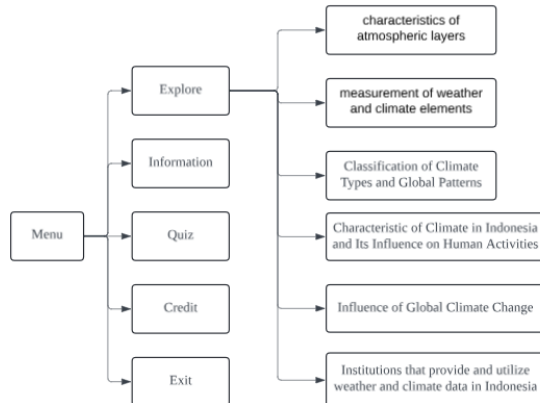
Development.

3D AR teaching materials developed use device soft special . Product end covers module learning interactive that can be accessed through smartphone or tablet device . At stage This is realization from results design products that have been completed in design stage before , be A product real ready For tested try it on students . Processing product started with make 3d image using Blender 2.8 software. For making Android application uses Unity 2024 software based on existing storyboards made . After stages the has finished held so furthermore will done synchronization . Synchronization between results from media and material design become A product in the form of learning media provided Name Deep AR atmosphere form Android application (.apk). Next , it is implemented evaluation of the product form validation by experts material and media experts for know appropriateness product before tested try in the learning process . Result of validation will made as guidelines For improvements to the learning media developed . Following results from development of learning media .
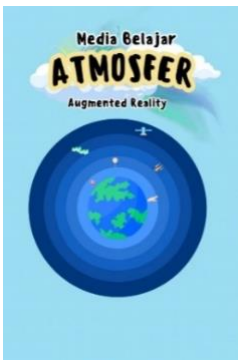

Fig 5. Marker Image

Fig 6. Image 3D menu display
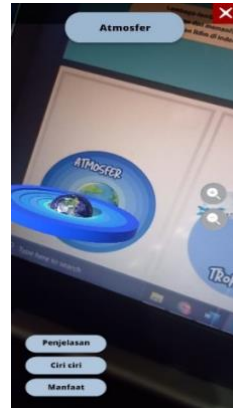

Fig 7. Instruction Image Use of

Fig 8. AR Application Display Images

Application.

At stage implementation shared into two test stages , namely trial stage phase First : 1) testing phase with expert validators material and media experts , 2) trial scale small on the teacher's eyes lessons and some student . Furthermore trial stage phase second that is carry out implementation directly in class with student scale big For know response they related to the media being developed .

Evaluation.

At stage This results assessment at stage implementation will used as material input related improvements to the media developed . The goal is for the media to be developed become worthy used and appropriate with need Study student so that can make it easier student related understanding material with fun way .

4.2   Teacher Responses Regarding AR-3D Teaching Learning Media

For know related teacher responses with this AR-3D learning media using five indicators namely design, materials , language , benefits and innovation . Following is the results table teacher responses regarding learning media .

Table 2. Table of Related Teacher Responses Development of AR-3D Learning Media

Variable	Information
Design	Interesting , current , complete can help imagination student in Study material atmosphere
Material	Complete covers all discussion atmosphere
Language	Easy , clear , simple and appropriate with age student
Benefit	Motivating student For creative , giving variation with innovation , yes describe material atmosphere
Innovation	Interactive , interesting specifically in lesson geography
Critics	Not all smartphones can do it used to install
Reason not yet implementing AR 3D teaching media	Teacher too Lots task so that not enough time For develop yourself , need facilitated school , need it motivation from school .

Source ; Primary Data, 2024

Response : Teachers all over school state that the use of AR 3D is very helpful in convey complex material . They appreciate visualization provided by AR because help student understand difficult concept explained only with text and images . All teachers have almost response The same related to this AR-3D media .

4.3   Response Student Regarding 3D AR Teaching Learning Media

Response Student : Mostly student give response positive to use of AR 3D. They interested and motivated For Study material geography specifically atmosphere .

student state that 3D visualization helps they understand material atmosphere with more Good . Following is results response student related development of 3D AR teaching media with indicator real learning , convenience understand material , pushing creativity , learning independence , and convenience For accessed .

Research result give positive response For all indicators that include convenience understand material , giving more learning contextual , encouraging creativity , giving chance For Study independence , and convenience For accessing augmented reality teaching media. On the chart seen condition the for all schools , both SMAN 6, SMAN 19, SMAN 16, SMAN 18 and SMAN 13.

Table 3. Responses Student Regarding 3D AR Learning Media

Variable	School name				
	SMAN 6	SMAN 13	SMAN 16	SMAN 18	SMAN 19
	Average Value				
Illustration	3.57	3.47	3.46	3.59	3.60
Design	3.56	3.36	3.22	3.38	3.55
Attractiveness	3.52	3.41	3.37	3.31	3.41
Use	3.91	2.13	3.79	2.68	3.41
Material	3.53	3.46	3.32	3.38	3.41
Language	3.54	3.43	3.32	3.44	3.52

Source : Primary Data, 2024

With use six variables in media development , viz illustration , design, attractiveness , use , material and language obtained results as seen in table 2. In the table no There is rating 1 (very poor) or 4 (very good), range mark is at between 2 – 3. The value range 2 is found in the usage variable at SMAN 13 with value 2.13 and at SMAN 18 with value 2.68. While the other variables are all school spread equally with almost value The same .

Related with response students , each school have almost response same , yes positive and negative responses . Response positive relate with use , illustration , design, attractiveness , material nor Language . Likewise for Negative responses are also related with all variables. Condition thereby This show equality quality education in all area the city of Surabaya, because exists policy system zoning nor means existing infrastructure equally.

5   Discussion

At the moment the teaching profession must Can increase competence in effort For increase final learning can increase quality education . Actually demands This Already the teacher is aware of it however the efforts he made apparently not enough maximum. Through activity like study This upload teacher motivation for Study increase his competence . Teacher sees exists enhancement understanding student to material atmosphere , which is indicated by the presence quiz at the end activity . ARmedia is

very effective in help student understand draft complex atmosphere , which is difficult explained only with method conventional [9].

Many teachers welcome positive AR use in learning Because considered capable give innovation material more interesting and easy understood [10]. The majority of teachers feel that AR is effective tool For explain draft abstract in material atmosphere , like structure layer atmosphere and phenomena weather . However in fact, all teachers in all school area Surabaya city, both senior teachers and junior feel not enough time For create learning media especially those based technology . This is caused by moment This the teacher's job is not only in classroom learning just but also related task confiscating administration Lots time. Especially that senior teacher Already many get it task addition like deputy chief school , guardian classes and other things to do until the afternoon even Evening day, no only day effective However day holidays too. More from Well , it seems there are not enough teachers realize benefit use of AR media.

Beside that's an obstacle technology and implementation, This is also found in the results Wijaya's research (2020) conveys that although There is enthusiasm , some teachers face constraint in matter Skills adequate technology and infrastructure For implementing AR in the classroom [11]. So teachers need it training additions and support technical For maximizing AR use in learning . In terms of This party school must give adequate facilities through routine activities for increase teacher competency . Without support schools , there are not enough teachers motivated For make innovative work , which is much needed For increase quality learning this 21st century .

Study from Prasetyo et al. (2022) shows that AR usage increases involvement students in class , with more Lots active students participate and show more interest big to material [12] . The teacher takes notes exists enhancement participation student in discussion classes and activities Study interactive . Condition This seen when held activity use of AR 3D teaching media, all student show his interest , with a sense of pleasure try and be enthusiastic For repeat it . With the use of augmented reality teaching media to teach student For behave each other cooperate and have new experience For value her friend [13] . Enthusiastic student visible to all schools in the Surabaya area evenly, like shown in the picture following.

Fig 9. Students using Atmosfer Reality 3D

According to research by Nugroho (2021), student show enhancement motivation and engagement moment using AR in learning . Student feel learning become more fun and interesting , so they more motivated For Study . Condition This seen For all students in all school in Surabaya, good students in the area center , north , south , east and west. All student show positive attitude This Because during this teacher is not Once using

interactive and innovative learning media . Teacher only using power point and pictures just so that condition learning not enough conducive .

Students studying with AR media shows comprehension and retention more material Good compared to with method learning traditional [8]. Visualization interactive help student remember information with more kind and understanding complex concepts . The results of the development of AR teaching media have been be equipped with interesting features , both audio and motivating video student For more creative .

Research by Rahman (2023) noted that although student generally receive AR with OK , there is challenge in accessibility devices and skills technology in some school [14]. There is a difference characteristics For students in central , west, east and south are more familiar and supportive in using this AR teaching media . Different with students in the area north , majority student more difficult For accept it because of their smartphones have not enough support . There are obstacles the cause student difficulty in access and use AR optimally . The use of augmented reality teaching media can give experience in adoption technology for student[13].

Students state that AR delivers experience learn more interactive and fun , which makes they more interested in the material atmosphere[15]. Student feel more engaged and motivated Because Can see visualization real from concepts learned , such as simulation weather and structure atmosphere . Response students in all school show positive , they are happy , enthusiastic and motivated with the existence of AR media. Interesting conditions occurred at SMAN 19 which is in the northern area of Surabaya with characteristics quite a student different Because many are from Madura however in fact results study show all variables are positive . They are very happy , interested and motivated with AR media. They also have a smartphone that supports it and a good network at school so that Can used to install the application with easy ,

Research result This show that use 3D AR teaching materials significant increase understanding student to material atmosphere . Use AR technology helps explain complex concepts with way more interesting and easy understood . Teachers feel it too helped with exists tool interactive visual aids , which are not only make learning become more interesting , but also more effective . In this AR media usage variable , there are quite a difference significant for SMAN 13 and SMAN 18 compared with other schools with range values 2, 13 and 2, 68. These values is at below the average for other SMAN . This matter happen Because in use of this media of course requires adequate network support . So , when at school less support with network , of course will hinder the final use of learning media influence the situation insufficient learning pleasant .

Study This support findings previously that AR can increase results learning and motivation students[1]. Additionally , results study This consistent with study by Garzón and Acevedo (2019), which states that AR media can give experience learn more immersive and interactive [5]. Teachers as well students in all school Surabaya area stated like However need motivation strong from strong For give the best for students and schools.

6   Conclusion

By overall , development of learning media AR -based for material the atmos-phere in class X is getting response positive from teachers and student . The teacher appreciates it innovation and improvement involvement students , though face a number of challenge technical . Student show more motivation and understanding Good with AR use, though accessibility and skills technology Still become problems in some place . Instructional Media This No only increase understanding student to material taught , but also improve interest and motivation Study they . Study This give contribution significant to innovation learning based technology and can used as a model for development teaching materials in the field other.

7   Acknowledgement

References

1. Ibáñez, M.-B., & Delgado-Kloos, C. (2018). Augmented reality for STEM learning: A systematic review. Computers & Education, 123, 109-123.
2. Fitria, N. et al. (2021). "Penggunaan Augmented Reality dalam Pembelajaran: Tanggapan Guru dan Siswa". Journal of Educational Technology.
3. Chang, K.-E., Chang, C.-T., Hou, H.-T., Sung, Y.-T., Chao, H.-L., & Lee, C.-M. (2021). Development and behavioral pattern analysis of a mobile guide system with augmented reality for painting appreciation instruction in an art museum. Computers & Education, 57(3), 1399-1408.
4. Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. Educational Research Review, 20, 1-11.
5. Garzón, J., & Acevedo, J. (2019). Meta-analysis of the impact of augmented reality on students' learning gains. Educational Research Review, 27, 244-260.
6. Özdemir, M., Karabağ, S., & Güven, E. (2020). The effect of augmented reality applications in science classes on academic achievement and motivation. International Journal of Instruction, 13(4), 837-854.
7. Yoon, S. A., Anderson, E., Lin, J., & Elinich, K. (2022). How augmented reality (AR) can enhance student learning: A review of the current literature. Journal of Science Education and Technology, 31(2), 143-158.
8. Sari, P. et al. (2022). "Pemahaman dan Retensi Materi dengan Media AR". Advances in Educational Research

9. Lestari, D. et al. (2023). "Efektivitas Media AR dalam Memahami Materi Atmosfer". Atmospheric Education Journal

10. Fitria, N. et al. (2021). "Penggunaan Augmented Reality dalam Pembelajaran: Tanggapan Guru dan Siswa". Journal of Educational Technology.

11. Wijaya, H. (2020). "Tantangan Implementasi Teknologi AR di Sekolah". Education and Technology Review.

12. Prasetyo, A. et al. (2022). "Keterlibatan Siswa dalam Pembelajaran Berbasis AR". Indonesian Journal of Education.

13. Park, S., Yun, H. Relationships between students' affective experiences and technology acceptance in augmented reality design training in higher education. Education Tech Research Dev 72, 479–501 (2024). https://doi.org/10.1007/s11423-023-10298-x

14. Rahman, F. (2023). "Aksesibilitas Teknologi AR di Sekolah". Journal of Educational Access.

15. Dewi, R. et al. (2024). "Pengalaman Belajar Interaktif dengan Augmented Reality". Interactive Learning Journal.