UNESA Journal of Chemical Education *ISSN: 2252-9454*
Vol.12, No.2, pp. 83-91, May, 2023

DEVELOPMENT OF AUGMENTED REALITY-BASED LEARNING MEDIA IN THE FORM OF CARDS ON ATOMIC STRUCTURE MATERIAL

Sri Wulandari, Jusniar Jusniar*, Ahmad Fudhail Majid
Department of Chemistry FMIPA Universitas Negeri Makassar
Email: wulandaris2090@gmail.com

Abstract

This development research aims to produce products in the form of *augmented reality-based* card media on atomic structure material that is valid, practical, and effective. This development adapts the 4D development model which includes *Define*, *Design, Development*, and *Disseminate*. The subjects in this study were 2 material experts, 2 media experts for the validity test, 2 chemistry teachers, and 36 students of class X MIPA 2 for the practicality and effectiveness test. The instruments used for validity are material expert validation sheets and media expert validation sheets. For practicality, namely the learning implementation observation sheet, teacher and student response questionnaires. While for effectiveness with learning outcomes test. The results showed: (1) The validity of the instrument includes the validation sheet of the observation sheet of the implementation of the device, the teacher response questionnaire, and the response of the students used respectively have an average of 3.8 and 3.65. The validity of learning materials and media has an average of 3.6 and 3.6 and the consistency between validators is in a very high category (100%). (2) the practicality of *augmented reality-based learning* media based on the learning implementation observation sheet, teacher response questionnaire, and student response questionnaire is 97.5%, 92.2%, and 88.3% respectively which is included in the very practical category, (3) *augmented reality-based* learning media meets the effective criteria (≥85%) based on the learning outcomes test with a class completeness percentage of 88.9%. Based on these data, the *augmented reality-based* card-shaped media on atomic structure material using the 4D development model can be declared valid, practical, and effective.

Keywords: *4D, Augmented Reality, Cards*

INTRODUCTION

Technological developments and innovations that continue to emerge have an influence and change in life, especially in the field of education. The basic skills in the 21st century that are needed are the 4Cs, including critical thinking, communication, collaboration, and creativity and it is hoped that it can be part of the learning experience. So that readiness to socialize widely and globally can be fulfilled with mastery of technology.

In particular, technology can also improve relationships with students who are Generation Z who grow up in a digital environment and have a tendency to always communicate through electronic media so that this can be utilized as a learning experience at school [1]. One of the compulsory subjects in the 2013 curriculum at the Senior High School level is Chemistry.

Winarti (2001) argues that in studying chemistry, one must not only have skills. Rather, it also requires a thought process to understand, demonstrate, and develop concepts, theories, and laws and combine the whole to solve problems in everyday life. Two of the various reasons above are what make students consider chemistry to be one of the most difficult lessons because of the wrong view of chemistry. So far, students view the concepts in chemistry as abstract and difficult to apply in real life. Thus, chemistry concepts become very far from the reality of students' lives [2].

The depiction of something conceptual and algorithmic in chemistry can be done by looking at the phenomena that exist in chemistry. Then reflected in the form of props, practicum in the laboratory or poured in the form of learning media. Pribadi (2017) revealed that the use of learning media is done so that the learning process becomes more interesting. Thus, it can increase students' learning motivation. In addition, the learning process can run more effectively and efficiently [3]. Then Prastiwi, et al. (2020) stated that innovation is also needed in learning including the development of teaching materials, methods, and learning media so that the learning process is not monotonous [4].

Regarding the use of learning media to support effective and efficient learning. On December 8, 2021, observations and interviews with chemistry teachers at SMA Negeri 10 Makassar were conducted, obtaining information that the media used were PowerPoint and Molymod. Molymod is one of the tactile learning media that can be touched and manipulated by students. However, the experience of using this learning media is considered monotonous because its use does not fully interact with students who grow and develop in a digital environment. These two learning media are quite popularly used in chemistry learning in some schools so the same problems can occur in other schools. Then the results of interviews with students revealed that one of the materials in chemistry subjects, namely atomic structure, is quite difficult to imagine in real form. In fact, students cannot show the position and are less precise in mentioning the charge of protons, neutrons, and electrons which are part of the atomic structure. This can happen because, during the learning process, the media used can only display the shape of the atom in the form of two-dimensional images only.

The solution that can be offered related to the above problems is to create a picture card learning media that contains images related to atomic structure material. These picture cards are equipped with *Android* and *iOS smartphone-based* applications that can display images in a two-dimensional (2D) form on cards into three-dimensional (3D) images. The basis for choosing visual media in the form of picture cards and integrated with three-dimensional (3D) visualization applications was chosen based on the Cone of Experience theory by Edgar Dale, which states that a person's learning experience is obtained from the sense of sight (eyes), the sense of hearing (ears) and other senses respectively by 75%, 13% and 12% [5].

One way that can be done to display two-dimensional images into three-dimensional images is by using *augmented reality (AR)* technology. According to Ismayani (2020), AR is a technology that can combine computer-made objects, two-dimensional or three-dimensional into the concrete environment around the *user* in *real-time*. The objects displayed by AR make it easier for users to generate new perceptions that allow them to interact in the real environment [6]. In connection with this, Tianyu in Chen (2019) added that the means of utilizing *augmented reality* technology include multimedia, 3D modeling, *tracking,* registration, interaction intelligence, sensing, and others. The principle of this technology is to simulate the results of computer application integration in the form of virtual information, such as text, images, 3D models, music, videos, and others into the real world [7].

The characteristics of the media developed are the use of cards using QR codes decorated with various colors, thus shortening the scan time and the appearance of the card does not seem monotonous. Furthermore, the application of this media can be run on Android and iOS-based smartphones, so that the device is more easily available and its reach is wider than using a computer and camera.

Based on the background that has been disclosed above, the researchers are interested in developing a picture card learning media "*Khazanah Card*" with a three-dimensional *Onirix* application on *Android* and *iOS smartphones* that can be utilized in the learning process in class with the title of research and development, namely "Development of Card-shaped *Augmented Reality-Based* Learning Media on Atomic Structure Material" in class X MIPA.

METHODS

The development of *AR-based* learning media in the form of cards on atomic structure material was developed by adapting the 4D development model proposed by Sivasailam Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel. This development model consists of 4 stages including: 1) *Define*, 2) *Design*, 3) *Development,* and 4) *Disseminate*. In this research only up to the development stage. This card-shaped *AR-based* learning media is implemented in the learning process in the 2022/2023 school year. The subjects of this study were 2 media experts and 2 material experts to determine the validity of the developed media, 2 chemistry teachers to determine the practicality of card-shaped augmented reality-based learning media, and X MIPA 2 class students totaling 36 people as respondents to determine the practicality and effectiveness of the media.

The research instruments used are instruments to test validity in the form of media expert validation sheets and material experts, instruments to test practicality in the form of media implementation observation sheets, teacher and learner response questionnaires, and instruments to test effectiveness in the form of student learning outcomes tests. Each instrument sheet contains various aspects according to their respective functions and designations.

The data analysis techniques used in this study are qualitative and quantitative data analysis techniques. Analysis of the results of validation of the feasibility of augmented reality-based learning media in the form of cards using a percentage of Likert scale scores.

DISCUSSION RESULT

1. Results

This research refers to the 4D model which consists of: *Define,* this stage researchers determine and limit the development of learning media. This stage consists of five main steps, namely: 1) front-end analysis, 2) student analysis, 3) task analysis, 4) concept analysis, and 5) formulation of learning objectives [8]. Front-end analysis is carried out to identify and determine the basis of the problems faced in the learning process. front end analysis is obtained from the results of interviews with teachers and students during the learning process in the classroom, learning media that are often used are PowerPoint and Molymod. The experience of using learning media is considered monotonous because its use does not fully interact with students who grow up in a digital environment. This results in students being less actively involved during learning because they only receive material from the teacher without any intense interaction with the learning media. Furthermore, based on the results of interviews with students, it is revealed that for chemistry subjects, one of which is on atomic structure material, it is quite difficult to imagine in its actual form. Even students cannot show the position and are less correct in mentioning the charge of protons, neutrons, and electrons which are part of the atomic structure. This can happen because, during the learning process, the media used can only display the shape of the atom in the form of two-dimensional images only.

Student analysis is obtained based on the real conditions or competencies that learners have before starting learning. Students at the high school level in the 2022/2023 academic year are classified as Generation Z (Gen Z). Gen Z is a generation that grew up in a digital environment and has a tendency to always communicate through electronic media [1]. (Abdillah, et al. 2020). Task analysis is adjusted to the basic competencies that must be achieved by students who have been listed in the 2013 curriculum containing chemistry subject matter, namely the subject matter of atomic structure. Concept analysis is obtained from identifying and collecting the main concepts in the material to be given to students and the formulation of learning objectives is a summary of the results obtained from the previous 2 steps, namely in the task analysis and concept analysis steps to determine the behavior of students.

Design, the design stage is the second stage after the defining stage. At this stage, several steps are carried out, namely designing benchmark reference tests (learning devices and research instruments), followed by designing *background* material content, 3D design, and picture cards equipped with *QR Code* using the WPS Writer application, Google Drive, Blender, Canva which then ends by combining the three using the *augmented reality-based* Onirix application.

Figure 1. The background design process for content material

Figure 2. Card Design Process with QR Code

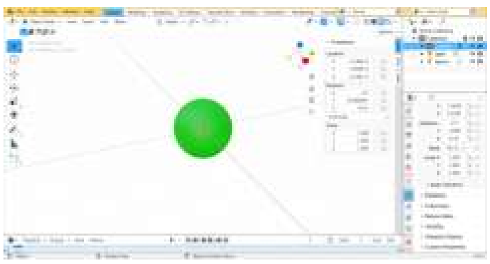

Figure 3. 3D Design Process using Blender Application

Figure 4. The process of combining material content, 3D design, and *AR-based* picture cards using the Onirix application

Development, the development stage in the 4D model consists of two steps, namely *expert appraisal* and *development testing.* In the *expert appraisal* step, validation is carried out by experts, namely material experts and media experts.

Before validation by experts, first validate the research instruments including the validation sheet of the device implementation observation sheet, teacher response questionnaire, and student response questionnaire. The data on the results of instrument validation are as follows:

Table 1. Validation Assessment Data of Learning Implementation Observation Sheet

Assessment Aspect	V1	V2	Average Score	Category
Observation Format	4	4	4	Very Valid
Content	3,2	3,6	3,4	Very Valid
Language	4	4	4	Very Valid
Average			**3,8**	Very Valid

Table 2. Teacher Response Questionnaire Validation Assessment Data

Assessment Aspect	V1	V2	Average Score	Category
Instructions (Construction)	4	4	**4**	Very Valid
Content	3	3,33	**3,17**	Very Valid
Language	4	3,67	**3,83**	Very Valid
Content	3	3,5	**3,25**	
Average			**3,6**	Very Valid

Table 3. Learner Response Questionnaire Validation Assessment Data

Assessment Aspect	V1	V2	Average Score	Category
Instructions (Construction)	4	4	**4**	Very Valid
Content	3	3,67	**3,33**	Very Valid
Language	3,67	3,67	**3,67**	Very Valid
Average			**3,7**	Very Valid

This validation was carried out by a material expert lecturer majoring in chemistry at Makassar State University. This validation consists of three aspects, namely aspects of material content, material presentation, and language feasibility. The material content aspect aims to determine the suitability of the material presented by the expected basic competencies. The material presentation aspect aims to determine whether the material presented is arranged systematically to fulfill basic competencies. Meanwhile, the language feasibility aspect aims to find out whether the language used in the content is easy to understand and clear. The data on the results of validation by material experts are as follows:

Table 4. Material Expert Assessment Data

Assessment Aspect	V1	V2	Average Score	Category
Material	3,3	3,67	**3,5**	Very Valid
Presentation of Material	3,6	3,8	**3,7**	Very Valid
Language Feasibility	3,5	3,75	**3,625**	Very Valid
Average			**3,6**	Very Valid

One of the improvements to *AR-based* learning media based on input suggestions from material experts is that the content of the material should be more tailored to the indicators:

(a) (b)

Figure 5. Adding material content in the form of advantages and disadvantages of the theory of the atomic model (a) after and (b) before revision

In addition to material experts, *AR-based* learning media are also validated by media experts. Media expert validation is carried out by media expert lecturers who are competent in the field of chemistry. Validation by media experts includes three aspects, namely aspects of media benefits, 3D media design, and media operation. The data on the results of validation by media experts are as follows:

Table 5. Media Expert Assessment Data

Assessment Aspect	V1	V2	Average Score	Category
Media Benefit	3,4	3,8	**3,6**	Very Valid
3D Media Design	3,7	4	**3,87**	Very Valid
Media Operation	3	3,7	**3,37**	Very Valid
Average			**3,6**	Very Valid

At this stage, *AR-based* learning media is also revised. One of the improvements to *AR-based* learning media is by increasing the degree of smoothness of the surface of Dalton's atomic model so that it does not look rough.

(a) Before Revision **(b) After Revision**

Improvements to Dalton's atomic model (a) Before and (b) After Revision

Furthermore, the *development testing* step, this step is carried out after the developed product is declared valid and ready to be implemented in the learning process. Media implementation was carried out at SMA Negeri 10 Makassar in the odd semester of the 2022/2023 school year. *AR-based* learning media is implemented in the learning process in class X MIPA 2 as many as 36 students will become respondents to determine the practicality and effectiveness of the *AR-based* learning media developed. The practicality of *AR-based learning* media is assessed from the learning implementation observation sheet, the student response questionnaire, and the teacher response questionnaire.

Table 6. Learners' Response to *AR-Based* Learning Media

No.	Assessment Aspect	Percentage	Category
1	Media Benefits	88,4	Very Practical
2.	Media Design	90,6	Very Practical
3.	Media Operation	86,8	Very Practical
4.	Content Presentation	87,5	Very Practical
5.	*Self Evaluation*	88,2	Very Practical
	Average	**88,3**	Very Practical

Table 7. Teacher's Response to *AR-Based* Learning Media

No.	Assessment	Percentage	Category
1	Material Quality	95	Very Practical
2.	Presentation of Material Content	87,5	Very Practical
3.	*Self Evaluation* Presentation	100	Very Practical
4.	Media Benefits	100	Very Practical
5.	Media Design	83,33	Very Practical
6.	Media Operation	87,5	Very Practical
	Average	**92,2**	Very Practical

Meanwhile, the observation sheet for the implementation of *AR-based* learning media is used to see the implementation of the developed media which is filled in by the observer. The following are the results of the learning implementation observation sheet.

Table 8. Learning Implementation Observation Sheet Results

No.	Aspects	Average Percentage (%)	Category
1.	Preliminary Stage	100	Very high
2.	Core activities *Stimulation* (Stimulus)	100	Very high
3.	*Problem Statement*	100	Very high

No.	Aspects	Average Percentage (%)	Category
	(Problem Identification)		
4.	Data *Collection*	100	Very high
5.	Data *Processing*	100	Very high
6.	*Verification*	100	Very high
7.	*Generalization* (Inference)	100	Very high
8.	Closing Activities	80	High
Average Total		**97,5**	**Very high**

In addition, to determine the effectiveness of *AR-based* learning media, a learning outcome test is given to measure the ability of students using *Google which* consists of 20 multiple-choice questions. The following are the results of the student learning outcomes test:

Table 9. Results of Descriptive Analysis of Student Learning Outcome Tests

Variables	Descriptive Value X MIPA 2
Research Subject	36
Ideal Value	100
KKM	75
Average	86
Maximum Score	100
Minimum Score	30
Number of Learners who Completed	32
Number of Students who did not complete	4
Percentage of Class Completion	88,9%

Disseminate, this stage is carried out by disseminating learning media so that it can be utilized by the public but at this stage it is not carried out by researchers considering the cost and time of research.

2. Discussion

a. Development Development of Card-shaped Augmented Reality-Based Learning Media on Atomic Structure Material

The initial stage in this development model is the defining stage *(Define), which* includes five main steps, namely: 1) front-end analysis, 2) student analysis, 3) task analysis, 4) concept analysis, and 5) formulation of learning objectives. Front-end analysis is obtained from the results of interviews and observations made with teachers and students. during the learning process in the classroom, learning media that are often used are *PowerPoint* and *Molymod.* The experience of using learning media is considered monotonous because its use does not fully interact with students who grow up in a digital environment. This results in students being less actively involved during learning because they only receive material from the teacher without any intense interaction with the learning media. Furthermore, based on the results of interviews with students, it is revealed that for chemistry subjects, one of which is on atomic structure material, it is quite difficult to imagine in its actual form. Even students cannot show the position and are less correct in mentioning the charge of protons, neutrons, and electrons which are part of the atomic structure. This can happen because, during the learning process, the media used can only display the shape of the atom in the form of two-dimensional images only.

The second step, namely learner analysis, is obtained based on the real conditions of students or the competencies possessed by students before starting learning. Task analysis is adjusted to the basic competencies that must be achieved by learners that have been listed in the 2013 curriculum. Concept analysis is obtained by identifying and collecting the main concepts in the material that will be given to students. The last step, the formulation of learning objectives is a summary of the results obtained from the previous 2 steps, namely in the task analysis and concept analysis steps to determine the behavior of students.

Design, this stage is carried out by designing benchmark reference tests in the form of learning devices and research instruments, designing 3D designs, *background* material content, and picture cards equipped with QR codes. Then combined using the *AR-based* Onirix application.

Development, The development stage is the third stage which is divided into 2 activity steps, namely *expert appraisal* and *development testing.* In the *expert appraisal* step, an assessment of the learning media is carried out by experts with the aim of knowing the validity of the learning media. The experts consist of 2 material experts and 2 media experts who are lecturers from the Department of Chemistry FMIPA UNM who provide assessments and suggestions for improving the learning media developed.

The valid statement of learning media by experts is the entry gate for the field trial stage (*Development Testing)* to get responses from users, namely students and teachers to determine the level of practicality and effectiveness of learning media. *AR-based* learning media that has been valid is tested at SMAN 10 Makassar class X MIPA 2 with as many as 36 students. To see the applicability of this media in real learning and determine the practicality and effectiveness of the *AR-based* learning media developed. The practicality of the media is based on the results of the observation sheet of learning implementation using the *discovery* learning model which consists of 5 stages, namely stimulus, problem identification, data collection, data processing, proof, and conclusion drawing. In addition, the practicality of the media is also assessed from the student response questionnaire and teacher response questionnaire. To determine the effectiveness based on student learning outcomes test.

Disseminate, in the last stage, the dissemination of learning media is carried out so that it can be utilized by the public. But at this stage, it was not carried out by researchers considering the cost and time of research.

.

b. Validity, Practicality, and Effectiveness of *AR-based* learning media

Research and development of *AR-based* learning media in the form of cards on atomic structure material are superior when compared to several studies, namely research from Aris, et al. (2020) entitled *Chemistry Structure Sheet* Sebagai Media Pembelajaran Kimia Berbasis Augmented Reality in terms of validity by media experts with an average value comparison of 3.6 with 3.2 [9]; research conducted by Indang, et al. (2019) with the title *The Validity and Practicality of Media for Teaching Atomic Bolls for Class X Students on the Material of Atomic Structure* seen in terms of material validity has an average comparison of 3.6 with 3.24 [10] and research conducted by Ramadani, et al. (2020) with the title Modul Pembelajaran Kimia Berbasis Augmented Reality in terms of practicality and effectiveness of learning media with a comparison of the average percentage of 92.7% with 91.0% and 88.9% with 82.0% respectively. The description of the feasibility of this learning media can be seen as follows [11].

1) Validity

The results of the assessment conducted by 2 material experts include aspects of material content assessment, presentation aspects, and language feasibility aspects. This assessment is carried out to determine the validity of the content of the material. The assessment results can be seen in Table 4. The content aspect of the material received an average score of 3.5, the presentation aspect received a score of 3.7, and the language feasibility aspect received a score of 3.625. All three aspects of this assessment are classified as very valid. This shows that *AR-based* learning media in the form of cards on atomic structure material is valid to be used as one of the variations of learning media usage options.

Furthermore, this assessment was carried out by 2 media experts to determine the validity of *AR-based* learning media. The assessment results can be seen in Table 5. In the aspect of media benefits, the average score is 3.6, the 3D media design aspect gets a score of 3.875, and the media operation aspect is 3.375. These three aspects are classified in a very valid category. This shows that the learning media developed can provide benefits in the form of facilitating the learning process, can be used as an alternative learning resource, has an attractive and more realistic display quality, and is easy and interactive to use. This is in accordance with the opinion of Azuma (1997) that one of the characteristics of *augmented reality* is an interactive process in a real environment [12] and in accordance with the research of Lia Kamelia (2015) on the use of Teknologi *Augmented Reality* pada Mata Kuliah Dasar provides a more realistic picture in the learning process [13].

2) Practicality

The practicality of *AR-based* learning media is seen from data analysis on the implementation observation sheet, teacher response questionnaire, and student questionnaire on learning media. This is in accordance with the opinion of Harta, et al. (2021) that the practicality of learning media can be seen through the results of the student and teacher response tests to determine the extent of the ease and applicability of the learning media used. Before that, a readability test was carried out using a response questionnaire to determine the extent to which the learning media could be read [14]. The assessment results were obtained with an average percentage of 88.75%.

The learning implementation observation sheet contains assessment aspects that are in accordance with the learning model used, namely discovery learning. The assessment results of the learning implementation observation sheet can be seen in Table 8. The lowest assessment was obtained by the closing activity aspect which obtained a percentage of 80%. This is because the learning process takes place in the first to third

 ISSN: 2252-9454

subject hours so that point d in the closing activity aspect is not implemented. If all aspects are accumulated, an average percentage of 97.5% will be obtained and classified as a very high level of practicality.

The teacher response questionnaire was assessed by 2 chemistry teachers of SMAN 10 Makassar. There are 6 aspects of assessment which include material quality, presentation of material content, presentation of self-evaluation, media benefits, media design, and media operation. The assessment results can be seen in Table 7. The highest aspect is obtained by the aspect of the presentation of self-evaluation and media benefits of 100%. This shows that AR-based learning media provides benefits in the learning process and the presentation of exercises is in accordance with the indicators and achievement of basic competencies. If all aspects of the assessment are accumulated, an average percentage of 92.2% is obtained and classified as very high for the level of practicality.

The assessment aspects in the learner response questionnaire include aspects of media benefits, media design, media operation, content presentation, and presentation of *self-evaluation. The* assessment results can be seen in Table 6. The media design aspect gives a positive impression on students. This is shown from the percentage of each aspect as a whole where the media design aspect gets the highest score of 90.6%. If all aspects are accumulated, the average percentage is 88.3% and is classified as very high for the level of practicality.

3) Effectiveness

The effectiveness of *AR-based* learning media developed can be seen from the student learning outcomes test which serves to determine the cognitive level of students on atomic structure material. The developed media is declared effective if the class completeness reaches 85% based on the KKM applicable at the school, which is 75.

The results obtained from the student learning outcomes test obtained a class completeness percentage of 88.9 (table 9) which shows that the developed media is effectively used in the learning process. This is in line with the regulations of the Ministry of National Education (2006) that learning is said to be complete if classically students who are complete based on KKM reach 85% of the total number of students.

Based on the results of the analysis of the validity, practicality, and effectiveness of the media *AR-based* learning has met the criteria of valid, practical, and effective. Thus *AR-based* learning media can be used as one of the variations in the use of learning media in the learning process.

c. Limitations of Development

The limitations of *AR-based* learning media based on development research conducted are the use of different emails for *free* account registration in the Onirix application.

CLOSING

Conclusion

Research and development of *AR-based* learning media in the form of cards on atomic structure material that has been done can be concluded as follows:

1. *AR-based* learning media in the form of cards on atomic structure material is developed using the 4D model which consists of 4 stages, namely: a. *Define* stage which consists of front-end analysis, learner analysis, task analysis, concept analysis, and formulation of learning objectives; b. *The design stage* includes making benchmark reference tests, making media and media presentations; c. *Development* stage which consists of *expert appraisal* (validation and revision according to the suggestions given by experts) and *development testing* (limited trials to teachers and students of SMAN 10 Makassar to determine the level of practicality and effectiveness); d. Disseminate stage which is the dissemination of learning media. *Disseminate* stage which is the dissemination of learning media.
2. *AR-based* learning media in the form of cards on atomic structure material has met the criteria of valid, practical, and effective. This is indicated based on the validity value on the material and media expert validation sheet respectively with an average of 3.6 and 3.6 which states that *AR-based* learning media is very valid, the level of practicality can be seen based on the learning implementation observation sheet, teacher response questionnaire and student response questionnaire respectively with an average percentage of 97.5%, 92.2%, and 88.3% which indicates that the learning media is very practical, and the effectiveness of *AR-based* learning media can be seen in the student learning outcomes test with a class completeness percent of 88.9% which states that the media is effective to use.

Suggestion

Suggestions that can be given by researchers in the development of card-shaped *AR-based* learning media on atomic structure material are:

1. *AR-based* learning media is only for atomic structure material, so it is hoped that the development of *AR-based* learning media can be developed in chemistry with different subject matter.
2. Teachers are expected to be motivated in developing *AR-based* learning media which can be used as one of the variations in the choice of using learning media.
3. This *AR-based* learning media utilizes paid applications but *free trials*, so it is hoped that the development of this media can use unlimited *free augmented reality* applications in its use.
4. Future researchers can use this Khazanah *Card* at the *Disseminate* stage in various school levels including low, medium, and high school levels.

REFERENCES

1. Abdillah, H., Punaji, S., Blasius, B.L., dan Muslihati, M. 2020. The Acceptance of School Counselors in the Use of ICT During School From Home in the Covid-19 Era. *Young Scientist.* Vol. 8. No. 4.
2. Damayanti, K., dkk. 2021. Analisis Miskonsepsi Peserta Didik Pada Materi Hidrolisis Garam Dalam Pembelajaran Dengan Model Guided Inquiry. *Jurnal Inovasi Pendidikan Kimia*. Vol. 15. No. 1.
3. Pribadi, B.A. 2017. *Media dan Teknologi dalam Pembelajaran*. Jakarta: Kencana.
4. Prastiwi, D.N., Punaji, S. dan Arafah,H. 2020. Pengembangan Multimedia Tutorial Sebagai Suplemen pada Mata Pelajaran Kimia Materi Asam dan Basa Kelas XI. *JINOTEP*. Vol. 6. No. 2.
5. Rahmawati, I.Y. dan Dwiana, B.Y. 2020. Kreativitas Guru Dalam Proses Pembelajaran Ditinjau Dari Penggunaan Metode Pembelajaran Jarak Jauh di Tengah Wabah COVID-19. *Al-asasiyya: Journal Basic of Education.* Vol. 5. No.1.
6. Ismayani, A. 2020. *Membuat Sendiri Aplikasi Augmented Reality.* Jakarta: PT Elex Media Komputindo.
7. Chen, Y., dkk. 2019. An Overview of Augmented Reality Technology. *Journal of Physics: Conference Series.*
8. Mulyatiningsih, E. 2014. *Metode Penelitian Terapan Bidang Pendidikan.* Bandung: Alfabeta.
9. Aris, A., dkk. 2020. *Chemistry Structure Sheet* Sebagai Media Pembelajaran Kimia Berbasis *Augmented Reality* Pada Materi Struktur Atom. Jurnal Pendidikan Matematika dan Sains. Vol. 8. No. 2.
10. Indang, dkk. 2019. The Validity and Practically of Media for Teaching Atomic Bolls for Class X Student on the Material of Atomic Structure. *Journal of Chemistry Education Research*. Vol. 3 No. 2.
11. Ramadani, R., dkk. 2020. Pengembangan Modul Pembelajaran Kimia Berbasis Augmented Reality. *Chemistry Education Review.* Vol. 3. No. 2.
12. Azuma. 1997. *A Survey of Augmented Reality*. Malibu: Hughes Research Laboratories.
13. Lia, K. 2015. Perkembangan Teknologi Augmented Reality Sebagai Media Pembelajaran Interaktif pada Mata Kuliah Dasar. *Jurnal Istek.* Vol. IX. No. 1.
14. Harta, W.G., Dessy, S.W. dan Gede, S.S. 2021. Kepraktisan Media Pembelajaran Augmented Reality Mata Pelajaran Sablon Untuk SMK. *Karmapati*. Vol. 10. No. 2.