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Development a Local Wisdom-Based Ratio E-Worksheet Based on Critical Thinking Indicators

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***Abstract*:**
Critical thinking skills are essential for dealing with various problems in life problems. However, many students still demonstrate low levels of these skills. This study aimed to develop a local wisdom-based ratio electronic student worksheet (E-Worksheet) designed based on critical thinking indicators and to examine its validity and practicality. The study adopted the Plomp development model, consisting of preliminary research, prototyping, and assessment phases. The participants were seventh-grade students in Singosari District, involving a small group of 10 students and a large group of 24 students. The developed web-based E-Worksheet integrates local wisdom contexts, such as Singhasari cultural heritage, Kirab Tirta Amarta Sari, and Petirtaan Watugede, into ratio learning. The validation results showed an average score of 94. 44%, categorized as highly valid. The practicality results indicated scores of 89. 29% from teachers and 80. 12% from students, both categorized as highly practical. These findings indicate that the developed E-Worksheet is valid and practical for use in mathematics learning and systematically designed based on critical thinking indicators. It has the potential to support meaningful and contextual learning. Further research is recommended to examine its effectiveness in improving students' critical thinking skills.

Keywords: critical thinking; E-Worksheet; local wisdom; ratio; contextual learning

Introduction

Critical thinking skills are essential for addressing various challenges in life (Diana & Saputri, 2021; Faizah et al. , 2025; Rahaju et al. , 2020, 2024). However, several studies show that students' critical thinking skills in solving contextual problems, non-routine problems, fraction problems, and comparison problems remain low (Fajrina et al. , 2024; Rosliani & Munandar, 2022; Suryawan et al. , 2023; Trisanti et al. , 2025). In general, students are not yet able to identify implicit information, understand problems and solution procedures, construct arguments, apply logical reasoning, and draw reasonable conclusions (Nurmalita & Zulkarnaen, 2024; Rahaju et al. , 2024; Rosliani & Munandar, 2022). These findings indicate that mathematics learning has

not yet optimally facilitated the development of students' critical thinking skills. Therefore, learning activities that encourage students to analyze information, construct arguments, and solve contextual problems are needed to support the development of these skills.

The pretest results on ratio material at SMP PGRI 02 Singosari and SMPN 5 Singosari Satu Atap also showed that less than 75% of students achieved the Minimum Passing Criteria. Students were not yet able to solve problems requiring critical thinking skills. This was due to their inability to identify the implicit information in the problems or provide arguments to justify their solutions. Approximately 40% experienced difficulties in solving contextual problems or word problems. Most students were only able to solve symbolic problems, such as simplifying the ratio 10: 4, which mainly require procedural manipulation without deeper analysis or reasoning. This indicates that students tend to rely on routine computational procedures rather than engaging in analytical thinking when dealing with ratio problems.

Critical thinking skills can be improved through ratio learning, as learning ratios involves not onlyu computation but also the ability to compare, analyze, and solve problems rationally (Trisanti et al. , 2025). Ratio concepts require students to understand proportional relationships, interpret quantitative comparisons, and apply reasoning in solving contextual problems. These characteristics make ratio an essential topic for developing higher-order thinking skills in mathematics learning. However, limited understanding of ratio concepts and inadequate numerical reasoning may hinder students from analyzing proportional relationships and drawing logical conclusions, which ultimately leads to low critical thinking skills (Im & Jitendra, 2020). Therefore, strengthening students' conceptual understanding of ratios is crucial to support the development of critical thinking skills.

Critical thinking skills are influenced by various factors. The use of inappropriate instructional methods, strategies, or learning models, such as those that do not actively engage students, can hinder their development (Risdiyanti et al. , 2024; Suryawan et al. , 2023). The provision of routine problems also hinders the critical thinking process (Rahaju et al. , 2024). In contrast, web-based interactive learning media have a positive and significant effect on students' critical thinking skills (Saputra et al. , 2025). These findings indicate that learning environments that actively involve students in interactive and problem-solving processes are important for fostering critical thinking skills. Therefore, the use of interactive digital learning media is considered a promising approach to support the development of students' critical thinking skills in mathematics learning.

Several studies indicate that developing critical thinking through ratio learning improves students' ability to solve academic and real-life problems (Fajrina et al. , 2024). Critical thinking skills can also be fostered through the use of an E-Worksheet, which requires analysis, evaluation, and reflective problem-solving (Alhamid et al. ,

2025; Basri et al. , 2024; Puspita & Dewi, 2021; Widiyaningsih et al. , 2025). The use of E-Worksheet on ratio material requires relational analysis and reasoning about quantity comparisons, thereby potentially improving critical thinking skills (Basri et al. , 2024). These characteristics suggest that integrating ratio material with E-Worksheet learning media can provide meaningful opportunities for students to engage in analytical thinking and reasoning processes. Therefore, the use of E-Worksheets in ratio learning has the potential to support the development of students' critical thinking skills.

In addition, critical thinking skills can be developed through contextual learning approaches that relate mathematical concepts to real-life situations (Sutarni & Gatiniggsih, 2022). Contextual learning can also be enriched by integrating cultural contexts or local wisdom making learning more meaningful and relevant to students' daily lives. Muyassaroh et al. (2024) through a systematic literature review, highlight that local wisdom in education can take the form of cultural traditions, community practices, and environmental knowledge that are familiar to students. Meanwhile, Rahmawati et al. (2025) integrate local wisdom into an E-Worksheet by using local cultural contexts as learning situations to support students' critical thinking skills. In this study, local wisdom is represented by cultural and socio-economic contexts from the Singosari District, such as historical sites and local products, which are used as contexts in ratio problems presented in the E-Worksheet.

Previous studies have attempted to integrate ratio material with E-Worksheet media and contextual approaches to develop critical thinking skills. However, the integration of ratio material, E-Worksheet learning media, and local wisdom in fostering students' critical thinking skills remains limited attention. Therefore, this study integrates these three components into a unified learning design. The use of a web-based E-Worksheet allows students to access learning materials, interactive tasks, and practice questions through an online platform, enabling independent and interactive learning. In addition, ratio material supports activities such as comparing, analyzing, and solving problems rationally.

In this study, local wisdom is specifically represented through contexts from the Singosari District, such as Singhasari cultural heritage, Kirab Tirta Amarta Sari tradition, and Petirtaan Watugede site, which are embedded in ratio problems to provide meaningful and contextual learning experiences. This study aims to develop a valid and practical local wisdom-based E-Worksheet on ratio material designed based on critical thinking indicators. The developed E-Worksheet is expected to provide structured learning experiences that engage students in interpreting information, analyzing relationships, and constructing logical reasoning within meaningful contexts.

Research Methods

This study employs Plomp's Research and Development model (Armiati et al. , 2022; Zulfa et al. , 2022). The development stage includes preliminary research, the prototyping phase, and the assessment phase. In the preliminary research phase, a needs analysis was conducted through three main activities: (1) collecting information on school curricula, student characteristics, learning media, and learning processes; (2) reviewing the literature on the scope and depth of ratio material; and (3) analyzing the environmental and natural resources potential in Singosari District.

In the prototyping phase, two activities were conducted: developing the prototype design and conducting formative evaluation. Prototype development included designing the E-Worksheet based on the local wisdom of Singosari District and preparing the research instruments. The formative evaluation included (a) validity testing by subject matter, learning media, and learning design experts to obtain a valid prototype, and (b) small-group testing to identify product deficiencies.

In the assessment phase, the product was revised based on feedback obtained from teachers and students during the small-group trial. The feedback included suggestions related to the clarity of instructions, the relevance of contextual problems, the readability of the content, and the usability of the E-Worksheet interface. These inputs were used to to refine the design and content of the product. After the revision process, the improved E-Worksheet was implemented in a large-group trial to evaluate its practicality in real classroom learning situations. The practicality test focused on students' and teachers' responses regarding the ease of use, clarity of learning activities, and the effectiveness of the E-Worksheet in supporting the learning process.

Data were collected using validation sheets, user response questionnaires, and field notes. The validation questionnaire was used to determine product validity, as assessed by subject matter experts, learning media experts, and learning experts. The material assessment covered content, language, and learning design. The learning media validation addressed practicality, appearance and interactivity, language, and learning design. The learning validation focused on learning, student characteristics, and critical thinking skills.

The user practicality questionnaire includes teacher and student response questionnaires. The teacher questionnaire addressed content, practicality, and learning design. The student questionnaire evaluated the ease of use, attractiveness, relevance of the questions to everyday life, and learning motivation. The validation and user response questionnaire consist of closed and open-ended questions. In the closed questions, validators or users selected a score for each statement, while open questions allowed validators and users to provide comments, criticisms, or suggestions to improve the quality of an E-Worksheet.

Field notes were used to record events occurring during the E-Worksheet trials, both in the small and large group trials. These notes enabled the identification of difficulties or obstacles in using the E-Worksheet (Murniasih et al., 2020).

The participants were seventh-grade students. The small group trial included 10 seventh-grade students at SMP PGRI 02 Singosari, while a large group trial included 24 seventh-grade students at SMP Negeri 5 Singosari Satu Atap. Both schools are located in the Singosari District, near the local wisdom integrated into the E-Worksheet development. Furthermore, these schools are equipped with computer laboratories, facilitating the implementation of web-based learning through the E-Worksheet.

Data analysis was conducted to determine the validity and practicality of the E-Worksheet (Supriyadi et al., 2024). The analysis involved the following stages: (1) summing the scores from the validation sheets and processing them using a formula; (2) determining the validity of the E-Worksheet based on predetermined criteria; (3) presenting and classifying criticism and suggestions from validators and users; (4) totaling the scores from the user response questionnaire and processing them using a formula; and (5) determining the practicality of the E-Worksheet based on predetermined criteria. Quantitative data from the validity and practicality questionnaires were analyzed using descriptive percentage techniques by comparing the total empirical score (Ts) to the maximum score (Smax) and converting it into percentages (Saragi & Hasanah, 2025).

$$V \,/\, Pr \;\; \frac{Ts}{Smax} \times 100\%$$

Table 1. Validity and Practicality Criteria (adapted from Armiati et al., 2022; Kahar et al., 2025)

Percentage of Validity / Practicality	Criteria
80% < V / Pr ≤ 100%	Highly Valid/Practical
60% < V / Pr ≤ 80%	Valid/Practical
40% < V / Pr ≤ 60%	Fairly Valid/Practical
20% < V / Pr ≤ 40%	Less Valid/Practical
0% ≤ V / Pr ≤ 20%	Not Valid/Practical

Based on Table 1, this study applies relatively strict criteria in determining the feasibility of the developed product. The E-Worksheet is considered valid if the validator assessment reaches at least 80%, indicating that the product meets a high level of material validity, media validity, and learning (instructional) validity. Meanwhile, the E-Worksheet is considered practical if the user assessment results (teachers and students) reach at least 70%, indicating that the product is sufficiently usable and acceptable in learning activities.

This classification is adapted from percentage-based feasibility criteria commonly used in recent educational development studies, where scores above 70% indicate acceptable feasibility, and higher scores reflect better levels of quality (Armiati

et al. , 2022; Kahar et al. , 2025; Saragi & Hasanah, 2025). The different thresholds are applied because validity emphasizes the accuracy and appropriateness of content and design, which requires a higher standard, whereas practicality focuses on usability and ease of implementation, which may still be acceptable at a slightly lower level.

Results and Discussions

The research results are presented according to the stages of Plomp's model development: preliminary research, prototyping phase, and assessment phase.

Preliminary research

During the preliminary research stage, a needs analysis was conducted through observation of the learning process and interviews with teachers and students. This analysis aims to identify the learning conditions at SMP PGRI 02 Singosari and SMP Negeri 5 Satu Atap Singosari. The curriculum analysis indicated that both schools implemented the Merdeka Curriculum. Seventh-grade students were in phase D and studied ratio material covering scale, proportion, and growth rate. The proportion material covered equivalent and inverse ratios.

The learning process was predominantly teacher-centered. Learning begins with explanations of concepts and formulas, followed by problem-solving exercises with detailed solution examples. This approach emphasized memorization of formulas and procedures, with limited student engagement. Consequently, students tended to feel bored and less involved in the learning process (Mohamad & Nasri, 2025; Paryshuri et al. , 2022; Saputri et al. , 2021; Yahya et al. , 2023).

Teachers have used learning media, however, these are neither technology-based nor interactive. Maps are commonly used to explain scale material, leading students to assume that scale applications are limited to map drawing and lack practical relevance. Consequently, students show limited interest in the learning process (Apriani & Sudiansyah, 2024; Jansen et al. , 2023; Mahardika & Setyawan, 2020; Sianipar et al. , 2025). Moreover, the computer laboratories available in schools have not been optimally used for mathematics learning.

The learning resources used are government-issued textbooks, which generally contain routine problems. Variations typically involve only changes in numerical values while maintaining similar sentence structure. This pattern is common in teacher-made problems and textbooks (Rahaju et al. , 2019; Wulandari et al. , 2020). Teachers have not provided problems that support the development of critical thinking skills, largely because they lack expertise to create such problems (Pratiwi et al. , 2025; Rahaju et al. , 2019). In addition, the problems presented are general and do not incorporate students' local contexts. This condition causes students to perceive mathematics as theoretical rather than as a tool for solving real-life problems.

Subsequently, a literature review was conducted to examine the structure and components of an E-Worksheet and to identify digital platforms suitable for developing a user-friendly product. In addition, a literature review was also

conducted to explore the scope of ratio material, commonly assigned practice problems, and non-routine problems that can develop critical thinking skills.

The analysis of local wisdom in Singosari District indicates that the area was the former center of the Singosari Kingdom and has many historical relics, including Singosari Temple, Sumberawan Stupa, and Dwarapala Statue. These historical relics attract tourists and have encouraged the local community to develop souvenir and specialty product businesses. The development of souvenirs through Micro, Small, and Medium Enterprises includes key chains, Singosari batik crafts, and the manufacture of toyosima sandals, which have been exported overseas (Andriani & Machfudz, 2021). The development of Singosari specialty products includes tempe chips, pare chips, and cassava chips.

Prototyping Phase

The prototyping phase includes three activities: prototype creation, instrument development, and formative evaluation. The E-Worksheet prototype includes four menus: home, material, E-Worksheet, and question.

The home menu (Figure 1) features alternating backgrounds of Arca Dwarapala and Stupa Sumberawan as representations of local wisdom from Singosari District. These cultural objects are not only used as visual elements but are also integrated into the learning context to support the understanding of ratio concepts.

Figure 1. Home page with Dwarapala statue and Sumberawan stupa in the background

Students are introduced to ratio through contextual problems involving proportional comparisons, such as the relative height, width, and structural proportions of these cultural heritage objects. The dimensions used in the E-Worksheet are based on documented references and simplified for educational purposes, rather than direct field measurements. This approach allows students to connect mathematical concepts with real-world cultural contexts while maintaining conceptual accuracy and accessibility at the junior high school level. Additionally, the home menu includes a welcome message and an overview of the E-Worksheet content.

The material menu contains teaching materials in the form of a ratio book covering scale, proportion, and rate of change. The material is contextualized using local wisdom from Singosari District. This book also contains examples of problems and solutions related to local context, as well as problems designed to promote critical thinking skills.

The E-Worksheet menu contains E-Worksheet, consisting of a cover page, learning outcomes, learning objectives, indicators, usage instructions, and ratio material. The material section explains the concept of ratios and provides example problems (Figure 2). This presentation aims to remind and reinforce the material learned from various learning sources.

Figure 2. Material in the E-Worksheet

Following the presentation of the material, practice questions are provided in two sections: Stimulus and Let's Answer. Stimulus contains a narrative of local wisdom in Singosari. For example, “Stimulus 1” describes Singosari Temple and the Dwarapala Statue, along with contextual information about the site (Figure 3). After reading Stimulus 1, students proceed to the “Let's Answer” section, where they answer several questions about ratios (Figure 3).

Figure 3. (a) Stimulus and (b) Let's Answer

The E-Worksheet ends with problems that require critical thinking to solve (Figure 4).

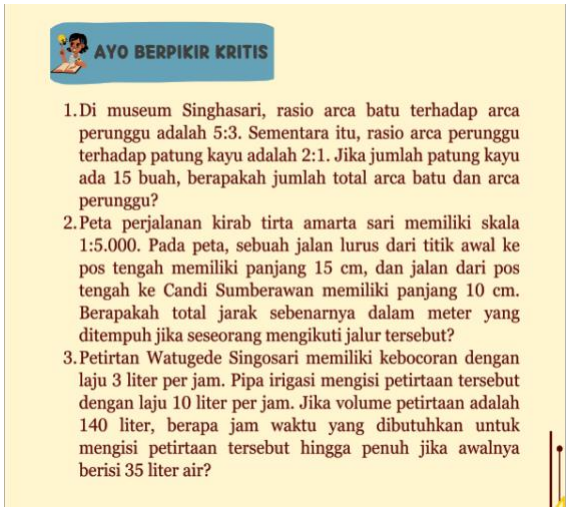

Figure 4. Critical Thinking Problems Based on Contextual and Local Wisdom Situations

The critical thinking problems in the E-Worksheet were systematically developed based on established indicators of critical thinking, including interpretation, analysis, inference, evaluation, and explanation (Facione, 2015). Each problem is contextualized using local wisdom from Singosari District, such as the Singhasari Museum, Kirab Tirta Amarta Sari, and Petirtaan Watugede, to provide meaningful and authentic learning experiences. To provide a clear overview of the alignment between each problem and the critical thinking indicators, Table 2 presents a mapping of the

problems to the corresponding indicators, illustrating the systematic design that ensures students engage in higher-order thinking during problem-solving activities.

Table 2. Mapping of E-Worksheet Problems to Critical Thinking Indicators

No	Problem Description	Critical Thinking Indicator
1	Students interpret contextual problems related to local cultural objects and identify relevant information	Interpretation
2	Students identify relationships between quantities and determine ratios based on given data	Analysis
3	Students compare possible solution strategies and select the most appropriate method	Evaluation
4	Students draw conclusions based on the results of their calculations	Inference
5	Students explain their reasoning and justify their answers logically	Explanation

This alignment between contextual problems and critical thinking indicators demonstrates the E-Worksheet's role in fostering higher-order thinking skills. It is reflected in students' ability to engage with tasks and solve problems with minimal guidance during the implementation phase. Designing learning tasks based on clear cognitive processes ensures that instructional materials not only convey content but also promote meaningful and analytical thinking activities (Facione, 2015).

The question menu contains pre-tests and post-tests items. The pre-test included symbolic, word, and critical thinking questions. The post-test comprises multiple-choice and essay questions. The multiple-choice questions assess students' understanding after studying the material and practicing questions in the E-Worksheet, while the essay questions assess critical thinking skills.

In this phase, instruments were also developed and formative evaluations were conducted. The research instruments were validated and tested with several seventh-grade students at SMP PGRI 02 Singosari to ensure their suitability for data collection. The formative evaluation included expert validity testing and small group trials. The results of the expert validity tests are presented in Tables 3.

Table 3. Summary of Expert Validation Results

Validator Type	Aspect	Ts	Smax	Percentage	Category
Material expert	Content	37	40	92. 50	Highly Valid
	Language	12	12	100	Highly Valid
	Learning Design	11	12	91. 67	Highly Valid
	Total	**60**	**64**	93. 75	**Highly Valid**
Media Expert	Practicality	19	20	95. 00	Highly Valid
	Interface & Interactivity	27	28	96. 43	Highly Valid
	Language	12	12	100	Highly Valid

Validator Type	Aspect	Ts	Smax	Percentage	Category
	Learning Design	11	12	91. 67	Highly Valid
	Total	**69**	**72**	95. 83	**Highly Valid**
Learning Expert	Learning	19	20	95. 00	Highly Valid
	Student Characteristics	8	8	100	Highly Valid
	Critical Thinking	18	20	90	Highly Valid
	Total	**45**	**48**	93. 75	**Highly Valid**

The results of expert validation were 93. 75% from material experts, 95. 83% from media experts, and 93. 75% from learning experts. The average percentage of the E-Worksheet validity was 94. 44%. These results indicate that the developed E-Worksheet is categorized as highly valid and is suitable for small group testing.

To ensure the credibility of these validation results**,** each aspect of validation (material, media, and learning) was assessed by one expert in the respective field. This approach is considered acceptable in development research, particularly in the early stage of product validation, where the focus is on obtaining in-depth and specific feedback from qualified experts. Each validator was selected based on their expertise and experience in their respective domains, ensuring the credibility of the validation results. Furthermore, the use of a limited number of experts is common in design and development research to obtain focused and iterative feedback before proceeding to broader field testing (Branch, 2018; McKenney & Reeves, 2019).

Nevertheless, the validators provided several suggestions, as presented in Table 4, which were used as the basis for revising and improving the quality of the E-Worksheet.

Table 4. Comments from Validators

Experts	Comments	Revisions
Material	- The material is appropriate and within the scope of the CP.	
	- The presentation of the material is systematic.	
	- Critical thinking questions need to be added.	- Add several critical thinking questions.
Learning media	- The E-Worksheet has linked the material and questions to the local wisdom of Singosari, making it contextual.	
	- Add learning objectives for each topic.	- Add learning objectives for each topic
	- Add an answer sheet to the "Let's Think Critically" section so that students can write down their answers directly.	- Add a column for writing answers to critical thinking questions

Experts	Comments	Revisions
Learning	- Questions should be designed according to the stages of critical thinking.	- Practice questions should include instructions or guiding questions for problem solving based on the stages of critical thinking (Rasyid et al., 2023).

The validators' comments or input addressed through revisions to the E-Worksheet. Subsequently, a small group trial was conducted at SMP PGRI 02 Singosari. The small group involved 2 teachers and 10 seventh grade students from SMP PGRI 02 Singosari. The results of the small group trial are presented in Tables 5.

Table 5. Practicality Results of Small Group Trial

Respondent	Aspect	Ts	Smax	Percentage	Category
Teacher (n=2)	Contents	34	40	85.00	Highly Practical
	Practicality	24	40	60.00	Practical
	Learning Design	24	32	75.00	Practical
	Average	—		**73.33**	**Practical**
Students (n=10)	Easy to use	100	120	83.33	Highly Practical
	Attractive	97	120	80.83	Highly Practical
	Suitable for every use	62	80	77.50	Practical
	Motivating	98	120	81.67	Highly Practical
	Average	—	—	**80.83**	**Highly Practical**

In the small group trial, the E-Worksheet obtained a practicality score of 73. 33% from teachers, which falls into the practical category, while students' responses reached 80. 83%, categorized as highly practical. These results indicate that the developed E-Worksheet is feasible to be used in learning activities with minor revisions.

Teachers tended to give slightly different responses compared to students. This difference may be influenced by variations in experience, expectations, and perspectives in evaluating learning media. Teachers are more likely to assess the pedagogical aspects of the E-Worksheet, while students tend to focus on usability and learning experience. Such differences are reasonable in educational evaluations, as different user groups may perceive and assess learning tools based on their roles and experiences.

In addition to the quantitative results, qualitative data in the form of user comments and suggestions are presented in Table 6.

Table 6. Users' comments

User	Comments	Revisions
Teachers	- The display has been simplified to make it easier to use on mobile phones. - It's already good and attractive.	- Some displays have been simplified.
Students	- The images and text are somewhat blurry. - The colors are varied, but the text is too small. - It is easy to understand and simple, but it takes quite a long time to access it. - It helps me understand the material because I am familiar with the problems. This is in line with the PISA international assessment, which emphasizes mathematical literacy (OECD, 2019). - The colors are varied, making it very enjoyable and not boring. The combination of colors attracts attention and motivates children to use it (Candra & Rahayu, 2021; Franoto et al. , 2025).	- The font size has been enlarged and the image resolution has been improved. - Some displays have been simplified to speed up access via mobile phones.

Assessment phase

The assessment phase began with revisions based on user suggestions. After the E-Worksheet was revised, a large-scale trial was conducted at SMPN 5 Singosari Satu Atap. The results of the analysis of the responses from 2 teachers and 24 students are presented in Tables 7.

Table 7. Practicality Results of Large Group Trial

Respondent	Aspect	Ts	Smax	Percentage	Category
Teacher (n=2)	Contents	39	40	97.50	Highly Practical
	Practicality	34	40	85.00	Highly Practical
	Learning Design	27	32	84.38	Highly Practical
	Average	—		**89.29**	**Highly Practical**
Students (n=24)	Easy to use	231	288	80.21	Practical
	Attractive	236	288	81.94	Highly Practical
	Suitable for every use	142	192	73.96	Practical
	Motivating	243	188	84.38	Highly Practical
	Average	—		**80.12**	**Practical**

%, which falls into the highly practical category, while student responses yielded an average score of 80. 12%, categorized as practical. Overall, the average practicality score from both groups was 84. 71, indicating that the developed E-Worksheet is practically feasible for use in learning ratio material.

This finding is consistent with previous studies indicating that E-Worksheets integrated with contextual or local wisdom elements are considered practical and suitable for classroom use, as well as effective in supporting students' critical thinking skills (Fatmawati et al. , 2023; Rahmawati et al. , 2025). In addition, practicality values above 80% generally indicate that learning media can be used without major revisions and are easy to implement in real classroom setting, based on the predetermined validity and practicality criteria used in this study..

However, differences were found between teacher and student evaluations. The results of the small group trial and field testing showed different response patterns between teachers and students. The teacher's response in the small group trial tended to be lower compared to the large group trial, while the students' responses showed the opposite trend, with higher responses in the small group trial than in the large group setting.

This difference can be explained by the variation in context and learning conditions during the implementation stages. In the small group trial, students tend to receive more intensive guidance, closer interaction, and greater attention from the teacher, which can increase their engagement and positive responses toward the E-Worksheet. In contrast, during the large group trial, the learning environment becomes more complex, with more diverse student characteristics and reduced individual attention. As a result, some students may experience difficulties in following the activities independently, which can lead to lower response scores.

Meanwhile, the increase in teacher responses in the large group trial indicates that the revised E-Worksheet is more practical and applicable in real classroom settings after undergoing improvements. This variation in responses reflects differences in implementation context and classroom complexity in educational research settings (Creswell & Creswell, 2018).

Furthermore, observations during the large group trial showed that students were able to use the E-Worksheet independently without requiring significant guidance, as indicated by the minimal number of questions related to its use. This finding suggests that the E-Worksheet is user-friendly and easy to understand. A well-designed E-Worksheet should facilitate ease of use so that students can focus more on understanding concepts rather than on technical aspects of the media, thereby minimizing unnecessary cognitive load during the learning process (Clark & Mayer, 2016; Mayer, 2009; Sweller, 1988). In this context, the E-Worksheet also has the potential to support students in analyzing information, drawing conclusions, and explaining their reasoning, which are essential components of critical thinking (Facione, 2015). Therefore, its practicality reflects not only usability but also its potential to foster students' critical thinking skills.

This study focuses on evaluating the validity and practicality of the developed E-Worksheet as initial stages of educational product development. The findings indicate that the E-Worksheet is valid and practical for classroom use and has been

systematically designed based on critical thinking indicators. However, its effectiveness in improving students' critical thinking skills was not examined in this study. Therefore, further research is recommended to investigate its effectiveness through broader implementation and more rigorous research designs.

Conclusions and Suggestions

The local wisdom-based E-Worksheet on ratio material was found to be highly valid, as indicated by a validity score of 94. 44% obtained from material, media, and learning experts. In addition, it was categorized as highly practical, with an average practicality score of 84. 71% based on user responses. Users also reported that the E-Worksheet was engaging, particularly due to the use of contextual images related to students' daily lives. A discrepancy between validators' and users' assessments was observed, which may be attributed to the inclusion of critical thinking tasks that were relatively unfamiliar and challenging for students. This finding underscores the importance of gradually introducing non-routine and higher-order thinking tasks in mathematics learning to better support students' adaptation to such activities

This study is limited to evaluating the validity and practicality of the developed E-Worksheet, with implementation conducted on a limited scale within one school in Singosari District. Therefore, further research is recommended to examine its effectiveness in improving students' critical thinking skills through broader implementation and more rigorous research designs. Future studies are also encouraged to involve more diverse educational settings to confirm its practicality across different contexts. In addition, the E-Worksheet may be further developed into more comprehensive digital learning resources, such as e-modules, to support independent learning. The integration of local wisdom contexts can also be expanded to provide richer and more meaningful learning experiences for students.

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