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Microplasmedha Comic: A Supplementary Learning Resource on Environmental Pollution Material to Improve High School Students' Knowledge of Microplastics

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ABSTRACT

The global plastic waste problem has led to the formation of microplastics, which negatively affect the environment and human health. Therefore, education about microplastics is important for high school students to increase environmental awareness and promote sustainable behavior. Although many studies have explored microplastics and related educational approaches, research on the development of comics as a learning media for microplastic education remains limited. This study aimed to develop the Mikroplasmedha comic as a supplementary learning resource on environmental pollution and assess the effectiveness of the comic in supporting student learning. The study employed a Research and Development (R&D) method using the ADDIE model, consisting of the Analysis, Design, Development, Implementation, and Evaluation stages. The results showed that the Mikroplasmedha comic obtained validation scores of 84.1% and 73.3% from media and subject matter experts, respectively, indicating that it was categorized as very valid and valid. Furthermore, the effectiveness test yielded an N-gain score of 0.52, indicating a moderate improvement in students' knowledge of microplastics after reading the comic. In addition the practicality aspect, assessed through student response questionnaires, also showed an average score of 81.9%, which falls into the good category. These findings indicate that the Mikroplasmedha comic is valid and moderately effective as a supplementary learning resource for improving secondary school students' knowledge of microplastics.

1. Introduction

Plastic consumption, which continues to increase in modern society, has become a significant global challenge. According to data from the World Economic Forum in 2023, approximately 350 billion metric tons of plastic waste are generated globally

each year. The high production of plastic waste is closely related to the increasing demand for plastic in daily life due to its durability and affordability (Seifi et al., 2025). Nevertheless, only 7% of plastic waste is recycled, 8% is incinerated, and the remainder is disposed of in landfills (Kalali et al., 2023). Plastic waste in the environment cannot fully decompose but instead fragments into smaller particles measuring less than 5 mm, known as microplastics, as a result of oxidation, temperature exposure, UV radiation, and physical environmental pressure (Isfarin et al., 2024).

Based on their formation process, microplastics are classified into two types: primary microplastics and secondary microplastics (Nel & Froneman, 2015). Primary microplastics are intentionally manufactured for use in cosmetic products, textiles, cleaning agents, and personal care products. In addition, primary microplastics may also originate from the production process or usage of larger plastic materials (Friot & Boucher, 2017). Secondary microplastics are microplastic particles formed through the fragmentation of larger plastic debris as a result of environmental degradation processes, including exposure to temperature variations, sunlight, mechanical forces, and other environmental factors (De Silva et al., 2022; Friot & Boucher, 2017).

Microplastics are contaminants that can cause various adverse effects on both the environment and human health (Friot & Boucher, 2017). In the environment, microplastics can clog root and seed pores, thereby causing stress in plants and inhibiting seed germination as well as plant growth (De Silva et al., 2022; Jia et al., 2023; Oliveri Conti et al., 2020; Zhang et al., 2023). Microplastics accumulated in soil also have the potential to be absorbed into plant tissues. Previous studies have reported the presence of microplastics in fruits and vegetables such as apples, potatoes, and lettuce commonly consumed by humans (Oliveri Conti et al., 2020). In addition to plants, microplastics have also been detected in marine organisms such as fish. The presence of microplastics within the food chain represents one pathway for the accumulation of microplastics in the human body (Isfarin et al., 2024).

Microplastics can enter the human body through the food chain, contaminated drinking water, and air. In vivo studies have identified microplastics in human lungs, blood, and feces, indicating that microplastic exposure has occurred systemically (Winiarska et al., 2024). Long term exposure to microplastics may lead to various health disorders, including lung cancer, asthma, hypersensitivity pneumonitis, intestinal inflammation, fatigue, dizziness, and gut microbiota disorders (Winiarska et al., 2024). Several chemical compounds found in microplastics, such as bisphenol A and phthalates, are toxic and carcinogenic, thereby increasing the risk of cancer and DNA damage in humans (Isfarin et al., 2024).

Due to their numerous harmful impacts, microplastics have become an issue that has attracted considerable attention from researchers over the past decade (Isfarin et al., 2024). Various educational efforts regarding microplastics, ranging from scientific research to social media content, have increasingly been conducted. A

study by Seifi et al (2025) found that mobile application based educational programs were able to improve women's knowledge, attitudes, and practices regarding microplastics. Previous studies (Miraç & Fatoş, 2024; Rahman et al, 2025) have also implemented environmental health education initiatives aimed at enhancing community understanding of the risks posed by microplastics. The results demonstrated that these educational efforts significantly increased public awareness of the potential hazards associated with microplastic exposure.

Despite the growing number of studies and educational campaigns on social media, microplastic education has not yet reached society widely, particularly high school students. To date, many high school students still lack awareness and understanding of microplastics and their impacts on the environment and human health, even though environmental pollution is included in the Phase E curriculum. This finding is consistent with the results of a preliminary study conducted by the researchers. The analysis showed that the average knowledge score of 30 high school students was categorized as moderate, with a score of 14. This result indicates that students conceptual understanding of microplastic issues remains insufficient. Nevertheless, 88.6% of students had previously heard the term "microplastics," and 80% expressed an interest in learning more about the environmental impacts of microplastics.

High school students are an important group to receive education regarding microplastics. Environmental education for high school students plays a crucial role in developing awareness and responsibility toward environmental sustainability in the future (Imran et al., 2024). Environmental awareness introduced during adolescence can foster values and attitudes that encourage active participation in environmental conservation (García-Muñoz et al., 2025). Environmental education among students also contributes significantly to the improvement of environmental citizenship behavior, which is essential for maintaining environmental sustainability. Furthermore, equipping students with environmental knowledge and critical thinking skills enables them to make informed decisions and adopt environmentally responsible behaviors in their daily lives.

The issues described above highlight the urgency of developing innovative educational media about microplastics that can attract students attention and improve their understanding. One educational innovation that can be utilized is presenting information about microplastics through story based media to increase students reading interest. One such media is educational comics. Educational comics are story based reading materials that incorporate learning content and present information in a direct and engaging manner. Comics combine illustrations and narratives, enabling complex scientific concepts to become more concrete and easier to understand (Fabillar et al., 2024). By presenting abstract concepts visually, learning materials can become more accessible to students, potentially leading to better learning outcomes (Fahrul & Hardiansyah, 2025; Khusnunnisa & Andriani, 2025; Oktama & Yulastri, 2026; Septiani et al 2025).

The use of comics as educational media can increase students interest in a topic, improve concentration, and enhance understanding of new information such as

microplastics (Koutníková, 2017). Through visual presentation, educational comics also have the potential to bridge the gap between academic knowledge and its application in real life situations (Fabillar et al., 2024). Due to their enjoyable, light, and adolescent friendly format, comics can serve as effective educational media for microplastic related topics (Koutníková, 2017). Rich visualizations enable comics to accommodate students with visual and kinesthetic learning styles, while textual narratives support verbal learners. Furthermore, comics are effective in attracting students attention, strengthening conceptual understanding, and fostering awareness and positive attitudes toward environmental issues. This study aims to develop the Mikroplasmedha comic as a supplementary learning resource to improve high school students knowledge of microplastics.

2. Methodology

Type of research

The Research and Development (R&D) method using the ADDIE model was applied to develop the Mikroplasmedha comic as a supplementary learning resource for environmental pollution material in Senior High School Phase E. The ADDIE model consists of five stages: analysis, design, development, implementation, and evaluation (Andi Rustandi & Rismayanti, 2021; Cahyadi, 2019; Kurnadi, 2023). The analysis stage included assessing students prior knowledge through a pretest, analyzing the curriculum being implemented, examining the content to be presented, and identifying the need for learning media based on students characteristics. The design stage involved planning the comic concept, creating character illustrations using the IbisPaint, and developing the storyline and learning content presentation using Canva. The development stage included validation by media experts and subject matter experts to ensure the feasibility of the comic. The implementation stage involved asking students to read the comic during their leisure time over a five day period. In addition, this stage included conducting a students response survey and administering a posttest. The evaluation stage was carried out throughout each phase of the development process. The research design is presented in Figure 1.

Research subject

The subjects of this study consisted of 30 Phase E senior high school students, a biology teacher, and validators comprising a material expert and a media expert. The validators in this study met the following criteria, including: (1) Lecturers in the Undergraduate Biology Education program, (2) having at least five years of teaching experience (Mulder et al., 2023), (3) possessing expertise in instructional media and teaching materials for the media expert, and (4) possessing expertise in microplastic-related material for the material expert (Prima & Suhartini, 2026). The criteria for the biology teacher selected in this study included being a Phase E biology teacher who held a bachelor's degree and had at least five years of teaching experience. Meanwhile, the student participants were Phase E students who had studied environmental pollution material. The sample selection was conducted

using random sampling, meaning that there were no specific criteria for selecting student participants.

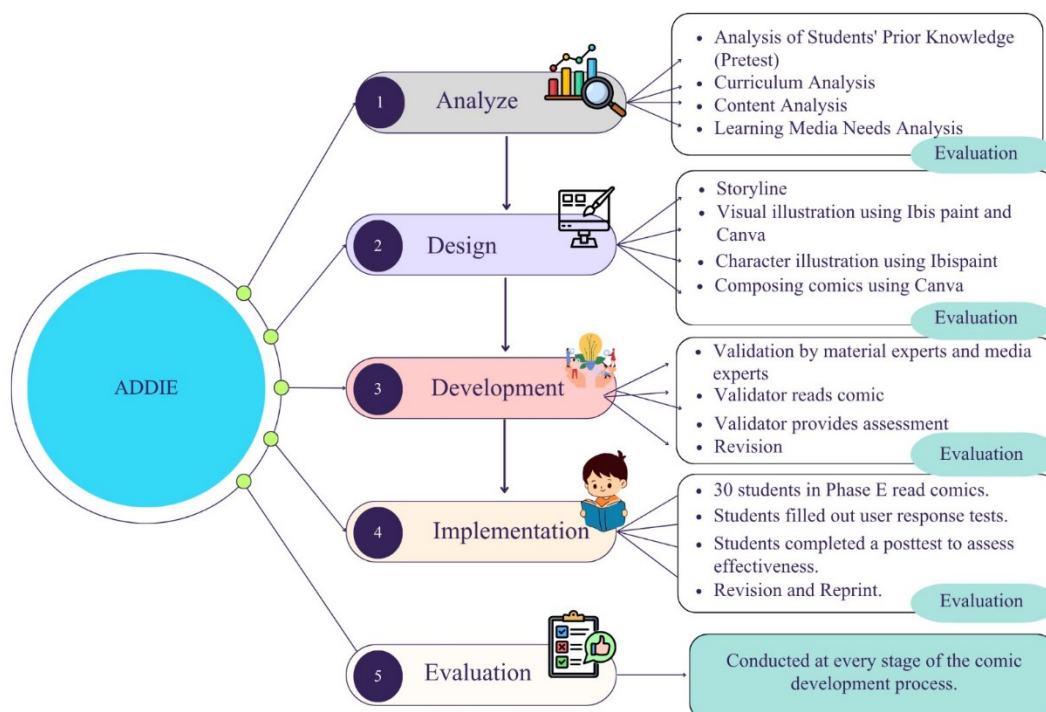


Figure 1. ADDIE Research Design

Data Collection Techniques and Research Instruments

The data collected in this study included students prior knowledge, the implemented curriculum, learning outcomes, microplastic-related materials, media needs, the feasibility of the comic, the practicality of the comic, and the effectiveness of the comic. Data on students prior knowledge were obtained through a pretest administered to Phase E students. Data regarding the implemented curriculum and learning outcomes were obtained through interviews with biology teachers and literature studies. Information regarding media needs was collected through interviews with Phase E biology teachers. The feasibility data of the comic were obtained from validity tests conducted by material experts and media experts. Data collection by the validators was carried out using a comic feasibility assessment sheet with a scoring scale ranging from 1 to 5, where 1 indicated “Not Valid” and 5 indicated “Highly Valid” for each aspect assessed. The practicality test of the comic was measured using student response questionnaires with a scoring scale ranging from 1 to 5, where 1 indicated “Poor” and 5 indicated “Excellent.” The effectiveness test was conducted through pretest and posttest activities completed by students. The instrument used was a questionnaire designed to measure students knowledge of microplastics, which was developed by the research team. The instrument had been validated, with the sig. (2-tailed) values for all 20 items being lower than 0.05 ($0.00 < 0.05$). The developed instrument was also considered

reliable, with a reliability value of $0.818 > 0.6$. Each correct answer was scored 1, while each incorrect answer was scored 0.

Data Analysis Techniques

The data analysis techniques used in this study included descriptive and quantitative analyses. Descriptive analysis was employed to explain the findings obtained from interviews with biology teachers. Meanwhile, quantitative analysis was used to process research data, including the results of material expert and media expert validations, students pretest and posttest scores, and students responses to the Mikroplasmedha comic. The expert validation results were presented using a five point linear scale, where a score of 1 indicated a very poor category and a score of 5 indicated a very good category. The validation scores obtained were then averaged and classified according to the criteria presented in Table 1.

Table 1. Learning Outcome – (Mulder et al., 2023)

Number	Percentage Range	Criteria
1	81 – 100%	Very valid (can be used without revision)
2	61 – 80 %	Valid (can be used with revision)
3	41 – 60%	Less valid (not recommended for use because it requires major revisions)
4	21 – 40%	Invalid (must not be used)
5	0 – 20%	Highly invalid (must not be used)

The average pretest and posttest scores of the students were categorized into levels ranging from very low to very high. The classification of these average scores was based on the criteria presented in Table 2.

Table 2. Student Knowledge Level Criteria

Number	Score	Criteria
1	$X > 20$	Very High
2	$15 < X \leq 20$	High
3	$10 < X \leq 15$	Moderate
4	$5 < X \leq 10$	Low
5	$X \leq 5$	Very Low

Furthermore, the effectiveness of the Mikroplasmedha comic in enhancing students knowledge of microplastics was evaluated using the N-gain test. The categories of knowledge improvement based on the N-gain test results are presented in Table 3.

Table 3. Classification Criteria for n-gain Test Results – (Hake, 1998)

Number	Score	Criteria
1	$0,7 \leq x$	High
2	$0,3 \leq x < 0,7$	Medium
3	$x \leq 0,3$	Low

Students responses to the Mikroplasmedha comic were assessed using a five point linear scale, with a score of 1 representing the very poor category and a score of 5

representing the very good category. The resulting response scores were subsequently averaged and categorized based on the criteria presented in Table 4.

Table 4. Student Response Criteria – (Ningrum & Dahlan, 2023)

Number	Score	Criteria
1	$85\% < X$	Excellent
2	$70\% < X \leq 85\%$	Good
3	$55\% < X \leq 70\%$	Fair
4	$40\% < X \leq 55\%$	Poor
5	$X \leq 40\%$	Very Poor

3. Results and Discussion

Results

Analysis

The analysis stage aimed to identify students prior knowledge, media needs, the curriculum implemented, and the microplastic-related materials to be delivered. Based on the analysis of students prior knowledge through a pre-test, it was found that students knowledge regarding microplastics obtained an average score of 14, which was categorized as moderate. Although the Phase E curriculum includes a chapter on climate change that discusses environmental pollution, microplastics had never been introduced by biology teachers as a pollutant issue. As a result, students did not yet have a proper understanding of microplastic pollution. Based on interviews conducted with biology teachers, it was found that SMA Muhammadiyah 1 Muntilan implements the National Curriculum. The learning objectives targeted by teachers in environmental pollution materials include: 1) students are able to define environmental pollution, 2) students are able to identify types of environmental pollution, 3) students are able to understand the relationship between human activities and environmental pollution, 4) students are able to understand the impacts of environmental pollution, and 5) students are able to formulate mitigation efforts for environmental pollution. Based on these findings and consultations with material experts, the content presented in the developed Microplasmedha comic includes explanations of environmental pollution, the definition of microplastics, types of microplastics, human activities that generate microplastics, the impacts of microplastics, and mitigation efforts to address microplastic-related problems.

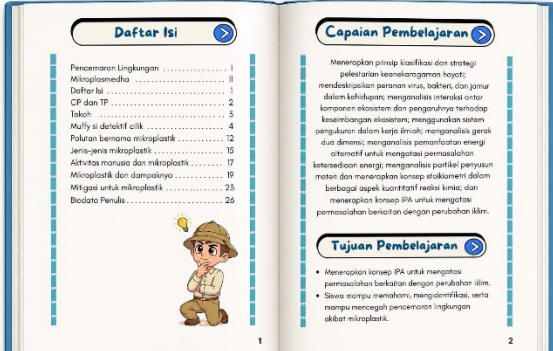
Based on interviews with biology teachers, it was also found that the learning media currently used are still limited to student worksheets (LKPD), either independently prepared by teachers or published by the ministry, as well as textbooks published by the Ministry of Education and Culture. Biology teachers considered comic-based learning media to have an attractive appearance and to be suitable for high school students. However, educational comics had never previously been used as learning media. Therefore, educational comics about microplastics were selected as supplementary learning resources for environmental pollution materials to improve high school students knowledge of microplastics. Comics are considered attractive

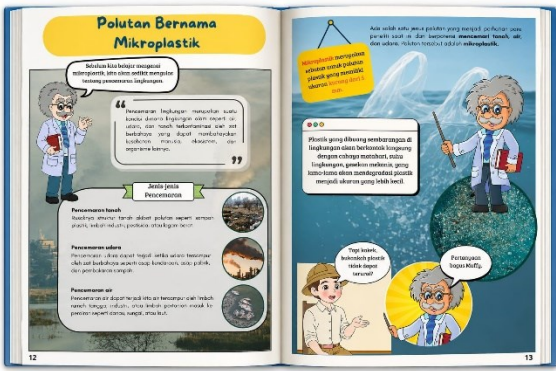
media that can clearly visualize information regarding microplastics. The development of the Mikroplasmedha comic media aims to facilitate students understanding of microplastic pollutants, thereby increasing their awareness of environmental sustainability.

Design

This stage included the planning and design of the product prototype to be developed. Based on the needs analysis conducted previously, an educational comic about microplastics was selected as a supplementary learning media for environmental pollution materials. The objective of this product development was to create a supplementary learning media to improve students' knowledge of microplastics. Comics were chosen as a supplementary learning media because of their attractive appearance, suitability for adolescent characteristics, and ability to accommodate various learning styles, particularly visual and verbal learning styles. The concept of the Mikroplasmedha comic developed in this study is presented in the table 5

Table 5. Concept of Mikroplasmedha Comics

Mikropasmedha Comic Display	Description
	The comic is presented in printed form. The front cover contains the comic's name, title, characters, author's name, and illustrations of microplastic pollution. Meanwhile, the back cover presents the comic synopsis. The backgrounds of both the front and back covers feature plastic waste pollutants to provide essential information related to the topic of microplastic pollution highlighted in this comic.
Front Cover Display	Back Cover Display
	The introductory section of the comic contains information about environmental pollution, which serves as the basis for the discussion of microplastic pollutants. This section also includes an explanation of the name "Mikroplasmedha," the table of contents, and an introduction to the comic characters.

Mikropasmedha Comic Display	Description
	The content section explains the definition of microplastics, the types of microplastics, human activities related to microplastics, the impacts of microplastics, as well as mitigation efforts for microplastic pollution.

Development

The development stage of this study included validation activities conducted by material experts and media experts. Based on the validation results, the Microplasmedha comic was considered feasible for use as a learning media. This was indicated by the average validation scores of 84.1% from the media expert validation and 73.3% from the material expert validation. The results of the media expert and material expert validations are presented in Table 4 and Table 5.

Table 6. Media Expert Validation Result

Number	Aspect	Score	Description
1	Comic media anatomy display	82.5%	Very valid
2	Use of words and language	90%	Very valid
3	Accessibility of the comic media	80%	Valid
Average		84.1%	Very valid

The media expert validation results obtained an average percentage score of 84.1%. This percentage falls into the highly valid category, indicating that the developed product can be used without revision. However, the validators provided several suggestions for minor improvements, such as adjusting the page layout, reducing the number of font types used on the cover, and adjusting the biography photo to prevent it from being cropped.

Table 7. Material Expert Validation Results

Number	Aspect	Score	Description
1	Suitability of CP and ATP	100%	Very valid
2	Accuracy of the material	76.6%	Valid
3	Language use	80%	Valid
4	Presentation of the material	76.6%	Valid
Average		73,3%	Valid

The material expert validation results obtained an average percentage score of 73.3%. This percentage falls into the valid category, indicating that the developed

product can be used with minor revisions. The evaluation aspects related to the material presented in the comic included simplifying the language to better suit the characteristics of high school students, correcting several typographical errors, and revising sentences that extended beyond the dialogue boxes. The revision results based on the comic feasibility assessment can be seen in Table 6.

Table 8. Results of Expert Review

Before revision	After revision	Suggestion
		Minimize the number of fonts on the cover to two font types..
		Adjust the layout of the page numbers, which were originally placed on the inner side of the comic, to the outer side of the comic.



Adjust the photo in the biography section so that it is not cropped.

Implementation

The implementation stage was conducted after the *Microplasmedha* comic was deemed feasible and practical for use. The implementation of the *Microplasmedha* comic as a supplementary learning media for environmental pollution material involved 30 Phase E high school students. The implementation phase was not directly integrated into the ongoing classroom learning process. Following instruction on environmental pollution topics in the classroom, students were assigned to read the *Mikroplasmedha* comic over a five day period, both at school and at home. After completing the comic, students were required to take a posttest and complete a response questionnaire to evaluate their perceptions of the *Mikroplasmedha* comic.

Furthermore, the effectiveness test results obtained through the post-test showed that students achieved an average score of 16, which falls into the “high” category. The differences between the pretest and posttest scores were further analyzed using the N-gain test to assess the extent of students learning improvement after reading the *Microplasmedha* comic. The results showed an N-gain score of 0.52, which falls within the moderate category. This finding indicates that the *Microplasmedha* comic was effective in moderately improving students knowledge of microplastics. Based on the student response results, the *Microplasmedha* comic was categorized as good, indicating that the comic is suitable for classroom use with minor revisions. The required revisions included simplifying several vocabulary terms to better match the characteristics of high school students. The results of the student responses can be seen in the following figure.

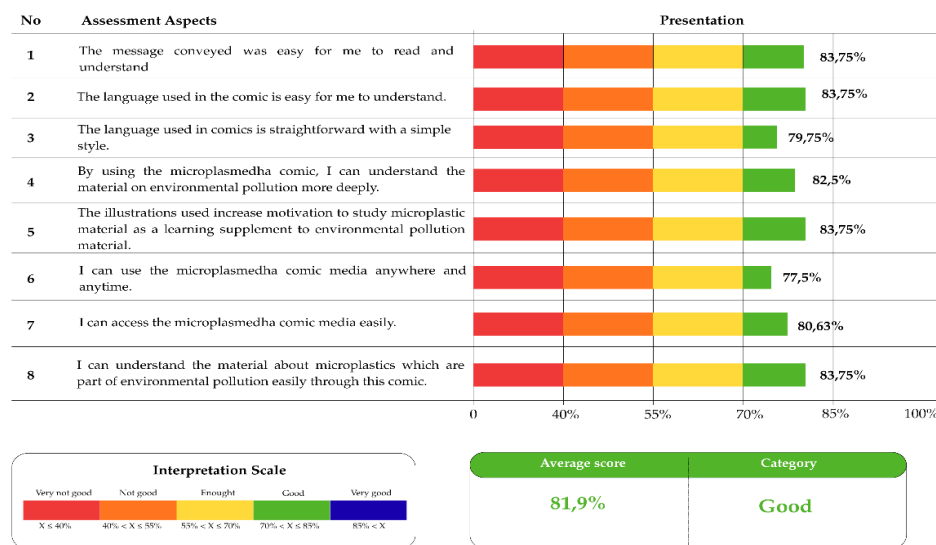


Figure 3. Results of the Student Response Questionnaire

Evaluation

The evaluation stage was conducted at every phase of the development process. The development of the Microplasma comic product could not proceed to the next stage until the evaluation of the previous stage had been completed. This stage aimed to minimize errors and improve the quality of the developed product.

Discussion

Microplastics have become an issue of growing concern among researchers today. Due to their numerous harmful impacts on both human health and the environment, educational efforts regarding microplastics have increasingly been conducted. This study aimed to develop a comic as a supplementary learning resource to improve high school students' knowledge of microplastics. Through comic-based media, it is expected that students interest in learning about microplastics can be enhanced. The information presented in the comic, packaged through illustrations and casual dialogue, is expected to simplify complex information and make it easier for students to understand. Educational comics have also been widely used as learning media that can increase students interest, motivation, creativity, and understanding of particular subjects (Koutníková, 2017).

The use of comics as learning media is considered effective in increasing students learning interest, helping them remember learning materials, and making the learning process more enjoyable (Koutníková, 2017; Muzumdar, 2016). A study conducted by Aryanti (2025), which reviewed 25 developments of comics and e-comics as science learning media, demonstrated that comics provide significant positive impacts on science learning processes. The study revealed that the use of comics successfully improved students' learning outcomes in science education. Similarly, Herdyana (2022) found that comics are suitable as learning media because they effectively enhance student learning outcomes.

Based on the students' responses, the Microplasmedha comic obtained an average score of 81.9%, indicating that it falls within the good category and is practical for use as a learning resource. Students reported that the comic increased their interest in learning about microplastics. They also considered the illustrations to be appropriate and supportive of the information presented. Most students stated that the messages conveyed and the language used in the comic were easy to understand. Furthermore, the majority of students felt that the Microplasmedha comic helped them gain a deeper understanding of environmental pollution, particularly issues related to microplastics. The effectiveness test, measured using the N-gain score based on students' pretest and posttest results, yielded a value of 0.52, indicating a moderate improvement in students' knowledge of microplastics after reading the comic. The improvement in students' knowledge after reading the Microplasmedha comic not only demonstrates the effectiveness of the comic but also indicates its role in helping students understand microplastic concepts. Unlike conventional learning resources, which are generally dominated by text, Microplasmedha integrates information about microplastics into a storyline that is closely related to students' daily lives. The presentation of the material through characters and a well structured narrative helps students understand environmental pollution issues, as well as prevention strategies and solutions to problems caused by microplastic. Innovative learning media that are tailored to students' learning styles and the characteristics of the subject matter have been shown to enhance students' knowledge acquisition and conceptual understanding (Febriyanti & Andriani, 2025).

The visual illustrations, research based images, and contextual case examples effectively represent complex concepts related to microplastics, making them more concrete and accessible for students. The combination of text, dialogue, and visual elements allows students to acquire information more clearly, facilitating comprehension and reducing the likelihood of misconceptions. In addition, the information presented in the Microplasmedha comic is organized sequentially using an investigative approach. Students are not immediately introduced to the concept of microplastics; instead, they are first encouraged to recall their prior knowledge of environmental pollution through cases experienced by the characters in the story. This approach helps students establish connections between their existing knowledge and the new information being learned. As a result, the learning process emphasizes not only the memorization of concepts but also the development of a more meaningful understanding of the sources, impacts, and mitigation efforts related to microplastic pollution.

Based on student response results, the Microplasmedha comic obtained an average score of 81.9%, indicating that the comic falls into the “good” category and is practical to use as a learning resource for students. Students reported that the use of the Microplasmedha comic increased their interest in learning about microplastics. The illustrations used in the comic were also considered appropriate and relevant to the information presented. Most students stated that the messages and language used in the comic were easy to understand. By using the Microplasmedha comic, most students felt that they could understand environmental pollution material more deeply, particularly regarding microplastics.

The Microplasmedha comic serves as a supplementary learning resource for environmental pollution material that can be used anytime. Its use is not limited to classroom learning activities, but can also be utilized during students' leisure time. Therefore, students can independently learn about environmental pollution and microplastics in a more flexible and pressure-free manner. Increasing students knowledge regarding environmental pollution and microplastics is considered a crucial effort in reducing microplastic pollution in the environment. The implementation of mitigation efforts, such as limiting plastic use, imposing plastic bag taxes as practiced in several European countries, and reducing the use of microplastics in cosmetic products, is a result of growing public awareness of the dangers of microplastics (Pillai, 2021). These measures have proven to be relatively effective in reducing the impacts of microplastics on the environment. This demonstrates that knowledge regarding microplastics is essential for implementing sustainable lifestyles. Improving knowledge about microplastics is also one of the efforts to achieve the Sustainable Development Goals (SDGs) (Maurya & Kumar, 2026).

The developed Microplasmedha comic possesses several strengths. Since the comic is produced in printed form, it can be accessed anywhere without dependence on internet access. Furthermore, the printed format, combined with numerous illustrations and images, helps minimize distractions while students are reading the comic. The layout and reading sequence of the dialogue boxes in the Microplasmedha comic are also designed in a simple manner. The dialogue boxes are arranged sequentially from left to right and then downward, with consistent sizes on each page. This arrangement aims to help students who are unfamiliar with reading comics easily follow the storyline. As a supplementary learning resource, the Microplasmedha comic also facilitates independent learning, allowing students to directly engage with information about microplastics and making the learning process more meaningful. However, the developed Microplasmedha comic also has several limitations. Some terms used in the comic may still be unfamiliar to high school students; therefore, language simplification is necessary to make the content easier to understand. In addition, the comic is still presented in a concise format with a relatively simple storyline. Further improvements to the Microplasmedha comic will continue to be carried out to enhance its effectiveness in the learning process. Future studies are also needed to further develop and refine the Microplasmedha comic over time.

4. Conclusion

The conclusion of this study indicates that the development of the Microplasmedha comic as a supplementary learning media for environmental pollution material falls into the valid category for use in the learning process. This finding is supported by the results of material expert validation, media expert validation, student response results, and the effectiveness test that was conducted. The Microplasmedha comic functions as a supplementary learning resource to help students gain a deeper understanding of environmental pollution material and improve their knowledge regarding microplastic pollutants. The visually appealing and engaging comic

design can help students understand the material more easily while also increasing their learning motivation. Improving students' knowledge regarding microplastics is considered one of the important efforts in promoting the implementation of sustainable lifestyles. However, this study has several limitations. The research was conducted using only a control class without involving an experimental class. Therefore, future studies are recommended to include both control and experimental groups in order to provide stronger evidence regarding the effectiveness of the developed learning product.

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