DEVELOPMENT OF DIGITAL COMIC BASED LEARNING MEDIA (CHEMTOON) WITH MARVEL APP ON CORROSION MATERIALS

Siti Hana Irawarni Alfu✉[1], Irhamni[1], Imas Eva Wijayanti[1]

[1]Pendidikan Kimia, Universitas Sultan Ageng Tirtayasa, Kota Serang, 42117, Indonesia
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ABSTRACT
This research project aims to design, develop and assess the feasibility of using chemical digital comic learning media (chemtoon) with the Marvel App on corrosion materials. Apart from that, to find out students' responses to digital comic learning media (chemtoon) with the Marvel App on corrosion material. Research uses methods research and development (R&D), with the ADDIE development model. The population of this research is all students in class XII Science. The sampling technique was purposive random sampling, obtained class XII-F Science, totaling 32 students as an experimental class. The results of media validation in developing digital comic-based media in the Marvel App show a V_{count} value from media expert validators is greater than V_{table} with a value of 0.85 – 0.95 > 0.80 , while the material expert assessment of all aspects shows a value of V_{count} greater than V_{table} with a value of 0.85 – 1 > 0.80. The results of student responses to digital comics obtained an average percentage of all aspects, namely 91.71%. This shows that the digital comic learning media (Chemtoon) with the Marvel App on corrosion material is valid, suitable for use and helps students' understanding of chemistry in corrosion material.

ABSTRAK
Tujuan dari projek penelitian ini adalah untuk merancang dan mengembangkan serta menilai kelayakan penggunaan media pembelajaran komik digital kimia (chemtoon) dengan Marvel App pada materi korosi. Selain itu, untuk mengetahui respon siswa terhadap media pembelajaran komik digital (chemtoon) dengan Marvel App pada materi korosi. Penelitian menggunakan metode *research and development* (R&D)*,* dengan model pengembangan ADDIE. Populasi penelitian ini yaitu seluruh siswa kelas XII IPA. Teknik pengambilan sampel dilakukan secara *purposive sampling*, diperoleh kelas XII-F IPA yang berjumlah 32 orang siswa sebagai kelas eksperimen. Hasil validasi media dalam pengembangan media berbasis komik digital dalam Marvel App menunjukkan nilai V_{hitung} dari para validator ahli media lebih besar dari V_{tabel} dengan nilai 0,80 > 0,85 – 0,95, sedangkan penilaian ahli materi semua aspek menunjukkan nilai V_{hitung} lebih besar dari V_{tabel} dengan nilai 0,80 > 0,85 – 1. Hasil respon siswa terhadap komik digital diperoleh persetase rata – rata keseluruhan aspek yaitu sebesar 91,71%. Hal ini menunjukkan bahwa media pembelajaran komik digital (Chemtoon) dengan Marvel App pada materi korosi sudah valid, layak digunakan serta membantu pemahaman siswa tentang kimia dalam materi korosi.

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✉Correspondence Author:
sitihanairawarnialfu@gmail.com

INTRODUCTION

Efforts to improve the quality of education in Indonesia will continue to be carried out by changing the curriculum from year to year until the implementation of the Merdeka Learning Curriculum. This Merdeka curriculum requires teachers to create fun, creative and innovative learning, especially in the learning media that will be used (Guntur et al., 2023). Learning media is a medium that is needed and used in the learning process in order to achieve a learning goal that is desired and to convey a learning message (Meling et al., 2019). One of the groups of Science subjects is chemistry. Thus, studying chemistry means studying theories, facts, principles, and laws about scientific processes and attitudes, because chemistry is a branch of science. Electrochemistry is one of the many chemical material coverages studied in the F phase of chemistry in the Merdeka curriculum. The scope of the discussion in the electrochemistry material is voltaic cells, corrosion, and electrolysis cells (Oktriyani, 2019).

Based on the results of interviews with chemistry teachers of class XII SMAN Negeri 6 Kota Jambi conducted by Oktriyani in 2019, there are problems in the learning process of corrosion material, where teachers still use lecture methods and students are only assigned to summarize material from textbooks. Then the teacher does not use media assistance as a tool for the teaching and learning process, resulting in only a few students being interested in participating in learning. Therefore, interesting learning tools are needed to improve students' understanding of corrosion material. Comics are one of these learning media. Comics are interpreted as a form of visual communication media that has the ability to convey information in a popular and easy-to-understand way because comics are a combination of images and writing arranged in a storyline that can facilitate the absorption of information so that the message is conveyed through the media is stored in memory with long term and difficult to forget. The use of comics as a teaching aid can help students understand chemical concepts because comics combine writing and images to form a storyline that makes information easier to absorb and understand. This can also attract students' interest by creating material content that is related to real-world situations (Minarni, 2020).

Over time, comics have increasingly developed variants, one of which is digital comics. Digital comics are comics in digital form such as PDF and not in physical form (print). In addition, digital comics can be easily accessed via laptops, smartphones, or other devices anytime and anywhere, such as being saved using the Marvel App platform. Marvel App is an online design platform that is useful for creating digital product designs online, then the design can be saved on the platform so that it is easy to access from any device (MArvelApp, 2013). From the statement above, it is said that students are still less interested in chemistry material because the learning media used by teachers are less varied, and abstract chemistry material requires precision to study. For this reason, researchers are very interested in researching and creating digital comics on the corrosion material of chemistry subjects, which distinguishes previous researchers, namely the corrosion chemistry material is discussed in relation to everyday life which is presented on a

Marvel app platform in the form of digital comics so that students can access it or study it anywhere.

METHOD

The development of digital comic learning media refers to the development of Research and Development (RnD) with the ADDIE model which consists of 5 (five) stages, namely analyze, design, develop, implement, and evaluate. The ADDIE model is used because the model can be used for various types of product development, one of which is learning media. Then, this model is considered an effective model for developing products, where there are evaluation stages in each process or step of its development. The evaluation process can have a positive impact on the quality of a product being developed because the error rate will be reduced or small (Branch, 2009).

The data analysis technique for this research was carried out after all data was collected and the data analysis process was Validation sheet analysis. Validation data was collected from validators and verified by five professionals in the field of validation to assess the feasibility of the learning materials being developed. By using the Aikens test assessment and Likert scale consisting of five (5) categories of choices, then providing a checklist symbol (√) answer to each question.

Table 1 Validation Sheet Assessment Guidelines Table

Score	Category
5	Very good (VG)
4	Good (G)
3	Adequate (A)
2	Bad (B)
1	Very Bad (VB)

The validation score data from the Digital Comic learning media with the Marvel App was then processed with a content validity test (Aiken, 1985). The following is a formula (1) for processing validity data:

$$V = \frac{\sum s}{[n\,(c-1)]} \quad ...(1)$$

Description:

V	: Item validity value	C	: Maximum assessment score
$\sum s$	: r-1o	r	: Score given by validator
N	: Number of validators	10	: Minimum assessment score

The provision and decision-making regarding the validity of digital comic learning media with Marvel app through a comparison between the V_{count} and the V_{table} value. The Vcount value is the validity value of the item obtained, and the Vtable value is the minimum value in the Aikens validity index table. If the $V_{count} \geq V_{table}$ then the item is declared valid, while if $V_{count} \leq V_{table}$ then the item is declared invalid.

Then in this study, 5 expert media and material validators were involved to assess the feasibility of the contents of the digital comic learning media with an error rate of 0.05, so that the minimum validity that must be obtained for the statement item to be valid is 0.80 (V_{table}) (Aiken, 1985).

To determine students' reactions to the digital comic learning material created, a questionnaire response data analysis was carried out. The questionnaire response data was obtained from chemistry teachers and high school students using the Likert scale. The Likert scale answer form uses 5

choice categories and then provides a checklist symbol (√) answer to each question item.

The scores on each scale given are in Table 2:

Table 2 Table of Response Questionnaire Scale Scores

Score	Category
5	Very good (VG)
4	Good (G)
3	Adequate (A)
2	Bad (B)
1	Very Bad (VB)

The results of the questionnpaire data are then converted into percentages and then analyzed. The percentage is calculated using the following formula (2):

$$\text{Score} = \frac{Gained\ Score}{Maximal\ Score} \times 100\% \qquad ...(2)$$

Decision-making from the feasibility of digital comic learning media is made into a percentage of feasibility using five scales.

The percentage interpretation criteria can be seen in Table 3:

Table 3 Percentage Interpretation Criteria

No	Score Range	Description
1	81,5% - 100%	Very Eligible
2	61% - 80%	Eligible
3	41% - 60%	Less Eligible
4	21% - 40%	Not Eligible
5	0 % - 20%	Very Uneligible

(Arikunto, 2010)

RESULT AND DISCUSSION
Development of Digital Comic Learning Media (Chemtoon) in Marvel App on Corrosion Material
Analyze Stage
Needs Analysis

In this analysis, the researcher conducted interviews with chemistry teachers and several high school students in grade XII Ipa. This interview was conducted as a start to find out the needs of chemistry teachers and students in learning media to support chemistry learning. This interview analysis was conducted at one of the high schools in Pandeglang, namely SMAN 2 Pandeglang. The students who participated in the interview in the analysis stage were five people and one chemistry teacher. The results of interviews with chemistry teachers showed that the media or learning devices commonly used in chemistry learning were in the form of powerpoints, videos, or teachers made themselves and textbooks from the school. Then the teacher also agreed if there was a digital chemistry comic learning media that was expected to increase students' enthusiasm in learning chemistry and make it easier for students to understand chemistry material. While the results of interviews with students showed that the learning resources used to teach chemistry were textbooks; there were no other learning resources, including digital comics, and the existing learning resources were still difficult to understand.

Analysis of learning outcomes, learning objectives, and learning objectives flow

In this step, the researcher analyzes Learning Achievements, Learning Objectives, and Learning Objective Flow.

The analysis process of these components is related to the Decree of the Head of the Education Standards, Curriculum, and Assessment Agency of the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia Number 033/H/KR/2022 which regulates learning achievements at the levels of Early Childhood Education, Elementary Education, and Secondary Education in the Merdeka Curriculum. This adjustment is made to be in line with the applicable curriculum, and the learning media developed can meet the needs of students in order to achieve learning objectives.

Design Stage
Storyboard Design

In designing this storyboard, the researcher made a storyboard containing Learning Achievements, Learning Objectives, and Learning Objective Flow, then the storyline was made interesting regarding corrosion material and included the source of the material.

Compiling Validation Instruments and Response Questionnaires

At this stage, a student response sheet instrument was developed for the learning media along with its validation instruments, such as media expert and material expert instruments. The validation instrument was created to determine and assess the feasibility of the designed digital comic learning media. The response questionnaire aims to determine students' responses through a limited test process for the digital comic development media that has been validated and revised.

Develop Stage (Development)
Digital Comic Construction

The construction of this digital comic is adjusted to the storyboard that has been made. According to Novisari (2022) the comic construction process consists of sketching, lettering, lineart, and coloring. In the first stage of compiling this digital comic, namely the sketching process using Procreate 5.3.7 software, in this sketching stage, the images created are still in the form of rough sketches. The second stage is lettering, this lettering process is the creation of text or speech bubbles contained in the digital comic. The third stage is Lineart, this lineart process is the process of thickening the actual comic image neatly and well before entering the coloring process using the Procreate 5.3.7 application. The last stage is the coloring stage, in this process, the comic image that has been thickened in the lineart process is then colored according to the theme of the comic being created. After going through all these stages, the comic image is saved in the form of a jpg file to then be entered into the Marvel App platform.

Digital Comic Validation

After the digital comic is finished, the next stage is the validation of the digital comic learning media. This stage is carried out to provide the results of the feasibility of the developed learning media. In the validation of materials and media, they are combined into one validator so that in one validator, two are validated, namely material and media validation. In the validation of materials, there are 3 (three) aspects of assessment, namely aspects of material, presentation, and language. While in the validation of media, there are 4 (four) aspects of assessment consisting of aspects of size, comic cover design, comic content design, and presentation of comics on the platform.

Implementation Stage

After the digital comic learning media has been validated and revised properly, the next step is to implement it. At this implementation stage, a limited trial was conducted on students of SMAN 2 Pandeglang who had used the Merdeka Curriculum in class XII-F majoring in Science, totaling 32 students. This trial was conducted in the learning process on corrosion material.

Evaluation Stage

In this phase, the researcher conducted an evaluation at each stage of the ADDIE process, starting from the analysis stage to the implementation stage. This step was taken to obtain good quality development media.

Feasibility of Digital Comic Learning Media (Chemtoon) in the Marvel App on Corrosion Material

This stage concentrates on the validation step as well as determining the feasibility of the digital comic learning material being developed. Validation was carried out to determine the feasibility of the digital comic learning media both in terms of media and material so that it can be said to be feasible and students can use it in the learning process. By using the media and material validation instrument sheet, five media and material experts verified this study. Qualitative and quantitative data were collected during the validation stage. However, quantitative data is in the form of Likert scale answers, while suggestions or comments are in the form of qualitative data. The validation value of the material expert was obtained using the Aikens formula calculation which can be seen in Table 4.

Table 4. **Results of Aiken Index Analysis on Material Expert Validation**

Aspect	V_{count}	V_{table}	Conclusion
Material	0,85 – 0,95	0,80	Valid
Presentation	0,85 – 0,95	0,80	Valid
Language	0,85 – 0,90	0,80	Valid

The results of the validation of material experts in the aspect of the calculation results show that the V_{count} is greater than the V_{table}, which is 0.85 - 0.95 > 0.80. This means that the material in this digital comic is valid and feasible. This is because the material presented in the digital comic on the corrosion material is in accordance with the learning outcome, learning objectives, and learning objective flow, the material is easy to understand and the material is presented clearly.

The second aspect is the presentation aspect, the results in the presentation aspect of the calculation results show that the V_{count} value is greater than the V_{table}, which is 0.85 - 0.95 > 0.80. Which means that in the presentation aspect of the digital comic it is

valid and feasible. This is because in the digital comic on this corrosion material, the material is presented in an interesting way, the material is sequential from easy to difficult, and the illustrations are in accordance with this comic, so it is interesting, easy to understand, and pleases the reader.

The last aspect is the Language aspect, the calculation results show that the V_{count} value is greater than V_{table}, which is 0.85 - 0.90 > 0.80. This means that the use of the Language aspect in digital comics on corrosion material is valid and feasible. This is because the language used is in accordance with the rules of good and correct Indonesian language use, the use of effective and efficient words so that it is easy

to understand by readers. In addition to validation by material experts, digital comic learning media on corrosion material is validated by media experts. The validation value obtained by media experts using the Aiken formula can be seen in Table 5.

Table 5. Results of Aiken Index Analysis on Media Expert Validation

Aspect	V_{count}	V_{table}	Conclusion
Size	0,90 – 1	0,80	Valid
Comic cover design	0,85 – 0,95	0,80	Valid
Comic content design	0,85 – 0,95	0,80	Valid
Presentation of comics on the platform	0,95 - 1	0,80	Valid

In the first aspect, namely validation in terms of size. The calculation results show that the V_{count} value is greater than V_{table}, namely 0.90 – 1 > 0.80. This means that in terms of size, this digital comic is valid and feasible. This is because the size of the chemical comic is in accordance with the International Standard (ISO) 216 paper size, namely B5 with a size of 176mm x 250mm. And the suitability of the size with the content of the material in the comic.

The second aspect is the comic cover design aspect. The calculation results show that the V_{count} value is greater than V_{table}, namely 0.85 - 0.95 > 0.80. This means that the comic cover design aspect is valid and feasible. This is because the front and back comic cover designs have unity, give a good impression of rhythm, and have good contrast.

The third aspect is the comic content design aspect. The calculation results show that the V_{count} value is greater than V_{table}, namely 0.85 - 0.95 > 0.80. This means that the comic content design aspect is valid and feasible. This is because the size and type of font are in accordance with the level of education unit, the spacing used is normal, depicts a good and clear storyline, images or illustrations are in accordance with the content of the material, creative, interesting, in accordance with the development of the reader's age, and the colors used are attractive and contrasting.

Finally, the aspect of comic presentation on the platform. The calculation results show that the V_{count} value is greater than V_{table}, which is 0.95 – 1 > 0.80. This means that the aspect of comic presentation on the platform is valid and feasible. This is because comics can be opened and easily accessed on the Marvel App platform.

Based on the results of the validation of material and media experts, it was concluded that the digital comic learning media in the Marvel App on corrosion material was said to be feasible. This is because in the process of developing digital comic learning media according to Septy's statement, 2015: 20-21 in Noprianti & Fujiastuti, n.d., digital comic learning media must (1) Instructions for using comics as comic learning media are conveyed clearly to readers; (2). The dialogue text or conversation between characters in the comic is quite capable of conveying the material correctly; (3). The use of comic media must be consistent in letters and images.

Student Responses to Digital Comic Learning Media (Chemtoon) in the Marvel App on Corrosion Material

The type of development research that the researcher conducted was research that was carried out only up to a limited test. Limited testing was carried out after going through the media and material validation process, media and material revisions and being declared feasible by experts. The purpose of this limited test was to test the feasibility of the digital comic learning media that had been developed. The limited

test was carried out on 32 students of class XII-F IPA at SMAN 2 Pandeglang. This limited test was carried out in the learning process on corrosion material by accessing the chemistry comic learning media link with the Marvel app. Then the students completed the response sheet to the digital comic learning media with the marvel app on corrosion material. The results of student responses are used to see and find out whether the media is suitable for use in the learning process. This student response questionnaire consists of seven assessment aspects that are developed into 20 statement items on a Likert scale. The results of student responses were obtained after conducting a limited learning test using digital comic learning media in the Marvel App on corrosion material. The following is the percentage of student response results in each aspect shown in Figure 1.

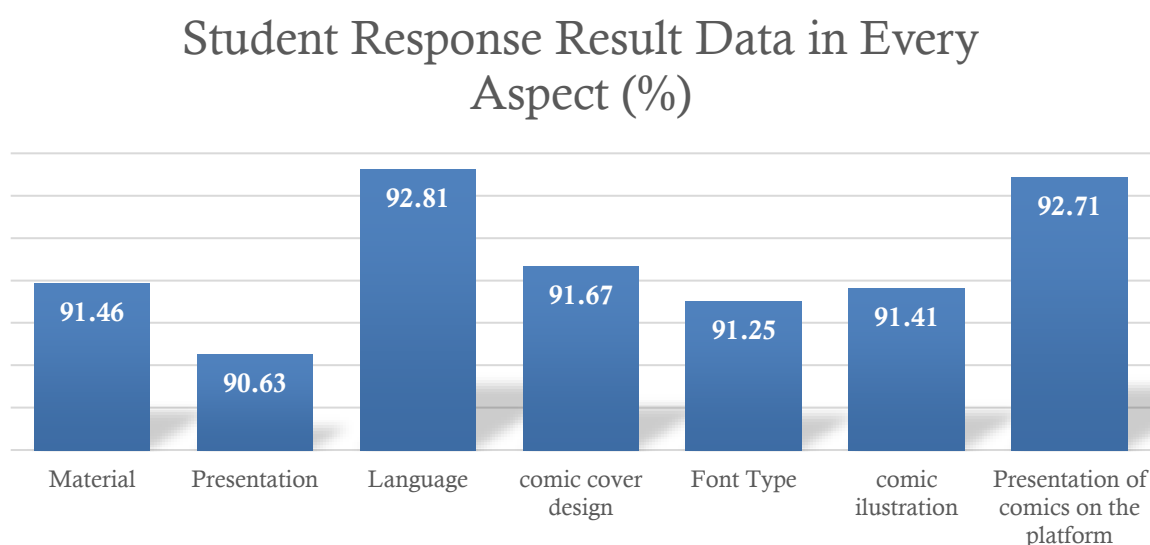## Student Response Result Data in Every Aspect (%)

Figure 1. Percentage Graph of Student Response Results in Each Aspect

The picture above shows the results of student responses to digital comic learning media in terms of material aspects showing a percentage value of 91.46% with very good essential criteria. This is in accordance with research (Mutiara et al., n.d. 2023), stating that the material or content in comic media when associated with events in everyday life will make students feel like they are directly experiencing the learning process so that it can increase student learning motivation, and facilitate student learning in understanding a chemical material.

Second, regarding the Presentation aspect, the results of the percentage of student responses show an average value of 90.63% with very good criteria. This is in accordance with research (Tsuroyya et al., 2022), regarding the development of digital comic media on chemical bonding material, it is stated that the presentation of material in comics can motivate students to learn chemical bonding material and the presentation of illustrations makes students understand chemical bonding material better because illustrations provide an explanation of the story.

Third, in terms of Language, the results of the percentage of student responses show an average value of 92.81% with very good criteria. This is in accordance with research (Johana & Widayanti, n.d. 2007), that comics are a type of reading that is light and easy to read and understand using simple vocabulary

and simple sentence structures so that students can understand each sentence. This is also confirmed by research conducted by (Addaafi & Nurita, 2020), that using clear and simple language according to students' thinking levels is the most important thing in learning tools.

Fourth, in terms of comic cover design, the results of the percentage of student responses showed an average value of 91.67% with very good criteria. This is in accordance with research (Mutiara et al., n.d., 2023) that with a clear image quality display, filled with attractive colors and illustrations, it can motivate students' enthusiasm to be interested in reading and understanding it.

Fifth, in terms of font type, the results of the percentage of student responses showed an average value of 91.25% with very good criteria. This is in accordance with research (Mery et al., 2022), the use of simple font sizes and types in e-comics will be easy to read and easy to capture the message conveyed in digital comic materials.

Next is the comic illustration aspect, the results of the percentage of student responses show an average score of 91.41% with very good criteria. This is in accordance with research (Mutiara et al., n.d., 2023) that comic illustrations with clear image quality displays, filled with attractive colors and illustrations can motivate students' interest to be interested in reading and understanding them.

Finally, related to the aspect of presenting comics on the Marvel App platform, the level of student response percentage results shows an average value of 92.71% with very good criteria. This is because digital comics on corrosion material can be opened, easily accessed on the Marvel App platform, and can be used or accessed anytime and anywhere. By

using the Mervel App platform, you can create digital product designs online, the design will be stored on the Marvel App platform and can be accessed from any device (MArvelApp, 2013). This is in line with research conducted by (Rahmatin et al., 2021), on the development of comic learning devices for learning computer algorithm and logic materials. The study found that comics can be used as alternative learning media in learning activities and can facilitate students' learning activities both at school and at home.

CONCLUSION

The process of developing digital comic media is carried out using the ADDIE model. The ADDIE model consists of 5 (five) stages, namely analyze, design, develop, implement, and evaluate. In the first stage, analyze analyzes the needs and compiles Learning outcomes, learning objectives, and learning objectives flow, at this stage it is concluded that the learning media used by teachers are only PPT, videos and textbooks, and there is no additional learning media such as digital comics. The learning objectives made based on learning outcomes are to explain the meaning of corrosion, the process of corrosion, analyze the factors that cause corrosion and how to overcome corrosion. In the second stage, design, making this storyboard contains material about corrosion which is made in the form of a storyline and making validation instruments and student response questionnaires. The third stage, develop, compiles digital comics according to the storyboard that has been made, After the digital comic is finished, the next stage is the validation stage of the digital comic learning media, finally making revisions to the digital comic that has previously been validated by the material and media expert validator. The fourth stage, implement, at

the implementation stage, a limited trial was conducted on students of SMAN 2 Pandeglang who had used the Merdeka Curriculum in class XII-F majoring in science, totaling 32 students. The last stage, evaluate. Researchers conducted evaluations at each stage in the ADDIE process from the analysis stage to the implementation stage to obtain good quality development media. The results of the validation of the development of digital comics with the Marvel App were obtained with a Vcount value from 5 material expert validators of 0.85 - 0.95 and a Vcount from 5 media expert validators of 0.85 - 1, so the results of the validation of the digital comic learning media assessed by the material and media expert validators were declared valid and suitable for use in chemistry learning. Meanwhile, the results of student responses to the development of digital comic learning media obtained an average of 91.71% with the highest percentage in the language aspect of 92.81%, followed by the comic presentation aspect in the Marvel App platform of 92.71%, then the comic cover design aspect of 91.67%, the material aspect of 91.46%, the font aspect of 91.25% and ending with the presentation aspect of 90.63%. Thus, the results of student responses to the digital comic development media created are very feasible to be used as additional learning media in chemistry learning.

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