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Development of Eco-Stem-Based Worksheets to Enhance Junior High School Students Scientific Creativity

Maretha Dewi Anggraeni[1], Iwan Wicaksono1[*], and Muhd Ibrahim Muhamad Damanhuri[2]

[1]Science Education Program, Universitas Jember, Jember, Indonesia
[2]Science Education, Sultan Idris Education University, Malaysia
*iwanwicaksono.fkip@unej.ac.id

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Abstract

Technological developments in the 21st century require students to possess critical and creative thinking skills as well as problem-solving abilities, including scientific creativity. However, science learning in schools still tends to be oriented toward rote memorization and the use of teaching materials that lack innovation, so that students' scientific creativity has not developed optimally. Previous studies have developed STEM-based worksheets, but few have integrated Eco-STEM approaches specifically to enhance junior high school students' scientific creativity in science learning. Therefore, this research aims to identify the validity, practicality, and effectiveness of Eco-STEM-based worksheets developed to enhance students' Scientific Creativity. This research applies the ADDIE development model, which consists of five phases: Analyze, Design, Development, Implement, and Evaluate. The participants in this research were seventh-grade students at State Junior High School No. 2 Kalisat. The results of the research indicate that: (1) the average validity percentage of the worksheets reached 91%, placing them in the "highly valid" category and suitable for use in science education; (2) the average practicality percentage was 89%, indicating that the worksheets are highly practical and easy for students to use; (3) the effectiveness test results showed that Eco-STEM-based worksheets were able to improve students' scientific creativity skills with an N-gain value of 0.404, which falls into the moderate category; and (4) the average percentage of student responses was 89%, which is classified as "very good," indicating that the worksheets were effective and received positive feedback from students.

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INTRODUCTION

In the 21st century, advancements in technology and communication have significantly impacted the world of education, especially in the teaching and learning process in schools. Teachers are expected to make effective use of technology to support active, collaborative, creative, and evaluative learning (Riani et al., 2021; Wicaksono & Erlina, 2024). Accordingly, 21st-century learning should not only focus on knowledge acquisition but also encourage students to develop problem-solving, critical thinking, and creative thinking skills that are closely related to real-life issues (Bowen et al., 2022; Mahjatia et al., 2021;

Purwanto et al., 2023; Thornhill-Miller et al., 2023). One of the important competencies that must be developed in science education is scientific creativity. Scientific creativity refers to the ability to generate original scientific ideas, formulate hypotheses, and develop innovative solutions based on scientific knowledge (Aninnas et al., 2022; Wicaksono et al., 2017). This ability is essential because it supports students in developing scientific process skills, scientific reasoning, imaginative thinking, and decision-making abilities in solving science-related problems (Aguilera & Ortiz-Revilla, 2021; Juliastari et al., 2022; Nursiwan et al., 2023; Wicaksono et al., 2020).

However, science learning in schools still tends to emphasize memorization of concepts and procedures rather than developing higher-order thinking skills, particularly scientific creativity (Azmi et al., 2023), resulting in the underdevelopment of higher-order thinking skills, particularly students' scientific creativity. Therefore, considering the importance of scientific creativity in science education and the broader educational landscape, efforts are needed to better prepare future generations to solve problems actively and creatively (Ozkan & Umdu, 2021; Papadopoulou, 2024). Findings from observations and interviews conducted with science teachers at State Junior High School No. 2 Kalisat, students' scientific creativity has not been optimally developed because the learning process still lacks activities that encourage creative and innovative thinking. In addition, the worksheets used in learning generally contain only summaries of materials and practice questions, making learning less engaging for students (Aldiyah, 2021; Irawati & Tri, 2024). As a result, students have limited opportunities to explore ideas, conduct investigations, and solve problems creatively.

Worksheets are important learning tools that can guide students in conducting exploration, experimentation, and problem-solving systematically (Aini et al., 2019; Widodo et al., 2023). However, the worksheets used in schools are generally not designed to develop students' creative and scientific thinking skills (Nopiansyah et al., 2022). Therefore, the development of worksheets requires innovation that not only presents content but also actively engages students in the learning process (Widiyani & Pramudiani, 2021). One approach that can support this objective is STEM, which integrates science, technology, engineering, and mathematics to improve students' critical thinking, creativity, and problem-solving skills (Herak, 2021; Kartika et al., 2025; Rahmawati & Juandi, 2022; Xu & Ouyang, 2022). Furthermore, STEM can be integrated with ecological principles through the Eco-STEM approach, which not only emphasizes interdisciplinary learning but also promotes environmental awareness and social responsibility (Menezes et al., 2022; Muttaqiin, 2023). Through Eco-STEM learning, students are encouraged to observe environmental issues, analyze problems, and design innovative solutions, making learning more contextual and meaningful (Afriani & Sabani, 2025; Fadhila et al., 2024; Rahmayanti et al., 2024; Sumo et al., 2025).

Several previous studies have discussed STEM-based worksheets and Eco-STEM learning approaches. However, studies specifically focusing on the development of Eco-STEM-based worksheets to enhance junior high school students' scientific creativity in science learning are still limited. In addition, most existing worksheets mainly emphasize concept mastery and have not been specifically designed to facilitate students in generating scientific ideas, conducting investigations, and producing innovative solutions. Therefore, this study contributes by developing Eco-STEM-based worksheets specifically designed to enhance students' scientific creativity skills through contextual and environmentally oriented science learning activities.

To implement the Eco-STEM approach optimally, appropriate learning tools are required, one of which is the worksheet (Effendi et al., 2021). Eco-STEM-based worksheets are designed to integrate concepts of science, technology, engineering, and mathematics with environmental issues in learning activities (Menezes et al., 2022). Through these worksheets, students not only grasp the concepts but are also trained to plan and design

experiments, develop creative ideas, and produce simple scientific products (Chalsum et al., 2023; Monyca & Hutahaean, 2024).

In addition, the development of worksheets must consider didactic, design, and technical aspects to ensure that they are feasible and effective for classroom implementation (Hidayat et al., 2023). Well-structured worksheets supported by clear language and engaging visual elements can increase students' interest, participation, and independent learning (Fitria & Simbolon, 2024; Irawati & Tri, 2024; Romadhon et al., 2024). Therefore, this study aims to develop valid, practical, and effective Eco-STEM-based worksheets to enhance junior high school students' scientific creativity in science learning, in line with Novianto et al. (2018) as cited in (Fauzia et al., 2024; Wicaksono & Erlina, 2024).

METHODS

This research utilizes the Research and Development (R&D) approach, which is intended to develop a product and evaluate its feasibility (Wahyuni et al., 2025). This research resulted in the development of Eco-STEM-based student worksheets designed to enhance the scientific creativity of junior high school students. The developed product uses material on substances and their changes, which is part of the seventh-grade first-semester curriculum. According to (Branch, 2009), this research employs the ADDIE development model, which comprises five phases, namely: Analyze, Design, Develop, Implement, and Evaluate. The ADDIE model applied in this rese is illustrated in Figure 1, showing a systematic and iterative process in which each phase is interconnected.

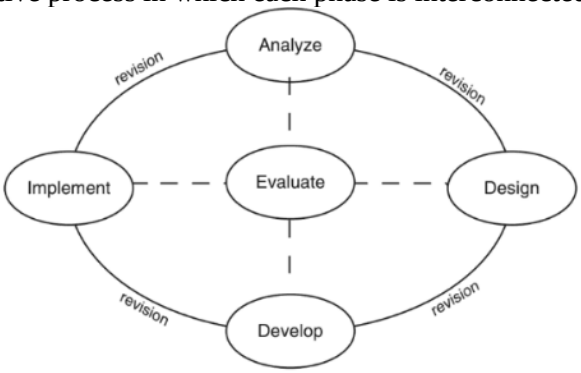

Figure 1 ADDIE Research Procedure (Branch, 2009)

The initial phase, "analyze," involves analyzing the needs for developing Eco-STEM-based worksheets, including curriculum analysis, student characteristics, and learning materials. Next, the "design" phase focuses on designing the detailed structure of the worksheets, including material selection, image references, and Eco-STEM activities that can foster students' scientific creativity. In the "develop" phase, the worksheet is developed according to the planned design. Then, the "implement" phase involves pilot-testing the worksheet with students to observe the learning process and collect data regarding its effectiveness. Finally, the "evaluate" phase is conducted through the completion of a questionnaire to assess the worksheet success in achieving learning objectives and enhancing students' scientific creativity.

Before being implemented in the research, all instruments, including validation sheets, pre-test and post-test questions, practicality observation sheets, and student response questionnaires, were validated by three expert validators in science education and instructional media to ensure content validity and the suitability of the instruments for data collection. Revisions to the instruments were conducted based on the suggestions and feedback provided by the validators. The reliability of the instruments was determined

through the consistency of the validators' assessments, indicating that the instruments were appropriate and reliable for use in the research process.

Validity testing of the developed product was conducted by three validators. The validity score was determined by comparing the total score obtained with the maximum possible score, which was then converted into a percentage. A product can be declared valid if the validity percentage is greater than 60%. The obtained validity scores are then interpreted according to specific categories to facilitate the evaluation of the product's feasibility. The criteria for assessing the validity level are presented in Table 1, which classifies the percentage ranges into four categories: invalid, fairly valid, valid, and highly valid.

Table 1 Interpretation of validity scores

No.	Percentage	Category
1	21-40	Invalid
2	41-60	Fairly Valid
3	61-80	Valid
4	81-100	Highly Valid

Source: Wahyuni & Zulyusri (2023)

The product's practicality test was derived from learning implementation data by calculating the average score for each item based on the number of respondents, which was then converted into a percentage. A product can be considered practical if the validity percentage is greater than 60%. The obtained practicality scores are then interpreted according to specific categories to facilitate the evaluation of the product's usability in the learning process. The criteria for assessing the level of practicality are presented in Table 2, which classifies the percentage ranges into four categories: not practical, fairly practical, practical, and very practical.

Table 2 Interpretation of practicality scores

No.	Percentage	Category
1	21-40	Not Practical
2	41-60	Fairly Practical
3	61-80	Practical
4	81-100	Very Practical

Source: Sartika et al., (2025)

Students' Pre-test and Post-test Results

Student learning test results were obtained by administering pre-tests and post-tests after the use of Eco-STEM-based worksheets. The improvement in students' scores was determined by comparing the difference between pre-test and post-test results relative to the maximum possible score, and then expressed as a normalized gain (N-gain). Once the N-gain scores were obtained, the level of improvement in students' learning outcomes was determined using the N-gain criteria. The N-gain score is then categorized to indicate the effectiveness of the learning intervention. The criteria for interpreting the N-gain scores are presented in Table 3, which classifies the scores into three categories: low, moderate, and high.

Table 3 N-Gain criteria

No.	Percentage	Category
1	$0.0 < N.g \leq 0.3$	Low
2	$0.3 < N.g \leq 0.7$	Moderate
3	$0.7 < N.g \leq 1.0$	High

Source: Safitri et al., (2022)

N-gain analysis was used to determine the improvement in students' scientific creativity before and after the implementation of the Eco-STEM-based worksheets. Additional inferential statistical tests were not conducted because this study focused on product development and preliminary effectiveness testing rather than hypothesis testing.

Student Response

Student response data were collected through questionnaire completion and analyzed by calculating the proportion of students selecting each response relative to the total number of respondents, which was then expressed as a percentage. Once the student response percentage is known, a product can be considered good if the student response percentage is greater than 50%. The obtained percentages are then interpreted using specific criteria to evaluate the overall quality of the product. The student response criteria are presented in Table 4, which classifies the percentage ranges into four categories: very poor, poor, good, and excellent.

Table 4 Student response criteria

No.	Percentage	Category
1	0-25	Very Poor
2	25-50	Poor
3	51-75	Good
4	76-100	Excellent

Source: Safitri et al., (2022)

RESULT AND DISCUSSION

This research produced Eco-STEM-based worksheets. The developed worksheets were implemented in the 7th-grade junior high school science lessons on the topic of Substances and Their Changes.

Analysis Phase

The analysis phase is the initial step in developing Eco-STEM-based worksheets. In this phase, the researchers conducted a review of the subject matter, student characteristics, and the curriculum in use. The student analysis was carried out through interviews with science teachers at State Junior High School No. 2 Kalisat. According to the results of classroom observation interviews, the school rarely employs worksheets in instruction. Lessons typically use the lecture method but are interspersed with other approaches such as Problem-Based Learning (PBL). Furthermore, classroom instruction rarely utilizes methods that foster student creativity, particularly in science education. This indicates that students' ability to think creatively and develop ideas independently remains relatively low.

Subsequently, in the curriculum and material analysis, the researchers conducted brief interviews with the science teachers. The curriculum used is the Merdeka Curriculum. The researchers selected the topic of substances and their changes for the development of the worksheets because it aligns with the learning needs at State Junior High School No. 2 Kalisat and is one of the foundational concepts in science education that is closely related to daily life and easily linked to environmental issues. The ecological aspects integrated into the worksheet include environmental pollution caused by plastic waste, recycling activities, and the impact of physical and chemical changes on the environment. Learning outcomes for this topic are that students can understand the properties and characteristics of substances, as well as physical and chemical changes.

Design Phase

In this phase, the researchers began drafting an Eco-STEM-based worksheet tailored to student needs, the subject matter of substances and their changes, and curriculum

requirements. During the drafting process, the researchers used the Canva application to create the worksheet. The design components of the worksheet can be outlined as follows:

Development of Worksheet Content

The worksheet design includes the topic title, instructions, supporting information, learning activities, research reports, relevant questions and problems, and conclusions presented as engagingly as possible. The Worksheet is created with attention to structure, presentation, and learning activities that can foster students' scientific creativity through the Eco-STEM approach using the topic of matter and its changes. Environmental context is also integrated into activities, such as identifying and analyzing waste problems, and discussing environmentally friendly solutions related to substance change. As presented in Figure 2, the worksheet cover design is developed to be visually appealing and informative, featuring relevant illustrations, clear titles, and a layout that reflects the learning theme, thereby attracting students' attention and supporting their initial engagement with the material.

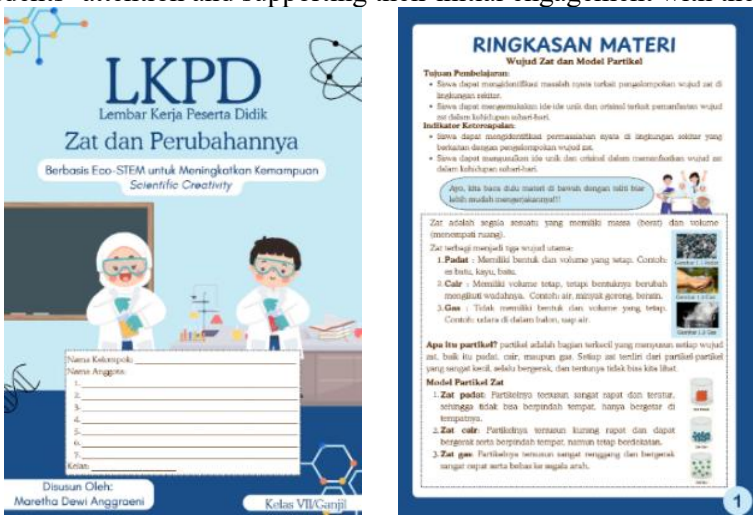

Figure 2 Worksheet cover design

Eco-STEM-based Worksheets provide a clear structure in the learning process so that students can follow activities in a focused and systematic manner. Through these Worksheets, students are guided through the Eco-STEM phases sequentially, starting from understanding scientific concepts, utilizing technology, designing solutions through engineering, and applying mathematics in the context of environmental issues. The advantage of Eco-STEM-based worksheets is that they encourage students to be more active, creative, and directly involved in learning through problem-solving activities related to local environmental issues.

Selection of experimental activities

The selection of experimental activities presented in Figure 3 is designed to align with the learning objectives and the characteristics of the Eco-STEM approach. Each activity is carefully chosen to encourage students' active involvement in observing, investigating, and analyzing phenomena related to matter and its changes. These experimental tasks not only support conceptual understanding but also provide opportunities for students to develop their scientific creativity through hands-on experiences, problem-solving, and critical thinking.

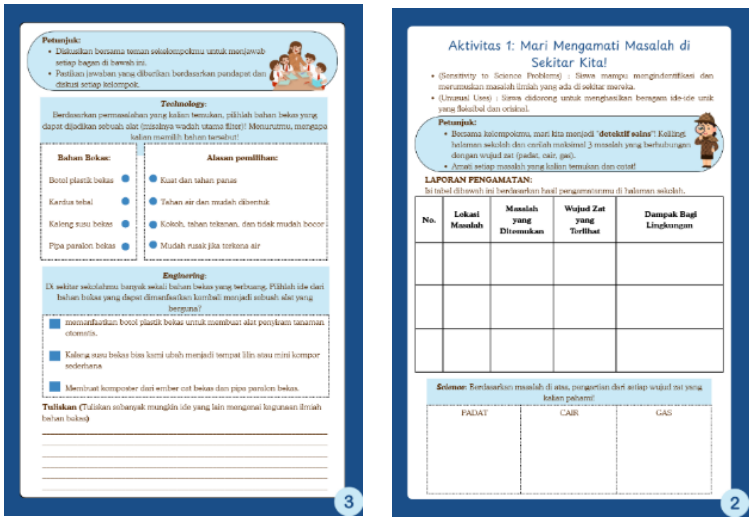

Figure 3 Example of an experimental activity

Activities in Eco-STEM-based worksheets are selected to align with the learning materials students must master, particularly regarding matter and its changes. Activities are designed not only as experiments but also to integrate elements of Science, Technology, Engineering, and Mathematics within a carefully chosen environmental context, enabling students to conduct experiments independently. For example, students analyze the impact of waste materials on environmental pollution and discuss recycling as a solution related to physical and chemical changes.

Development Phase

The initial design of the developed worksheets was then subjected to a validation process by three validators. The results from these three validators were analyzed to obtain an average score and aligned with the predefined validity categories. The validation results for the Eco-STEM-based worksheets are presented in Table 5, which includes the assessment aspects, scores from each validator, the average percentage, and the corresponding validity category.

Table 5 Worksheet validation test results

Assessment Aspects	Validator			Percentage (%)
	1	2	3	
Structure	92	92	96	93
Presentati on	88	88	94	90
Language	89	89	93	90
Total Average				91
Score Criteria				**Highly Valid**

Referring to Table 5, which presents the validators' assessment results, it can be observed that the developed Eco-STEM-based worksheets demonstrate a very high level of validity, with an average score of 91%, and are categorized as "highly valid". This finding indicates that the worksheets are suitable for use in science education. The validators also considered the integration of environmental issues into the learning material to be relevant and supportive of students' understanding of ecological problems in everyday life. This is in line with Wahyuni & Zulyusri (2023), who state that a product can be considered valid if its validity percentage exceeds 60%.

Implementation Phase

The development product, having been declared valid by the validators, was continued to the next phase: the implementation phase. The implementation phase is conducted to apply the revised product—based on the validators' suggestions and feedback—into the actual learning process and to measure the effectiveness of the Eco-STEM-based worksheets in science learning in the classroom. The science learning process using the Eco-STEM-based worksheets took place over 6 sessions with a sample of 33 students from Class VII D. Data on the practicality of the worksheets were obtained from the observations of three observers during each learning session. The results of the feasibility analysis of the Eco-STEM-based worksheet on the topic of matter and its changes are designed to enhance students' scientific creativity. The results of the worksheet usability test are presented in Table 6, which includes the observed aspects, the percentage scores obtained, the overall average, and the corresponding usability categories.

Table 6 Results of the worksheet practicality test

Aspects Observed	Percentage per session (%)
Students opened the worksheets to read and pay attention to the teacher's instructions	96
Students began each activity according to the instructions in the worksheets	83
Students collaborate with one another to complete each activity	98
Students discuss the tables and columns consisting of STEM	83
Each group presents the results of their discussion	86
Total Average	**89**
Score Category	**Very Practical**

Referring to Table 6, which presents the results of the worksheets' practicality test, it can be observed that the developed Eco-STEM-based worksheets fall into the "very practical" category, with an average percentage score of 89%. This is in line with the criteria stating that worksheets are considered very practical if they achieve a score within the range of 80–100% (Nesri & Kristanto, 2020; Novanda et al., 2024). These results indicate that the worksheets are easy for students to use in the learning process.

Evaluation Phase

The last phase in developing the Eco-STEM-based worksheets is the evaluation phase. The evaluation phase is a comprehensive assessment process of the product that has been implemented in learning activities. Effectiveness data were obtained from the administration of pre-tests and post-tests, as well as students' responses to the use of Eco-STEM-based worksheets. In the chapter "Substances and Their Changes," ecological aspects integrated into the worksheets include environmental pollution caused by household waste and plastic, waste recycling processes, and changes in substances related to environmental issues. Students are guided to identify environmental problems around them, such as water pollution from the accumulation of plastic waste, which are then connected to the concepts of physical and chemical changes. The results of the analysis of these two activities are as follows.

Scientific Creativity Skills

The effectiveness of the Eco-STEM-based worksheets is evaluated based on the results of tests conducted before and after their implementation in the learning process. The following presents the results of the average improvement in students' Scientific Creativity skills. As shown in Figure 4, the comparison between pre-test and post-test scores indicates a

noticeable increase in students' performance after using the worksheets, reflecting the positive impact of the Eco-STEM approach on enhancing their scientific creativity.

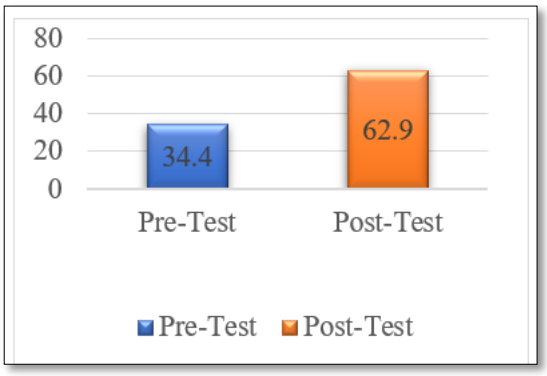

Figure 4 Average pre-post scores

Referring to Figure 4, it can be observed that the students' average scores increased after using the Eco-STEM-based worksheets in classroom learning. The average pre-test score, which was initially 34.4%, increased to 62.9% on the post-test. The results of the N-gain test assessing the effectiveness of the developed product are presented in Table 7, which includes the number of students, the lowest and highest scores, the average scores for both pre-test and post-test, as well as the N-gain value and its corresponding category.

Table 7 Effectiveness of scientific creativity skills

No.	Component	Grade VII D	
		Pre-Test	Post-Test
1	Number of Students	33	33
2	Lowest Score	23	37
3	Highest Value	55	87
4	Average Score	34.4	62.9
N-Gain		**0.404**	
Category		**Moderate**	

The N-gain test results used to assess the effectiveness of the Eco-STEM-based worksheets showed a score of 0.404, which falls into the moderate category. This is in accordance with the criteria stating that an N-gain score is categorized as moderate when it falls within the range of $0.3 < g < 0.7$ (Safitri & Sukardi, 2025). These findings indicate that there was a reasonably significant improvement in students' scientific creativity after the implementation of the Eco-STEM-based worksheets. Subsequently, the data was analyzed again using the N-gain test for each indicator of Scientific Creativity. The results of the N-gain analysis for each indicator are presented in Table 8, which includes the N-gain values and their corresponding categories for each indicator of scientific creativity ability.

Table 8 Results of the achievement of scientific creativity ability indicators

Indicator	N-Gain	Category
Sensitivity to Science Problems	0.89	High
Unusual Uses	0.63	Moderate
Creative Science Product Design	0.20	Low
Creative Experimental	0.21	Low
Scientific Imagination	0.22	Low
Creative Science	0.32	Moderate
Improve a Technical Product	0.42	Moderate

Referring to Table 8, which presents the results of the Scientific Creativity competency indicators, it is evident that the improvement in the competencies of 7th-grade Class D students following the " " lesson using Eco-STEM-based worksheets showed varying levels across each indicator. The "Sensitivity to Science Problems" indicator showed a significant improvement, falling into the high category, which means students are more sensitive to scientific problems. This improvement occurred because students were directly involved in identifying ecological issues related to material changes, such as waste management, environmental pollution, and recycling activities integrated into the learning process. However, several indicators, such as "Creative Science Product Design," "Creative Experimentation," and "Scientific Imagination," fall into the low category, indicating that these competencies still need improvement. Meanwhile, the indicators "Unusual Uses," "Creative Science," and "Improving a Technical Product" are in the moderate category. Overall, the Eco-STEM-based worksheets are effective in enhancing students' scientific creativity, although the improvement is not yet consistent across all indicators.

Student Responses

In addition to being assessed through pre-test and post-test results, the effectiveness of Eco-STEM-based worksheets is also evaluated based on the summary of student response questionnaires. The researchers distributed the questionnaires to elicit positive feedback from students regarding the use of Eco-STEM-based worksheets during classroom learning. The results of the student response questionnaire analysis are presented in Table 9, which shows the percentage score for each assessment aspect, the average score, and the corresponding category.

Table 9 Results of the student response questionnaire analysis

Assessment Aspect	Percentage (%)
Interest	91
Content	86
Language & Interface	90
Average	**89**
Category	**Very Good**

Referring to Table 9, which shows the analysis results of the student response questionnaire, it is evident that students expressed highly positive responses toward the use of Eco-STEM-based worksheets. The total average of 33 student responses regarding the worksheets reached 89%, which falls into the "very good" category. This indicates that the Eco-STEM-based worksheets are both effective and appropriate for use, as they have garnered positive feedback from students. This finding is in line with Novitasari & Admoko, (2022), who state that such results indicate that worksheets are engaging and do not make the learning process monotonous.

Referring to the results of this research, the Eco-STEM-based worksheets received validation scores from experts. The developed worksheets were classified as highly valid, with an average score of 91%. The evaluation covered structural, presentation, and language aspects, all of which received high scores. This indicates that the worksheets meet the criteria for quality in terms of both content and presentation. In addition, the integration of ecological issues into the material "Matters and Their Changes" is considered relevant to students' daily lives, thus enabling students to better understand the relationship between science concepts and environmental issues.

Referring to the results of the practicality test through observations of instructional implementation, the Eco-STEM-based worksheet falls into the "highly practical" category with an average percentage of 89%. These results indicate that all phases of learning within

the worksheet can be effectively carried out by students. Students are able to follow learning activities systematically, actively participate in discussions, experiments, and presentations, ensuring that the learning process proceeds effectively and purposefully in line with the intended objectives. During learning activities, students are also encouraged to analyze environmental issues related to changes in matter and propose simple solutions, such as recycling waste leaf materials in their surrounding environment.

Referring to the effectiveness test results, the Eco-STEM-based worksheets were proven to enhance students' Scientific Creativity skills. This is evidenced by an increase in the average score from 34.4 on the pre-test to 62.9 on the post-test, with an N-gain of 0.4 in the moderate category. Additionally, improvements were observed across various Scientific Creativity indicators, spanning different categories. Student responses to the use of the worksheets were also very positive, with an average approval rate of 89%, indicating that the worksheets are engaging, easy to understand, and optimally support the learning process. The integration of ecological contexts, such as environmental pollution, waste recycling, and the impact of matter changes on the environment, also helped students connect scientific concepts with real-life situations, thereby increasing their engagement and sensitivity toward environmental problems.

CONCLUSION

Referring to the results and discussions, it can be concluded that the Eco-STEM-based worksheets are highly valid, practical, and effective in enhancing students' scientific creativity. The validity aspect achieved an average score of 91% (highly valid), indicating that the worksheets are appropriate for use in science learning. In terms of practicality, the worksheets obtained an average score of 89% (highly practical), showing that they are easy to use during the learning process. Furthermore, their effectiveness is demonstrated by an average N-gain score of 0.4 and a student response rate of 89% (very good), confirming that the worksheets are effective in improving students' scientific creativity.

However, this research has several limitations. First, the research was conducted in only one school and was specifically limited to a single class, which may restrict the generalizability of the findings to broader educational contexts. Second, the duration of the research was relatively short, as the effectiveness of the Eco-STEM-based worksheets was observed only during the implementation period. Therefore, the results may not fully reflect the long-term impact on students' scientific creativity. These limitations suggest that further research involving a wider sample, longer duration, and different subject matter is needed to obtain more comprehensive results

The implications of this research imply that Eco-STEM-based worksheets can be used as an effective and practical learning resource to support science learning and enhance students' scientific creativity. This research also strengthens the use of Eco-STEM approaches in science education. For future research, it is recommended to apply these worksheets in different schools, over a longer period, and across various science topics to examine their broader effectiveness.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS STATEMENT

Conceptualization, MDA and IW; methodology, MDA, IW, and MIMD; formal analysis, MDA; writing—preparation of the original draft, MDA.

AI DISCLOSURE STATEMENT

The author used DeepL during the preparation of this work for language translation and grammar improvement. After using the tool/service, the author thoroughly reviewed and edited the content as needed and takes full responsibility for the content of the publication.

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AUTHOR PROFILES

Name: Maretha Dewi Anggraeni
Email: dewimaretha06@gmail.com
Expertise: Science Education
Affiliation: University of Jember

Name: Iwan Wicaksono
Email: iwanwicaksono.fkip@unej.ac.id
Expertise: Science Education
Affiliation: University of Jember
https://scholar.google.co.id/citations?user=FdCnaLoAAAAJ&hl=id
https://sinta.kemdiktisaintek.go.id/authors/profile/6004343
Orcid : https://orcid.org/0000-0003-0717-1577
Scopus Link: https://www.scopus.com/authid/detail.uri?authorId=57191155659

Name: Muhd Ibrahim Muhamad Damanhuri
Email: muhdibrahim@fsmt.upsi.edu.my
Expertise: chemistry education / science education
Affiliation: Sultan Idris Education University, Malaysia
https://scholar.google.com/citations?user=QCgQPEwAAAAJ&hl=en
Orcid: https://orcid.org/0000-0001-9052-6994
Scopus Link: https://www.scopus.com/authid/detail.uri?authorId=56974516500