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Development of Chemical Literacy Oriented *Speed Cruiser* Interactive Multimedia on Reaction Rate Material

Ratu Tiara Nurfazhira[1], Sari Sari[2], Ferli Septi Irwansyah[3]

[1,2,3]Chemistry Education, Faculty of Tarbiyah and Teacher Training Universitas Islam Negeri Sunan Gunung Djati Bandung, Jalan A.H, Nasution Cipadung, Cibiru, Bandung, 40614, Indonesia.

*E-mail: ratutiaranf@gmail.com

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Abstract

The purpose of this study is to analyze the results of the validation test and describe the appearance of the chemical literacy-oriented Speed Cruiser multimedia on the developed reaction rate material. The novelty aspect of this research lies in the delivery of chemical content in the multimedia developed, not only discussing chemical concepts thoroughly, but also integrating the four aspects of chemical literacy namely content, context, scientific process, and scientific attitude in one application that can be accessed through various devices. This research uses the Design-Based Research (DBR) method with the stages of analysis, design, and development. The types of data used are quantitative and qualitative data. Quantitative data was obtained through validation tests and feasibility tests. The validation test was carried out by material experts and media experts, while the feasibility test was carried out by high school students in class XI IPA who participated in IT extracurricular activities. The qualitative data is obtained from suggestions for improvement from validators and respondents. The validation test results for this study obtained an average rcount of 0.89 for all aspects and the percentage of feasibility test results obtained a value of 86%. This shows that the Speed Cruiser multimedia is declared valid and feasible to use in learning.

1. Introduction

The development of technology has had a positive impact in various fields, one of which is education (Lubis & Ikhsan, 2015; Muzzalifa & Oktaviani, 2021). The use of technology in education can help in the teaching and learning process (Bagus et al., 2016; Junaidi, 2019). The use of technology in learning can not only attract students' interest, but also help them understand and illustrate abstract concepts that are difficult to explain (Larasati & Sumarti, 2021), as well as in learning reaction rate material

in chemistry lessons (Fibonacci et al., 2020). The reaction rate material requires students to understand the mechanism of chemical reactions, the factors that affect the reaction rate, and their relationship to phenomena in everyday life (Stephanie, 2023), so that learning it requires the ability to analyse and continuous practice to really understand the material (Basit et al., 2023). Based on research conducted by Lestari et al (2021), the results showed that students' understanding of the reaction rate material was still relatively low, with an average percentage of material understanding below 50% on several indicators (Lestari et al., 2021). Students' difficulty in understanding the concept of reaction rate is partly due to the lack of use of media in the learning process (Silalahi, 2020)

One of the learning media that can be used to assist the learning process is interactive multimedia (Ihsan & Jannah, 2021). Interactive multimedia can be effectively used to improve student understanding of reaction rate material because it is able to combine text, images, videos, and animations in one application (Yustiqvar et al., 2019). The presentation of reaction rate material using interactive multimedia can not only help students to understand the material, but can also help present material that can support the strengthening of students' chemical literacy (Munawarah et al., 2022).

Chemical literacy is an important thing to develop in chemistry learning (Herman & Herman, 2022), because in addition to having aspects that direct students to understand concepts, aspects of chemical literacy also direct students to be able to apply these concepts contextually (Laila et al., 2022). This is in line with the indicators of the achievement of chemistry learning, where chemistry learning not only emphasises understanding of concepts but also emphasises the context in applying science concepts (Handayani, 2020). Chemistry learning explains the relationship between the existence of a phenomenon and the reasons why it can occur (Sari et al., 2019). Some studies show that students' chemical literacy in Indonesia is still relatively low (Yusmar & Fadilah, 2023). Low chemical literacy can have an impact on students' ability to understand and apply chemical concepts critically and relevantly (Ihsan & Jannah, 2021).

Based on the results of observations through the Field Experience Practice (PPL) program in one of the high schools, it is known that teachers still dominantly use the lecture method and display material in the form of text or simple images from textbooks and presentation slides, so that some abstract material such as reaction rates, is not conveyed optimally (Pillena et al., 2019). The delivery of material that refers to the package book is also not varied, so that the concepts conveyed are not accompanied by examples of their application (Kusumawardhani et al., 2019).

The above problems indicate that it is important to develop a technology-based learning medium that can assist in the delivery of material, as well as support the strengthening of students' chemical literacy (Ismiyanti et al., 2023). In addition, interactive multimedia can make it easier for students to learn material independently in the learning process and outside the learning process because it can be accessed flexibly, so that it can be used anywhere and anytime (Rahmi & Hastuti, 2024).

The development of android-based multimedia for the concept of reaction rate has been done before by Sinaga & Roza (2022) who developed android-based multimedia on reaction rate material, getting research results with an average N-gain of 0.80 and testing the effectiveness of using interactive multimedia to improve students' concept understanding of reaction rate material to achieve an average acquisition of learning outcomes of 87.65 with 100% completeness of student learning outcomes, this shows that interactive multimedia is effectively used to improve students' concept understanding of reaction rate material. The research presents complete reaction rate material, along with reaction rate factors and collision animations, in one medium that can be accessed through several hardware platforms. However, there is a gap where the reaction rate material discussed only focuses on conveying the concept of reaction rate without any examples of real and contextual phenomena. In addition, media operations can only be done on one device, such as being used on an Android or a computer.

In contrast to previous research, this study aims to analyze the results of the validation test and describe the appearance of the learning multimedia development product named Speed Cruiser, presenting the concept of reaction rate completely for high school / equivalent levels and the material presented is also oriented to chemical literacy so that it presents the material contextually. In addition, the developed media can be accessed on various devices.

The benefits of this research are that the chemical literacy-oriented Speed Cruiser multimedia on reaction rate material can serve as an innovative learning medium, increasing students' interest in learning reaction rate material and also helping the strengthen students' chemical literacy.

2. Materials and Methods

This research uses the Design-Based Research (DBR) method, which is a research approach that aims to develop and evaluate solutions to practical problems, especially in the context of education (Sari et al., 2017). The DBR method emphasises the process of designing and developing interactive learning interventions to improve student learning practices and outcomes. In this context, DBR is used to design and develop an interactive learning media that can support the improvement of chemistry learning quality (Rosmiati et al., 2022).

The multimedia developed in this study refers to the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation), but is limited to the development stage only because the media have not been directly implemented in the classroom learning process the classroom (Hidayat & Nizar, 2021).

The purpose of this study is to analyse the results of validation tests conducted by material experts and media experts, as well as to describe the appearance and features of the developed Speed Cruiser multimedia. It is expected that this media can be an innovative learning tool, help students in improving concept understanding on reaction rate material, and strengthen chemical literacy through the presentation of contextual and interesting content.

This research uses quantitative and qualitative data. Quantitative data is obtained from filling out the validation test questionnaire and feasibility test by interpreting the questionnaire results in the form of statistical numbers, to determine the validity and feasibility of the multimedia developed (Siregar, 2021). Meanwhile, qualitative data is obtained from suggestions for improvement from validators and respondents (Septryanesti & Lazulva, 2019).

The validation test results questionnaire is used to determine the validity of the chemical literacy-oriented Speed Cruiser multimedia on the reaction rate material that has been developed, by calculating the rcount value and comparing it with the rcritical value that has been set at 0.3. If the rcount value is more than 0.3, it can be said to be valid, but if the rcount value is less than 0.3, it can be said to be invalid (Sugiyono, 2017).

The formula used to calculate the rcount value is as follows:

$$r = \frac{x}{N.n}$$

The feasibility test questionnaire is used to determine the feasibility of the chemical literacy-oriented Speed Cruiser multimedia on the reaction rate material that has been developed. The score used consists of possible answers: strongly disagree (1), disagree (2), agree (3), and strongly agree (4). This feasibility test questionnaire is processed to produce a percentage of results in the form of numbers that reflect the level of feasibility of each aspect and also the total percentage. The results of the feasibility test questionnaire were calculated using the following formula:

$$\%\ Results = \frac{the\ total\ score\ obtained}{maximum\ score}\ x\ 100\%$$

The stages of the research conducted are described in the following chart.

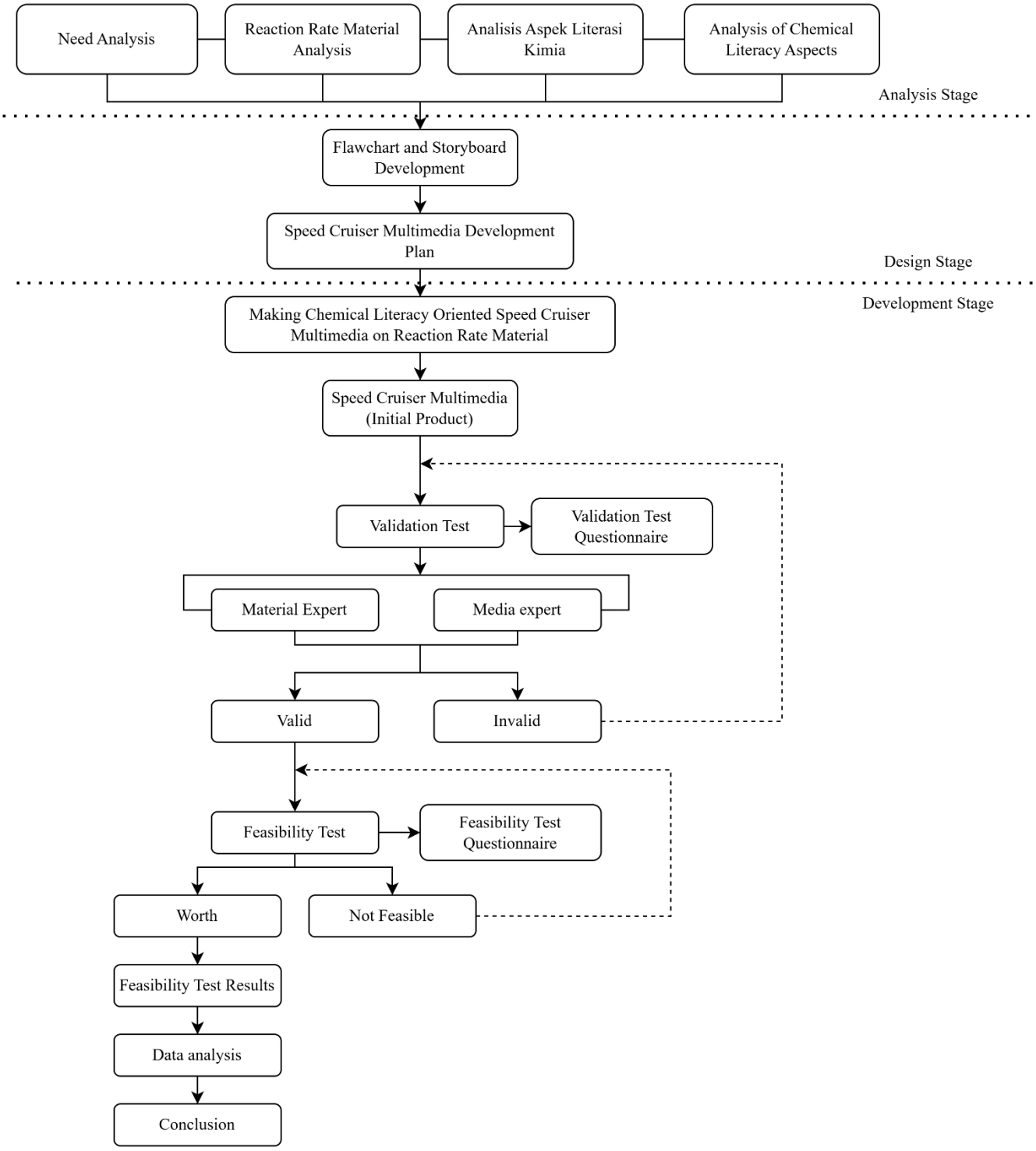

Figure 1. Development Research Produce

3. Results and Discussions

a) Advantages and Uniqueness of Interactive Multimedia Based on Chemical Literacy

There are several unique aspects of the interactive multimedia developed in this study compared to previous studies. First, the multimedia developed is explicitly oriented to all aspects of chemical literacy, namely content, context, process, and attitude. The material is presented by linking real phenomena that are often encountered in everyday life, such as the use of hydrogen peroxide in cleaning stains, the process of decay, the use of wood as fuel, and the use of catalysts in reducing vehicle exhaust emissions. The selection of these contexts aims to help students understand concepts in a more relevant and applicable manner. Although some previous studies have linked reaction rate material to the context of everyday life in general, the development of multimedia that raises specific phenomena, such as those used in this study, has not been found in previous studies.

Second, this multimedia is equipped with an evaluation feature that is directly integrated into one platform, allowing students to do the evaluation without the need to use additional platforms such as Google Forms, as still done in Ramadhoni and Muchtar's research (2024). In addition, the questions presented in this media have been prepared regarding aspects of chemical literacy, following the pattern of presenting questions that have been developed by Pakesa and Yusmaita (2019).

Third, the multimedia is designed to be used on various devices, both computers and Android, which makes it flexible for various learning conditions. In addition, the use of Articulate Storyline software allows the insertion of videos with good display quality, helping to explain abstract concepts more clearly and interestingly. With the combination of a chemical literacy approach, good visual appearance, and full integration, this multimedia is expected to be an alternative learning medium that supports the improvement of students' understanding.

b) Analysis of Validation Test Results and Feasibility Test Results of Speed Cruiser Multimedia Development

Validation Test Results

The validation test was conducted to obtain data that could determine whether or not the chemical literacy-oriented Speed Cruiser multimedia on the reaction rate material developed, and to obtain suggestions as material for improving the multimedia that had been made. This validation test was carried out by three validators as media experts and material experts, through filling out a validation test questionnaire in the form of numerical data, which was then processed to determine the validity of the media developed using a Likert scale. The answer form of the Likert scale consists of strongly disagree (1), disagree (2), agree (3), and strongly agree (4) (Andriati et al., 2023). One Chemistry Education lecturer at UIN Sunan Gunung Djati Bandung, one Informatics Engineering lecturer at UIN Sunan Gunung Djati Bandung, and one Chemistry teacher at Karya Budi High School. The following are the validation test results of the media that have been developed, with the acquisition of the rcount value can be seen in Tables 1 and 2.

Table 1 shows the results of the validation test of the material contained in the media. This validation test was conducted by three validators. Based on the data obtained, the rcount value for the validation aspect of material learning is 0.89; material substance is 0.95; chemical literacy is 0.91; quiz is 0.83; language is 0.83; and understanding is 0.95. The rcount value for each aspect of the assessment of the material validity test is above the critical value (0.3). This material presented in the Speed Cruiser multimedia is declared valid. The overall average value of rcount can be seen in Table 1.

Table 1. Material Validation Results: Average rcount *for* Each Aspect

No.	Aspects Assessed	rcount	rcritical	Conclusion	Interpretation
1.	Reaction Rate Material	0,89	0,3	Valid	High

2.	Material Substance Aspects	0,95	0,3	Valid	High
3.	Chemical Literacy Aspects	0,91	0,3	Valid	High
4.	Quiz	0,83	0,3	Valid	High
5.	Language	0,83	0,3	Valid	High
6.	Understanding	0,95	0,3	Valid	High
	Average	0,89	0,3	Valid	High

In Table 2, the results of the validation test of the developed media display are shown. This validation test was conducted by three validators. Based on the data obtained, the rcount value for the validation aspect of the learning media display is 0.90; the use of learning media is 0.91; language is 0.88; visibility is 0.88; and graphic elements are 0.97. The rcount value for each aspect of the assessment of the material validity test is above the rcritical value (0.3). Thus, the media display in the Speed Cruiser multimedia is declared valid. The overall average value of rcount can be seen in Table 2.

Table 2. Media Validation Results Average rcount Each Aspect

No.	Aspects Assessed	rcount	rcritical	Conclusion	Interpretation
1.	Learning Media Display	0,90	0,3	Valid	High
2.	Learning Media Usage	0,91	0,3	Valid	High
3.	Language	0,88	0,3	Valid	High
4.	Visibility	0,88	0,3	Valid	High
5.	Graphic Elements	0,97	0,3	Valid	High
	Average	0,90	0,3	Valid	High

Feasibility Test Results

This feasibility test was carried out by 15 respondents from the SMA class XI IPA students who participated in IT extracurricular activities, through filling out a feasibility test questionnaire. The score used consists of the possibility of answers strongly disagree (1), disagree (2), agree (3), and strongly agree (4). This feasibility test questionnaire is processed to produce percentage results in the form of numbers that reflect the level of feasibility of each aspect and also the total percentage. The following are the results of the feasibility test of chemical literacy-oriented Speed Cruiser multimedia on reaction rate material can be seen in Table 3

Table 3. Feasibility Test Results

No	Aspects Assessed	Percentage	Description
1	Material substance aspect	85	Feasible
2	Language aspect	84	Feasible
3	Visual communication aspect	86	Feasible
4	Software engineering aspect	90	Very feasible
Average		86	Feasible

Based on the table above, there are four aspects contained in the feasibility test questionnaire, namely aspects of material substance, linguistic aspects, visual communication aspects and software engineering aspects. The material substance aspect is intended to analyze the extent to which the material is packaged attractively, the media's ability to improve students' understanding of the reaction rate material, the flow of material presentation, the suitability of the material and quiz questions with learning objectives, and the assessment of the ability of the material and quizzes presented in developing students'

chemical literacy. The results of the feasibility test for the substance aspect of the material obtained a percentage of 85% in the feasible category. This shows that the developed Speed Cruiser multimedia has good quality in presenting the concept of reaction rate.

The linguistic aspect is intended to analyse the clarity of the language used, the use of language that does not cause double meaning, accuracy in spelling and punctuation, and consistency in the use of foreign terms. The results of the feasibility test for the linguistic aspect obtained a percentage of 84% in the feasible category. The results of this percentage indicate that the use of language in the multimedia Speed Cruiser has good quality.

Visual communication aspects, to analyse the effectiveness of media in learning, ease of operation, attractiveness of the design display, the proportion of text and image size, and the clarity of sound and resolution on video. The percentage of eligibility generated in this visual communication aspect is 84% with a decent category. This percentage value indicates that the Speed Cruiser multimedia developed has an attractive visual design and functions properly.

The software engineering aspect is aimed at analysing and understanding in the instructions for using the media, ensuring that the program control buttons function properly, and ensuring that the developed media can be operated on various types of smartphones and laptops. The percentage result of the feasibility test for the software engineering aspect is 90% with a very feasible category. This percentage shows that the Speed Cruiser multimedia developed can function properly with ease of operation on various types of smartphones and laptops.

Based on the feasibility test results, an average calculation is carried out, and the percentage result is 86% which is included in the feasible category. These results indicate that the chemical literacy-oriented Speed Cruiser multimedia product is feasible to use as learning media for reaction rate material.

c) Describe the Display of Speed Cruiser Multimedia Development

This research produces a product in the form of interactive multimedia called Speed Cruiser, which is developed in the form of software, so that it can be accessed through installation on Android devices and computers. This application includes a developer profile menu, instructions for use, learning objectives, materials, and evaluations, which are presented in various formats such as text, images, and videos. All content can be accessed independently by users according to their learning needs.

The materials in the application include an introduction, collision theory, factors affecting the reaction rate, as well as a discussion of the rate equation and reaction order. In addition, the green chemistry menu presents contextual phenomena that are relevant to everyday life, such as the use of hydrogen peroxide to clean stains, the process of food decay, burning wood as fuel, and the use of catalysts in catalytic converter systems. The selection of these phenomena is intended to integrate aspects of chemical literacy that include content, context, process, and attitude, to support a holistic understanding of concepts.

The questions in the exercises and evaluations refer to the chemical literacy question model developed by Pakesa and Yusmaita (2019), which is a phenomenon-based presentation followed by conceptual questions. In this multimedia, questions are presented in the form of multiple choices to facilitate digital integration, but still maintain a context-based approach. The evaluation consists of 10 items developed based on chemical literacy indicators. Users are required to fill in their identity before accessing the questions and complete all items without being able to repeat or skip. After completing the evaluation, users get a final score and can access the review feature to view the answer key.

To support easy navigation, all media displays are equipped with interactive buttons such as back, continue, close, and sound settings. These features aim to facilitate a structured, interactive and easy-to-operate learning experience. Here are some examples of chemical literacy-oriented Speed Cruiser multimedia displays on the developed reaction rate material

Figure 2. Initial Display

Figure 3. Main Menu Display

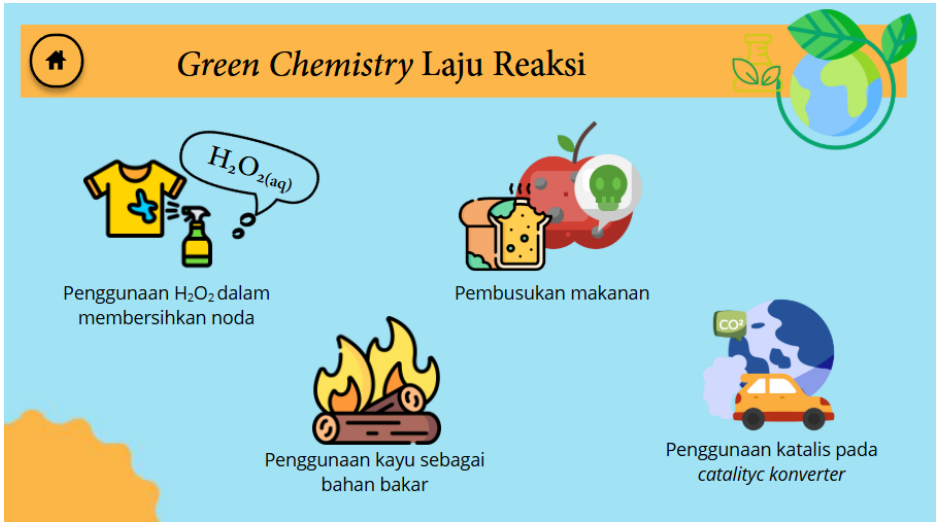

Figure 4. Display of Green Chemistry Content

5. Conclusions

This study successfully developed an interactive learning multimedia called Speed Cruiser, which is oriented towards chemical literacy for reaction rate material. This media is designed by integrating aspects of chemical literacy, which include context, content, process, and attitude, so that in the presentation of the material, several applications of reaction rates in life are involved. The multimedia developed can be accessed via a laptop and smartphone, so it can be accessed flexibly anywhere and anytime. The results of the validation test obtained an average value of 0.89 from the average value of the material quality aspect of 0.89, and the media validation aspect obtained a value of 0.90. From the calculation data, it can be seen that the rcount value for each aspect of the validity test assessment is above the critical value (0.3), so that it can be said that the media developed has valid material and media quality. The feasibility test was carried out by 15 respondents from high school students in grade XI IPA who took the IT extracurricular. The results of this feasibility test obtained a percentage that was categorised as feasible, with an average value of 86% which proves that the Speed Cruiser multimedia oriented towards chemical literacy is feasible to use.

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