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Content Validity in Android-Based Augmented Reality Media for High School Science Students on Covalent Bonds Topic: Rasch Model Analysis

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Abstract. The 21st-century chemistry learning that teaches abstract and complex concepts needs to develop learning media that can increase students' learning motivation and visualize abstract concepts in chemistry. One of the media in the 21st century developed in this study is Android-based augmented reality media. The purpose of this study was to test the validity of the Android-based Augmented Reality media and see the differences in perceptions between teachers and students in assessing media. The validation of android-based Augmented Reality learning media uses a questionnaire and is quantitative. The Rater for assessing the product consisted of 6 senior chemistry teachers at 5 different schools in Surakarta and 20 students who had obtained the material for covalent bonding at SMA N 1 Ngemplak Boyolali. The data obtained were analyzed by Rasch Model using Facets software. The results of the analysis show that exact agreements are 35.1% and exacted agreements are 35.2%. This happens because the aspects are considered easy by the teacher, but the students consider these aspects difficult. The aspect or item that is considered the most difficult to achieve is the suitability of the example with the material and improving understanding of the material. Based on this research, in developing media, it must be packaged properly so that it is easily understood and understood by students.
Keywords: Learning Media, Augmented Reality, Content Validity, Rasch Model

Introduction

Chemistry is the study of the structure of matter and the changes it undergoes, which are abstract and complex, so it is considered a difficult subject to understand (Pradilasari et al., 2019; Ristiyani & Bahriah, 2016; Safitri et al., 2019). The difficulty of understanding chemical concepts in relating to everyday life can be caused by an imbalance in understanding multiple chemical representations (Apriani et al., 2021). Multiple chemical representations consist of three levels, namely microscopic, submicroscopic and symbol (Cheng & Gilbert, 2009). One of the multiple levels of chemical representation that is often overlooked is submicroscopic. Chemical representation skills are important because the ability to understand abstract and complex chemical material depends on students' ability to master the three levels of representation and the ability to relate multiple levels of chemical representation (Widiastari & Redhana, 2021). Chemical bonds are related to the bonds that occur in compounds, the forms of compounds to the nature of ionic or covalent compounds which are abstract concepts.

In the 21st century, the development of technology in the world is increasing rapidly. This development also has an impact on learning that applies 21st century skills and is also marked by changes in the curriculum, the development of learning media and other technologies that support learning. Learner-centered 21st century learning adapts 21st century skills, one of which is mastering information and communication technology to increase student motivation (Gani & Winarni, 2021; Harahap & Siregar, 2020; Pratiwi et al., 2019). 21st century skills applied in chemistry learning make teachers think and innovate how these skills are owned by students. These skills can be stimulated by developing learning media. Learning media is a tool used to help the learning process so that the message to be conveyed becomes clearer and learning objectives can be achieved (Dwijayani, 2019).

The learning media needed in chemistry learning are those that can visualize abstract and complex chemical concepts to students that are easy to understand (Hanum et al., 2017). Interactive media in the form of an Android-based augmented reality application. Augmented Reality is a technology that combines the real and virtual worlds that are interactive in the form of 3D animation (Azuma, 1997). In previous research, augmented reality applications that combine animation and 3D objects help students visualize and improve understanding of abstract chemistry learning (Abdinejad et al., 2020). In addition, augmented reality media responds to students curiosity and can make it easier for students to understand information when described visually (Macariu et al., 2020; Safri et al., 2017). In this study, augmented reality learning media is presented in the form of an android application, this is because most students have smartphones (Nazar et al., 2020). In addition, the media presented in the form of android makes it easier for students to access material anytime and anywhere.

The development of android-based augmented reality media needs to be tested to find out whether the media is feasible or not and can find out what aspects are liked by students and teachers in a media. Validity is a method that can be used to determine the feasibility of the developed media. In this study, content validity was carried out to see the extent to which the content presented in the developed media had a decent quality for use. There are two approaches in analyzing instrument quality, namely Item Response Theory (IRT) and Classic Test Theory (CTT). IRT is a modern assessment that combines responses from respondents to items (Rizki & Yusmaita, 2021; Sabekti & Khoirunnisa, 2018; Bichi et al., 2019). In previous research related to the development of augmented reality learning media, it focused on the feasibility of using learning media only. This article aims to examine the feasibility and differences of opinion between students and teachers on augmented reality learning media.

Methods

This study uses quantitative methods, the data obtained from the study were analyzed using the Rasch model. The analysis in this article is analyzed using facet software. Analysis using the Rasch model is used to map out how the agreement between teachers and students on Augmented reality learning media is developed. Analysis using the Rasch model on the partial credit model will show more sensitive results because it can measure up to the person and item level. This analysis provides an overview of the interaction between the indicators specified in the readability test and the person (rater). This article focuses on how the interaction between the indicator and the person (rater), the rater in this article is the teacher and student. Research flow can be see in Figure1.

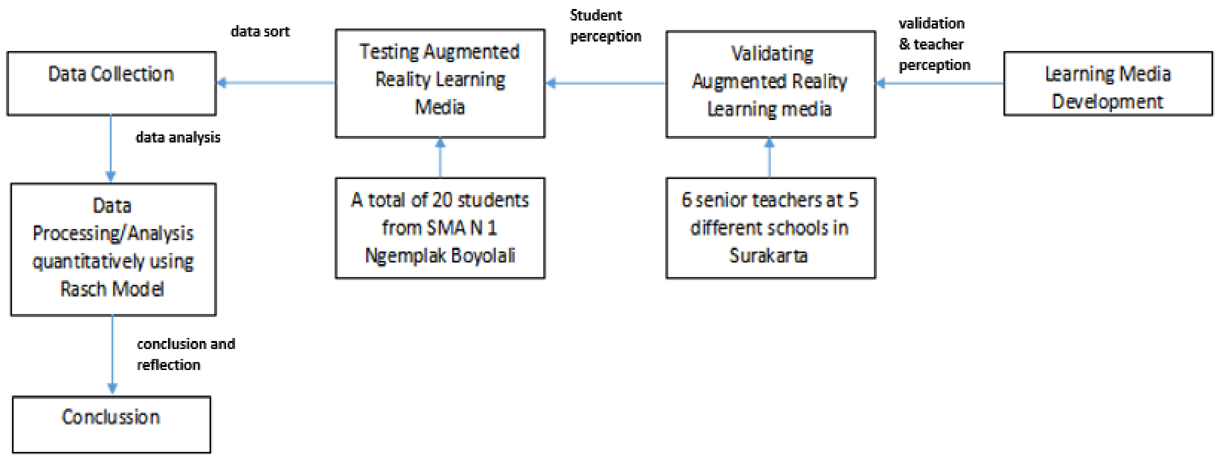

Figure 1. Research flow

Participant. The data used were obtained from product validation conducted by 6 senior chemistry teacher tests with more than 15 years of teaching experience in 5 different schools in Surakarta and the first 20 years of receiving covalent material. The selection of teachers was carried out by purposive sampling where teachers who had the criteria of teaching experience more than 15 years, had a master's degree in chemistry education, and were in a school with a UTBK rating for chemistry in the top 10 grades in the city of Surakarta. The android-based augmented reality media product developed contains covalent materials and covalent polarity compounds. The instrument used in the validation is in the form of a questionnaire with a Likert scale of 1-5 on each aspect that is measured. Teacher data collection was carried out using focus group discussions, at the end of the session a questionnaire was given to see the learning media developed. Student data collection was carried out during chemistry learning in class X MIPA 3 SMA N 1 Ngemplak Boyolali. The selection of student participants by purposive sampling where the selected students are students who have followed the topic of covalent and covalent polarity compounds. Then, the data obtained were analyzed using the Rasch Model with Facets software.

Instrument. The media validation instrument consists of 4 aspects, namely aspects of material presentation, aspects of visual communication, aspects of media display and aspects of AR benefits. The aspect of presenting the material consists of the sub-aspects of the suitability of the example with the material, the accuracy of the evaluation tool. Visual communication aspects consist of sub-aspects of 3D image accuracy, appropriateness of media display and buttons. The aspect of media display consists of sub-aspects of simple media use. As for the benefits aspect, among others, the AR benefits sub-aspects, the sub-aspects increase students' interest in learning and the sub-aspects increase students' understanding of the material. Data collection was carried out after teachers and students used Android-based augmented reality media.

Results and Discussion

Learning media is one of the essential things in the teaching and learning process; media has a role in conveying concepts so that students easily accept them. The teacher will use media that is in the teacher's perception according to the criteria that have been set as suitable media to use. Thus, students as subjects in the teaching and learning process become consumers of learning media. As consumers, students have the right to judge whether the media used is appropriate with what is learned and has benefits and ease in explaining concepts. So far, media development is centred on how trials are carried out and what level of agreement is there to assess the suitability of media content. This article tries to discuss the differences in perceptions of teachers and students regarding how engaging and easy-to-use learning media are.

The feasibility test was carried out on 6 senior teachers in Surakarta and 20 students who had received the topic of covalent bonds. Senior teachers who have been teaching for more than 15 years were asked to rate the quality of our learning media using the focus group discussion method. While our students did the same thing, we gathered 30 students and did a focus group discussion. The results of the feasibility test conducted by teachers and students are shown in Table 1.

Table 1. Augmented reality media validation indicators, raters (teachers and students), facet assessment maps for assessing the feasibility of augmented reality media using the Rasch model

Measr	+Media	-Aitem	-Guru dan Siswa	Scale
2 +	+	+	+	(5)
1 +	+	+	Siswa 17 Siswa 20	
		Kesesuaian contoh soal dengan materi		- - -
		Meningkatkan pemahaman peserta didik	Siswa 5	
		Fungsi Tombol Ketepatan alat evaluasi	Siswa 14 Siswa 9	
:	:	Penggunaan media sederhana :		
0 *	*	Meningkatkan minat belajar *	Siswa 13 Siswa 8 *	
			Siswa 10 Siswa 11	
		Manfaat AR		
		Ketepatan gambar 3D	Siswa 18 Siswa 4	3
-1 +	+	Kesesuaian tampilan media +	Siswa 7	
			Siswa 15 Siswa 3 Siswa 6	
			Siswa 19	- - -
-2 +	+	+	Siswa 12 +	
			Guru 1 Guru 6 Siswa 16	
:	:	:	Siswa 2 :	
			Siswa 1	2
-3 +	+	+	+	
				- - -
			Guru 4 Guru 5	
-4 +	+	+	+	
			Guru 3	
-5 +	+	+	+	
			Guru 2	
-6 +	+	+	+	(1)
Measr	+Media	-Aitem	-Guru dan Siswa	Scale

The analysis used in this article is the Rasch model because it can describe in more detail the differences in perceptions between teachers and students regarding the augmented reality-based learning media that was developed. In addition, the Rasch model can find out how the interaction between the rater and the item is. Figure 2 shows graphical measurements for items, aspects and raters. In Figure 1, the measuring column shows the logit scale for all aspects with a range of 2 to -6. Logit with a value of 0 is the minimum criteria for good or bad quality items considered by the validator (Darmana et al., 2021). The second column shows the validated media column. The third column shows the items or aspects assessed by the rater (Fahmina et al., 2019). In this column, the items in the top position are the most difficult aspects to achieve or fulfill in the media according to the rater. For example, the most difficult item in Augmented Relaity media is the suitability of sample questions and increasing student understanding, while for the lowest item, the suitability of the media display is the item that is the easiest to achieve according to the validator. The fourth column shows teachers and students which means validators of the media (Rizki & Yusmaita, 2021). In that column, Students 17 and 20 are the most difficult validators to give grades, while teacher 2 is the easiest validator to give grades. The results of the multi-facet Rasch can be seen in Table 2.

Table 2. Summary of Rasch Multi-Facet Results

	Strata Value	Reliability	Exact Agreements	Expected Agreements
Rater	3.89	0.88	35.2%	35.1%
Item	3.97	0.88	-	-

Rater. In this study, 26 people rated augmented reality media. The total rater consists of 6 Education practitioners and 20 students. The assessment results presented in Table 1 state that the rater reliability index is 0.88, which means that the rater's reliability is in a good category (Sanjaya et al., 2020). At the same time, the reliability of the item is also good, which is equal to 0.88. the reliability of a rater or item can be in the sufficient category if the reliability is at 0.8. Therefore, the reliability index shows the reliability of the rater in providing an assessment of augmented reality media (Rizki & Yusmaita, 2021). The strata value obtained from the analysis is above 3, which is 3.89 for the rater and 3.97 for the item, which means that the assessment given by the validator is reliable.

Table 2 also shows the results of the rater of exact and expected agreements. The exact agreements obtained were 35.2%, while the expected agreements were 35.1%. The results of the analysis show that the exact agreement and the expected agreement are considered less. An exact good agreement and expected agreement should be worth >40%. According to the teacher, the low exact agreement and expected agreement are because the learning media is by what is desired. However, according to the students, the media developed is still challenging to understand and needs improvement. Based on the results presented in Figure 2, it can be seen that students 17 and 20 are the most difficult to score, while teacher 2 is very easy to score in augmented reality learning media. The teacher assesses the augmented reality learning media with perfect scores in all aspects. This is considered not good because it cannot assess the weaknesses and strengths of the media. In contrast to students who provide varied values to be used as an improvement and perfection of augmented reality learning media. In Figure 2 it is shown that students 17 and students 20 have a high standard of assessment. This assessment can be used as a reference for improvement because it is considered a product weakness. If many raters are in top positions, the media developed is not feasible. Teacher 2 who is below assesses that the augmented reality learning media is good (Vebrianto & Osman, 2011).

Item. The item in this study is an android-based augmented reality product. In this study, the aspects assessed in the media consist of 4 aspects: aspects of content presentation, aspects of visual communication, aspects of the media display, and aspects of AR's benefits. These specs consist of several sub-aspects. After the results were analyzed using the Rasch Model and Facets software, the results are shown in Table 1 where the reliability value is 0.88 with a strata value of 3.97. This shows that the data that has been analyzed is reliable. Based on the analysis results in Figure 1, it can be seen that the items considered problematic by the validator are the suitability of the sample questions with the material and improved student understanding. Meanwhile, the most liked item or gets a good score is the display of augmented reality learning media. After being analyzed based on suggestions and comments from the validator, some content needs improvement.

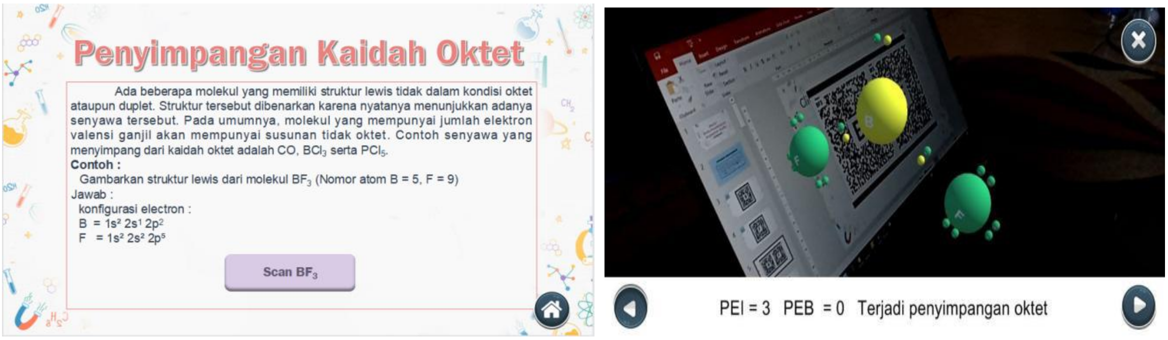

Figure 3. Difficult Items in Media

One is the concept of deviation from the octet rule; Figure 3 shows that the content in the media is a compound that has deviations from the octet rule. Meanwhile, compounds that do not experience deviations from the octet rule do not exist. In addition, the content in this medium also does not show electrons that deviate from the octet rule. This lack of content can make students less able to understand, and misconceptions can occur. Therefore, the preparation of learning media such as augmented reality requires visual and content power. In addition, visual reinforcement and content can help students understand to accept the concepts given more clearly (Abdinejad et al., 2020; Lay & Osman, 2018). This is reinforced by previous research, which states that only 44.93% of students can understand the octet rule deviation material because students do not understand the concept (Safitri, et al., 2018).

Based on comments and suggestions from content raters about the molecular shape of the VSEPR theory. In Figure 3 it can be seen that the shape of the molecule is not visible. The explanation of each molecular shape that appears is unclear, causing students to understand less about the concept. Figure 3 also does not show which PEB and PEI are causing students to have difficulty understanding them. Good picture power is needed so that students do not understand misunderstandings in understanding chemical concepts. Mental pictures are useful for representing chemical concepts and are a way for students to capture concepts in augmented reality media (Bucat & Mocerino, 2009).

Figure 4. Difficult Items in Media

The second point that is still difficult is the suitability of the sample questions with the content. Based on suggestions and comments, examples of questions on augmented reality learning media are not included with a complete discussion, and examples of questions on learning media are less varied. In addition, some sections do not have sample questions, for example, on the material of the VSEPR molecular shape. The content only describes the various shapes of the molecule; no examples are given (Heinich, et al., 2002). From the explanation above, in preparing android-based augmented reality learning media, the material must be packaged adequately to be understood. In addition, examples in varied media and maximum discussion help students understand the content to avoid misconceptions (Barke, et al., 2009).

Conclusion

The feasibility of Augmented Reality learning media can be known from the assessment instrument in the form of a validity questionnaire. Differences of opinion regarding android-based augmented reality learning media can be seen from the results of the Rasch Model analysis. From the results of the analysis obtained an exact agreement of 35.2% and expected agreements of 35.1%, which indicates that augmented reality learning media is in accordance with the wishes of the teacher but according to students the media is still difficult to understand. Items that are difficult to achieve are the suitability of the sample questions with the material and improve student understanding, while the easy items are media displays. Judging from the results, students 17 and 20 had difficulty giving grades and teacher 2 was an evaluator who was easy to give grades. Therefore, android-based augmented reality learning media must be packaged properly so that it is easy for students to understand.

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