



The Effectiveness of Using Reality Augmented Media to Increase The Students' Learning Motivation in Chemical Bonding Material

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Abstract:

The purpose of this study was to determine the effectiveness of using Augmented Reality media to increase student learning motivation. This type of research is a quantitative quasi-experimental design with Pretest-Posttest Non-Equivalent Control Group Design. The sample in this study were 42 students in class X-Natural Science and X-Social Science. The research instrument used was a motivational questionnaire with 4 indicators, namely Attention, Relevance, Confidence, Satisfaction (ARCS). Data collection techniques were carried out by giving motivational questionnaires to students before and after learning. The data that has been obtained, then analyzed using the completeness formula of student achievement to determine the level of effectiveness of Augmented Reality media on student learning motivation. The results of the effectiveness of the media in the experimental class and the control class obtained the final motivational completeness percentages of 100% and 86%, respectively. Based on the results of the effectiveness of the media, it can be concluded that the use of Augmented Reality media is stated to be very effective for increasing student motivation in chemical bonding material.

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Introduction

Along with the era development that becomes more modern, the revolution change is also be more developed. Nowadays, the world has entered Industry Revolution 4.0 era where the manual system is change to the digital system (Sumartono & Huda, 2020). In the Industry Revolution 4.0, the technology holds an important role in the human's social change. The technology is impacting all of the aspects in life whether in economic, politic, culture, art and especially in education field.

In the education field, technology has a benefit in the learning process. The technology's benefit in the education such as increasing the students' learning skill. With the use of technology in the education field, it is expected that the use of technology in the learning activity can increase the students' learning motivation and interest. It is in line with the opinion by Qumilaila & Zulfiani (2017) which stated that the use of technology as the learning media can help to increase the learning quality. Moreover, the curriculum development now demands the teacher to implement the learning that centered to the students. In this case, the students can utilize the technology as the learning media to increase the students' activeness and interest in the learning process (Smaldino, et al., 2011). However, this development seems not able to fulfill the needs of appropriate learning media with the lifestyle dynamics yet.

Based on the previous observation result, the researcher finds that chemical subject is one of the subjects that difficult to understand. It is because the less of students' interest in learning it, so the students feel bored

in learning chemical. The boredom can cause the students to be less attention to the explained material. The students' less interest and attention in learning chemical can cause the students' learning motivation to be low. The low of students' motivation is a less concentrate during the learning process, the students easily feel bored, and the students difficult to understand the material taught. However, there is the most difficult material to be understood in chemical subject, which is chemical bonding material. The observation result states that the difficulties that the students get during learning chemical bonding material are determining the type of the bonding of a compound, drawing Lewis' structure, writing molecule formula, predict a formed compound, and predict the type of bonding based on Lewis' structure. It is supported by the research from Sari, et al., (2020) which stated that chemical bonding material is a difficult material for students to understand.

Based on the problem above, then a learning model that can be one of the solutions is needed, which is ARCS (Attention, Relevance, Confidence, Satisfaction) learning model. ARCS learning model is the learning model which designed to encourage and preserve the students' learning motivation to learn (Keller, 1987). According to Keller (1987), the learning model is divided into 4 (four) components, which are attention, relevance, confidence, and satisfaction. ARCS learning model has the component that can be implemented in the learning activity, such as building the students' attention during learning, presenting the material that relate to the students' life, embedding the students' confidence, and

developing the students' satisfaction to the learning. Beside of that, it also needs the learning media that can be a support solution in the problem above. One of the things that can be implemented is with using Augmented Reality media.

According Yuen, et al., (2011), Augmented Reality learning media has advantages which are has a potential to involving, stimulating, and motivating the students to explore class material from a different angle in the learning process. Beside of that, Augmented Reality media can visualize 3D form from the molecule structure in chemical bonding material. Based on its advantages, Augmented Reality media can be the support for ARCS learning model with the help of Augmented Reality media can be one of the solutions that can be implemented to create the learning motivation which triggers the learning motivation. It is strengthened by Pratama's research (2018) which stated that the used of ARCS learning model can help Augmented Reality media to be used as the learning media for the learning motivation get the average percentage from attention indicator of 85,73%, relevance indicator of 86,53%, confidence indicator of 85,89%, and satisfaction indicator of 85,85%. Based on the average percentage result from each indicator includes in the category of very good which means that the students feel easier to understand the molecule form concept learning with using ARCS learning model with the help of Augmented Reality media, so it can increase the students' learning motivation.

Research Method

This research was quantitative quasi-experimental design with Pretest-Posttest, Non-Equivalent Control Group

Design. The research was done on May, 28th until June 2nd 2022 at one of the high schools in Lamongan city with 5 (five) meetings. The sample in this research consist of the students of X IPA and X IPS class with the total of each class is 21 students. During the learning process, the students of the experiment class would get the treatment of using ARCS learning media with Augmented Reality media. Meanwhile, for the control class students would get the treatment of using ARCS learning model with PowerPoint media.

The used instrument in this research was the motivation questionnaire that consist of 20 questions. The motivation questionnaire item was adapted from Purwanto & Fatayah's (2019) instrument that had been modified by referring based on ARCS motivation theory. The questionnaire was given before and after the treatment (learning). Then, the obtained score was conversed to score with the formula as follows.

$$\text{Score} = \frac{\text{Skor yang diperoleh}}{\text{Skor total}} \times 100$$

In this research, the learning motivation questionnaire was divided into 4 indicators. The indicators consist of attention, relevance, confidence, and satisfaction indicators. The percentage measurement of the learning motivation questionnaire in each indicator could be done with Microsoft Excel. Here is the formula and criteria of the determining of the presented score percentage result on the equation and Table 1.

$$\text{NP} = \frac{\text{R}}{\text{SM}} \times 100\%$$

Description:

NP = *nilai persen* (percent score)

R = the obtained score

SM = the maximum score

Table 1 Score Percentage Criteria

No.	Percent Score (%)	Criteria
1.	81 - 100	Very Good
2.	61 - 80	Good
3.	41 - 60	Enough
4.	21 - 40	Less
5.	0 - 20	Very Less

(Riduwan, 2015)

Based on the criteria in Table 1, the learning motivation level is categorized good if the percent result is classified in the "good" and "very good" criteria.

The data collection technique in this research was in the form of given the learning motivation questionnaire. The first motivation questionnaire was given to the experimental class students and the control class students had not been given the treatment to be done. As for the final motivation questionnaire was given to the experimental class and the control class students to be done. After that, the researcher measured the students' completeness percentage to know the effectiveness of Augmented Reality media.

The analysis of the Augmented Reality media effectiveness is based on the students learning motivation achievement completeness in the learning process. As for the students who are stated success / complete if the score is ≥ 75 , while the students who get the score ≤ 75 are stated not success yet. Here is the formula of measuring the completeness percentage of the students' learning motivation and achievement result.

$$P = \frac{\sum s}{n} \times 100\%$$

Description:

P = completeness percentage

S = the total of the students who get the score ≥ 75

n = the sample total

The learning motivation completeness is stated as success if the percentage of the students who success has a total more than 75% from the overall of the students' total. From the analysis result that is used as the determine tool in determining the effective learning media.

Finding and Discussion

The learning result description is the answer from the research problem that has been determined before. The research result is stated based from the result of the learning motivation questionnaire deployment that has been analyzed using the help of IBM SPSS Statistics 20. The measurement of the students' motivation questionnaire result data is used to know the students' learning motivation score in the experimental and control class. Form the obtained data result, then it is analyzed to search the completeness percentage score between the experimental and control class. The acquisition from the completeness percentage score, then it is analyzed to search the learning media effectiveness. The achievement result completeness percentage measurement is done with Microsoft Excel 2016. Here is the completeness percentage result of the experimental and control class students' learning motivation that is presented on Table 2.

Table 2 The Students' Learning Motivation Completeness Percentage Result

Description	Experimental Class		Control Class	
	First	Final	First	Final
Percentage (%)	0	100	0	86

Based on the data result on Table 2, it was obtained the first motivation completeness percentage score of the

experimental class of 0%, while the final motivation of 100%. As for the control class, it was obtained the first motivation percentage score of 0%, while the final motivation percentage score of 86%.

Here is the measurement result of each indicator of the experimental and control class students' learning motivation questionnaire that is presented on Table 3 and Table 4.

Table 3 The Result of the Motivation and Average Score Measurement per Item of the Experimental Class

No.	The Statement Item	First Motivation		Final Motivation	
		Score	Average	Score	Average
Attention					
1.	From the beginning, I like chemical bonding material because the content discussion is very easy to understand	30	1.4	60	2.9
2.	From the beginning, I am interested to learn chemical bonding material because it is easy to understand	29	1.4	57	2.7
3.	From the beginning, I want to participate in chemical bonding learning because the content discussion is interesting to be learned	30	1.4	61	2.9
4.	From the beginning, I feel interested to learn chemical bonding because the content discussion is very interesting	28	1.3	56	2.7
5.	From the beginning, I want to participate in chemical bonding learning because I like to learn chemical bonding material	31	1.5	59	2.8
Relevance					
6.	I feel the chemical bonding material is useful for the daily life	36	1.7	47	2.2
7.	I can connect the content discussion with the things that I have seen, done, and thought in daily life	32	1.5	52	2.5
8.	I feel the delivered chemical bonding has appropriate to the learning objective	43	2	60	2.9
9.	I feel the used method in the learning has appropriate with the chemical bonding learning	34	1.6	60	2.9
10.	I feel the chemical bonding learning is appropriate with my interest, because I can understand most of the learning content	32	1.5	58	2.8
Confidence					
11.	From the beginning, I feel confident that I can understand the chemical bonding material well because the discussion content is less interesting	30	1.4	55	2.6
12.	From the beginning, I feel sure that I can understand the chemical bonding material because the chemical learning material is easy to understand	26	1.2	50	2.4
13.	From the beginning, I feel sure to learn the chemical bonding because I like the chemical bonding material	33	1.6	58	2.8
14.	From the beginning, I feel sure that I can understand the picture display of molecule formed process in the chemical bonding material	28	1.3	58	2.8
15.	From the beginning, I feel I can do the chemical bonding questions correctly	31	1.5	46	2.2

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Satisfaction					
16.	I feel satisfied when I reach the highest score in test	42	2	53	2.5
17.	I feel satisfied when I can understand the chemical bonding material very well	33	1.6	56	2.7
18.	I feel satisfied when my teacher and friends accept my ideas	44	2.1	55	2.6
19.	I feel satisfied when I can solve a problem that occur during the learning process	40	1.9	54	2.6
20.	During the learning process, I feel satisfied because I can answer the question asked by the teacher well	38	1.8	55	2.6

Table 4 The Result of the Motivation and Average Score Measurement per Item of the Class Control

No.	Statement Item	First Motivation		Final Motivation	
		Score	Average	Score	Average
Attention					
1.	From the beginning, I like the chemical bonding material because the discussion content is very easy to understand	25	1.2	55	2.6
2.	From the beginning, I am interested to learn chemical bonding material because the chemical bonding material is easy to understand	24	1.1	51	2.4
3.	From the beginning, I want to participate in chemical bonding learning because the content discussion is interesting to be learned	24	1.1	57	2.7
4.	From the beginning, I feel interested to learn chemical bonding because the content discussion is very interesting	26	1.2	55	2.6
5.	From the beginning, I want to participate in chemical bonding learning because I like to learn chemical bonding material	27	1.3	51	2.4
Relevance					
6.	I feel the chemical bonding material is useful for the daily life	35	1.7	46	2.2
7.	I can connect the content discussion with the things that I have seen, done, and thought in daily life	33	1.6	48	2.3
8.	I feel the delivered chemical bonding has appropriate to the learning objective	41	2	54	2.6
9.	I feel the used method in the learning has appropriate with the chemical bonding learning	36	1.7	52	2.5
10.	I feel the chemical bonding learning is appropriate with my interest, because I can understand most of the learning content	32	1.5	52	2.5
Confidence					
11.	From the beginning, I feel confident that I can understand the chemical bonding material well because the discussion content is less interesting	25	1.2	44	2.1
12.	From the beginning, I feel sure that I can understand the chemical bonding material because the chemical learning material is easy to understand	24	1.1	44	2.1
13.	From the beginning, I feel sure to learn the	37	1.8	47	2.2

	chemical bonding because I like the chemical bonding material				
14.	From the beginning, I feel sure that I can understand the picture display of molecule formed process in the chemical bonding material	31	1.5	52	2.5
15.	From the beginning, I feel I can do the chemical bonding questions correctly	35	1.7	43	2
Satisfaction					
16.	I feel satisfied when I reach the highest score in test	43	2	47	2.2
17.	I feel satisfied when I can understand the chemical bonding material very well	38	1.8	49	2.3
18.	I feel satisfied when my teacher and friends accept my ideas	44	2.1	51	2.4
19.	I feel satisfied when I can solve a problem that occur during the learning process	44	2.1	48	2.3
20.	During the learning process, I feel satisfied because I can answer the question asked by the teacher well	43	2	47	2.2

From the measurement result of each indicator on Table 3 and Table 4, then it was analyzed to search the percentage of each indicator. Here is the percentage result of each indicator of

the experimental and control class students' learning motivation questionnaire that is presented on Table 5.

Table 5 The Result of the Learning Motivation Questionnaire Percentage of the Experimental Class and Control Class

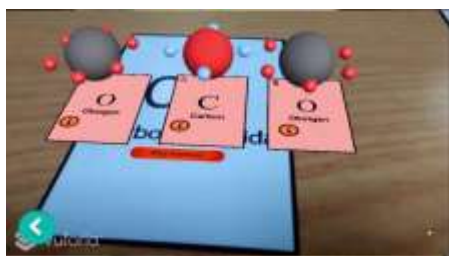
Motivation	Item	Experimental Class		Control Class	
		Percent	Criteria	Percent	Criteria
First	A	47%	Good enough	39%	Good enough
	R	56%	Good enough	56%	Good enough
	C	47%	Good enough	47%	Good enough
	S	63%	Good	68%	Good
Final	A	93%	Very good	85%	Very good
	R	88%	Very good	80%	Good
	C	89%	Very good	73%	Good
	S	87%	Very good	78%	Good

Based on the attention indicator data result, it was obtained the first motivation result of the experimental class gets the percentage of 47%, so it can be categorized as good enough. It was because the discussion material could not attract the students' attention, so it

caused the students felt less interest. It is in line with Baharuddin's (2007) opinion which states that the attention is very influenced by feeling, interest and mood which are determined by the students' interest. As for the final motivation result, it was obtained the percentage of 93%, so it can be categorized as very good. It is because the discussion content

display of the Augmented Reality media could attract the attention, so the students could easily understand the material. It is in line with Rusman's (2013) research which stated that the Augmented Reality media has a function to raise the students' learning motivation and attention in the learning because the learning media can help giving the understanding to the students.

The Augmented Reality is the combination technology of 2D or 3D virtual object into the real environment which then project the virtual objects in reality in the real time (Roedavan, 2014). As for the type of Augmented Reality that was used in this research was in the form of Marker-Based Augmented Reality. Marker-Based Augmented Reality is usually the square black and white illustration with thick black border and white background (Mustaqim, 2016). The user can move the device to see the virtual model with different angle, as displayed on the Figure 1.



Source: AR Chemical Bond by Irene Mugiarti

Figure 1. Marker-Based Augmented Reality

Meanwhile, for the first motivation result of the class control got the percentage of 39%, so it can be categorized as less good. It is because the discussion material could not attract the students' attention and difficult to understand the material, so it caused the students felt less interest in learning the material taught. It is in line with Slameto's (2010) opinion which stated that the attention to the learning will

emerge if the material is appropriate with the interest of the material. As for the final motivation percentage result, it was obtained the percentage of 85%, so it can be categorized as very good because of its discussion content display is interesting. It is supported by the research from Trisnawati (2007) which stated that the used of ARCS learning model can raise the students' enthusiasm, so the students tend to be more active in the learning process.

In the relevance indicator, it was obtained the first motivation result of the experimental class and control class which each of the class got the percentage of 56%. from the learning motivation percentage result of the experimental class and control class, it is known that the first motivation percentage result can be categorized as good enough. It is because the discussion content of the material was difficult to understand, so the students felt the discussion content was less appropriate with the students' interest. It is supported by Hanik's (2015) research which stated that the students' interest and motivation can affect the students' understanding level. Meanwhile, for the final motivation result of the experimental class, it was obtained the percentage of 88%, so it can be categorized as very good. It is because the Augmented Reality media can show the appropriateness between the learning purpose and method. It is in line with the research by Yuen, et al., (2011) which stated that the Augmented Reality media has advantages which are the big potential and benefit for teaching development, and can motivate the students to explore the class material from a different angle. As for the final motivation result of the control class, it was obtained the percentage of 80%, so it

can be categorized as good because the delivered material has been appropriate with the learning purpose. It is supported by the research from Sulastris (2017) which stated that the effectiveness of PowerPoint media using can show the appropriateness of the learning purpose.

In the confidence indicator, it was obtained the first motivation percentage result of the experimental class and control class of 47%. The first motivation percentage result showed that the first motivation percentage result can be categorized as good enough. It is because the students' confident level in understanding the material was low enough, so it could cause the students' confident level in answering the question was also low. It is in line with the research from Nastiti (2020) which stated that the students' less concept understanding makes the students do not sure in answering a question. As for the final motivation of the experimental class, it got the percentage result of 89%, so it can be categorized as very good. It is because the use of Augmented Reality media could give the students confidence in completing the learning, so the students interested in learning the material. It is supported by the research done by Yuen, et al., (2011) that stated the Augmented Reality media has a potential to stimulate, practice a creativity, and imagination, also help the students mastering the learning independently.

Meanwhile, for the final motivation of the control class got percentage of 73%, so it can be categorized as good. It is because the use of PowerPoint media could make the students felt certain in understanding the discussion content display. It is supported by the research from Trisnawati (2007) which stated that the

used of ARCS learning model could raise the students' enthusiasm, so the students tend to be more active in the learning process.

Based on the satisfaction indicator, the learning motivation questionnaire result of the experimental class got the first motivation percentage of 63%, so it can be categorized as good. It is because the students difficult to understand the material well so the students felt less satisfy. It is in line with Sopiati's (2010) opinion which stated that the students' satisfaction can be measured with the students' understanding level. As for the final motivation percentage obtains the score of 87%, so it can be categorized as very good. It is because the use of Augmented Reality media could give the satisfaction when the students could understand the material well. It is line with the research done by Iordache, et al., (2012) which stated that by using the Augmented Reality media, the students could be more understand chemical material easily. Meanwhile, for the first and final motivation results of the control class got the percentage of 68% and 78%. The first and final motivation percentage result of the control class is categorized good. It is because the students satisfied when their idea could be accepted well. It is in line with the students' understanding level.

The effectiveness of Augmented Reality media and PowerPoint media can be seen from the completeness percentage result between the experimental class and the control class. In the completeness percentage result, it was obtained the first motivation percentage score of the experimental class and the control class of 0%, so the lecture model that was used by the teacher is stated not effective. It is because the content discussion material

could not attract the students' attention, so it caused the students to less interest. It is in line with the opinion from Baharuddin (2007) which stated that the attention is very influenced by the feeling, interest, and mood that are determined by the students' interest. As for the final motivation percentage result of the experimental class, it was obtained the percentage score of 100%, so the use of ARCS model with the help Augmented Reality media is stated very effective. It is because the Augmented Reality media's discussion content display could build the students' curiosity, interest, favorite, and learning motivation. Beside of that, the use of Augmented Reality media could give the students confidence in completing the learning so the students were interested in learning the material. It is supported by the research done by Zulfahmi (2020) which stated that the use of Augmented Reality media has a potential to increase the students' learning motivation and gets a positive respond in the learning process. It is in line with the research done by Shatte, et al., (2014) which stated that the Augmented Reality media on Smartphone potentially increase the attractiveness, curiosity, learning motivation, and can create the effective learning environment. While, for the final motivation percentage result of the control class, it was obtained the percentage score of 86%, so the use of ARCS model with the help of PowerPoint media is stated effective. It is because the discussion content display could attract the students' attention. It is supported by Irfan & Ristiana's (2019) research which stated that the use of PowerPoint media can attract the attention and increase the students' learning motivation.

Conclusion

The use of Augmented Reality media as the learning media to increase the learning motivation obtains the average percentage from the attention indicator of 93%, the relevance indicator of 88%, the confidence indicator of 89%, and the satisfaction indicator of 87%. From the average percentage of ARCS indicator, then it can be categorized as very good. As for the PowerPoint media obtains the average percentage from the attention indicator of 85%, so it can be categorized as very good. Meanwhile, the relevance indicator obtains the average percentage of 80%, the confidence indicator of 73%, and the satisfaction indicator of 78% which can be categorized good. The Augmented Reality media effectiveness result obtains the percentage 100%, then it can be stated that the Augmented Reality media is very effective in increasing the students' learning motivation. While, the PowerPoint media obtains the percentage of 86%, it can be stated that the PowerPoint media is effective in increasing the students' learning motivation.

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