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Development of Comics Media to Improve Science Literacy and Concepts Understanding Junior High School Students in Central Halmahera Regency Through Reading Literacy Program

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Abstract: In the era of globalization and information technology that continues to develop, the world of education must be able to adapt to various changes. One very important aspect of the world of education is the use of learning media. This study aims to determine whether the development of learning media in the form of comics based on scientific literacy and students' conceptual understanding developed in this study is suitable for use in the learning process at SMP Negeri 4 Halmahera Tengah through the reading literacy program and to determine whether learning media in the form of comics can improve scientific literacy and students' conceptual understanding at SMP Negeri 4 Halmahera Tengah through the reading literacy program. This research is a type of development research (Research and Development). The data collection technique used in this study is to use five stages, namely the Define Stage, Development Stage, Interview, Observation, and Response Questionnaire. The study's data sources are divided into two parts, namely qualitative and quantitative data. Data analysis techniques in the study used the One-Group Pretest-Posttest Design, T-Test, and N-Gain Test. The study results showed that: 1) Regarding validity, the total percentage of the average value of media and material experts was 96%, categorized as "Very Valid." 2) Practicality is obtained by the total average percentage value of small-scale student responses, resulting in a score of 96%, which is categorized as "Very Practical." 3) Effectiveness is obtained from the T-test with Sig. 0.000, where <0.05 indicates a difference in students' scientific literacy and conceptual understanding before and after using comic media on the material of plant and animal reproductive systems. The N-Gain test obtained an average percentage score of 0.65, categorized as "Moderate." Based on these three results, it can be concluded that the development of comic media to improve scientific literacy and conceptual understanding of junior high school students in Central Halmahera Regency through the reading literacy program can be said to be feasible to be used to improve scientific literacy and conceptual understanding.

Keywords: Comics; Concept Understanding; Development; Science Literacy.

Introduction

Education must adapt to various changes in globalization and ever-evolving information technology. One very important aspect of education is the use of learning media. Learning media is a tool used to convey information from educators to students, which aims to facilitate the learning process and improve learning outcomes. Learning media can convey messages or information from teachers to students, stimulating students' thoughts, feelings, attention, and interests in the learning process. This media can be physical tools or digital technology used in education to clarify information and improve interaction between teachers and students [1].

Learning media can be said to be anything that can be used to convey or channel material from teachers in a planned manner so that students can learn effectively and efficiently [2]. This means that everything that is used must be able to stimulate students' thoughts, feelings, attention, and abilities or process skills so that they can encourage the learning process. Therefore, it can also be explained that learning media is in the form of materials, tools, or techniques used in teaching and learning activities in the classroom with the intention that the process of educational communication interaction between teachers and students can take place scientifically, interactively, effectively, and efficiently.

There are various learning media that teachers can use in the classroom, such as audio media, visual media, audiovisual media, and multimedia. Audio media is a media that only involves the sense of hearing and is only able to manipulate sound capabilities alone. One example of audio media is a radio and a recording media program (*software*). However, this audio media is rarely used by teachers to conduct learning in the classroom. Teachers tend to choose to explain the learning material themselves using visual media.

Based on the evaluation data from the Program for International Student Assessment (PISA) in 2018, Indonesia

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is one of the countries with reading ability ranked 74th out of 79 countries. Meanwhile, Indonesia is ranked 73rd and 71st out of 79 countries for assessing mathematics and science abilities [3]. The PISA survey data shows that students' scientific literacy skills in Indonesia are in the low category. Several factors cause low scientific literacy among students in Indonesia, one of which is students' low understanding of the nature of science. Students have not been able to apply scientific concepts in everyday life. Students are only able to understand science as far as theory. Students cannot read and interpret data in images, diagrams, and tables. Low ability to think critically, reason scientifically, think creatively, and solve problems [4].

A survey conducted by (Political and Economic Risk Consultant) PERC (2015) showed that the quality of education in North Maluku was ranked 29th out of 33 provinces. The data showed that education in North Maluku was not good. Various internal and external factors also influenced the low quality of education in North Maluku. One of the factors causing the low quality of education is reading literacy. Low student literacy can hurt the quality of education. Student literacy skills can be improved through the teaching and learning process in schools by using effective learning media. Implementing a reading literacy program as an alternative step in realizing an increase in student science literacy is important [5].

The concept is an abstraction that involves relationships between concepts (relational concepts) formed by individuals by grouping objects, responding to the objects, and then labelling them (concept by definition) [6]. Bloom's Taxonomy in Anderson (2010) states that comprehension is the ability of students to prove simple relationships between conceptual facts.

Therefore, conceptual understanding is the fruit of a person's or a group of people's thoughts expressed in a definition that produces a product of knowledge. Through generalization and abstract thinking, conceptual understanding is obtained from facts, events, and experiences. Conceptual understanding develops with subsequent experiences in situations, events, treatments, or other activities, whether from reading or direct experience.

Based on the explanation above, the researcher feels it is important to conduct initial data collection to support the problems in the researcher's research. The researcher conducted observations at SMP Negeri 4 Halmahera Tengah to see data on students' scientific literacy and conceptual understanding. Data on students' scientific literacy through the 2023 national assessment data source, which was updated on February 23, 2024, the results of the education report at SMP Negeri 4 Halmahera Tengah showed that students' scientific literacy skills were at the Medium level (with a category of 51.11% of students having achieved minimum competency). Then, the proportion of students with students' scientific literacy skills below the minimum competency was 48.89%. The education report card results show that students' scientific literacy is still low. In the conceptual understanding data that the researcher has obtained, namely from the results of interviews with science teachers, it was obtained that students tend to memorize biological concepts such as in their textbooks so that the ability to analyze, synthesize, and evaluate (think critically) on collections of biological facts and ideas is very low, this is evidenced when the teacher asks students to give examples other than those listed in the textbook, students cannot answer them.

Due to various problems, both the low scientific literacy of students and students' understanding of concepts explained above, the use of learning media is one alternative, in this case, comic media. Comic learning media, as a form of visual art that combines text and images, can be an effective tool in the learning process where teaching will attract more students' attention, teaching materials will be clearer in meaning, teaching methods will be more varied, and students will do more learning activities [7]. Comics in education can help explain complex concepts in a fun and easy-to-understand way.

Research methods

This research is a type of development research (Research and Development). Development research produces certain products and tests the product's effectiveness [8]. To assess the products made by comic media based on scientific literacy and conceptual understanding, this study conducted validation and practicality tests on comic media based on scientific literacy and conceptual knowledge that researchers developed. This research was conducted in Weda Utara District at the SMP Negeri 4 Halmahera Tengah educational unit. This location was chosen because the researcher had conducted a pre-survey before. Then, the researcher found that the area had characteristics and problems suitable for use or research. This research was conducted from September to October 2024.

Researchers use the Thiagarajan (Research and Development) method in the development model, usually called 4-D. This development method has four stages: define, design, development, and dissemination [9] . The stages of explanation are as follows:

Define stage aims to determine and define the learning requirements. This defined stage includes 5 phases: (a) needs analysis, (b) student analysis, (c) task analysis, (d) concept analysis, (e) learning objective analysis. The needs analysis and student analysis phases use interviews and observations, and then the task analysis, concept analysis, and learning objective analysis phases use observation techniques.

The design stage aims to prepare a prototype of learning devices. This stage consists of: a. Prototype design, Data obtained from prototype analysis is used to design a prototype of comic media based on scientific literacy. The activities at this stage include creating a story plot, compiling a framework, comic format, and image/sketch form. Type of writing, use of language, giving a short conversation according to the story idea and the material compiled, and so on. b. Creating a media program outline (GBPM) Contains identification and analysis of the title, objectives, and learning materials outlined in the media

program outline (GBPM). c. Creating *a Storyboard:* The first step to creating a storyboard is to look at learning outcomes by paying attention to learning objectives. After knowing the material, a storyboard table is made consisting of a) the beginning (consisting of the opening), b) story content (in the story content section explaining the storyline, c) images, d) design characteristics (creating color types, font types, and font sizes, e) conversation content about the material. d. Comics and sketches are designed digitally using applications (ibish Paint, procreate, and Adobe Indesign). The next process is determining the story, determining the storyline (arranging scenes, text, and illustrations), creating characters, making rough sketches and compositions, making illustration outlines, coloring, inserting text using easy-to-understand language, and making images. Then, the last stage is editing.

Develop stage (development stage): this stage aims to produce revised learning devices based on expert input. In this stage, there are 3 steps: a) validation of the device by experts, b) simulation, namely the activity of operationalizing the learning plan, and c) limited practicality testing on real students.

Disseminate Stage: This stage involves using devices developed and tested on a limited or narrow scale. At the development stage, a trial was conducted using a pre-experimental design, namely one group (one group pretest-posttest). The pre-experimental design aims to determine the increase in students' scientific literacy skills and conceptual understanding [10].

Data collection techniques in this study include media expert validation sheets, material expert validation sheets, and student and teacher response questionnaires. Media expert validation sheets and material expert sheets are used to see the feasibility of the product being developed. In contrast, student and teacher response questionnaires are used to see the students' and teachers' responses to the product being developed. Validation and response data are used to measure feasibility. The percentage formula used is as follows:

$$\text{Validity Percentage} = \frac{\text{skor yang diperoleh}}{\text{skor maksimal}} \text{x } 100\%$$

The results obtained were interpreted using the following criteria [11]. The following table shows the results of the percentage of practicality interpreted qualitatively [12].

Table 1. Comic validity categories

No	Criteria	Percentage Range (%)
1	Very valid	81-100
2	Valid	61-80
3	Quite valid	41-60
4	Less valid	21-40
5	Invalid	0-20

Table 2. Practicality test scale categories

No	Criteria	Percentage Range (%)
1	Very valid	81-100
2	Valid	61-80
3	Quite valid	41-60
4	Less valid	21-40
5	Invalid	0-20

Limited scale trial results data using gain normality test (N-gain) [13]. The N-Gain score formula used to determine the pre-test and post-test result values shows the level of comic effectiveness. Data on scientific literacy and conceptual understanding were analyzed by comparing pre-test and post-test scores. The N-Gain score formula is as follows:

$$g = \frac{\text{Skor Posttest} - \text{skor pretest}}{\text{Skor maksimal} - \text{skor pretest}} \text{x } 100\%$$

The results of the normalized gain calculation are interpreted in the following table:

Table 3. Grouping Criteria for g Values *(Ng ain)*

Average	Criteria
$g \geq 0.7$	Tall
$0.3 \leq g \leq 0.7$	Currently
$0 < g < 0.3$	Low
$g \leq 0$	Fail

Results and Discussion

This research development model uses the Thiagarajan (Research and Development) method, commonly called 4-D. This development method has four stages: define, design, development, and dissemination. The following are the four stages that the researcher did, namely:

Table 4. Comic Development Results

Stages	Results
Define	At the definition stage, several steps of activities are carried out. This definition stage begins with a needs analysis by conducting interviews with subject teachers, analyzing the flow of learning objectives (ATP), analyzing grade IX science textbooks, and reviewing the media used. The results obtained from this stage are described as follows: 1. Interviews with science teachers, the problems and obstacles in the learning process are (1) minimal use of books as learning resources during learning, (2) lack of use of science learning media in improving science literacy and students' conceptual understanding, (3) The reproduction system of plants and animals is one of the abstract materials so that educators have difficulty in improving science literacy and students' conceptual understanding, (4) comics have not been found and developed specifically to improve science literacy and students' conceptual

	understanding. Meanwhile, in interviews conducted with students, students expressed that the textbooks provided were not interesting, causing a lack of interest in reading science textbooks for students. 2. After analyzing learning devices such as ATP and Class IX Teaching Modules, it was found that the learning devices were based on the independent curriculum. The materials taught also included learning achievements and learning objectives. 3. The media used in schools is in the form of PowerPoint, which is presented with a less attractive appearance. In contrast, PowerPoint displays a lot of writing and is not accompanied by interesting creations. Then, the learning resources available at SMP Negeri 4 Halmahera Tengah are only textbooks that display long texts. The language used is less communicative, so students are lazy to read.
Design	The comic design for the material on plant and animal reproductive systems is as follows: 1. Creating a Media Program Outline (GBPM) This activity contains identification of the program. 2. A storyboard is a description containing a picture of the story from the comic media. Storyboards in the development of comic media are based on scientific literacy and conceptual understanding and consist of plant and animal materials. 3. Design and revise comics on plant and animal reproduction systems material according to input from expert media and material validators.
Development	This stage has the main objective of producing comic media in printed form that has been revised based on input from experts. This stage is carried out in 3 phases: validity, practicality, and effectiveness.
Disseminate	A limited trial was conducted at SMP Negeri 4 Halmahera Tengah in class IX-A with 29 students. From the research data, it can be concluded that the comic learning media based on scientific literacy and conceptual understanding developed by the researcher is very feasible to use with the criteria of being feasible and receiving a positive response from students.

Table 5. Percentage data of average scores of student needs analysis questionnaire results

No.	Question	Average Percentage
1.	Do you like using pictures or illustrations when learning?	100% Yes 0 % No
2.	Do you like reading comics that help explain lessons?	100% Yes 0 % No
3.	Do you like reading books or stories to understand lessons?	100% Yes 0 % No
4.	Would you like to discuss the lesson with your friends to understand more about it?	100% Yes 0 % No
5.	Do you prefer to study alone or with the help of friends or teachers?	100% With friends or teachers 0 % Self-study
6.	What type of learning media do you like the most?	83% of Educational comics 17% Textbooks
7.	Does your teacher only use printed books when teaching?	97% No 3% Yes

Comic validation results

The media expert validators developed consisted of two validators, one of whom was a lecturer of Biology Education at Khairun University. Overall, the average value of the media expert validator was 95 %. The percentage of the average value indicates that the comic is very feasible to be applied in learning activities. The aspects that media experts assess are language effectiveness, communicative language, using interactive dialogue, straightforward, and leading to understanding concepts, actively involving students, relevance of learning with CP and TP, relevance of student-oriented learning, providing learning motivation, creativity and innovation in learning media, image characteristics, story appeal, typography, and display design.

The expert validators of the material developed consisted of two validators; one was a lecturer in Biology Education at Khairun University. Overall, the average value of the expert validators of the material was 96 %. The

percentage of the average value shows that comic material on the reproductive system of plants and animals is very feasible to apply in learning activities. The aspects that the material experts assess are material in the comic is by the textbook and the latest developments, the material in the comic contains applications in real life, the material in the comic is by facts, concepts, principles, and procedures, the material in the comic is presented from abstract to concrete, the nature of science-biology investigations, science-biology as a way of thinking, and the interaction of science-biology, technology, and society. The comic validation results are presented in Table 6.

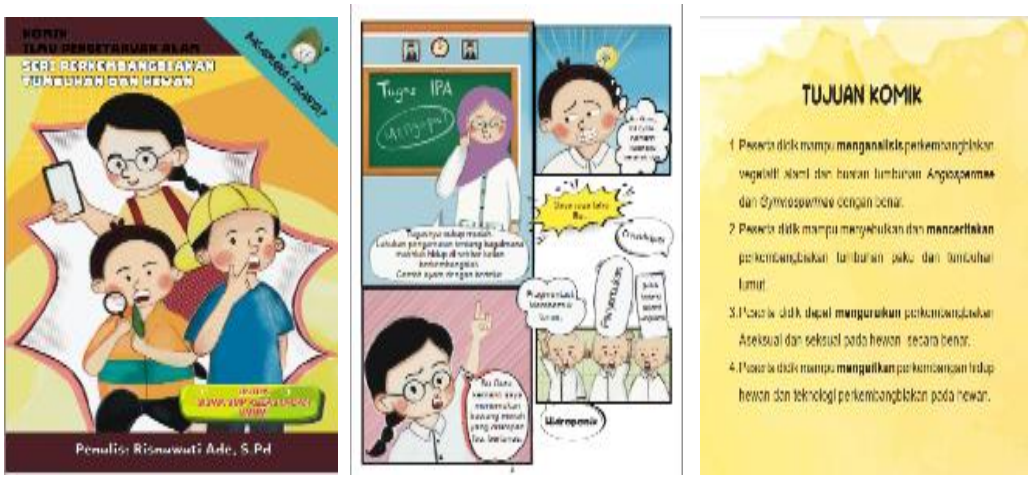
Based on Table 6, it can be seen that the total percentage of validation obtained by media experts and material experts is 96%. It can be categorized as "Very Valid." The categorization of the questionnaire validation results is based on Handayani's opinion, 2021 where the percentage range is 0% - 20% with the invalid category, 21% - 40% with the less valid category, 41% - 60% with the fairly valid category, 61% - 80% with the Valid category, 81% - 100% with the very valid category. This shows that the comic media development product to improve science literacy and students' conceptual understanding in Central Halmahera Regency is valid and suitable for learning. The parts of the revised comic are shown in table 7.

Table 6. Comic Validation Results

Validators	Average Percentage %	Eligibility Criteria
Subject Matter Expert	95 %	Very Worth It
Media Expert	96 %	Very Worth It
Total average	96%	Very Worth It

Table 7. Improvements to the comic

No	Repair
1	Before revision, the title of the plant and animal reproduction series was placed in the upper right corner, and how to do it was in the middle of the comic. After validator 1, a media expert, saw the existing cover display, the validator suggested changing the position of the title of the plant and animal reproduction series to be in the middle of the comic, and how to do it was shifted to the upper right corner so that readers would not be confused with the main title of the comic.
2	The next revision of the comic section contains the display of the comic content section; before the revision of the display of the comic content on page 3, the conversation starter did not mention how plants and animals reproduce in its entirety; after validator 1, a material expert saw the comic content and suggested adding the overall method of plant and animal reproduction.
3	The revised comic content section contains a display of the comic content section; before the revision of the display of the comic content on page iii, the purpose of the comic in point one did not specifically explain the reproduction of the *Angiosperm plants* being analyzed, after the validator 2 media experts saw the purpose of the comic and suggested adding specifically the reproduction of the *Angiosperm plants* being analyzed.
4	The second revised section contains the appearance of the comic content section; before the revision, the appearance of the comic content on page 6 was an example of a picture of an open-seeded plant, namely pine, after the validator 2 media experts saw the contents of the comic and suggested replacing the pine picture with a melinjo picture according to the relevant examples in local wisdom.
5	The next revised comic content contains a display of the comic content section; before the revision, the display of the comic content did not contain an invitation sentence to read; after the validator 2, material experts saw the comic content and suggested adding an invitation sentence for students to read because one of the goals of the comic is for students to be literate in reading.



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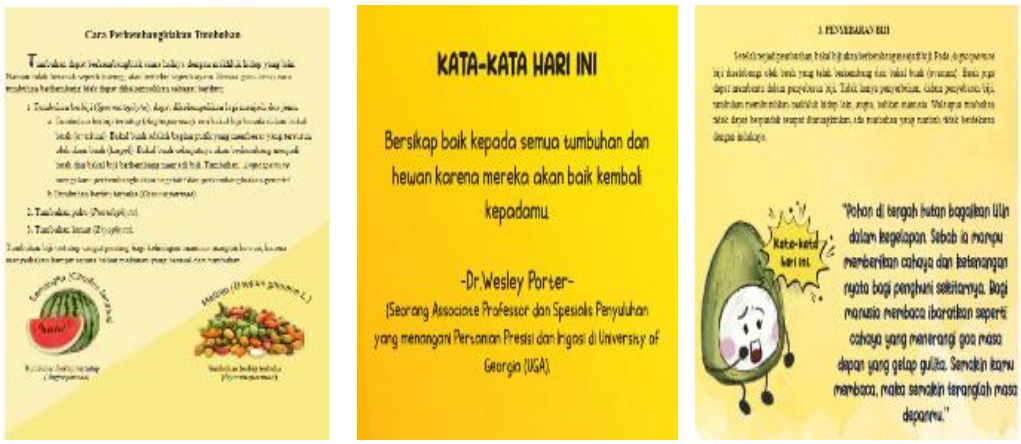

d e

Figure 1. Learning comic after revision

Caption:
1a: Title position fix
1b: Improvement of material content
1c: Comic goal improvement
1d: Improvement of plant examples in comic content
1e: Improvement of invitation/motivation sentences to read
(Source: Personal Documentation, 2024)

Figure 1 below shows the comic cover, comic content, comic purpose, examples of plants in the comic, and sentences inviting reading. After the revision given by validator 1 media expert, the results of the comic improvements are as Figure 1.

Comics of plant and animal reproduction systems to improve scientific literacy and conceptual understanding after being declared valid by the validator. The trial was conducted to determine the responses of students and teachers to the comics of plant and animal reproduction systems to improve scientific literacy and conceptual understanding. The trial was conducted on 29 students of class IX-A and 2 science teachers. The results of the practicality of the comic are presented in Table 8 as follows:

Table 8, presents student and teacher responses at SMP Negeri 4 Halmahera Tengah. Based on the average percentage value obtained, 97%, the comic product is very practical for learning. The following is the pre-test and post-test value data at SMP Negeri 4 Halmahera Tengah, which was obtained based on the activities carried out as follows (Table 9).

Table 8. Practicality of Comics

Respondents	Amount	Score	Percentage %	Category
Teacher	2	97.50	98%	Very Practical
student	29	1.007	96%	Very Practical
Average			97%	Very Practical

Table 9. Pretest and Posttest Value Data

Data	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	29	20.00	85.00	52.06	18.15200
Posttest	29	75.00	100	82.93	7.38208
Valid N (listwise)	29				

Table 10. N-Gain Value Data

	N	Minimum	Maximum	Mean	Std. Deviation
Gain	29	.33	1.00	.6517	.13546
Valid N (listwise)	29				

Table 9 above compares students' pre-test and post-test results in a limited-scale test of 29 students. The average pre-test score was 52, and the average post-test score was 83. It was concluded that students' pre-test and post-test scores increased after implementing learning using comics.

The following data on the results of the N-Gain scores of students at SMP Negeri 4 Halmahera Tengah in Table 10.

Based on Table 10, it can be seen that N-gain shows an average value of 0.6517, which indicates a moderate interpretation by the category if the percentage of N-gain is $0.3 \leq g \leq 0.7$. Thus, the application of comics is quite effective (moderate).

Developing comic products on plant and animal reproduction systems to improve scientific literacy and conceptual understanding using an R&D research design with four stages of development. Stage 1) Define, 2) Design, 3) Development, 4) Disseminate.

Validity is a measure that shows the extent to which a measuring instrument can measure what we want to measure [14]. Media is valid if the analysis results are based on previously determined criteria. Validity criteria for Teaching Modules include construct, language, and technical requirements. The validity of comic media contains aspects that are assessed by media experts, namely language effectiveness, communicative language, using interactive dialogue, straightforward, and leading to conceptual understanding, actively involving students, relevance of learning with CP and TP, relevance of student-oriented learning, providing learning motivation, creativity and innovation in learning media, image characteristics, story appeal, typography, and display design. Meanwhile, aspects that material experts assess are material in comics by textbooks and the latest developments, material in comics contains applications in real life, material in comics by facts, concepts, principles, and procedures, material in comics is presented from abstract to concrete, the nature of science-biology investigations, science-biology as a way of thinking, and the interaction of science-biology, technology, and society. Science literacy-based comic media has met the validity criteria that four validators have assessed.

Description of the validation results of media experts and material experts of comic media based on scientific literacy and conceptual understanding carried out by four validators. The validity of media experts and material experts can be seen in the total percentage of validation of media experts and material experts is 96%. It can be categorized as "Very Valid," the categorization of questionnaire validation results based on opinion (Handayani, 2021) where the percentage range is 0% - 20% with the invalid category, 21% - 40% with the less valid category, 41% - 60% with the fairly valid category, 61% - 80% with the Valid category, 81% - 100% with the very valid category. This shows that the comic media development product to improve scientific literacy and students' conceptual understanding in Central Halmahera Regency is valid and suitable for learning.

The level of media validity is measured from the analysis results according to previously determined criteria. A learning media is valid if the results are by the requirements, meaning the test results align with the criteria. One of the criteria for media that is worthy of being selected is media that is in line with and by the needs of the learning task; in addition, the media is said to be worthy of use if it supports the content of the learning material [15]. The learning media that is developed can be classified as valid because a) the learning media that is developed is by the demands of the curriculum, b) the learning media can motivate students in learning because the learning media that is developed is by the level of development of the students, c) learning activities are focused on students which makes it easier for students to rediscover a concept.

The overall validation results show that the comic media based on scientific literacy and conceptual understanding produced has been tested for quality and has been declared valid by the validator in line with the validation results of the study conducted by Novi Ning Diah (2019), entitled "Development of comic-based learning media in science subjects, circulatory system material for class VIII SMP/MTs" with a very valid category of 90.08%. The validity of the validation results is declared valid because the comic media is designed using aspects of scientific literacy and conceptual understanding so that the development of comic media based on scientific literacy and conceptual understanding can improve students' scientific literacy and conceptual understanding skills, and students can learn independently or collaboratively.

The results of the analysis of student response and teacher response questionnaires on comic media based on scientific literacy and conceptual understanding used in the trial are in the very practical criteria with an average value for students of 96% and teachers of 98%. This means that comic media based on scientific literacy and conceptual understanding can help teachers provide easy explanations for students.

The developed learning media is considered practical because it benefits teachers and students. Some of the benefits provided are (1) the learning media used can foster student enthusiasm in learning plants and animals because students are given a visual display, (2) learning media can facilitate students to make conclusions, (3) detailed and clear teaching modules make it easier for teachers so that preparation is more mature, (4) students become more aware that science is not only theoretical, especially on the topic of plants which have many sub-topics, (5) students are motivated to learn using comic media because they consider it more practical and can be accessed using gadgets and in printed form, (6) the learning atmosphere in the classroom becomes more conducive because students maximize their abilities by discussing in groups [16].

Nieveen shows how to measure practicality [17]. The study results explain that the level of practicality is seen from whether teachers and other experts consider the material easy and can be used by teachers and students. The product resulting from the development is concluded to be practical if: (1) practitioners state that theoretically the product can be applied in the field, (2) the level of product implementation is included in the good category.

The development of comic media based on scientific literacy and conceptual understanding that researchers develop is categorized as very practical because it has met the criteria for the practicality of a product from the analysis of student response questionnaires. The requirements for the practicality of comic media include aspects of interest,

material, and language. The results of the practicality trial with students that researchers conducted can be supported by the results of the practicality of the study conducted by Putri Haria Amzani (2019), entitled "Development of comic media based on scientific literacy for class VIII MTsS Thawalib Tanjung Limau" in the very practical category with an average of 92%.

Test analysis results in T-test obtained Asymp Sig. (2-tailed) of 0.000. Where 0.000 <0.05, this shows a difference between the pre-test before students use comic media on the material of plant and animal reproduction systems and the post-test after students use comic media on the material of plant and animal reproduction systems. While in the N- Gain Test obtained an average of 0.6517 where $0.3 \leq g \leq 0.6517$, which is categorized as " Moderate ". So it can be concluded that "The development of comic media to improve scientific literacy and conceptual understanding of junior high school students in Central Halmahera Regency through the reading literacy program" is declared effective and feasible to be used in improving scientific literacy and students' conceptual understanding.

The absorption of the five human senses varies [18]. Each of the five human senses has its characteristics in learning absorption. A person's learning process using the sense of sight reaches 82%, hearing 11%, touch 3.5%, taste 2.5%, and smell 1%. From here, it can be concluded that the delivery of material by utilizing the sense of sight will produce higher results. If the use of the sense of sight and hearing is combined, the results will be more optimal. The results of the analysis, which were stated to be effective and suitable for use, are in line with the research conducted by Eko Wahyudi (2024) entitled "Development of Integrated Islamic, science, environment, technology, and Society (I-SETS) animated video learning media on plant propagation material to improve the scientific literacy of fourth-grade students at SD NU 16 Rowotengah Sumberbaru Jember" with the "High" N-Gain category of 0.7813, so it is declared effective and suitable for use to improve scientific literacy.
Comics can increase students' interest in reading [19,20]. According to Nurgiyantoro, more than 90% of students are comic readers. This fact shows that comics are one of the most popular reading materials for children and perhaps even college students.

Conclusion

Based on the development of comics based on scientific literacy and conceptual understanding as a learning medium for grade IX students and the discussion of the research results that have been discussed in the previous chapter, it can be concluded that the results of the validation of comic media based on scientific literacy and conceptual understanding are categorized as very valid, with an average of 96%. Meanwhile, the results of the practicality trial in one class showed a percentage of 96% in a very practical category, which means that it has met the criteria for practicality; namely, it can be used and implemented in learning. The effectiveness test results on students before and after using comics show the percentage of the t-test obtained Asymp Sig. (2-tailed) of 0.000, where 0.000 < 0.05, and the N- Gain Test obtained an average of 0.6517 where $0.3 \leq g \leq 0.6517$, which is categorized as " Moderate ". This means that it has met the effectiveness criteria, namely effective and feasible to be used to improve science literacy and students' conceptual understanding.

Author Contributions
Risnawati Ade: conducted an observation at the school, which was used as the research site to obtain information related to problems that were obstacles for students and teachers in the learning process. From the information during the observation, the author conducted research on the development of learning media in the form of comics; the author designed the comics and then tested them by validators and passed the feasibility test, so the comics were tested on class IX-A students at SMP Negeri 4 Halmahera Tengah. The author used the research data obtained to create the article; Arini Z. Nasichah: helped guide, direct and evaluate author one in the process of creating the article; Abdu Mas'ud: assisted in research direction, experimental design and manuscript completion.

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References

[1] YS Siregar, M. Darwis, R. Baroroh, and W. Andriyani, "Increasing Students' Interest in Learning by Using Interesting Learning Media during the Covid 19 Pandemic at HKBP 1 Padang Sidempuan Private Elementary School," *J. Ilm. Kampus Mengajar* , no. 2, pp. 69–75, 2022, doi: 10.56972/jikm.v2i1.33.

[2] Abdul Karim, Dini Savitri, and Hasbullah, "Development of Android-Based Mathematics Learning Media in Grade 4 of Elementary School," *J. Lebesgue J. Ilm. Educ. Mat. Mat. and Stat.* , vol. 1, no. 2, pp. 63–75, 2020, doi: 10.46306/lb.v1i2.17.

[3] L. Hewi and M. Shaleh, "Reflection on PISA (The Programme for International Student Assessment) Results: Improvement Efforts Focus on Early Childhood Education," *J. Golden Age* , vol. 4, no. 01, pp. 30–41, 2020, doi: 10.29408/jga.v4i01.2018.

[4] W. Sopandi, "Socialization and Workshop on Implementation of the RADEC Learning Model for Elementary and Secondary Education Teachers," *Pedagog. J. Educator.* , vol. 8, no. 1, pp. 19–34, 2019, doi: 10.21070/pedagogia.v8i1.1853.

[5] SS Sain, R. Achmad, U. Khairun, and ER Consultant, "Analysis of Students' Science Literacy Skills in Physics Science Learning of Vibration and Wave Concepts Using Discovery Learnin Learning Model," *SAINTIFIK@ J. Pendidik. MIPA* , vol. 7, no. 2, pp. 52–56, 2022, doi:

10.33387/saintifik.v7i2.5499.
[6] M. Danial, T. Gani, and H. Husnaeni, “The influence of learning models and initial abilities on critical thinking skills and conceptual understanding of students,” *J. Educ. Sci. Technol.* , vol. 3, no. 1, p. 18, 2017, doi: 10.26858/est.v3i1.3509.
[7] I. Martha Rusmana and Mila Kurniawarsih, “Development of Mathematics Comic Learning Media for Grade IV Elementary School Students Based on Culture,” *Lebesgue* , vol. 1, no. 1, pp. 39–48, 2020, doi: 10.46306/lb.v1i1.11.
[8] Torang Siregar, "Stages of Research and Development Model Research and Development (R&D)," *DIROSAT J. Educ. Soc. Sci. Humanite.* , vol. 1, no. 4, pp. 142–158, 2023, doi: 10.58355/dirosat.v1i4.48.
[9] TA Putri, U. Tisngati, and L. Erviana, “Development Of Ethnoscience-Contained Comics Media In Science Learning To Improve Students’ Science Literacy Introduction Natural Science (IPA) at elementary school level is one of the subjects that plays an important role in education,” *Dr. Diss. STKIP PGRI Pacitan* , pp. 1–12, 2021.
[10] S. Purnama, “Research and Development Methods (Introduction to Develop Arabic Language Learning Products),” *LITERASI (Journal of Educational Sciences)* , vol. 4, no. 1, p. 19, 2016, doi: 10.21927/literasi.2013.4(1).19-32.
[11] T. Handayani, EW Winarni, and I. Koto, “Development of STEM-Based Digital Comic Media in Improving Students’ Science Literacy Skills,” *J. Learning and Teaching Educator. Basis* , vol. 4, no. 2, pp. 22–29, 2021, doi: 10.33369/dikdas.v4i2.14630.
[12] NM Dwijayani, "Development of ICARE Learning Media," *Kreano, J. Mat. Creative.* , vol. 8, no. 2, pp. 126–132, 2017, doi: 10.15294/kreano.v8i2.10014.
[13] SN Cholifah and D. Novita, “Development of E-LKPD Guided Inquiry-Liveworksheet to Improve Science Literacy in Reaction Rate Factor Sub-Material,” *Chem. Educ. Pract.* , vol. 5, no. 1, pp. 23–34, 2022, doi: 10.29303/cep.v5i1.3280.
[14] M. Fransisca, “Testing the Validity, Practicality, and Effectiveness of E-Learning Media in Vocational High Schools,” *VOLT J. Ilm. Pendidik. Tech. Elektro* , vol. 2, no. 1, p. 17, 2017, doi: 10.30870/volt.v2i1.1091.
[15] AD Fitria, MK Mustami, and AU Taufiq, “Development of Local Potential-Based Image Media in Learning Biodiversity Material in Class X at SMA 1 Pitu Riase, Sidrap Regency,” *Islamic Elementary School Journal* , vol. 4, no. 2, pp. 14–28, 2017, [Online]. Available: http://journal.uin-alauddin.ac.id/index.php/auladuna/article/download/5176/4669
[16] E. Lovisia, F. Firdaus, and A. Amin, “Powtoon-Based Physics Learning Media with a Contextual Approach to Measure the Practicality and Effectiveness of Grade X Students of SMA Muhammadiyah 2 Tugumulyo,” *Sci. Phys. Educ. J. (SPEJ* , vol. 6, no. 2, pp. 79–87, 2023, doi: 10.31539/spej.v6i2.6979.
[17] T. & Roby, “Local Wisdom Theme My Favorite Sub-Theme Likes Sports & Likes Singing And Dancing In Grade I Sdn Utama 1 Tarakan Tiara Adi Pratiwi as a team is to obtain comprehensive and opt-thematic learning,” vol. 6, no. c, pp. 146–161, 2016.
[18] R. Rejeki, MF Adnan, and PS Siregar, “Utilization of Learning Media in Integrated Thematic Learning in Elementary Schools,” *J. Basicedu* , vol. 4, no. 2, pp. 337–343, 2020, doi: 10.31004/basicedu.v4i2.351.
[19] A. F. Alie, M. L. Ilhamdi, and H. H. Saputra, "The effect of the media comic education on science learning outcome," *Jurnal Pijar Mipa*, vol. 16, no. 5, pp. 589-594, 2021. doi: https://doi.org/10.29303/jpm.v16i5.2931
[20] SN Wijaya, A. Johari, and EJ Wicaksana, “Development of Digital Comic Learning Media Based on Indonesian Heroic Characters on Circulatory System Material,” *Didact. Biol. J. Researcher. Educator. Biol.* , vol. 4, no. 2, pp. 67–78, 2020, [Online]. Available: http://jurnal.um-palembang.ac.id/index.php/dikbio