

THE VALIDITY OF DIGITAL COMIC TO TRAIN METACOGNITIVE SKILLS ON REACTION RATE

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Abstract: This research aims to determine the level of validity of digital comic media on reaction rate to practice developed metacognitive skills. This research is Research & Development (R&D) with the ADDIE model, through 5 stages, namely analyze, design, development, implement, and evaluate which is limited to the development stage. The instrument used to determine the level of validity is a validation sheet assessed by two chemistry lecturers and one chemistry teacher. The level of validity is obtained based on the value mode of the assessment results of three validators. Based on the results of the validation that has been carried out, the digital comic developed received a score of 4 which is categorized in each aspect of both content and construct which is categorized as valid. So it can be concluded that the digital comics developed are suitable for testing with students.

Keywords: validity, digital comic, metacognitive skill

INTRODUCTION

The 21st century can be characterized by 1) easily accessible information; 2) faster computing or data processing; 3) automation that replaces jobs; and 4) fast communication (Halawa et al., 2022). With the increasing development of science and technology, the world faces challenges in the 21st century that are very different from previous centuries (Tirri et al., 2017). The real challenge in the world of education is that learning in the 21st century requires educators to be able to use digital technology and internet networks to access, manage, evaluate and create information that can be used in the learning process (Halawa et al., 2022). Apart from that, chemistry learning activities are a challenging and quite complicated learning process (Hidayah, Fajaroh, & Narestifuri, 2021). So in this era, learning media utilizes technology in its use. One of the technology-based learning media that can be used in the learning process is digital comics (Syahrani et al., 2022).

Comics are a form of visual communication media that has the power to convey information by combining images and writing. In comics, the text makes it more understandable and the plot makes it easier to understand (Sholihah, 2023). The comics that will be developed are digital comics. The reason for choosing

digital comics is that digital comics are environmentally friendly, cost-effective and flexible. It is said to be environmentally friendly because digital comics do not use paper as a delivery medium so we can save on paper usage. Digital comics are said to be cost-effective because they do not need to be printed, bound, or duplicated in book form. To assist its use, the digital comics developed are published digitally via a webtoon platform which can be accessed easily via Android/iOS smartphones, laptops, tablets and others provided they must be connected to internet data (Nuryanah et al., 2021).

Comics are a pictorial medium, so the right material is material that can be visualized, one of which is reaction rates. The material on reaction rates includes five sub-topics, namely the concept of reaction rates, collision theory, factors that influence reaction rates, reaction rate equations, and reaction orders. Reaction rate is one of the materials that studies microscopic things such as collision theory and factors that influence reaction rates. The abstractness of this concept makes students tend to only memorize the theories without understanding them (Sinta et al., 2021). In research conducted by Fitriawati et al. (2022) regarding the development of chemical comics on colloidal materials which was carried out in class educate. From research conducted by Harahap (2020) regarding the development of digital comics on reaction rate material to improve student learning outcomes, research results showed that digital comics are suitable for use as learning media that can improve student learning outcomes.

In reaction rate material, students are required to understand and master the concepts correctly. Concepts in chemistry are multilevel concepts. This means that concepts in chemistry develop from simple concepts to more complex concepts. This multilevel concept also results in students understanding that a concept needs to be sequential (Marthafera et al., 2018). Furthermore, Putri & Muhtadi (2018) wrote in their article that chemistry is a science that requires students to have factual, conceptual and metacognitive knowledge in science. Understanding metacognition is necessary for students to understand a concept because to understand a concept students need to carry out a series of activities that are consciously carried out in a process known as metacognitive awareness (Putri & Muhtadi, 2018).

Metacognition consists of two, namely metacognitive knowledge and metacognitive regulation (Moritz et al., 2019). Metacognitive knowledge refers to the general knowledge that students have about how they learn, process information, and their knowledge of their own learning process (Indira et al., 2020). Metacognitive skills have an important role in students' learning process. Metacognitive knowledge can help students understand and regulate their own thinking processes so that students are able to learn on their own without too much help from the teacher. The reason why metacognitive abilities need to be developed

is because metacognitive abilities support the formation of cognitive processes (Amellya & Khasanah, 2021). Metacognitive skills help students to gain knowledge and improve their intellectual abilities in the learning process. There are three important skills in metacognitive skills, namely planning, monitoring, and evaluating (Schraw & Moshman, 1995). Planning ability is when students are able to write or mention known information correctly and completely (Patmawati, Wigati, & 'Aini, 2023). Monitoring ability is the ability of students when they are able to show where and how changes need to be made when there are work steps that do not match the problem (Sophianingtyas & Sugiarto, 2013). The third ability is evaluating. Evaluating ability is a skill that students have when they are able to explain the conclusions of a problem correctly (Sophianingtyas & Sugiarto, 2013).

The results of research conducted by Handayani & Irawan (2022) show that metacognitive skills can be applied if students find it difficult with the learning material, and can also be applied by students when working on assignments so that students can choose strategies to complete the task. As for the results of pre-research data carried out at SMA Negeri 1 Sidoarjo using metacognitive test sheets, it was obtained that students' planning skills were 56.25% which were categorized as sufficient, monitoring skills were 62.5% which were categorized as good, and evaluation skills were 37.5% which was categorized as good. categorized as less. This shows that students' metacognitive skills still need to be improved.

Based on the background, valid learning media is needed to train students' metacognitive skills. Developing digital comics on reaction rate materials to train metacognitive skill is the novelty of this research. Therefore, this research was conducted to determine the validity of digital comics that have been developed so that they can train students' metacognitive skills.

METHOD

This research is Research and Development (R&D) research. The Research and Development (R&D) research method aims to produce a product and test the effectiveness of the product (Sugiyono, 2016). The development model used in this research is the ADDIE model. The ADDIE model consists of five main stages, namely analysis, design, development, implementation and evaluation (Branch, 2009). However, this research is only limited to the development stage.

1. Analysis stage

This stage aims to identify and analyze the problems faced by students and educators, as well as to obtain information about what is needed in the learning media development process. The series of activities carried out at the analysis stage are (1) conducting needs analysis through metacognitive skills tests and teacher interviews; (2) perform CP analysis; (3) determine learning objectives;

(4) identifying the characteristics of the target students; (5) identify and collect necessary resources; and (6) develop a digital comics development plan.

2. Design Stage

The second stage is design. The design stage is used to design products and research instruments according to the results of the analysis in the previous stage (Firda, 2023). The series of activities carried out at the design stage are (1) determining the digital comic components; (2) determine the content or material in digital comics; (3) create a digital comic design storyboard; and (4) compiling an instrument for the feasibility of digital comics to train students' metacognitive skills.

3. Development Stage

The third stage of the ADDIE model is the development stage, which aims to produce valid learning media (Cahyadi, 2019). The instrument used for expert validation is a questionnaire. The instrument used for expert validation is a questionnaire. This questionnaire will be assessed by two lecturers and one chemistry teacher to validate the media based on content and construct as a form of validity level of digital comics. Data obtained from media validation results were then analyzed. The data obtained in the form of responses, suggestions or input obtained from validators was used to improve the product. For quantitative data, the validation classification was determined by validators based on the ordinal scale mode with intervals of 1-5. The questionnaire sheet uses a Likert scale assessment as shown in Table 1.

Table 1 Validation Likert

Likert Scale	Category
5	Very Valid
4	Valid
3	Valid Enough
2	Less Valid
1	Not Valid

(Riduwan, 2015)

Validation data is in the form of scores which are analyzed quantitatively which is ordinal data which can be analyzed by determining the mode in each aspect using the following conditions. If the aspect being assessed has a score mode ≥ 3 , then the aspect is declared valid. If the aspect being assessed has a score < 3 , then the aspect is declared invalid. Then, if there are aspects that do not meet the validity requirements, revisions and validation must be carried out again until they reach the specified criteria (Lutfi, 2021).

RESULTS AND DISCUSSION

Digital Comic Design

Digital comics which are developed based on comic content components are divided into two, namely, prologue as an opening and introduction to digital comics and the core content of digital comics. The prologue contains an introduction to the function of digital comics, learning objectives, and instructions for using comics. Meanwhile, the core content of the digital comic contains material on reaction rate factors which is presented with a storyline that includes metacognitive planning and monitoring skills, and a barcode at the end for follow-up activities that include evaluating skills. The digital comics developed can be accessed via the link: <https://t.ly/ZHD1v>. The episode title components can be seen as in Figure 1.



Figure 1 Each title of each episode

The digital comic being developed consists of five episodes. The first episode contains a guide to using comics as a learning medium. The second episode is about concentration reaction rate factors. The third episode is about surface area reaction rate factors. The fourth episode is about temperature reaction rate factors and the last episode is about catalyst reaction rate factors. Because it has five episodes with different material, the researchers added the title of each episode to make it easier for users.

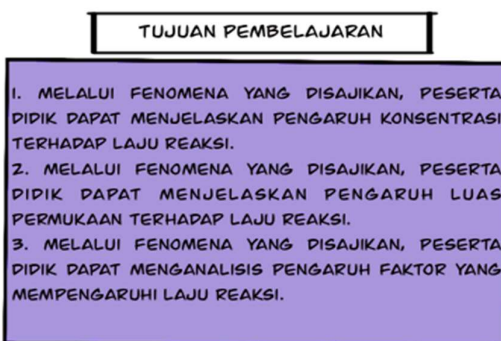


Figure 2 Learning objective in digital comics

The learning objectives component contains learning objectives in accordance with the results of the needs analysis and also informs users about using chemical comics as a learning medium.



Figure 3 Display of instructions for using digital comics

The next component is instructions for using digital comics that can be seen in Figure 3. The instruction is not only about how to use digital comic but also an introduction to Webtoon features. So if there are potential users who have never used Webtoon, this can be helped.

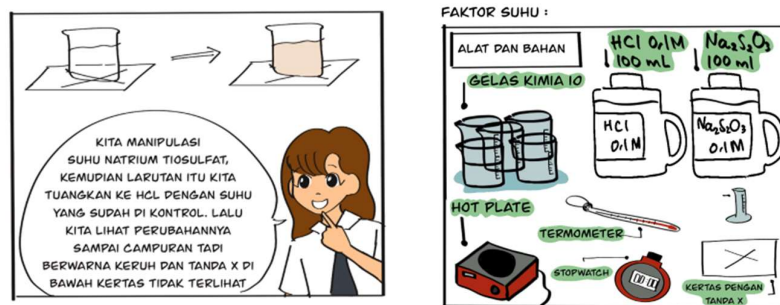


Figure 4 Display of planning skill in digital comic

The next component is reaction rate material which is packaged with stories that reflect metacognitive skills. The reaction rate factor material presented is the concentration, surface area, temperature and catalyst reaction rate factors which are connected to the collision theory. It is felt that reaction rate material needs to support the learning process because the material contains many abstract concepts, for this reason, tools in the form of appropriate learning media are needed (Minarni, 2020). One form of appropriate learning media for reaction rate material is digital comics because digital comics combine text with images or visuals, making it easier for students to understand reaction rate material (Pahria & Hendrawan, 2018). The metacognitive skills presented in digital comics are planning skills, monitoring skills, and evaluating skills. Planning ability is when students are able to write or mention known information correctly and completely (Patmawati, Wigati, & Aini, 2023). An example of the display of planning skills can be seen as in Figure 4.

In the comics being developed, planning skills are shown in how the characters in the comics discuss before solving problems or when researchers are able to design tools and materials appropriately. As in Figure 4, the character's planning ability can be seen in how the character can determine information on the problem to be solved, and design an HCl experiment with $\text{Na}_2\text{S}_2\text{O}_3$ with manipulated temperature as one of the experiments to see the reaction rate factors that are influenced by temperature precisely.



Figure 5 Display of monitoring skill in digital comic

According to (Rizalia & Syam, 2020) metacognitive monitoring skills are students' abilities when they are able to show where and how changes need to be made when there are work steps that do not match the problem (Sophianingtyas & Sugiarto, 2013). If there are no errors, then students realize that they have not made any mistakes in their work steps or while solving problems (Febrianty, Bambang, & Usman, 2022). The monitoring skills can be seen in Figure 5. In Figure 5, the monitoring skills displayed in digital comics are when the character is able to carry out the steps he has arranged correctly.

The last one is evaluating skills. The third skill is evaluating. Evaluating skills are skills that students have when they are able to explain the conclusions of problems correctly (Sophianingtyas & Sugiarto, 2013). Barcodes are presented so that students can continue learning activities by evaluating their learning outcomes. At this stage students will evaluate their knowledge regarding the reaction rate factors material they have studied.

Validity of Digital Comics

Based on research that has been conducted on the validity of digital comics, it was obtained from the assessments of three validators, namely two chemistry lecturers and one chemistry teacher. The validation results obtained can be seen based on Table 2.

Table 2 Validity Score

No	Aspect	Validity Score			Mode	Criteria
		V1	V2	V3		
1	Material Suitability					
	The questions given are according to the storyline in the digital comic which is in accordance with the concept in the reaction rate material.	4	4	4	4	Valid
	The concept given to comic media is correct.	4	4	4	4	Valid
	Symbols, logos, numbers and formulas in comic media are correct.	4	4	5	4	Valid
	Suitability of learning materials with indicators that students will achieve.	4	4	4	4	Valid
					4	Valid

2	Presentation					
	Ease of material to understand.	4	4	5	4	Valid
	The material presented is coherent.	4	4	4	4	Valid
	Completeness of the material presented in comic.	4	4	4	4	Valid
	Comic learning media that can be presented anytime and anywhere.	4	4	4	4	Valid
	The font used are simple and easy to read.	4	4	4	4	Valid
					4	Valid
3	Language					
	Links of meaning between conversational dialogues.	4	4	4	4	Valid
	The language used is clear and easy for students to understand.	4	4	4	4	Valid
	The language used does not give rise to multiple interpretations or misinterpretations.	4	4	4	4	Valid
					4	Valid
4	Graphic quality					
	Selection of color composition	4	4	4	4	Valid
	Communicative and interactive	4	4	4	4	Valid
	Match between image and text	4	4	4	4	Valid
	The text can be read well	4	4	4	4	Valid
	Correspondence between images and dialogue between characters	4	4	5	4	Valid
					4	Valid
5	Metacognitive indicators					
	There are planning components that are appropriate in digital comics.	5	4	4	4	Valid
	There are monitoring components that are appropriate in digital comics.	4	4	4	4	Valid
	There are evaluating components that are appropriate in digital comics.	5	4	4	4	Valid
					4	Valid

Table 2 shows the validation results of the digital comic media that has been developed. The validity of media content can be seen based on aspects of material

suitability and metacognitive indicators in digital comics. One assessment of content validity is the continuity of the story with the material presented. This continuity is one of the things that can influence students' motivation in the learning process and the difficulty of understanding the material (Wijayati, Khoirunnisa, & Sabekti, 2021). Meanwhile, construct validity can be seen based on aspects of presentation, language and graphic quality. In the presentation aspect, there is an assessment of the ease of comics to be accessed anywhere and anytime. This is supported by the opinion of Wijayati, Khoirunnisa, & Sabekti (2021) that learning media that can be used anywhere helps students in the learning process and can repeat the material they have studied.

Based on the results of the validation that has been carried out, it can be seen that the suitability aspect of the material gets a score of 4 with valid criteria and the metacognitive indicator gets a score of 4 with valid criteria. So it can be concluded that the content validity of digital comics gets a mode score of 4 with valid criteria. The linguistic validation results obtained a score mode of 4 with valid criteria. The presentation validation results get a score mode of 4 with valid criteria and the graphic quality validation results get a score mode of 4 with valid criteria. Therefore, it can be concluded that digital comics get a validation score of 4 which is categorized as valid so that digital comics can be tested on potential users.

CONCLUSION

Based on the results of the research that has been carried out, it can be concluded that digital comics on reaction rate material for practicing metacognitive skills are valid with a content validity value of 4 and construct validity with a mode value of 4. Therefore, it can be concluded that digital comics get a validation score of 4 which is categorized as valid so that digital comics can be tested on potential users.

REFERENCE

- Amalia Syahrani, R., Jusniar, J., & Hardin, H. (2022). Pengembangan Media Pembelajaran E-Komik Materi Reduksi dan Oksidasi Berbasis Flip PDF Professional Pada Model Discovery Learning. *UNESA Journal of Chemical Education*, 11(3), 235–242.
- Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. New York: Springer.
- Cahyadi, A. (2019). *Pengembangan Media dan Sumber Belajar Teori dan Prosedur*. Banjarmasin: Penerbit Laksita Indonesia.
- Disca Amellya, & Khasanah, U. (2021). Pengembangan Media Pembelajaran Matematika Menggunakan Google Site Dengan Pendekatan Metakognisi

- Untuk Kelas XI. *Quadratic: Journal of Innovation and Technology in Mathematics and Mathematics Education*, 1(2), 101–107.
<https://doi.org/10.14421/quadratic.2021.012-04>
- Febrianty, C., Bambang, R., & Usman, U. (2022). Kemampuan Metakognisi Siswa Sma dalam Pemecahan Masalah Matematis. *Jurnal Peluang*, 10(1), 55-65.
<https://doi.org/10.24815/jp.v10i1.27673>
- Firda, Hanum. (2023). Penerapan Model ADDIE dalam Pengembangan Instrumen Penilaian Diri Sendiri Peserta Didik SMA Negeri Kabupaten Mojokerto. *Jurnal Hikari (Jurnal Ilmiah Mahasiswa Jurusan Bahasa dan Sastra Jepang)*, 7(1), 14-26.
- Fitriawati, Hartatiana, & Jayanti, E. (2022). Pengembangan Media Pembelajaran Comic Berbasis Scientific Approach Pada Materi Koloid. *Prosiding Seminar Nasional Pendidikan Kimia I*. Palembang : S1 Chemistry Education Program, FMIPA UIN Raden Fatah.
- Halawa, A. A., Yulita, I., & Adriani, N. (2022). The development of Acid-Base Electronic Chemistry Comic Learning Media for High School Students. *Journal of Science Education Research*, 6(1), 24–30.
<https://doi.org/10.21831/jsr.v6i1.44997>
- Handayani, I. P., & Irawan, D. (2022). Keterampilan Metakognitif Ditinjau Dari Perspektif Taksonomi Bloom Edisi Revisi Dalam Pembelajaran PAI. *Studia Religia : Jurnal Pemikiran dan Pendidikan Islam*, 6(2).
<https://doi.org/10.30651/sr.v6i2.13038>
- Harahap, Nur Fatni Amirah. (2020). *Pengembangan Buku Komik Kimia Laju Reaksi Dan Hasil Belajar Siswa Kelas IX Di Mas Lab Ikip Al Washliyah Medan* (Undergraduate thesis). UNIMED Bachelor's Degree Program : Medan.
- Hidayah, R., Fajaroh, F., & Narestifuri, R. (2021). Pengembangan Model Pembelajaran Collaborative Problem Based Learning Pada Pembelajaran Kimia di Perguruan Tinggi. *QALAMUNA: Jurnal Pendidikan, Sosial, dan Agama*, 13(2), 503-520. <https://doi.org/10.37680/qalamuna.v13i2.1016>
- Indira, S. M., Sundaryono, A., & Elvia, R. (2020). Pengembangan E-Modul Kimia Berbasis Metakognisi Menggunakan Aplikasi Edmodo. *Alotrop*, 4(1).
<https://doi.org/10.33369/atp.v4i1.13707>
- Lutfi, A. (2021). *Research and Development (R&D): Implikasi dalam Pendidikan Kimia*. Surabaya: Jurusan Kimia FMIPA Universitas Negeri Surabaya.
- Marthafera, P., Melati, H. A., & Hadi, L. (2018). Deskripsi Pemahaman Konsep Siswa Pada Materi Laju Reaksi. *Jurnal Pendidikan dan Pembelajaran*

- Khatulistiwa, 7(1).
<https://doi.org/http://dx.doi.org/10.26418/jppk.v7i1.23493>
- Minarni, M. (2020). Pengembangan Bahan Ajar Dalam Bentuk Media Komik Dengan Adobe Photoshop CS6 Pada Materi Laju Reaksi. *Jurnal Inovasi Pendidikan Kimia*, 14(2), 2596-2607.
<https://doi.org/10.15294/jipk.v14i2.23148>
- Moritz, S., Klein, J. P., Lysaker, P. H., & Mehl, S. (2019). Metacognitive and Cognitive-Behavioral Interventions For Psychosis: New Developments. *Dialogues in Clinical Neuroscience*, 21(3), 309–317.
<https://doi.org/10.31887/DCNS.2019.21.3/smoritz>
- Nuryanah, N., Zakiah, L., Fahrurrozi, F., & Hasanah, U. (2021). Pengembangan Media Pembelajaran Webtoon untuk Menanamkan Sikap Toleransi Siswa di Sekolah Dasar. *Jurnal Basicedu*, 5(5), 3050–3060.
<https://doi.org/10.31004/basicedu.v5i5.1244>
- Pahria, P., & Hendrawani, H. (2018). Pengembangan Bahan Ajar Laju Reaksi Dengan Multipel Representasi Berbasis Inkuiri. *Hydrogen : Jurnal Kependidikan Kimia*, 6(1), 32-42. <https://doi.org/10.33394/hjkk.v6i1.1598>
- Patmawati, P., Wigati, I., & 'Aini, K. (2023). Analisis Keterampilan Metakognitif Peserta Didik Dalam Pembelajaran Biologi Melalui Asesmen Pemecahan Masalah Di MAN 3 Palembang. *Jurnal Al 'Ilmi : Jurnal Pendidikan MIPA*, 11(2), 12–19.
- Putri, D. P. E., & Muhtadi, A. (2018). Pengembangan Multimedia Pembelajaran Interaktif Kimia Berbasis Android Menggunakan Prinsip Mayer Pada Materi Laju Reaksi. *Jurnal Inovasi Teknologi Pendidikan*, 5(1), 38–47.
<https://doi.org/10.21831/jitp.v5i1.13752>
- Riduwan. (2015). *Skala Pengukuran Variabel-Variabel Penelitian*. Bandung: Alfabeta.
- Rizalia, S., & Syam, A. N. (2020). Penguasaan Keterampilan Metakognitif Mahasiswa Tadris Biologi Melalui Tugas Menulis Jurnal Belajar. *Al-TA'DIB: Jurnal Kajian Ilmu Kependidikan*, 13(1), 1.
<https://doi.org/10.31332/atdbwv13i1.1844>
- Schraw, G., & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review*, 7(4), 351–371. <https://doi.org/10.1007/BF02212307>
- Sholihah, I. (2023). Media X-Recorder dan Youtube Untuk Meningkatkan Motivasi Belajar Bahasa Indonesia Moda Daring. *El-Tsaqafah : Jurnal Jurusan PBA*, 21(2), 145–158. <https://doi.org/10.20414/tsaqafah.v21i2.6052>

- Sinta, T., Mawaddah, I., & Haryani, S. (2021). Pengaruh Pembelajaran Berbasis Multirepresentasi Terhadap Keterampilan Metakognisi Pada Materi Laju Reaksi. *Chemistry in Education*, 10(1), 22–29. <http://journal.unnes.ac.id/sju/index.php/chemined>
- Sophianingtyas, F., & Sugiarto, B. (2013). Identifikasi Level Metakognitif Dalam Memecahkan Masalah Materi Perhitungan Kimia. *UNESA Journal of Chemical Education*, 2(1), 21–27.
- Sugiyono. (2016). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung: PT Alfabet.
- Tirri, K., Cho, S., Ahn, D., & Campbell, J. R. (2017). Education for Creativity and Talent Development in the 21st Century. *Education Research International*, 2017, 5417087. <https://doi.org/10.1155/2017/5417087>
- Wijayati, A., Fitriah, K., & Sabekti, A. (2021). Validitas dan Praktikalitas Multimedia Interaktif dengan Konteks Kemaritiman Materi Faktor-Faktor Yang Mempengaruhi Laju Reaksi. *Jurnal Zarah*, 9(2), 111-116. <https://doi.org/10.31629/zarah.v9i2.3741>