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Evaluation of the Feasibility of Educational Comic Media on the Material of Substances and Their Changes Based on the Perceptions of Chemistry Education Students

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Abstract

Educational comic media has great potential in increasing learning motivation and conceptual understanding, but its use needs to go through a feasibility evaluation process before being implemented widely.This study aims to evaluate the feasibility of educational comic media on the topic of substances and their changes based on the perceptions of chemistry education students. The study used a quantitative approach with a survey method. The subjects were 30 Chemistry Education students at Jakarta State University who were selected using a total sampling technique. The research instrument was a questionnaire distributed via Google Form to measure several aspects of media feasibility, namely the feasibility of content, presentation and appearance, language, and usability or practicality of the media. Data were analyzed using descriptive statistics in the form of percentages to describe the tendency of respondents' perceptions. The results showed that educational comic media received very positive responses from students in all aspects of the assessment. In terms of content feasibility, the majority of respondents stated that they strongly agreed that the material in the comic was relevant, accurate, and in accordance with learning outcomes. The educational comic media that has been developed may still have shortcomings in terms of visual design, depth of material, or interactivity, so it still requires further improvement.

Keywords: educational comics, learning media, substances and their changes

Introduction

The development of digital learning media is growing rapidly in line with the demands of the times, which require more creative and engaging learning methods for students. One emerging medium is educational comics, which combine visual narratives with learning

content to simultaneously increase reading interest and understanding of scientific concepts. Previous studies have shown that digital comic-based media is considered feasible and effective for use in the context of microeconomics learning, with very high feasibility scores from subject matter and media experts and positive student responses to the media (Silaban et al., 2023).

In chemistry lessons, particularly in the topic of Substances and Their Changes, students often struggle to grasp abstract concepts such as atomic structure, phase changes, and chemical reactions. This lack of understanding can lead to low learning motivation and poor learning outcomes. Therefore, integrative and engaging learning media such as educational comics are proposed as an innovative solution to facilitate conceptual understanding (Juwita Kumala Sari Anne, 2016). Comics have long been used as a learning medium in science education due to their ability to present material visually and narratively, thus helping students develop conceptual meaning. Research on the use of scientific comics has shown that this medium is effective in improving students' scientific literacy skills through an inquiry-based approach. Inquiry-based e-comics have been reported to generate positive responses, with a very good percentage of respondents (Priadi et al., 2023).

Validation of comics in other learning contexts has also shown positive results. For example, comics for learning on biological topics such as the human excretory system were declared highly feasible based on validation by media and materials experts, with validation scores exceeding the feasible criteria. This indicates that comics have strong validity potential if developed systematically (Rafi Quddus,Wati Oviana, 2022). Another study also showed that the use of science comics can significantly influence the reading interest and learning outcomes of science students. This suggests that comics can be a motivating tool in the learning process, especially for students who tend to be visual learners (Widyawati & Wijayanti, 2019).

The expansion of research on e-comics in chemistry learning also demonstrates a new trend in integrating digital media with a STEM (Science, Technology, Engineering, and Mathematics) approach, helping students acquire higher-order thinking skills and an understanding of basic chemistry concepts. This is relevant to the complex delivery of the topic of Substances and Their Changes (Ilmi et al., 2023). Other research on interactive comics shows that this medium is not only instructionally feasible but also practical for use in chemistry learning because it can increase student participation and learning activities through engaging visual media. These findings support the potential use of educational comics in the context of chemistry education students (Firda Nurramdani Putri, 2022).

Based on the results of the study on "Science Education Students' Perceptions of Interactive Visual Media on Additive and Addictive Substances Material," it was found that interactive visual media has a very positive impact on learning. Of the 21 respondents of Science Education students from the 2023–2024 batch of Medan State University, 85.7% stated that the media was very helpful and 14.3% stated that it helped in understanding the material, without any negative responses. In terms of appearance, 71.4% considered the media interesting and 19% found it very interesting, indicating good visual quality. In addition, 90.5% of respondents stated that learning became more interesting with the use of interactive media, and all respondents reported experiencing increased learning motivation. 81% of students also stated that the media helped differentiate the concepts of additives and addictive substances more clearly. Overall, these findings confirm that interactive visual media is effective in increasing students' conceptual understanding, interest, and learning motivation, making it suitable for use as a supporting medium for science learning, especially on additive and addictive substances material (Dame et al., 2025).

Although numerous studies have demonstrated the feasibility and effectiveness of comics in various science and science learning topics at the elementary, secondary, and college levels,

studies that focus on evaluating the feasibility of educational comics specifically for the topic of Substances and Their Changes in chemistry education students are still limited. This raises the need for further research in the context of higher education (Juwita Kumala Sari Anne, 2016). Evaluating the feasibility of educational comic media based on the perceptions of chemistry education students is important to determine the extent to which this media can be accepted, understood, and implemented by students as part of an effective chemistry learning strategy in the digital age. Focusing on the assessment of students as direct users will provide concrete insights into the suitability of comic media for their academic learning needs (Priadi et al., 2023).

Although digital media is widely available today, those specifically integrating the chemistry curriculum with aesthetic elements and content accuracy are still limited. Many educational comics are simply entertaining without depth, or, conversely, are too text-heavy, diminishing the essence of the comic. A feasibility evaluation serves as a crucial filter to ensure media meets the standards for appropriate content, language, and presentation (Arı, 2025). Educational comics offer solutions through a combination of narrative and illustrations that simplify abstract concepts. Unlike conventional textbooks, comics possess the power of storytelling that can enhance readers' emotional engagement. The use of graphic panels in comics effectively illustrates the process of substance change step-by-step, facilitating cognitive understanding (Hadi Akbar Bin Dahlan, 2015).

Chemistry Education students play a dual role as both learners and prospective teachers who will eventually design learning media. Therefore, their perceptions of the appropriateness of a medium are crucial. Evaluating the medium from a student perspective will provide two-way feedback, both in terms of the effectiveness of the chemistry content and in terms of pedagogical aspects, or ease of delivery in the classroom.

The evaluation of media appropriateness in this study refers to several key aspects: content appropriateness (material accuracy), presentation appropriateness, linguistic aspects, and graphic aspects. Student perceptions will be measured to determine the technical and conceptual acceptability of the comic. The results of this evaluation will determine whether the comic is suitable for mass production or requires in-depth revision. Media development is inseparable from the formative evaluation process. By involving Chemistry Education students, researchers can map which parts of the "Substances and Their Changes" material are most helpful with comic illustrations and which parts still cause confusion. Critiques and suggestions from students who understand chemical structures are invaluable for the validity of the instrument and media.

Based on the explanation above, the research entitled "Evaluation of the Feasibility of Educational Comic Media on the Topic of Substances and Their Changes Based on the Perceptions of Chemistry Education Students" is very important to conduct. The results of this study are expected to not only produce scientifically valid media but also inspire lecturers and students to continue innovating in creating creative, effective, and enjoyable learning media.

Method

This study used a quantitative method with a questionnaire-based survey approach. This study was conducted to gain an objective understanding of the variables being studied. To achieve this goal, questionnaires were systematically distributed to respondents (Purwono, F.H., Ulya, A. U., Purnasari, N., & Juniatmoko, 2019). The population in this study was all 30 students of the Chemistry Education Study Program at Jakarta State University (UNJ) who had taken or were currently studying the topic "Substances and Their Changes." This population was selected because it had characteristics that matched the research objectives, namely being able to provide an assessment of educational comic media based on relevant

chemistry learning experiences. The sampling technique used was total sampling, meaning all 30 students were used as the research sample using a Likert scale. (John W. Creswell, 2017).

The research instrument was a questionnaire, uploaded to the Google Form platform, developed based on the learning media feasibility indicators. This instrument was designed to measure students' perceptions of educational comic media in several main aspects, namely: a. Content (material) feasibility aspect, b. Presentation and Display Feasibility Aspect, c. Language Aspect, d. Usefulness/Practicality Aspect, e. General Perception of Feasibility Aspect. The data collection process was carried out by sending a link to respondents via digital communication media. To ensure that there were no duplicate or incomplete answers, the researcher re-checked the data collected through the Google form. Furthermore, according to the research needs, the data were analyzed using descriptive statistical techniques such as calculating averages, percentages, and value trends. This method was chosen because it can provide a clear, organized, and easy-to-understand picture to produce structured, standardized quantitative data and enable accurate statistical analysis.

Results and Discussion

Based on the results of a questionnaire given to UNJ Chemistry Education students regarding educational comic media on the material of substances and their changes consisting of 20 questions using a Likert scale. Respondents in this study numbered 30 student who were UNJ chemistry education students. Data were analyzed using descriptive statistics by calculating the percentage of scores on each assessment aspect. The results of the analysis regarding the evaluation of the feasibility of educational comic media on the material of substances and their changes are presented in table 1 as follows:

Table 1. Results of Student Perception Analysis on Each Aspect

Assessment Aspects	Number of Item	Maximum Score	Achived Score	Persentage	Category
Content (material) Suitability Aspect	5	25	22,7	90,8	Very good
Presentation and Display Suitability Aspect	5	25	23,17	92,68	Very good
Language Aspect	3	15	13,43	89,53	Very good
Usability/ Practicality Aspect	4	20	18,2	91	Very good
General Perception of Suitability Aspect	3	15	13,6	90,6	Very good
Average			91,1	90,92	Very good

Based on table 1, it was found that all aspects of the assessment obtained very good. The aspect of feasibility of Presentation and Display obtained the highest percentage of 92.68%. In the Aspect of Content (Material) Feasibility, the percentage obtained was 90.8%. In the Linguistic Aspect, the percentage obtained was 89.53%, in the Aspect of Usefulness/Practicality, the percentage obtained was 91. Furthermore, in the Aspect of General Perception of Feasibility, the percentage obtained was 90.6%. Overall, the average percentage

of the evaluation of the feasibility of educational comic media was 90.92% which is classified as very good.

Content (material) Suitability Aspect

The findings of a questionnaire involving 30 respondents indicate that the content suitability of the educational comics developed received a very positive assessment. This is evident in the percentage of respondents who strongly agreed (60%), agreed (37%), and somewhat agreed (3%) that the material in the educational comics aligns with the learning outcomes of the "Substances and Their Changes" course.

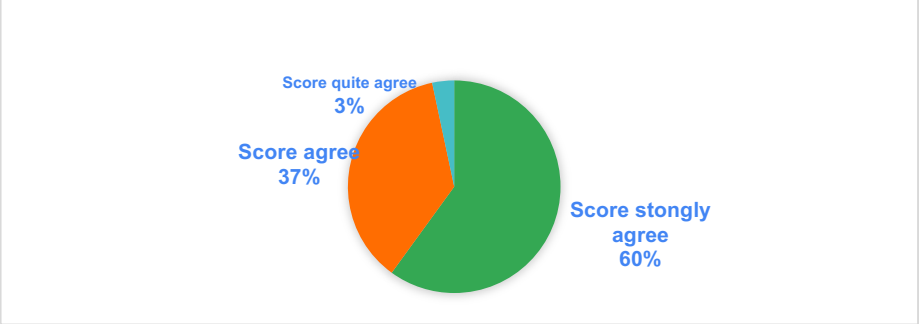

Figure 1. The material in the educational comic is in accordance with the learning outcomes of the subject of Substances and Their Changes

These results indicate that the majority of respondents considered the content in the educational comics to be relevant, accurate, and supportive of achieving the expected competencies in the learning process. The alignment between learning materials and learning outcomes is a crucial indicator in determining the suitability of teaching materials, as good teaching materials must be able to help students understand concepts systematically and align with the established learning objectives (Daryanto, 2016). These findings align with expert opinion, which states that good teaching materials must be designed based on their suitability to the curriculum, learning objectives, and student characteristics to improve the quality of the learning process. Therefore, the educational comic developed can be categorized as suitable for use as a learning medium because it meets the principle of material suitability to learning outcomes (Arsyad, 2019).

Based on the content feasibility test results, which showed that the concept of matter and its changes was explained scientifically and accurately in the comic, 67% of respondents strongly agreed, 23% agreed, and 10% somewhat agreed.

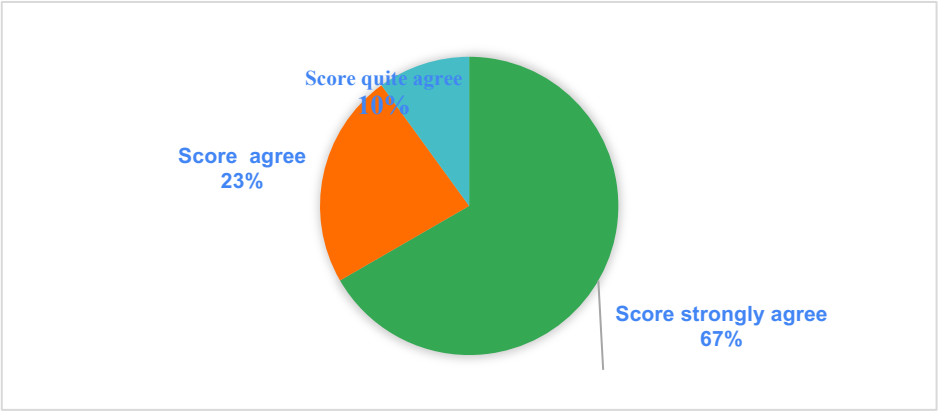

Figure 2. The Concept of Matter and Its Changes Explained Scientifically and Accurately in Comics

These results indicate that the majority of respondents assessed that the presentation of the material in the comic met the scientific aspects and conceptual accuracy. The high percentage of strongly agreeing indicates that the comic presented the concept of matter and its changes clearly, systematically, and in accordance with scientific concepts in science learning (Sudjana, N., & Rivai, 2019).

The research results show that presenting material in comic form is considered effective in helping students understand abstract concepts. This is evident in the percentage of respondents who strongly agreed (63%), agreed (27%), and somewhat agreed (10%).

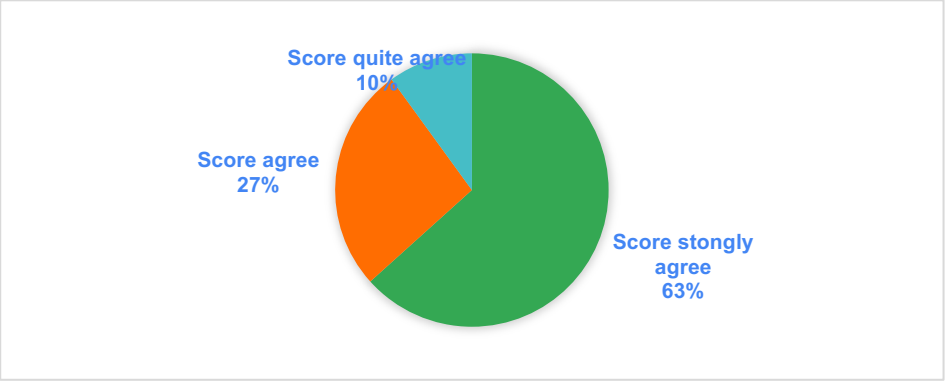

Figure 3. presentation of material in comics helps me understand abstract concepts

These findings indicate that the majority of respondents have a positive perception of the use of comics as a learning medium. The visualization of images combined with the storyline in comics can simplify difficult concepts into easier, more engaging, and contextual concepts. Comics can also increase learning motivation due to their communicative and non-monotonous presentation, thus helping students construct conceptual understanding more effectively. Therefore, the use of comics as a learning medium can be an innovative alternative for explaining abstract concepts in the learning process (Sudjana, N., & Rivai, 2019).

The content feasibility results indicate that the examples provided in the comics are considered relevant to everyday life by the majority of respondents. This is evident in the percentage of respondents who strongly agreed (60%), followed by those who agreed (37%), and those who somewhat agreed (3%).

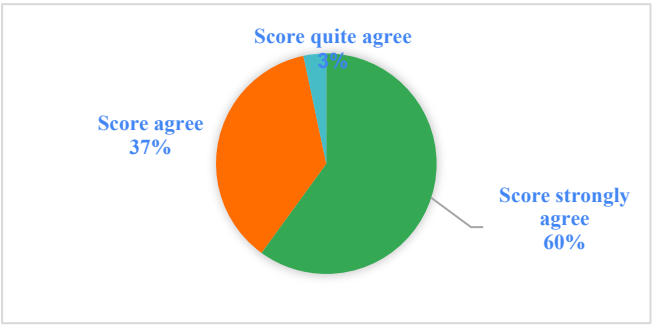

Figure 4. The examples given in the comic are relevant to everyday life

These findings indicate that using examples close to students' real-life experiences can improve students' understanding and relate the material to their own lives. Comics, as a learning medium, can present contextual situations, making it easier for students to grasp the concepts presented. Furthermore, presenting material through illustrations and stories

depicting everyday activities can increase learning interest and make the material easier to understand. Therefore, the relevance of examples in comics to everyday life is an important indicator in assessing the feasibility of the content of the learning media being developed (Arsyad, 2019).

Based on the research results regarding the content suitability of the sequence of material presentation in the comic, 60% of respondents strongly agreed, 37% agreed, and 3% somewhat agreed. These results indicate that the majority of respondents considered the material presented in the comic to be systematically and logically structured, making it easier for readers to understand the flow of the material.

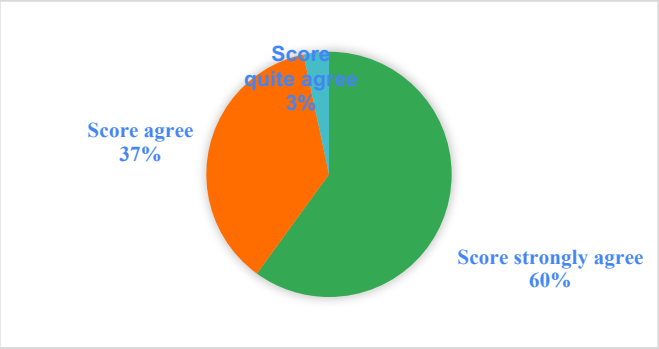

Figure 5. The order of presentation of material in comics is arranged systematically and logically

A coherent and structured presentation of material is an important indicator in developing teaching materials, as a clear structure can help students understand concepts gradually, moving from simple to more complex. Comics, as a visual teaching material, are also considered capable of presenting information in an engaging and communicative manner, thereby increasing reader engagement in the learning process. Therefore, the results of this study indicate that the comic developed meets the content suitability aspect, particularly in its systematic and logical sequence of material presentation, making it suitable for use as an effective learning medium (Kustandi, C., & Sutjipto, 2016).

Presentation and Display Suitability Aspect

Based on the research results regarding the appropriateness of media presentation and display, it was found that the majority of respondents gave a positive assessment of the comic illustrations and images used in delivering the material. Eighteen respondents strongly agreed, and 12 respondents agreed, that the comic illustrations and images presented were engaging and supported understanding of the material.

These findings indicate that the use of visuals in the form of comics can increase the appeal of learning while also facilitating student comprehension of the concepts presented. Learning media that combine text and images in an engaging manner have been shown to increase attention, learning motivation, and aid cognitive processes in understanding information. This aligns with Richard E. Mayer's opinion that the combination of text and visuals in learning can improve comprehension by helping students integrate information more effectively in working memory (Mayer, 2009)

Research results related to the appropriateness of presentation and appearance indicate that the color selection in comics was deemed comfortable to read by the majority of respondents. Of the 30 respondents involved in the study, 22 strongly agreed and 8 agreed that the colors used in comics provide comfort while reading. These findings indicate that the appropriate use

of color in comic learning media can increase visual comfort, appeal, and help readers better understand the content. Harmonious and non-contrasting colors can facilitate reading and increase student interest in learning. This aligns with expert opinion, stating that visual design, including color selection, is a crucial element in learning media because it can increase attention, motivation, and the effectiveness of message delivery to readers (Arsyad, 2019)

Based on the research findings regarding the appropriateness of presentation and display, respondents found that the comic's page layout was well-organized and unambiguous. Nineteen respondents strongly agreed, while 11 agreed, indicating that the comic's overall appearance met the requirements for readability and visual comfort. A well-organized layout facilitates readers' ability to follow the storyline, understand the message, and enhances engagement with the learning medium.

This aligns with expert opinion, stating that good visual design, including layout, significantly impacts the effectiveness of learning media by helping students understand information in a more systematic and engaging manner. Therefore, the results of this study indicate that the comic's presentation meets the appropriateness criteria in terms of appearance and page structure, thus optimally supporting the learning process (Sudjana, N., & Rivai, 2019).

The results of the study indicate that the comic's presentation and appearance were rated very well by respondents. This is evident from the questionnaire results, which stated that the size and type of font in the comic were easy to read, with 22 respondents choosing the strongly agree category and 8 respondents choosing the agree category. This finding indicates that the use of typography in the comic has been well-designed, making it easier for readers to understand the content of the material presented. Clear font size and appropriate font are important parts of visual learning media because they can improve readability and help students focus more on the information presented. Learning media that has an attractive and easy-to-read appearance has also been shown to increase learning interest and facilitate the process of understanding the material by students (Arsyad, 2019).

The research results showed that the clarity and communicativeness of the dialogue or narrative in the comics' presentation and display aspects received a very positive response from respondents. Of the total respondents, 16 agreed and 14 strongly agreed, indicating that the majority of respondents considered the dialogue or narrative in the comics to be clearly presented, easy to understand, and able to convey the learning message effectively.

The clarity of dialogue and narrative in comics is crucial because it can help readers understand the storyline and message in a more engaging and communicative manner. Comic-based learning media with clear dialogue can also increase reader engagement and facilitate comprehension. This aligns with expert opinion, stating that the use of simple, communicative language that is appropriate to the reader's personality is a crucial indicator of the appropriateness of learning media presentation, ensuring that the message is well received by users(Arsyad, 2017).

Language Aspect

The results of the linguistic research indicate that the language used in the comics is considered easy to understand by respondents. This is evident in the percentage of respondents who strongly agree (53%) and agree (47%), indicating that all respondents gave a positive assessment of the clarity of the language in the comics. These findings indicate that the use of simple, communicative language that is appropriate to the reader's level of understanding can help convey learning messages more effectively. Easy-to-understand language in comics can also increase reading interest and facilitate student comprehension of the material presented. This aligns with Arief S. Sadiman's opinion that learning media that uses simple and

communicative language will be easier for students to understand and can increase learning effectiveness (Sadiman, A. S., Rahardjo, R., Haryono, A., 2014)

The results of the linguistic study indicate that the chemical terms used in the material were deemed well-explained by the majority of respondents. This is evident in the percentage of respondents who strongly agree (57%), followed by agree (30%), and somewhat agree (13%). These findings indicate that the language used in conveying chemical terms is relatively easy for readers or students to understand, thus helping them grasp the chemical concepts presented. Clarity of scientific terminology is a crucial factor in science learning, as precise and systematic language can enhance conceptual understanding and reduce misinterpretations of the material being studied. Therefore, the use of chemical terms accompanied by clear and communicative explanations significantly supports the effectiveness of the learning process (Chiappetta, E. L., & Koballa, 2010).

The results of the linguistic research indicate that the sentences used in the comics do not give rise to multiple interpretations. This is evident in the percentage of respondents who strongly agreed (60%) and agreed (40%). Overall, this indicates that the language used in the comics is clear, simple, and easy to understand for readers. Clarity in the use of sentences in learning media is crucial because it helps students understand the message without creating ambiguity. Communicative language that does not create multiple meanings also supports the effectiveness of comics as a learning medium, particularly in conveying material in an engaging and easy-to-understand manner. The results of this study indicate that the linguistic aspects of the comics meet the criteria for good language use in learning media (Arsyad, 2019)

Based on the research results on the usability and practicality of the media, it was found that the educational comics used in teaching about matter and its changes received a very positive response from students. This was evident in the majority of respondents who strongly agreed (19), followed by 10 who agreed, and 1 who somewhat agreed. These results indicate that educational comics are considered practical and effective in helping to increase students' interest in the material being studied. Comics, which combine elements of images, stories, and dialogue, are able to capture students' attention, making the learning process more enjoyable and easier to understand. This finding aligns with Daryanto's opinion that visually appealing learning media can increase students' motivation and interest in learning because they present information in a simpler and more communicative manner. Furthermore, the use of comics as a learning medium can also facilitate students' understanding of abstract scientific concepts (Daryanto, 2016).

Usability/Practicality Aspect

The results of the study, focusing on the usability/practicality aspect, indicate that the use of comics in learning provides an enjoyable learning experience for students. This is evident from the questionnaire results, which showed that 19 respondents strongly agreed and 11 respondents agreed that comics make the learning process more enjoyable. These findings indicate that comics have a high level of practicality because they create a more engaging and less boring learning environment and help students more easily understand the material presented. Visual media such as comics can also increase motivation and interest in learning because they combine elements of images, stories, and dialogue, making them easier for students to understand. Therefore, the use of comics as a learning medium can be an effective, innovative alternative to improve the quality of the teaching and learning process in the classroom. These results align with previous research that suggests comics can increase student engagement and make learning more engaging and enjoyable (Mayer, 2009).

Based on the research results on the usability or practicality aspect, the majority of respondents stated that comic media can be used independently without additional explanation from the lecturer. This is evident from 19 respondents who chose the category strongly agree,

10 respondents chose agree, and only 1 respondent chose somewhat agree. This finding indicates that comic media has a high level of practicality as a learning medium, because it is able to present material clearly, interestingly, and easily understood by students independently. Comic media that combines visual and text elements can help students understand learning concepts more effectively and increase learning motivation. This is in line with the opinion of Richard E. Mayer who stated that the use of a combination of images and text in learning can improve understanding and facilitate the learning process because information is processed through visual and verbal channels simultaneously. Thus, comic media can be an alternative learning medium that is practical and effective to support students' independent learning process (Mayer, 2009)

The results of the study, focusing on the usability/practicality aspect, indicate that using comics as a learning medium makes it easier for students to remember the concepts of matter and its changes. This is evident from the majority of respondents who gave positive responses: 17 strongly agreed, 11 agreed, and 2 somewhat agreed that comics helped them understand and remember the material. These findings indicate that comics have visual appeal and a storyline that can enhance comprehension and facilitate the process of remembering scientific concepts. The engaging illustrations and narrative presentation of the material make the information easier to understand and retain in students' memories. This aligns with the notion that visual media such as comics can increase learning motivation, support cognitive processes, and facilitate students' understanding of abstract concepts in science learning (Arsyad, 2019).

General Perception of Suitability Aspect

The results of the study, focusing on general perceptions of suitability, indicate that educational comics are considered suitable for use as a learning medium. This is evident in the percentage of respondents who strongly agreed (64%) and agreed (33%). Overall, the majority of respondents gave a positive assessment of the use of educational comics in the learning process. These findings indicate that educational comics can be an effective, engaging, and easily understood medium for students, as they combine visual and narrative elements, which can increase attention and motivation to learn. Comics also help simplify complex material, making it easier for students to understand. These research findings align with the opinion that the use of visual media such as comics in learning can increase student interest in learning, conceptual understanding, and engagement in the learning process (Arsyad, 2017)

The results of the study, focusing on general perceptions of feasibility, showed that the use of comics in chemistry learning received a very positive response from respondents. Sixty-three percent of respondents strongly agreed with the recommendation to use comics as a learning medium for chemistry. These findings indicate that comics are viewed as a viable and effective medium for supporting the learning process because they present material in a more engaging, contextual, and easily understood manner for students. Comics can also increase learning interest, facilitate conceptual understanding, and create a more enjoyable learning environment. Therefore, the high percentage of respondents agreeing indicates that comics have significant potential as an alternative, innovative medium for chemistry learning in the classroom (Sudjana, N., & Rivai, 2019).

The results of the study, focusing on general perceptions of feasibility, indicate that the use of educational comics is considered more effective than the lecture method in helping students understand the topic of matter and its changes. This is evident from the majority of respondents who gave a positive assessment: 60% strongly agreed, 37% agreed, and only 3% somewhat agreed. These findings indicate that educational comics can increase students' interest, motivation, and ease in understanding abstract learning concepts. Comics, as a visual medium combined with a storyline, can help students connect scientific concepts to more concrete

situations, making the learning process more engaging and easier to understand than the lecture method, which tends to be one-way. These results also align with previous research that found that the use of comics in science learning can improve conceptual understanding and student engagement in the learning process (Arsyad, 2017).

Conclusion

Based on the research results, it can be concluded that educational comic media on the material of substances and their changes is considered suitable for use as a learning medium based on the perceptions of chemistry education students. The results of the questionnaire analysis involving 30 respondents showed that most students gave very positive assessments on various assessment aspects, namely the appropriateness of the content, presentation, language, appearance, and aspects of the usefulness or practicality of the media. Educational comics are considered capable of presenting material scientifically, systematically, and relevant to everyday life, making it easier for students to understand abstract chemical concepts. In addition, the illustrations, use of color, layout, and communicative dialogue in comics can increase the appeal, reading comfort, and motivation of students to learn. Comic media is also considered practical to use both in the learning process in the classroom and for independent learning. Educational comic media has great potential as an alternative innovative learning media that can increase interest, understanding of concepts and student involvement in chemistry learning, especially on the material of substances and their changes.

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