Developing a Problem-Based Learning E-Worksheet Using Top Worksheet for Learning Measures of Central Tendency

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Abstract

This study aimed to develop and evaluate the validity and practicality of a Problem-Based Learning (PBL)-based Electronic Student Worksheet (E-Worksheet) using the Top Worksheet platform for teaching measures of central tendency to eighth-grade students. The study employed a design research methodology with a development study approach following Tessmer's formative evaluation stages, including preliminary analysis, self-evaluation, one-to-one evaluation, expert review, and small-group. Data were collected through interviews, validation sheets, practicality questionnaires, and documentation. The results showed that the developed E-Worksheet achieved high levels of validity, with scores of 92% for content validity, 92% for construct validity, and 88% for language validity. In the small-group evaluation involving six students, the E-Worksheet was found to be easy to use, enabling students to follow the instructions, complete the learning activities, and actively engage in the learning process. The practicality questionnaire yielded a score of 82,1%, indicating that the E-Worksheet was very practical. These findings suggest that the PBL-based E-Worksheet developed using the Top Worksheet platform is a valid and practical digital learning resource for teaching measures of central tendency.

Keywords

E-Worksheet; Problem-Based Learning; Measures of Central Tendency; Mathematics Learning; Top Worksheet

Introduction

Mathematics is one of the core subjects that plays a crucial role in developing students' logical, analytical, and critical thinking skills (Allen et al., 2020; Kemdikbud, 2022). To support effective mathematics learning, teachers utilize various media and learning resources, one of which is the student worksheet (Hiltrimartin et al., 2024; Utari et al., 2024). The students worksheet is a structured learning tool that guides students in carrying out learning activities systematically and independently (Hikmah et al., 2023). Since the implementation of the 2013 Curriculum, student worksheet have been widely used by teachers as part of the classroom learning process (Septian et al., 2022).

Additionally, student worksheets are recognized as a form of learning media that supports the achievement of learning objectives (Friska et al., 2022).

With the rapid advancement of technology, the worksheet format has evolved into an electronic form commonly referred to as E-worksheets (Putri & Susantini, 2021). This shift has been further accelerated by the limitations of conventional worksheets in supporting online learning (Puspita & Dewi, 2021). E-Worksheet offers various advantages over conventional worksheet, including the ability to integrate multimedia elements, provide automatic feedback, and facilitate interactive student engagement (Thoyibah & Marhaeni, 2026). The use of E-Worksheet in mathematics learning has been proven to increase student motivation, support critical thinking skills, and improve the overall learning experience (Aini & Putri, 2024).

However, the use of E-Worksheet is not without its challenges. Sarman et al. (2023) point out that the implementation of E-Worksheet requires adequate digital devices and internet connectivity to ensure that learning can take place optimally. Furthermore, most research on the development of E-Worksheet still focuses on the validity, practicality, and effectiveness of the product (Rizki et al., 2026), while the utilization of digital platforms capable of providing automatic feedback (Rahmah et al., 2026), enhancing interactivity (Raisatunnisa et al., 2025), and supporting continuous problem-solving activities remains largely unexplored. Consequently, optimizing the use of E-Worksheet to create a more interactive and student-centred learning experience remains an issue that has not been fully addressed in previous research. These challenges underscore the importance of designing E-Worksheets that are not only interactive but also accessible, user-friendly, and aligned with students' learning needs. Therefore, selecting the appropriate platform and learning model is crucial in ensuring the effectiveness of E-Worksheets as learning tools.

One learning model considered relevant for the development of E-Worksheet is the Problem-Based Learning (PBL) model. The Problem-Based Learning model is viewed as effective because it places students at the centre of learning through the resolution of contextual problems that foster the development of critical thinking, reasoning, and mathematical problem-solving skills (Antari et al., 2024; Hiltrimartin et al., 2024). The PBL model encourages students to be actively engaged in solving real-world problems, stimulates higher-order thinking skills, and fosters collaborative learning (Puspita & Dewi, 2021). By integrating PBL into E-Worksheet, students are not merely

passive recipients of information but are guided through structured problem-solving activities to deepen their conceptual understanding. According to Cholid & Peni (2024) PBL is an effective model for improving students' mathematical reasoning skills, problem-solving abilities, and critical thinking. Therefore, the integration of the PBL model into E-Worksheet is expected to create more meaningful mathematics learning that is oriented toward the development of students' thinking skills.

To support the development of interactive E-Worksheets, this study utilizes the Top worksheet platform, a digital platform specifically designed for creating interactive online worksheets that enables educators to develop engaging instructional materials equipped with various interactive features, such as automatic answer correction, multimedia integration, and real-time tracking of student responses (Rohmah, 2025). These features make Top worksheet a suitable platform for the development of PBL-based E-Worksheets, as it supports structured problem-solving activities while maintaining student engagement throughout the learning process.

The topic selected for the development of this E-Worksheet is data central tendency, a topic in eighth-grade mathematics that covers the mean, median, and mode. Data central tendency is considered appropriate for this assessment because it requires students to apply procedural and conceptual understanding in analysing data sets, thereby supporting the implementation of PBL-based activities, and necessitates that students understand the concepts of the mean, median, and mode through computational skills, data interpretation, and connecting analysis results to real-life contexts (Hulva Sari et al., 2025). Although research on the development of E-Worksheets in mathematics education continues to grow, studies specifically focused on integrating the PBL model and the Top worksheet platform for data central tendency material at the junior high school level remain limited. Therefore, this study aims to develop a Top Worksheet-assisted Problem-Based Learning E-Worksheet and evaluate its validity and practicality for teaching measures of central tendency to eighth-grade students.

Method

This study adopted a design research methodology of the development study type using Tessmer's formative evaluation framework (Tessmer, 1993). The study employed a descriptive approach to analyse both quantitative and qualitative data

collected throughout the development process. Quantitative data were obtained from validation sheets and practicality questionnaires to evaluate the validity and practicality of the developed E-Worksheet. Qualitative data were collected through interviews, comments, suggestions from experts and students, and documentation of learning activities, which were used to support product revisions during the formative evaluation process.

Tessmer's formative evaluation framework consists of five stages: preliminary, self-evaluation, expert review, one-to-one evaluation, small-group evaluation, and field testing. However, this study was limited to the small-group evaluation stage because its primary objective was to develop and obtain a valid and practical Problem-Based Learning (PBL)-based E-Worksheet using the Top Worksheet platform. Therefore, the formative evaluation process focused on examining the validity and practicality of the developed product through expert review, one-to-one evaluation, and small-group evaluation. The field-testing stage, which is generally conducted to investigate the potential effects and effectiveness of a product in a broader classroom context, was beyond the scope of this study and is recommended for future research. The stages of the formative evaluation process are presented in Figure 1.

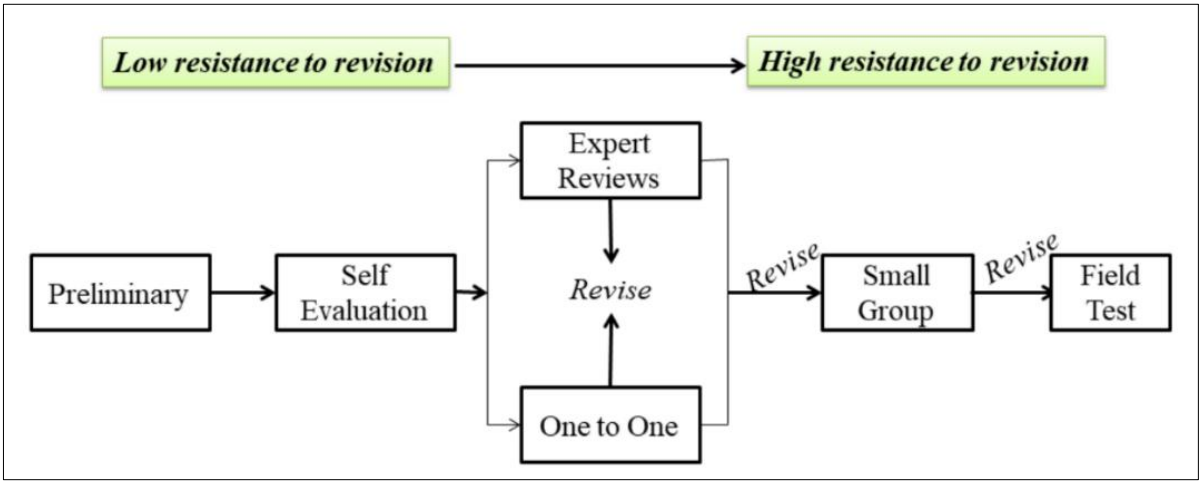


Figure 1. Formative Evaluation Flowchart

In the preliminary stage, researchers analysed students, the applicable curriculum, learning outcomes (CP), learning materials, learning objectives (TP), and achievement indicators. After conducting the analysis, the researcher created an initial prototype of PBL-based E-Worksheet measures of central tendency material for grade VIII using Top worksheet. In the self-evaluation stage, the researcher evaluated the initial prototype together with colleagues to analyse the suitability of the CP, TP,

achievement indicators, learning materials, and E-Worksheet design. The result of this stage was prototype 1. In the one-to-one and expert review stages, the researcher conducted one-to-one interviews with three eighth-grade students at SMP Negeri 1 Indralaya, while the expert review was given to experts. This stage produced prototype 2. Next, the researcher conducted a small group involving six students in one group using prototype 2, then made improvements to produce prototype 3.

The data collection techniques employed in this study included interviews, questionnaires, and documentation. Interviews were conducted to obtain suggestions and comments from students as well as feedback from experts regarding the developed E-Worksheet. The questionnaires consisted of validation sheets used to assess the validity of the E-Worksheet and practicality questionnaires used to evaluate its practicality. Documentation was used to record students' learning activities and learning outcomes during the implementation process. The validity data were analysed using a five-point Likert scale, as presented in Table 1.

Table 1. Likert Scale for Validity Assessment

Criteria	Score
Very Poor	1
Poor	2
Fair	3
Good	4
Very Good	5

The criteria used to interpret the validity scores are presented in Table 2.

Table 2. Validity Criteria

Interval	Criteria
80% < x ≤ 100%	Highly Valid
60% < x ≤ 80%	Valid
40% < x ≤ 60%	Moderately Valid
20% < x ≤ 40%	Less Valid
0% < x ≤ 20%	Invalid

The practicality data were collected using a four-point Likert scale, where 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, and 4 = Strongly Agree. The scale used for the practicality assessment is presented in Table 3.

Table 3. Likert Scale for Practicality Assessment

Criteria	Score
Strongly Disagree	1
Disagree	2
Agree	3
Strongly agree	4

The indicators of the practicality of using E-Worksheet are explained in Table 4.

Table 4. Practicality Indicator

Interval	Criteria
80% < x ≤ 100%	Very Practical
60% < x ≤ 80%	Practical
40% < x ≤ 60%	Moderately Practical
20% < x ≤ 40%	Less Practical
0% < x ≤ 20%	Not Practical

The quantitative data obtained from the validation sheets and practicality questionnaires were converted into percentages and interpreted based on the criteria presented in Tables 2 and 4. Meanwhile, qualitative data collected through interviews, comments, and suggestions from experts and students were analysed descriptively and used to revise the E-Worksheet throughout the formative evaluation process.

Results and Discussion

The results of this study are presented according to the stages of formative evaluation employed in the development process. The development process consisted of a preliminary stage and a prototyping stage, including self-evaluation, peer review, expert review, one-to-one evaluation, and small-group evaluation. Each stage generated findings that informed subsequent revisions of the E- WORKSHEET and contributed to establishing its validity and practicality.

Preliminary Stage

The preliminary stage involved curriculum analysis, student needs analysis, and content analysis related to measures of central tendency. The curriculum analysis focused on identifying the relevant learning outcomes (Capaian Pembelajaran), learning objectives (Tujuan Pembelajaran), and achievement indicators required for Grade VIII mathematics learning.

The curriculum analysis indicated that students were expected not only to calculate measures of central tendency, including mean, median, and mode, but also to interpret statistical information and apply these concepts in contextual problem-solving situations. Based on this analysis, several revisions were made to strengthen the alignment between the curriculum requirements and the instructional components included in the E-Worksheet. The learning outcomes section was explicitly incorporated into the worksheet, and the learning objectives and achievement indicators were refined to better reflect the expected competencies.

The revised learning objectives emphasized students' ability to organize data, determine measures of central tendency, identify frequently occurring values, interpret statistical results, and formulate conclusions based on data analysis. Similarly, the achievement indicators were expanded to include identifying important information from contextual problems, determining mean, median, and mode, completing missing data, interpreting results, and drawing conclusions from problem-solving activities. These revisions ensured a stronger alignment between curriculum expectations and learning activities embedded in the E-Worksheet.

The student needs analysis revealed that students frequently experienced difficulties in distinguishing among mean, median, and mode, interpreting statistical information, and solving contextual problems involving measures of central tendency. Furthermore, learning activities were often dominated by teacher explanations, limiting students' opportunities to actively construct mathematical understanding. These findings highlighted the need for instructional materials that could facilitate active engagement and support students in developing problem-solving skills.

In response to these findings, Problem-Based Learning (PBL) was selected as the pedagogical foundation of the E-Worksheet because it encourages students to investigate contextual problems, engage in collaborative discussions, and construct mathematical concepts through inquiry. In addition, the Top Worksheet platform was chosen to support interactive learning through features such as automatic feedback, answer checking, and digital worksheet integration. These features were considered suitable for supporting the implementation of PBL activities and enhancing student engagement during mathematics learning.

Based on the curriculum analysis, student needs analysis, and content analysis, a PBL-based E-Worksheet assisted by the Top Worksheet platform was designed for

learning measures of central tendency. The findings from the preliminary stage provided the basis for developing instructional materials that were aligned with curriculum requirements, responsive to students' learning needs, and supportive of meaningful mathematics learning.

Prototyping Stage

Self-Evaluation and Peer Review

At this stage, the initial prototype of the E-Worksheet was developed based on the results of the preliminary analysis. The E-Worksheet consisted of a cover page, student identity section, learning outcomes, achievement indicators, learning objectives, activity instructions, contextual problems, guided questions based on the Problem-Based Learning (PBL) model, answer fields, and reflective questions. The worksheet was subsequently converted into an interactive digital format using the Top Worksheet platform, enabling students to complete activities and receive feedback electronically.

Following the development of the initial prototype, a self-evaluation and peer review were conducted to examine the appropriateness of the content, the organization of learning activities, the visual design of the worksheet, and the clarity of language. The evaluation process identified several aspects requiring improvement, which were subsequently revised to enhance the quality and usability of the E-Worksheet.

Figure 2 presents one of the revisions made to the student identification section. The initial design provided only a single row for student names, whereas the worksheet activities were intended to be completed collaboratively in groups. Therefore, additional rows and clearer instructions were added to accommodate group work and improve the usability of the worksheet.

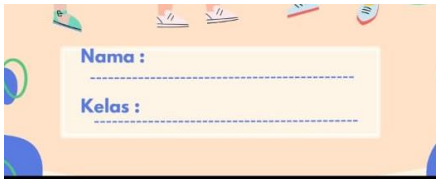
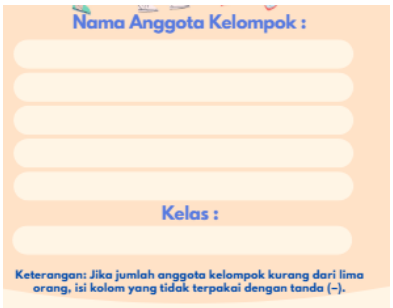
Before Revision	After Revision
	

Figure 2. Before and after views of the student identification column

The evaluation process also revealed several areas for improvement related to the instructional design of the E-Worksheet, particularly the alignment among learning outcomes, learning objectives, and achievement indicators. As shown in Figure 3, the initial version of the E-Worksheet presented achievement indicators and learning objectives without explicitly stating the learning outcomes. Following the evaluation process, a learning outcomes section was added, and the achievement indicators were revised to provide a more detailed description of the expected student competencies. These revisions were made to strengthen the alignment between the curriculum, learning objectives, and assessment indicators, thereby ensuring that the learning activities implemented through the E-Worksheet support the intended competencies in learning measures of central tendency.

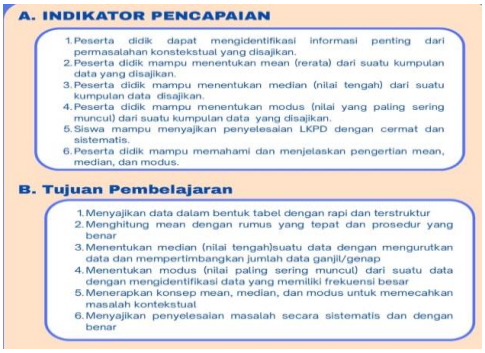
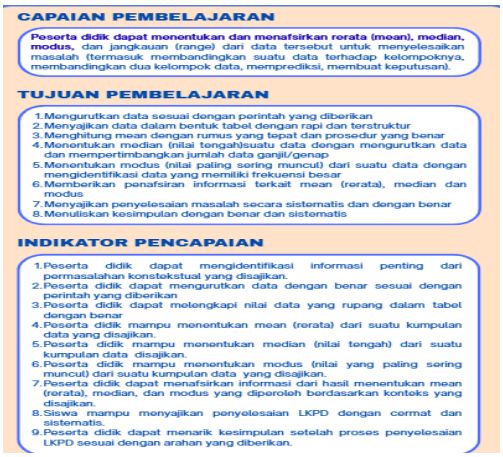
Before Revision	After Revision
	

Figure 3. Before and after view of the learning outcomes component

As shown in Figure 3. there was a shortcoming in the researcher's previous work, the researcher did not specify the learning outcomes but instead listed the achievement indicators and learning objectives directly. Therefore, to address this, the researcher has added the learning outcomes and provided more detailed information regarding the achievement indicators.

As shown in Figure 4, the evaluation process revealed that the initial version of the E-Worksheet did not utilize the auto-correction feature available in the Top Worksheet platform. Consequently, this feature was activated in the revised version to provide immediate feedback on students' responses. Through this feature, correct answers are highlighted in green and incorrect answers in red, enabling students to monitor their understanding, identify errors, and make corrections independently. This revision

enhances the interactivity of the E-Worksheet and supports students' self-regulated learning during the problem-solving process.

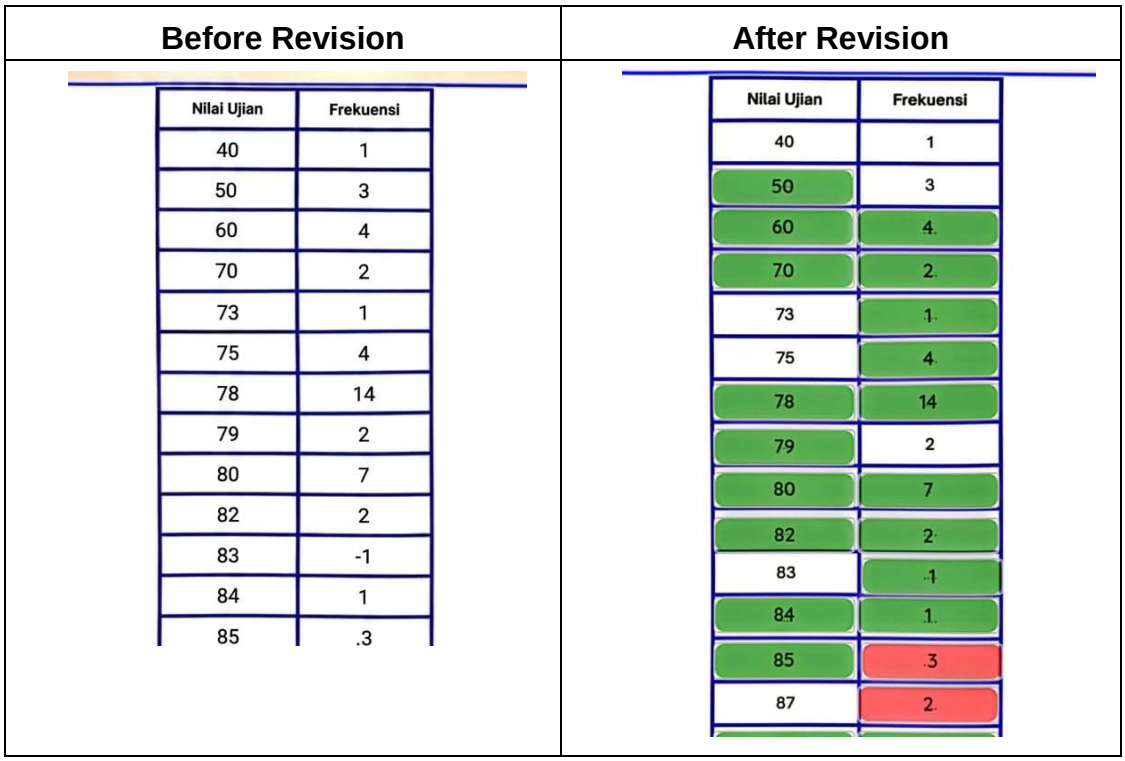


Figure 4. Before and after view of the revised E-Worksheet answers

Expert Review and One-To-One

The expert review stage was conducted to examine the validity of Prototype 1 in terms of content, construct, and language aspects. The validation process involved one Mathematics Education lecturer with expertise in mathematics learning, instructional media development, and curriculum implementation. The validator assessed the E-Worksheet using a validation rubric developed based on Tessmer's formative evaluation framework, covering content validity, construct validity, and language validity. The results of the expert review are presented in Table 5.

Table 5. Expert Review Results

Types of Validation	Assessment Indicators					Percentage
	P1	P2	P3	P4	P5	
Content	5	4	5	5	4	92%
Construction	5	4	5	4	5	92%
Language	4	4	5	5	4	88%

As shown in Table 5, the content validity score reached 92%, the construct validity score reached 92%, and the language validity score reached 88%. These results indicate that the developed E-Worksheet met the criteria of being highly valid in terms of content, construct, and language. The content presented in the E-Worksheet was considered relevant to the curriculum and learning objectives, the learning activities were consistent with the principles of Problem-Based Learning, and the language used was appropriate for eighth-grade students. Although the E-Worksheet achieved a high level of validity, the validator provided several suggestions for improvement regarding the clarity of instructions, visual presentation, consistency of symbols, and completeness of explanations related to statistical concepts. Therefore, revisions were made to further improve the quality of the developed E-Worksheet before proceeding to the next stage.

In addition to the expert review, a one-to-one evaluation was conducted involving three eighth-grade students representing high, moderate, and low mathematical ability levels. The purpose of this stage was to identify difficulties experienced by students when using the E-Worksheet individually and to obtain feedback regarding the clarity of instructions, readability, use of mathematical symbols, and overall appearance of the worksheet. The results of the one-to-one evaluation showed that students were generally able to understand the learning activities and complete the tasks provided in the E-Worksheet. However, several difficulties were identified. Some students experienced challenges in understanding specific activity instructions, interpreting the symbol (n) and the notation used to determine median positions, understanding the meaning of frequency notation (fi), and reading text displayed in smaller font sizes. Students also suggested adding more explicit guidance for interpreting the results of mean, median, and mode calculations and for writing conclusions at the end of the activities.

The findings from both the expert review and one-to-one evaluation served as the basis for revising Prototype 1. The revisions focused on improving conceptual explanations, instructional clarity, visual presentation, and readability. A summary of the revisions made based on the comments and suggestions obtained during these stages is presented in Table 6.

Table 6. Revisions Made Based on Expert Review and One-to-One Evaluation

No	Aspect Revised	Before Revision	After Revision
1	Activity Instructions	Some instructions were lengthy and less explicit, making it difficult for students to identify the required tasks.	The instructions were revised using clearer, more concise, and direct language to improve students' understanding of the activities.
2	Visual Presentation of Tables	The table sections used the same background colour as other worksheet components, making them less noticeable.	Contrasting colours were applied to the table sections to improve visual emphasis and readability.
3	Text Formatting	Excessive use of bold text reduced the overall readability of the worksheet.	Unnecessary bold formatting was reduced to create a cleaner and more organized layout.
4	Explanation of Median	The explanation of the median did not clearly distinguish procedures for datasets with odd and even numbers of values.	Additional explanations were provided to clarify how the median is determined for both odd and even datasets.
5	Guidance for Interpreting Results	Students received limited guidance for interpreting the results of mean, median, and mode calculations.	Additional instructions were added to guide students in interpreting results and drawing conclusions from the activities.
6	Student Identity Section	The worksheet was designed for individual use and included only individual identity information.	The identity section was revised to accommodate group identities for the small-group evaluation stage.
7	Explanation of Symbol (n)	The symbol (n) was used without a clear explanation of its meaning.	An explanation was added stating that (n) represents the total number of data points in a dataset.
8	Median Position Notation	The notation used to determine the median position was presented without sufficient explanation.	Additional information and formulas were provided to explain how median positions are determined for odd and even datasets.
9	Explanation of Frequency (fi)	The frequency symbol (fi) appeared in tables without explanation.	An explanation was added indicating that frequency represents the number of

			occurrences of a value and is denoted by (fi).
10	Font Size	Some instructions and answer sections used font sizes that were difficult for students to read.	Font sizes were increased and adjusted to improve readability and user comfort.

The revisions presented in Table 6 were intended to improve the validity and usability of the E-Worksheet. Following these revisions, Prototype 2 was produced and subsequently used in the small-group evaluation stage to examine the practicality of the developed E-Worksheet.

Small Group

Following the revisions made during the expert review and one-to-one stages, Prototype 2 of the E-Worksheet was implemented in a small-group involving six eighth-grade students from SMP Negeri 2 Indralaya Utara. The purpose of this stage was to examine the practicality of the developed E-Worksheet and to obtain students' feedback regarding its usability during learning activities. During the implementation, students were able to access and use the E-Worksheet without encountering technical difficulties. Most students were able to follow the instructions, complete the activities, and utilize the interactive features provided through the Top Worksheet platform. Although some students still experienced difficulties in solving several problems related to measures of central tendency, these difficulties were primarily associated with their prior understanding of the concepts rather than with the design of the E-Worksheet.

To obtain additional feedback, informal interviews were conducted after the implementation. The interview results indicated that students responded positively to the E-Worksheet. Students reported that the interactive design and automatic feedback features helped them identify errors in their answers and encouraged them to review their work independently. Furthermore, students expressed interest in using the E-Worksheet because it provided a more engaging learning experience compared to conventional worksheets. These findings are consistent with previous studies suggesting that electronic worksheets can enhance student engagement and support interactive learning experiences (Marlina, 2022). After completing the learning activities, students were asked to complete a practicality questionnaire consisting of

seven statements assessed using a four-point Likert scale. The results of the practicality assessment are presented in Table 7 and Table 8.

Table 7. Results of the E-LKPD Practicality Survey

Name	Question							Total Percentage
	1	2	3	4	5	6	7	
DS	2	3	3	3	3	3	3	82,1%
DF	3	3	3	3	3	3	3	
RPD	3	3	4	3	3	3	4	
MA	3	3	3	3	3	3	3	
AW	3	4	4	3	4	3	4	
APM	4	4	4	4	4	4	4	

The individual student responses presented in Table 7 were further analyzed to determine the practicality level of each questionnaire item. The results of the item-based analysis are summarized in Table 8.

Table 8. Results of the Practicality Questionnaire

Item	Total Score	Mean Score	Percentage	Category
Q1	18	3.00	75.0%	Practical
Q2	20	3.33	83.3%	Very Practical
Q3	21	3.50	87.5%	Very Practical
Q4	19	3.17	79.2%	Practical
Q5	20	3.33	83.3%	Very Practical
Q6	19	3.17	79.2%	Practical
Q7	21	3.50	87.5%	Very Practical
Result	**138**	**3.29**	**82.1%**	**Very Practical**

As shown in Table 8, the result of practicality score reached 82.1%, which falls within the Very Practical category. The highest percentages were obtained for Items 3 and 7 (87.5%), indicating that students responded positively to the learning activities and interactive features provided by the E-Worksheet. Meanwhile, Items 1, 4, and 6 obtained slightly lower percentages, although they remained within the Practical category. Overall, the results suggest that the developed E-Worksheet was easy to use, understandable, and supportive of students' learning activities.

The practicality findings indicate that the integration of Problem-Based Learning activities with the interactive features of the Top Worksheet platform contributed positively to students' learning experiences. Although the small-group evaluation involved only six students, the results provide preliminary evidence that the developed E-Worksheet is practical for use in mathematics learning. Similar findings were reported by Marlina (2024), who found that an E-Worksheet developed through

formative evaluation achieved a high level of practicality and was suitable for classroom implementation.

Based on the results of the expert review, one-to-one evaluation, and small-group, the developed Problem-Based Learning E-Worksheet assisted by the Top Worksheet platform met the criteria of validity and practicality. Therefore, the E-Worksheet can be considered an appropriate digital learning resource for teaching measures of central tendency to eighth-grade students. The final version of the developed E-Worksheet is presented in Figure 5.

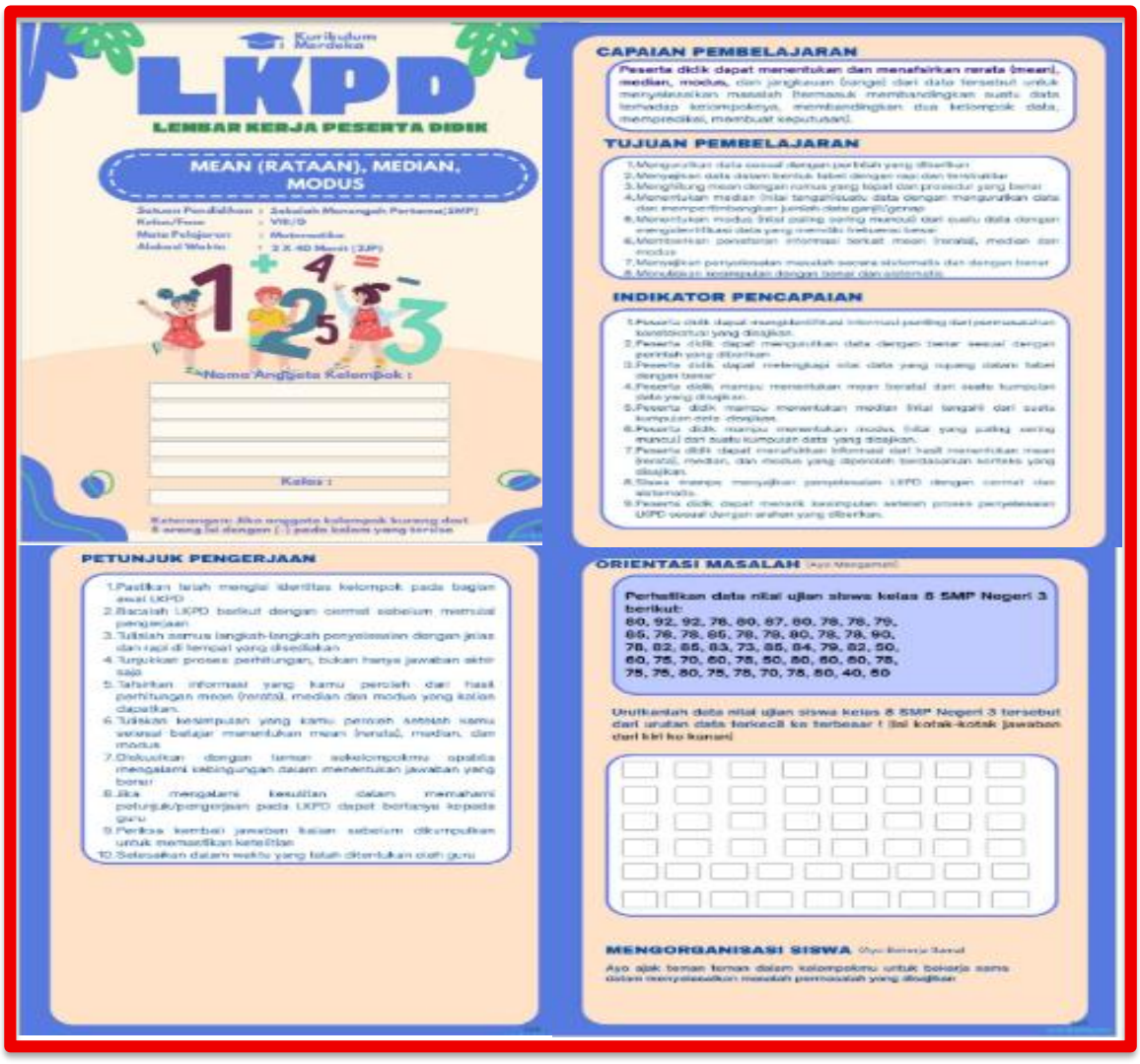


Figure 5. A screenshot of the E-Worksheet for a problem-based learning model supported by Top Worksheet

Discussion

The validation results indicate that the developed E-Worksheet achieved a high level of validity in terms of content (92%), construct (92%), and language (88%). These findings suggest that the E-Worksheet was successfully designed in accordance with curriculum requirements, learning objectives, and students' characteristics. According to Tessmer (1993), a learning product can be considered valid when its content, structure, and language are appropriate for achieving the intended learning objectives. The high content validity score demonstrates that the materials, examples, and activities included in the E-Worksheet were relevant to the topic of measures of central tendency and aligned with the expected competencies for eighth-grade students.

The high construct validity score indicates that the learning activities were systematically organized and reflected the essential principles of Problem-Based Learning. This finding supports the argument of Antari et al. (2024) and Cholid & Peni (2024), who emphasize that Problem-Based Learning should engage students in contextual problem-solving activities that encourage reasoning, inquiry, and active participation. In the developed E-Worksheet, students were guided through a sequence of activities involving problem identification, data analysis, interpretation, and conclusion drawing, thereby supporting the implementation of student-centered learning.

Furthermore, the language validity score of 88% suggests that the instructions, explanations, and questions were generally understandable and appropriate for the target learners. Although several revisions were required to improve the clarity of instructions, explanations of symbols, and statistical terminology, the validation results indicate that the language used in the E-Worksheet was suitable for supporting students' comprehension. These findings are consistent with the view that clear and readable language is essential for enabling students to engage effectively with worksheet-based learning activities (Hikmah et al., 2023).

The validity findings demonstrate that the integration of Problem-Based Learning with the Top Worksheet platform resulted in a learning resource that was pedagogically appropriate, conceptually accurate, and suitable for junior secondary mathematics learning. The revisions suggested by the validator further enhanced the quality of the E-Worksheet and contributed to the development of a more effective learning product.

Conclusion

This study developed a Problem-Based Learning (PBL)-based E-Worksheet assisted by the Top Worksheet platform for learning measures of central tendency among eighth-grade students. The results of the formative evaluation indicated that the developed E-Worksheet met the validity criteria, with content validity, construct validity, and language validity scores ranging from 88% to 92%. Furthermore, the small-group evaluation showed that the E-Worksheet was practical to use, as reflected by a practicality score of 82.1%, which falls into the Very Practical category. These findings indicate that the developed E-Worksheet is appropriate for supporting mathematics learning on measures of central tendency and can serve as an alternative digital learning resource for junior secondary school students.

This study was limited to the small-group evaluation stage and involved a relatively small number of participants. Therefore, the findings are limited to evidence of validity and practicality and cannot yet be generalized to broader classroom contexts. Future research is recommended to conduct field testing with larger samples to examine the effectiveness of the E-Worksheet in improving students' learning outcomes and mathematical abilities. In addition, further studies may explore the application of the developed E-Worksheet to other mathematics topics and educational settings.

Acknowledgement

The author gratefully acknowledges SMP Negeri 1 Indralaya for facilitating the one-to-one evaluation involving three students and SMP Negeri 2 Indralaya Utara for supporting the small-group evaluation involving six students. The cooperation, participation, and support provided by both schools were invaluable to the successful implementation of this study.

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