Journal of Educational Management and Instruction
ISSN: 2797-8923 (e) I 2797-8931 (p)
2024, Vol. 4, No. 1, page 196-212
https://ejournal.uinsaid.ac.id/index.php/jemin/index

OPEN ACCESS

Developing worksheet-based 7E learning cycle to foster elementary school students' critical and creative thinking skills

Ryzal Perdana[1]* https://orcid.org/0000-0001-6845-1797
Helvi Yanfika[2] https://orcid.org/0000-0003-2960-5081
Ridho Sholehurrohman[3] https://orcid.org/0000-0002-4854-7748
Winda Annisha Bertiliya[1] https://orcid.org/0009-0001-7699-1555

[1]*Faculty of Teacher Training and Education, University of Lampung, Indonesia*
[2]*Faculty of Agriculture, University of Lampung, Indonesia*
[3]*Faculty of Mathematics and Natural Science, University of Lampung, Indonesia*

ABSTRACT

Enhancing students' critical and creative thinking skills is a crucial objective in education. Numerous studies have explored effective teaching methods to foster these skills, with models such as Problem-Based Learning (PBL), the STEM-5E Learning Cycle, and the 7E Learning Cycle showing significant promise. This study aims to develop and validate a worksheet designed to enhance critical and creative thinking in elementary school students using the 7E Learning Cycle, following the ADDIE instructional design model. The study was conducted with fourth-grade students at SDN 1 Pasir Gintung, Lampung province of Indonesia, with two classes serving as the sample: Class IV A as the experimental group and Class IV B as the control group. Product validation indicated a high level of effectiveness, with a material average score of 0.833, a language component score of 0.693, and a media aspect score of 0.917. The test tool, validated as part of the research product, achieved an average score of 0.733. Instructor feedback was overwhelmingly positive, with a 98% approval rate, while student feedback indicated a 94% satisfaction rate, both underscoring the product's practical value. Post-test results from the experimental group demonstrated a significant improvement in critical and creative thinking skills, with an average score of 89.49, markedly higher than the control group. These findings provide empirical evidence supporting the effectiveness of the 7E Learning Cycle in enhancing critical and creative thinking through the use of the developed worksheet in educational settings.

ARTICLE INFO

Keywords:
Elementary School Worksheets; Critical Thinking Skills; Creative Thinking Skills; 7E Learning Cycle

Article History:
Received: 21 July 2024
Revised: 17 August 2024
Accepted: 19 August 2024
Published: 27 August 2024

How to Cite in APA Style:
Perdana, R., Yanfika, H., Sholehurrohman, R. & Bertiliya, W. A. (2024). Developing worksheet-based 7E learning cycle to foster elementary school students' critical and creative thinking skills. *Journal of Educational Management and Instruction*, *4*(1), 196-212.

Introduction

The demands of 21st-century education necessitate the cultivation of human capital capable of thriving in a globalized environment. Quality human capital is characterized by the ability to oversee, utilize, and develop advanced thinking skills (Adilah & Budiharti, 2015). Contemporary educational priorities emphasize enhancing a nation's competitiveness, which hinges not only on the comprehension of concepts but also on the development of critical and creative thinking (CCT) skills (Novianti, 2014). These skills

* Corresponding author: Ryzal Perdana ryzalperdana2009@gmail.com
https://doi.org/10.22515/jemin.v4i1.9659

are indispensable for navigating a rapidly changing world (Tsai, 2013). The progression of the 21st century mandates the emergence of individuals who can consistently engage in critical and creative thought, thereby contributing to national advancement. Moreover, CCT plays a pivotal role in fostering a sustainable future (Mitchell & Walinga, 2017; Baharin et al., 2018). As higher-order thinking skills, CCT is essential in the contemporary educational landscape (Ataizi & Donmez, 2020; Bialik et al., 2015).

The educational sector must keep pace with these developments. Educators, in particular, must innovate by continually refining learning tools to enhance problem-solving quality. One pertinent example of governmental directives in this regard is the emphasis on cultivating students' critical and creative thinking abilities. As Indonesia seeks to equip students with 21st-century skills, including CCT, the government advocates for the development of educational tools that foster these abilities (Mahanal & Zubaidah, 2017). Additionally, the policy of educational decentralization has positively impacted student participation, empowered local governance, and facilitated curriculum adaptation to better meet local needs. This underscores the government's role in crafting policies that support the development of learning tools responsive to both local and global imperatives (Sofiani et al., 2024).

In addition to educators, students must also be agile in adapting to these evolving demands. Enhancing educational quality is achievable when educators introduce innovations in the learning process. Such innovations can be fostered through teaching techniques that empower active student participation. Learning innovation often stems from teachers' efforts to harness their full range of teaching skills and to employ novel strategies, methods, and models (Mitchell & Walinga, 2017).

Effective learning is inherently student-centered, with educators assuming the role of facilitators. In this paradigm, educators employ various tools, including teaching materials, to assist students in grasping the content. These educational materials serve as a medium for educators to effectively convey knowledge to students. The core concept of student-centered learning encompasses the development of students' potential, experiential learning grounded in social realities, the freedom to innovate, and the encouragement of creativity and independence (Adirilany, 2023).

The focus of this research is the development of student worksheets (LKPD), which serve as guides in the learning process, facilitating tasks that include both questions and activities for students (Mitchell & Walinga, 2017). The LKPD designed for this study aims to enhance CCT skills through the Learning Cycle 7E model. Rooted in inquiry-based learning, the Learning Cycle 7E model enables students to construct their own understanding through exploration and elaboration, thereby rendering the learning process more engaging.

The Learning Cycle 7E model consists of seven structured stages—Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend—that are centered on students, ensuring an active learning experience. These stages are designed to foster student engagement, beginning with the elicitation of prior knowledge (Elicit), followed by capturing students' interest (Engage), exploring concepts (Explore), explaining content (Explain), deepening understanding (Elaborate), assessing comprehension (Evaluate), and extending the application of learned concepts (Extend) (Parno, 2024; Shesilya & Aloysius, 2023; Yennita et al., 2023). The 7E model, as a constructivist approach, provides a comprehensive framework for student-centered learning, promoting active participation in the discovery and understanding of concepts.

In the Elicit phase, educators draw out students' prior knowledge, while the Engage phase focuses on capturing their attention. The Explore phase provides students with hands-on experiences, which they then articulate in the Explain phase. During the Elaborate stage, students apply concepts, definitions, and skills to problem-solving scenarios. In the Evaluate phase, educators assess student understanding, and in the Extend phase, students expand their knowledge by exploring applications of learned concepts or relating them to other concepts (Adilah & Budiharti, 2015). The 7E Learning

Cycle model is designed to enhance students' critical thinking, problem-solving, and intellectual abilities (Fajria et al., 2023). This research aspires to reinforce students' CCT skills through the development of LKPD based on the Learning Cycle 7E model. The creation of innovative, creative, effective, and efficient learning models aligned with critical and creative thinking skills is essential for students (Perdana et al., 2019).

Observations and interviews with elementary school teachers in several schools in Bandar Lampung, particularly within the Labuhan Ratu cluster, revealed that they primarily rely on textbooks as teaching materials, which has led to a lack of student engagement and focus (see Table 1). This over-reliance on textbooks results in a passive learning environment, adversely affecting students' CCT skills. They often assign tasks directly from textbooks or create assignments that closely align with the textbook content. However, they have expressed a need for teaching materials that better support the development of students' critical and creative thinking. To address these challenges, innovative solutions are required.

Table 1. Observation results

No.		Aspects observed	Yes	No
1	Introduction	Do educators take attendance, motivate/increase interest in learning?	✓	
		Does the educator explain the learning objectives?	✓	
		Explaining the flow of activities that students will carry out	✓	
2	Core activities	Do educators use learning tools, materials or media?		✓
		Is the material provided appropriate?	✓	
		Motivating students to ask questions		✓
		Act as a facilitator	✓	
		Enable discussion		✓
		Monitoring students' learning difficulties/progress		✓
		Students become active in learning in class		✓
		Students actively ask questions during learning		✓
		Apart from the test book, are there other teaching materials used during learning?		✓
3	Closing	Do students make summaries/notes?		✓
		Do educators give assignments?	✓	
		Do educators do reflection?	✓	

The analysis performed using VOSviewer, as illustrated in Figure 1, reveals a significant correlation between the enhancement of students' creative thinking skills and the implementation of student worksheets within the Learning Cycle framework. This finding underscores a gap in the existing research regarding the in-depth examination of the effectiveness of student worksheets in bolstering students' critical and creative thinking (CCT) skills. Figure 1 highlights the interconnectedness of these elements, suggesting that the integration of student worksheets in educational practices could potentially amplify CCT skills among students. Consequently, there is a clear necessity for further research focused specifically on evaluating the impact of the Learning Cycle-based student worksheets in enhancing CCT skills, to provide empirical support and guide educational strategies.

Given the issues and challenges observed in educational settings, this research aims to fortify CCT skills through the development and application of Student Worksheets (LKPD) based on the Learning Cycle 7E model within elementary schools. The research objectives are threefold: (1) to assess the feasibility of the Learning Cycle 7E-based Student Worksheets (LKPD) through expert validation, ensuring that these tools are

pedagogically sound and aligned with educational standards; (2) to evaluate the practicality of implementing these Student Worksheets (LKPD) in real classroom settings, determining their effectiveness in promoting critical and creative thinking among students; and (3) to measure the overall effectiveness of these worksheets in strengthening CCT skills in elementary school students, providing a comprehensive understanding of their impact on student learning outcomes. The outcomes of this research are expected to contribute significantly to the body of knowledge on educational tools designed to enhance critical and creative thinking in young learners.

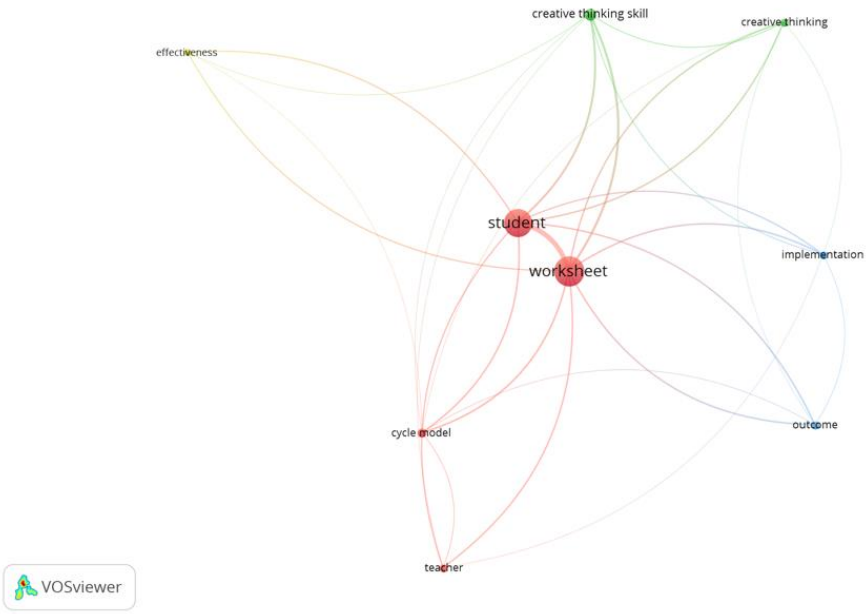


Figure 1. VOSviewer analysis

7E learning model

The 7E learning model is an instructional framework that expands on the well-established 5E model, widely recognized in educational practices, particularly in science education. The 7E model, an acronym for Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend, was developed to provide a more comprehensive structure to guide teaching and learning processes (Balta & Sarac, 2016). The model is designed to facilitate deeper understanding and active student participation by organizing learning into distinct, interconnected phases (Marfilinda et al., 2020). Each phase serves a specific purpose in the learning process: Elicit draws out prior knowledge, Engage stimulates interest, Explore allows hands-on investigation, Explain encourages articulation of understanding, Elaborate extends knowledge through application, Evaluate assesses learning outcomes, and Extend encourages the application of knowledge in new contexts. This structured approach not only helps in the systematic development of students' cognitive skills but also ensures that learning is more engaging and meaningful, promoting retention and deeper understanding of the material (Maskur et al., 2019).

The 7E learning model holds significant potential for enhancing students' critical and creative thinking skills, which are essential for success in the 21st century. Critical thinking involves the ability to analyze information, evaluate evidence, and make reasoned judgments, while creative thinking involves generating innovative ideas and solutions. The 7E model supports the development of these skills by encouraging students to actively engage with content, question assumptions, and explore multiple perspectives (Firdaus et al., 2017). The model's emphasis on hands-on exploration (Explore), followed

by articulation and refinement of ideas (Explain), promotes critical analysis and synthesis of information (Turgut et al., 2017). Moreover, the Elaborate phase, where students apply their knowledge to new situations, fosters creativity by challenging students to think beyond the initial context of their learning (Ilhami & Laksono, 2022). The Extend phase further reinforces creative thinking by encouraging students to make connections between what they have learned and real-world problems (Adam et al., 2022). This comprehensive approach ensures that students are not merely passive recipients of information but active participants in their learning process, equipped with the skills needed to tackle complex challenges both in academic settings and in life.

Numerous studies have demonstrated the positive impact of the 7E learning model on various educational outcomes, particularly in enhancing critical and creative thinking skills. For instance, Parno et al. (2019) found that the implementation of the 7E model in mathematics education significantly improved students' problem-solving abilities, which are closely linked to critical thinking. Similarly, a study by Twiningsih and Retnawati (2023) highlighted that students exposed to the 7E learning cycle demonstrated greater improvements in critical thinking compared to those in traditional learning environments. These findings are supported by Suardana et al. (2018), who noted that the combination of problem-based learning and the 7E model effectively fostered higher-order thinking skills. Moreover, research by Mitchell and Walinga (2017) emphasized the model's role in preparing students for the complexities of the modern world by equipping them with the necessary cognitive tools to innovate and adapt. In the context of Indonesian education, studies have shown that the 7E model aligns well with the government's goals of enhancing educational quality and competitiveness (Mahanal & Zubaidah, 2017). The consistency of these findings across different educational settings underscores the 7E learning model's effectiveness in promoting critical and creative thinking, making it a valuable tool for educators aiming to improve student outcomes and prepare them for the demands of the 21st century.

Method

The present research adopts a Research and Development (R&D) methodology, which is particularly suited to the objective of enhancing elementary students' critical and creative thinking (CCT) skills through the implementation of Student Worksheets based on the Learning Cycle 7E model. The R&D approach is chosen for its systematic and iterative nature, which allows for the creation, refinement, and validation of educational tools in real-world settings. As illustrated in Figure 2, the research follows a five-step process: Analysis, Design, Development, Implementation, and Evaluation.

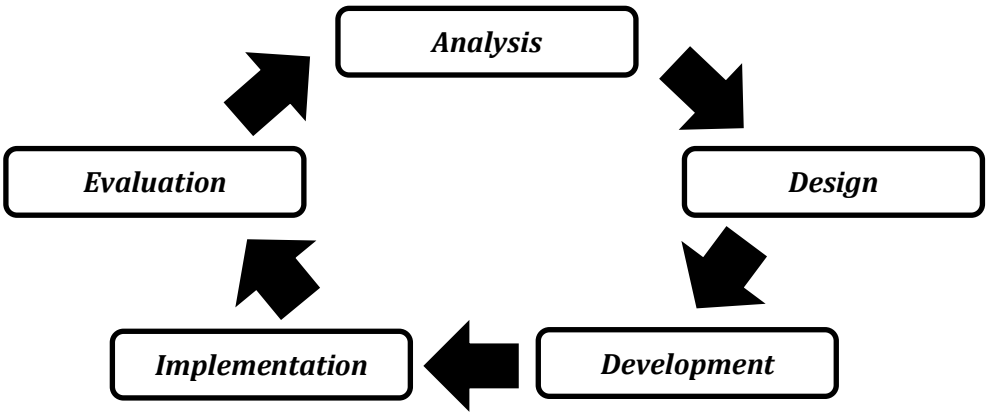


Figure 2. The ADDIE model (Branch, 2009)

Analysis stage

The analysis stage involved identifying needs and gathering various pieces of information related to the product to be developed. This information was collected through a preliminary study that included a comprehensive literature review of relevant journals, articles, books, and previous research findings. This stage set the foundation for understanding the educational context and the specific requirements for the development of the Student Worksheets based on the Learning Cycle 7E model.

Design stage

The design stage followed the analysis and involved synthesizing data from the previous stage with the existing educational modules, curriculum, syllabus, and lesson plans used in schools. This alignment was crucial to ensure that the worksheet being developed was consistent with the KI (Core Competencies) and KD (Basic Competencies) as outlined in the educational standards. The product designed in this research focuses on the development of a worksheet-based on the Learning Cycle 7E model, specifically targeting the instruction of fraction material for fourth-grade students in the first semester.

Development Stage

In the development stage, all the elements prepared during the design phase were integrated to produce the LKPD product based on the Learning Cycle 7E model. This stage also involved validating the product's content, language, and media components through expert assessments. The validation process aimed to ensure the product's relevance and appropriateness before it was tested on students. The validity of the product was determined using expert evaluations, applying the Aiken's V formula to analyze the data:

$$V = \frac{\sum S}{n(c-1)}$$

where V is the Aiken's V index of validity, S ($r–l_0$) is the score set by each validator minus the lowest score, r is the score set by the validator, l_0 is the lowest score in the category used, c is the highest validity assessment score, and n is the number of validators (Anjelina et al., 2023). The Aiken's V scale was used to determine the validity of the test instruments, with the criteria as shown in Table 2.

Table 2. Aiken's criteria eligibility

Scale Range	Classification
0.6 <	Not valid
> 0.6	Valid

Implementation stage

In the implementation stage, the developed product was applied in a classroom setting to assess its practicality. This trial involved a small-scale preliminary test with six teachers and six fourth-grade students from SDN 1 Pasir Gintung, categorized by ability levels (high, medium, and low) based on daily test scores. The implementation included distributing the worksheet based on the Learning Cycle 7E model to the students and collecting their responses through questionnaires. This phase helped measure the practicality of the developed worksheet, which was calculated using the following formula.

$$\%NK = \frac{\sum NK}{NK\ Maksimum} \times 100\%$$

where %NK is the percentage of practical value, $\sum NK$ is the total score obtained by each question item, and NK Max is the maximum total score for each item. The interpretation of the percentage of practical value was based on the criteria in Table 3.

Table 3. Criteria of practicality

Practicality Index	Criteria
75% < NK < 100%	Very Practical
50% < NK <= 75%	Practical
25% <= NK < 50%	Less Practical
0% < NK <= 25%	Very Less Practical

Evaluation stage

The final stage of the ADDIE development model is the evaluation stage, where the effectiveness of the worsheet based on the Learning Cycle 7E model was assessed through broader field trials. These trials involved two classes from SDN 1 Pasir Gintung: Class IV A as the experimental group using the worksheet, and Class IV B as the control group. The evaluation revealed a significant improvement in the critical and creative thinking (CCT) skills of students in the experimental class, thereby demonstrating the efficacy of the worksheet in enhancing CCT skills.

Population and sample

The study's population comprises all fourth-grade students at SDN 1 Pasir Gintung. The sampling method employed is saturation sampling, whereby the entire population is selected as the sample. Specifically, the sample includes all fourth-grade students from SDN 1 Pasir Gintung, with Class IV A designated as the experimental group and Class IV B as the control group. These two groups were chosen for comparison due to the homogeneity of the teachers and students in both classes. In both cases, the teachers relied solely on school-provided textbooks and did not utilize any supplementary teaching materials or aids beyond the classroom blackboard. Additionally, the students in both groups faced difficulties in comprehending the lessons presented in class and exhibited a lack of focus during the learning process, which contributed to less-than-optimal learning outcomes.

Data analysis

First, the item validity in this research is determined using the Product Moment correlation formula with raw scores (Novalia & Syazali, 2014). The validity test is used to determine whether an item is valid or not. The value of $r_{x(y-1)}$ will be compared with the correlation coefficient from the table, r_{tabel}= $r_{(a,n-2)}$. Jika $r_{x(y-1)} \geq r_{tabel}$, the instrument is valid; however, if $r_{x(y-1)} < r_{tabel}$, the instrument is considered invalid. Valid items will be used in the research, while invalid items will be discarded and not used. Second, reliability test was conducted using Cronbach's alpha to determine the correlation level, by using the formula below:

$$r_i = \frac{k}{(k-1)} \left\{1 - \frac{\sum S_i^2}{S_t^2}\right\}$$

Where r_i is the reliability test, k is number of questions, $\sum S_i^2$ is the number of variant scores of each question, and S_t^2 is the total score of variances. The cut of value of the reliability test is 0.60 – 0.80 of each item score (Budi, 2006).

Third, the level of difficulty of the worksheet was also determined. The difficulty level of a question refers to the likelihood that it will be answered correctly by individuals at a certain ability level, which is quantified as an index. This index ranges from 0.00 to

1.00, with higher values indicating that the question is easier. To determine the difficulty level of an essay-type question, this index can be calculated using the following formula:

$$P = \frac{B}{JS}$$

Where P is the difficulty index, B is the number of students who answered questions correctly, and JS is the total number of test participants. The interpretation of the difficulty index used the criteria in Table 4.

Table 4. Difficulty index

Difficulty level index	Criteria
P 0,00 - 0,30	Difficult
P 0,31 – 0,70	Medium
P 0,71 – 1,00	Easy

Last but not least the discrimination power test was also administered to assess the ability of an item or question to differentiate between individuals with high and low levels of the measured trait or ability, thereby ensuring that the item effectively distinguishes between varying levels of proficiency. Conducting a discrimination power test can help teachers assess which students have not mastered the material and which students have. The discrimination index is usually expressed as a comparative measure: the higher the index, the better the question is at distinguishing between students who have mastered the material and those who have not. The formula to calculate the discrimination power of a question is as follows:

$$D = \frac{B_A}{J_A} - \frac{B_B}{J_B} = P_A - P_B$$

Where D is the discriminatory power, B_A is the number of participants in the upper group, B_B is the number of participants in the lower group, J_A is the number of participants in the upper group who answered correctly, J_B is the number of participants in the lower group who answer correctly, P_A is proportion of upper group participants who answered correctly, and P_B is proportion of lower group participants who answered correctly. The criteria used as guideline of distinguishing power (Surapranata, 2009) is presented in Table 5.

Table 5. Question distinguishing power criteria guideline

Distinguishing power index	Criteria
> 0,30	Accepted
0,10 - 0,29	Revised
< 0,10	Rejected

Results

Analysis

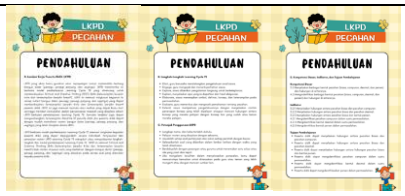
After conducting observations and interviews with teachers at several elementary schools in Bandar Lampung, specifically within the Labuhan Ratu cluster, it was revealed that the teachers predominantly relied on textbooks as the sole teaching material during classroom instruction. This approach has led to a lack of student engagement and focus in the learning process. Ideally, they should utilize a variety of teaching aids to facilitate easier comprehension of the lessons by students. However, the heavy reliance on textbooks has resulted in a passive learning environment, which adversely affects students' critical and creative thinking skills. Teachers tend to assign tasks directly from the textbooks or design assignments that closely follow the textbook content, further

limiting the opportunities for students to engage in more active and critical learning activities.

Design

The product to be developed is a Student Worksheet designed using the 7E learning cycle to enhance students' critical and creative thinking (CCT) skills. The LKPD will include both student and teacher versions, encompassing a cover page, a foreword, an introduction, a concept map, and a series of questions or assignments at the end of the lesson aimed at strengthening students' CCT skills specifically in the topic of fractions. Additionally, an answer key will be provided. The prototype of the worksheet developed in this study is presented in Table 6.

Table 6. Worksheet design based on 7E learning cycle

No.	Appearance		Information
	Teacher	Student	
1			Cover/Cover page
2			Foreword
3			The introduction consists of: student worksheets, 7e learning cycle steps, instructions for using worksheets, basic competencies, indicators and learning objectives
3			Concept maps
5			
6	-		The answer key is on the teacher.

Development

Based on the results from the validation of the worksheets designed with the Learning Cycle 7E model to enhance critical and creative thinking (CCT) skills, specifically for teaching fractions in the fourth grade of elementary school during the first semester, the appropriateness of the developed worksheet was assessed across three dimensions: material, language, and media. The detailed results of the product validation are presented in Table 7.

Table 7. Results of validation

Appropriateness	Average value	Criteria
Material	0.833	Valid
Language	0.693	Valid
Media	0.917	Very Valid

The research findings indicate that the overall validation of the product, based on the average scores provided by each validator across the assessment aspects, yielded the following results. The holistic Aiken index for material validity was 0.833, which is interpreted as "Valid." The linguistic validation produced a holistic Aiken index of 0.693, also interpreted as "Valid." Meanwhile, the validation by media experts resulted in a holistic Aiken index of 0.917, which is considered "Very Valid." Consequently, it can be concluded that the worksheet based on the Learning Cycle 7E model for enhancing students' CCT skills is appropriate for use, albeit with some recommended revisions.

The validation results for the test instruments, specifically the pre-test and post-test questions, were also examined to determine their suitability for this study (see Table 8). According to the validation conducted with the validators, the test instruments designed to assess students' critical and creative thinking skills achieved an average Aiken index of 0.733, which is interpreted as "Valid." This indicates that the instrument is appropriate for measuring students' critical and creative thinking skills.

Table 8. Validation results of pre-test and post-test instruments

No	Assessment Aspect	Aiken Index	Interpretation
1	Pre-test	0,733	Valid
2	Post-test	0,733	Valid
Holistic Aiken Index		0,733	Valid

The results of the validity test for the question items in this study, as outlined in Table 9, indicate that out of the total questions analyzed, 10 items met the validity criteria. These valid questions include numbers 2, 3, 4, 5, 6, 7, 9, 11, 14, and 17. The validity of these questions suggests that they are effective in measuring what they are intended to assess, ensuring that the responses obtained from students will accurately reflect their understanding and abilities in relation to the tested material. On the other hand, 8 questions, specifically numbers 1, 8, 10, 12, 13, 15, 16, and 18, were found to be invalid. This means that these items did not sufficiently meet the criteria to be considered reliable measures for the intended constructs, potentially leading to inaccurate or misleading results if they were to be included in the final assessment. Consequently, the study will need to revise these invalid items to ensure the overall quality of instrument.

Table 9. Result of validity test of question items

Criteria	Question number
Valid	2, 3, 4, 5, 6, 7, 9, 11, 14, 17
Not Valid	1, 8, 10, 12, 13, 15, 16, 18

After completing the validity testing of the questions, the next step in the study was to assess the reliability of the items using a reliability test. The results of this test are presented in Table 10, which shows that the reliability coefficient calculated for the question items is 0.6273817. This coefficient falls within the range of 0.60 to 0.80, which, according to the reliability criteria guidelines, indicates that the test items are considered reliable. Reliability, in this context, refers to the consistency of the test items in measuring what they are intended to measure across different administrations or instances. The coefficient of 0.6273817 suggests that the questions produce stable and consistent results, thereby confirming that the items are suitable for use in further stages of the research. This statistical evidence underscores the dependability of the test, ensuring that the data collected through these questions will be reliable and reflective of the students' actual abilities and understanding.

Table 10. Result of reliability test

Reliability coefficient	**Interpretation**
0,6273817	Reliable

Moreover, the difficulty level test conducted in this study aimed to categorize the test items based on their level of difficulty—whether they are easy, medium, or difficult. The analysis results, as presented in Table 11, indicate that the test items are distributed across all three difficulty categories. Specifically, six questions (numbers 1, 2, 6, 8, 12, and 13) were classified as difficult, suggesting that these items posed significant challenges to the students and were less likely to be answered correctly by the majority. Nine questions (numbers 3, 4, 5, 7, 9, 10, 11, 14, and 15) fell into the medium difficulty category, indicating a balanced level of challenge where these items were neither too easy nor too difficult for the students. Lastly, two questions (numbers 16 and 17) were categorized as easy, meaning that these items were answered correctly by a large number of students, indicating a lower level of difficulty. The distribution of these questions across different difficulty levels ensures a well-rounded assessment, capable of distinguishing between students with varying levels of understanding and mastery of the material. This stratification of difficulty is crucial for identifying the effectiveness of each test item in evaluating student competencies across the spectrum of ability levels.

Table 11. Result of difficulty level test

Difficulty level	**Question number**
Difficult	1, 2, 6, 8, 12, 13
Medium	3, 4, 5, 7, 9, 10, 11, 14, 15, 17
Easy	16, 17

Furthermore, the item discrimination test aims to determine the effectiveness of individual test items in distinguishing between students who have mastered the material and those who have not. This assessment is crucial for educators as it helps to identify students who have a weaker grasp of the subject matter and those who require additional support to achieve mastery. The discrimination index is a quantitative measure, with higher values indicating that a test item is more effective at differentiating between students based on their level of understanding. The results of this discrimination test are detailed in Table 12. From Table 12, it is evident that out of the 18 question items, some were accepted as they demonstrated strong discriminative power (questions 2, 3, 4, 5, 6, 7, 9, 11, 14, and 17). These items are effective at distinguishing between students with varying levels of mastery. However, certain items (questions 3, 8, 13, 16, and 1) were flagged for revision, suggesting that while they have some discriminatory power, they need adjustments to better fulfill this role. Lastly, questions 10, 12, 15, and 18 were rejected due to their inability to effectively differentiate between students who have

mastered the material and those who have not. These results underscore the importance of refining test items to ensure they accurately reflect students' understanding and performance.

Table 12. Result of discrimination index test

Distinguishing power index	Question number
Accepted	2, 3, 4, 5, 6, 7, 9, 11, 14, 17
Revised	3, 8, 13, 16, 1
Rejected	10, 12, 15, 18

Implementation

After the revision process was completed, the research products and instruments were tested with both teachers and students. This testing was conducted to evaluate the practicality of the developed item. The trial was a small-scale pilot test involving six teachers and six fourth-grade students at SDN 1 Pasir Gintung. The student participants were selected to represent a range of abilities, with two students categorized as high, two as medium, and two as low based on their daily test scores. The purpose of including students with varying abilities was to assess the practicality of the product across different levels of student performance. The results of the practicality test, based on the responses from both educators and students, are summarized in Table 13.

Table 13. Result of practicality test

Subject	Percentage	Interpretation
Educator	98%	Very Practical
Learners	94%	Very Practical

Based on the outcomes from the implementation stage, as derived from the responses of both teachers and students using the developed product—specifically, the worksheet based on the Learning Cycle 7E—the results indicated a high level of practicality. The average percentage for the practicality of teacher responses was 98%, which is interpreted as very practical. Similarly, the average percentage for the practicality of student responses was 94%, also classified as very practical. Consequently, the conclusion drawn from this preliminary testing is that the product is highly practical and suitable for advancement to the next stage of research, which involves field testing on a larger scale.

Evaluation

After completing the limited trials, the next phase was the field testing. This field testing was conducted with fourth-grade students at SDN 1 Pasir Gintung, where one class (IV A) served as the experimental group and another class (IV B) as the control group. The objective was to collect data on student learning outcomes following the implementation of the Learning Cycle 7E-based LKPD (Student Worksheets).

Table 14. Recapitulation of test results

Information	Experiment		Control	
	Pre-Test	Post-Test	Pre-Test	Post-Test
Max Score	48	100	43	58
Min Score	35	83	33	38
($\bar{X}$)	40.00	89.09	37.29	44.79
S	3.78	4.85	3.21	5.80

Upon completion of the field testing, a post-test was administered to assess the improvement in students' critical and creative thinking (CCT) skills. The summarized data for both the Pre-Test and Post-Test in this study are presented in Table 14.

The evaluation results demonstrate a significant improvement in the CCT skills of students in the experimental class that used the Learning Cycle 7E-based worksheet. During the pre-test, the experimental class had a maximum score of 48, a minimum score of 35, an average score of 40.00, and a standard deviation of 3.78. After the intervention, the post-test scores improved, with a maximum of 100, a minimum of 83, an average of 89.09, and a standard deviation of 4.85. In contrast, the control class, which did not use the worksheet, had more modest improvements, with a pre-test maximum score of 43, a minimum of 33, an average of 37.29, and a standard deviation of 3.21. The post-test results for the control class showed a maximum score of 58, a minimum of 38, an average of 44.79, and a standard deviation of 5.80. Further analysis of the CCT skills indicators is summarized in Table 15.

Table 15. CCT identification results

No	CCT indicator	Experiment		Control	
		Pre-Test	Post-Test	Pre-Test	Post-Test
1	Sensitivity Problems	42.61	92.05	35.42	38.54
2	Analysis	40.91	89.20	38.54	46.35
3	Inference	35.23	92.05	32.29	43.75
4	Make Elaboration	38.07	88.64	38.54	44.27
5	Evaluation	35.23	90.91	35.42	50.00
6	Novelty	43.18	84.09	40.10	47.92
Mean CCT		39.20	89.49	36.72	45.14

The analysis of the CCT indicators reveals that there has been a marked improvement in all measured areas for students in the experimental group. For example, the Sensitivity to Problems indicator showed a substantial increase from an average of 42.61 in the pre-test to 92.05 in the post-test. Similarly, the Analysis indicator improved from 40.91 to 89.20, and the Inference indicator from 35.23 to 92.05. These increases were consistent across all other indicators as well. The mean CCT score for the experimental group increased from 39.20 in the pre-test to 89.49 in the post-test, demonstrating the significant impact of the LKPD based on the Learning Cycle 7E. In comparison, the control group showed only minor improvements across the same indicators. In conclusion, the field-testing results clearly indicate that the use of the Learning Cycle 7E-based worksheet significantly enhances students' critical and creative thinking skills, as evidenced by the substantial gains in the experimental group compared to the control group.

Discussion

The research conducted aims to enhance students' critical and creative thinking (CCT) skills through the implementation of student worksheets based on the 7E learning cycle. The findings from this study indicate that these worksheets are not only highly valid and practical but also significantly effective in improving students' CCT skills. The validation results affirmed the reliability and appropriateness of the worksheets, which were rigorously tested through small-scale and field trials. These trials demonstrated a notable enhancement in the CCT skills of students who utilized the 7E learning cycle-based worksheets compared to their counterparts in the control class. This significant improvement underscores the potential of the 7E learning cycle in fostering higher-order thinking skills, aligning with previous research that has shown the efficacy of student

worksheets grounded in this model for enhancing critical and creative thinking in mathematics education (Redhana, 2013).

The success of the 7E learning cycle-based worksheets in this study can be attributed to several factors inherent in the learning model itself. The 7E learning cycle, which includes stages such as Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend, provides a structured yet flexible framework that actively involves students in their learning process (Adilah & Budiharti, 2015). This involvement is crucial in developing CCT skills, as it encourages students to engage deeply with the material, explore concepts in depth, and apply their knowledge in various contexts (Baharin et al., 2018). The stages of the 7E learning cycle are designed to build upon each other, progressively leading students from basic understanding to more complex levels of thinking. This progression is essential in fostering critical thinking, as students are required to analyze, evaluate, and synthesize information, which are key components of CCT (Twiningsih & Retnawati, 2023).

Moreover, the effectiveness of the 7E learning cycle in enhancing CCT skills is further supported by its alignment with contemporary educational theories that emphasize the importance of active learning and student-centered approaches. Research has consistently shown that problem-based learning and the use of Socratic questioning are highly effective in promoting critical thinking skills (Sholihah & Amaliyah, 2022). The 7E learning cycle integrates these approaches by encouraging students to question assumptions, explore multiple perspectives, and solve complex problems (Balta & Sarac, 2016). In doing so, it not only enhances their critical thinking abilities but also nurtures creativity by allowing students to generate novel ideas and solutions. This dual focus on critical and creative thinking is particularly relevant in the context of 21st-century education, where students are expected to be adaptable, innovative, and capable of navigating complex challenges (Mitchell & Walinga, 2017).

The role of educators is also pivotal in the successful implementation of the 7E learning cycle-based worksheets. Teachers act as facilitators, guiding students through the learning process and providing the necessary support to help them develop their CCT skills (Perdana et al., 2019). The research highlights the importance of teacher involvement in creating a learning environment that fosters critical thinking through methods such as group discussions and collaborative problem-solving (Suryaningsih & Nurlita, 2021). By encouraging students to articulate their thoughts, ask questions, and engage in dialogue with their peers, teachers help students to deepen their understanding and refine their thinking processes. This interactive approach is crucial in helping students to internalize the learning material and apply it in real-world contexts, thereby enhancing the overall effectiveness of the 7E learning cycle.

Furthermore, the results of this study have important implications for educational policy and practice in Indonesia. As the country strives to improve the quality of its education system and prepare students for global competition, the findings from this research provide valuable insights into the effectiveness of competency-based learning innovations. The successful implementation of 7E learning cycle-based worksheets demonstrates that such innovations can significantly enhance higher-order thinking skills, which are critical for students' success in the 21st century. This aligns with the Indonesian government's efforts to promote educational practices that prioritize critical and creative thinking as key competencies (Mahanal & Zubaidah, 2017). The adoption of the 7E learning cycle in Indonesian classrooms could therefore contribute to the broader goal of improving educational outcomes and ensuring that students are equipped with the skills necessary to thrive in a rapidly changing world.

In conclusion, this research underscores the value of the 7E learning cycle in enhancing students' CCT skills. The findings confirm that the LKPDs based on this model are both valid and practical, with a significant positive impact on students' ability to think critically and creatively. These results are consistent with previous studies and contribute to the growing body of evidence supporting the effectiveness of the 7E learning cycle in

promoting higher-order thinking skills. The implications of this research are far-reaching, suggesting that the 7E learning cycle could play a crucial role in educational reform efforts in Indonesia and beyond. By fostering critical and creative thinking, the 7E learning cycle-based LKPDs not only improve student learning outcomes but also prepare students to meet the demands of the 21st century. This research provides a strong foundation for further studies and the continued development of innovative teaching methods that support the cultivation of essential cognitive skills in students.

Conclusion

This research provides robust empirical evidence supporting the effectiveness of student Worksheets based on the 7E learning cycle in enhancing students' critical and creative thinking skills. The findings indicate that this learning model fosters active student engagement, allowing them to explore concepts deeply and apply their knowledge in diverse real-world contexts. By systematically guiding students through the stages of Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend, the 7E learning cycle promotes a comprehensive understanding of subject matter while simultaneously developing higher-order thinking skills. The successful implementation of this model in the study suggests that worksheets based on the 7E learning cycle hold significant potential for widespread adoption in educational settings. This could lead to a substantial improvement in the quality of learning, better equipping students to meet the complex challenges of the 21st century.

However, despite the positive outcomes, this research also has certain limitations that should be acknowledged. The study was conducted within a limited geographical area and focused on a specific grade level, which may limit the generalizability of the results. Additionally, the study primarily relied on quantitative methods, which, while useful for measuring specific outcomes, may not fully capture the nuances of students' learning experiences and cognitive development. Future research could benefit from a more diverse sample, including different age groups and educational contexts, as well as the integration of qualitative methods to provide a more holistic understanding of the impact of the 7E learning cycle on student learning. Moreover, practical implementation of this model on a larger scale would require adequate teacher training and support to ensure effective application in diverse classroom settings. These considerations are crucial for refining the approach and ensuring that the potential benefits of the 7E learning cycle can be realized across a broader spectrum of educational environments.

References

Adam, U. A., Lameed, S., & Ayodele, B. B. (2022). Attaining meaningful learning of ecological concept: a test of the efficacy of 7E learning cycle model. *GPH-International Journal of Educational Research*, *5*(04), 18-29. https://doi.org/10.5281/zenodo.6790327

Adilah, D. N., & Budiharti, R. (2015). Model Learning Cycle 7E Dalam Pembelajaran IPA Terpadu. *Prosiding Seminar Nasional Fisika Dan Pendidikan Fisika (SNFPF) Ke-6*, *6*, 212–217.

Adirilany. (2023). Pengawasan Pembelajaran yang Berpusat pada Siswa di Era Society5.0. *Proceedings Series of Educational Studies*, *1*(1), 359–367. https://doi.org/10.17977/um083.7903

Anjelina, Y., Supriadi, S., Musril, H. A., & Okra, R. (2023). Pengembangan Media Promosi Lembaga Pendidikan Menggunakan Papan Informasi Digital di MAN 1 Padangsidimpuan. *ANTHOR: Education and Learning Journal*, *2*(3), 363–371. https://doi.org/10.31004/anthor.v2i3.148

Ataizi, M., & Donmez, M. (2020). Book Review: 21st Century Skills - Learning for Life in

Our Times. *Contemporary Educational Technology*, *5*(3), 272–274. https://doi.org/10.30935/cedtech/6129

Baharin, N., Kamarudin, N., & Manaf, U. K. A. (2018). Integrating STEM Education Approach in Enhancing Higher Order Thinking Skills. *International Journal of Academic Research in Business and Social Sciences*, *8*(7), 810–821. https://doi.org/10.6007/ijarbss/v8-i7/4421

Balta, N., & Sarac, H. (2016). The effect of 7E learning cycle on learning in science teaching: A meta-analysis study. *European Journal of Educational Research*, *5*(2), 61-72. https://doi.org/10.12973/eu-jer.5.2.61

Bialik, M., Fadel, C., Trilling, B., Nilsson, P., & Groff, J. (2015). 21st Century Skills: What should students learn? *Center for Curriculum Redesign*, *1*(1), 1–129. https://curriculumredesign.org/wp-content/uploads/CCR-Skills_FINAL_June2015.pdf

Branch, R. M. (2009). Instructional Design: The ADDIE Approach. In *Instructional Design: The ADDIE Approach* (New York). Springer. https://doi.org/10.1007/978-0-387-09506-6

Budi, T. P. (2006). *SPSS 13.0 Terapan: Riset Statistik Parametrik.* Yogyakarta: Andioffse.

Fajria, I., Putri, D. H., & Setiawan, I. (2023). Pengembangan Lembar Kerja Peserta Didik (Lkpd) Kinematika Gerak Lurus Pada Sma Menggunakan Learning Cycle 7E Untuk Melatihkan Keterampilan Berpikir Kritis Siswa. *Amplitudo : Jurnal Ilmu Dan Pembelajaran Fisika*, *2*(2), 151–160. https://ejournal.unib.ac.id/jipf/article/view/18833

Firdaus, F., Priatna, N., & Suhendra, S. (2017, September). An implementation of 7E learning cycle model to improve student self-esteem. In *Journal of Physics: Conference Series* (Vol. 895, No. 1, p. 012084). IOP Publishing. https://doi.org/10.1088/1742-6596/895/1/012084

Ilhami, R., & Laksono, E. W. (2022). 7E Learning Cycle Model Implementation: Students' Activities and Critical Thinking Skills towards Online Learning. *Universal Journal of Educational Research*, *10*(5), 311-317. https://doi.org/10.12189/ujer.2022.100501

Mahanal, S., & Zubaidah, S. (2017). Model Pembelajaran Ricosre Yang Berpotensi Memberdayakan Keterampilan Berpikir Kreatif. *JUrnal Pendidikan*, *2*(5), 676–685. http://journal.um.ac.id/index.php/jptpp/

Marfilinda, R., Rossa, R., Jendriadi, J., & Apfani, S. (2020). The effect of 7e learning cycle model toward students' learning outcome of basic science concept. *Journal of teaching and learning in Elementary Education*, *3*(1), 77-87. http://dx.doi.org/10.33578/jtlee.v3i1.7826

Maskur, R., Latifah, S., Pricilia, A., Walid, A., & Ravanis, K. (2019). The 7E learning cycle approach to understand thermal phenomena. *Jurnal Pendidikan IPA Indonesia*, *8*(4), 464-474. https://doi.org/10.15294/jpii.v8i4.20425

Mitchell, I. K., & Walinga, J. (2017). The Creative Imperative: The Role of Creativity, Creative Problem Solving and Insight as Key Drivers for Sustainability. *Journal of Cleaner Production*, *140*, 1872–1884. https://doi.org/10.1016/j.jclepro.2016.09.162

Novalia, & Syazali, M. (2014). *Olah Data Penelitian Pendidikan*. Lampung: Anugrah Utama Raharja (AURA).

Novianti, A. (2014). Pengaruh Model Pembelajaran Learning Cycle Terhadap Keterampilan Berpikir Kritis Siswa. *Edusains*, *6*(1), 109–116. https://doi.org/10.33394/bioscientist.v12i1.9992

Parno, E. S., Yuliati, L., Widarti, A. N., Ali, M., & Azizah, U. (2019). The influence of STEM-based 7E learning cycle on students critical and creative thinking skills in physics. *International Journal of Recent Technology and Engineering (IJRTE)*, *8*(2), 761-769. https://doi.org/10.35940/iirte.B1158.0985S919

Parno, Putri, M. K., Munfaridah, N., Khusaini, Fitri, N., & Ali, M. (2024). Exploration of

Students' Scientific Literacy in Work and Energy Through STEM-based 7E Learning Cycle with Formative Assessment. *Journal of Physics: Conference Series*, *2684*(1). https://doi.org/10.1088/1742-6596/2684/1/012004

Perdana, R., Budiyono, ., Sajidan, ., & Sukarmin, . (2019). Analysis of Student Critical and Creative Thinking (CCT) Skills on Chemistry: A Study of Gender Differences. *Journal of Educational and Social Research*, *9*(4), 43–52. https://doi.org/10.36941/jesr-2019-0006

Redhana, I. W. (2013). Model Pembelajaran Berbasis Masalah Dan Pertanyaan Socratik Untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. *Jurnal Cakrawala Pendidikan*, *3*, 351–365. https://doi.org/10.21831/cp.v0i3.1136

Shesilya, & Aloysius, S. (2023). Development of E-worksheet of Coordination System in Human Based on Learning Cycle 7E to Improve Critical Thinking Ability and Student Motivation. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 11568–11575. https://doi.org/10.29303/jppipa.v9i12.5907

Sholihah, M., & Amaliyah, N. (2022). Peran Guru Dalam Menerapkan Metode Diskusi Kelompok Untuk Meningkatkan Keterampilan Berpikir Kritis Siswa Kelas V Sekolah Dasar. *Jurnal Cakrawala Pendas*, *8*(3), 898–905. https://doi.org/10.31949/jcp.v8i3.2826

Sofiani, N., Frinaldi, A., Magriasti, L., & Wahyuni, Y. S. (2024). Kebijakan Desentralisasi Pendidikan Serta Implmentasi Dalam Pendidikan di Indonesia. *Menara Ilmu*, *18*(1), 118–127. https://doi.org/10.31869/mi.v18i1.5273

Suardana, I. N., Redhana, I. W., Sudiatmika, A. A., & Selamat, I. N. (2018). Students' Critical Thinking Skills in Chemistry Learning Using Local Culture-Based 7E Learning Cycle Model. *International Journal of Instruction*, *11*(2), 399-412. https://eric.ed.gov/?id=EJ1174908

Surapranata, S. (2009). *Analisis, Validitas, Reliabilitas dan Interpretasi Tes.* Bandung: Remaja Rosda Karya.

Suryaningsih, S., & Nurlita, R. (2021). Pentingnya Lembar Kerja Peserta Didik Elektronik (E-LKPD) Inovatif dalam Proses Pembelajaran Abad 21. *Jurnal Pendidikan Indonesia*, *2*(7), 1256–1268. https://doi.org/10.36418/japendi.v2i7.233

Turgut, U., Colak, A., & Salar, R. (2017). How is the learning environment in physics lesson with using 7e model teaching activities. *European Journal of Education Studies, 3*(6), 1-28. http://dx.doi.org/10.46827/ejes.v0i0.712

Tsai, K. C. (2013). Being a Critical and Creative Thinker: A Balanced Thinking Mode. *Asian Journal of Humanities and Social Sciences (AJHSS)*, *1*(2), 1–9. www.ajhss.org

Twiningsih, A., & Retnawati, H. (2023). Keterampilan Berpikir Kritis Dan Kreatif Dalam Pembelajaran Ipa Pada Siswa Kelas Iv Di Sd. *Jurnal Penelitian Bidang Pendidikan*, *29*(1), 1-8. https://doi.org/10.24114/jpbp.v29i1.38220

Yennita, Astriawati, F, & Jumiarni, D. (2023). Learning Cycle 7E: Efektivitasnya dalam Meningkatkan High Order Thinking Skills (HOTS) Mahasiswa pada Mata Kuliah Anatomi Tumbuhan. *Diklabio: Jurnal Pendidikan Dan Pembelajaran Biologi*, *7*(1), 124–132. https://doi.org/10.33369/diklabio.7.1.124-132