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DESIGN OF AN E-STUDENT WORKSHEET ON MEASUREMENT BASED ON INQUIRY LEARNING INTEGRATED WITH LOCAL WISDOM TO FACILITATE STUDENTS' CRITICAL THINKING SKILLS

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ABSTRACT

The development of the Society 5.0 era requires learning to equip students with various skills, one of which is critical thinking through the use of digital technology. Physics learning needs to facilitate students' critical thinking skills through contextual and meaningful learning activities. However, the needs analysis conducted at SMAN 1 Lubuk Sikaping revealed that learning was still predominantly teacher-centered, the teaching materials were not systematically structured according to the syntax of the learning model, and local wisdom and critical thinking indicators had not been optimally integrated. Therefore, this study aimed to analyze needs, develop an E-Student Worksheet on Measurement based on Inquiry Learning integrated with local wisdom, and determine its validity and practicality. The E-Student Worksheet was designed to facilitate students' critical thinking skills. This study employed a Research and Development (R&D) method using the Four-D (4D) model, which was limited to three stages: Define, Design, and Develop, without implementing the Disseminate stage. The needs analysis involved one physics teacher and 32 Grade X Phase E students, while product validation involved five expert validators. The practicality test involved one physics teacher and 36 Grade X Phase E students. Product validity was analyzed using Aiken's V index, while practicality was analyzed based on score percentages. The results showed that the developed E-Student Worksheet obtained an average Aiken's V value of 0.93, categorized as valid. The practicality test yielded scores of 94% based on the teacher's response and 88% based on students' responses, both of which were categorized as highly practical. These findings indicate that the developed E-Student Worksheet meets the validity and practicality criteria for use in physics learning. However, since this study was limited to the Develop stage, the effectiveness of the E-Student Worksheet in improving students' critical thinking skills has not been tested and requires further investigation.

Keywords :E-Student Worksheet; Inquiry Learning; Local Wisdom; Measurement; Critical Thinking Skills

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I. INTRODUCTION

Physics education is a learning process that emphasizes not only conceptual understanding but also students' active involvement in scientific activities. The development of learning in the Society 5.0 era requires students to possess various relevant skills, one of which is critical thinking. Developing critical thinking skills is an essential part of science education because it supports students' ability to understand and evaluate scientific knowledge [1]. The use of digital technology in physics education can support student engagement in learning activities through learning environments that facilitate interaction, learning activities, and active learning processes [2]. Critical thinking skills in physics education encompass interpretation, analysis, evaluation, inference, explanation, and self-regulation [3].

Measurement is one of the fundamental topics in physics, closely related to scientific activities and everyday life. Learning about measurement can engage students in identifying physical quantities and units, using measuring

instruments, processing measurement results, and drawing conclusions based on data. Research by [4] indicates that learning physics is associated with the development of students' critical thinking skills. However, based on an interview with a Grade X Phase E physics teacher at SMAN 1 Lubuk Sikaping, classroom instruction remains predominantly teacher-centered and relies heavily on lectures. Students mainly listen to and take notes on the teacher's explanations, while opportunities to analyze information, establish conceptual connections, and draw conclusions remain limited. Simple laboratory activities are also not yet optimal, as students still require guidance in using equipment and materials and following experimental procedures.

These learning problems are also related to the teaching materials used in schools. Based on the analysis of the student worksheets, the materials were found to be aligned with the learning outcomes and objectives. However, the activities in the worksheets were not systematically organized according to the syntax of the learning model, and scientific activities had not been implemented optimally. Research by [5] indicates that technological innovations in physics education can support student engagement and the learning process when integrated with appropriate approaches. A study by [6] shows that physics teaching materials based on local wisdom can be used in physics learning and support students' critical thinking skills. Another study by [7] demonstrates that E-Student Worksheets assisted by Liveworksheets and integrated with an inquiry-based learning model can be developed to facilitate students' critical thinking skills and science process skills. These conditions highlight the need for teaching materials that are systematic, interactive, contextual, and provide students with opportunities to develop their critical thinking skills.

One alternative teaching material that can be used to address these problems is an Inquiry Learning-based E-Student Worksheet. An E-Student Worksheet can incorporate various digital elements, such as images, videos, animations, and interactive activities, to support student engagement in learning. A study by [8] demonstrated that a guided inquiry-based E-Student Worksheet can be developed to support students' critical thinking skills. The Inquiry Learning model provides students with opportunities to engage in a series of learning activities, beginning with observing phenomena, formulating questions and hypotheses, collecting and analyzing data, drawing conclusions, and discussing the results of their investigations [9]. Inquiry-based learning allows students to discover answers to problems through systematic investigation.

An Inquiry Learning-based E-Student Worksheet becomes more meaningful when the problems presented are connected to students' real-life experiences. One relevant context is the local wisdom of West Sumatra, which is closely associated with the daily lives of the Minangkabau community. An example related to measurement is the traditional unit sukek, which is used by local communities to measure rice or harvested paddy. Local wisdom can serve as a learning resource that connects scientific knowledge with students' experiences and living environments [10]. Science learning based on local wisdom can also support the development of students' critical thinking skills [11]. A study by [12] developed physics teaching materials incorporating local wisdom to foster students' critical thinking skills. Therefore, the local wisdom of West Sumatra can be integrated into measurement learning as a contextual learning resource that makes the concepts more relevant to students' everyday lives.

Research on the development of E-Student Worksheets and the integration of local wisdom in physics learning has been conducted across various topics. A study by [13] analyzed the validity of a physics E-Student Worksheet integrated with the local wisdom of the egrang traditional game to improve students' critical thinking skills in the topic of work and energy. Another study [14] integrated ethnoscience with virtual simulation and augmented reality technologies in physics learning based on Inquiry Learning to create contextual learning experiences and actively engage students. Furthermore, a study by [15] developed a Project-Based Learning E-Student Worksheet integrated with the local wisdom of the traditional gasing game in the topic of rotational dynamics to improve students' critical thinking skills. These studies demonstrate efforts to develop learning materials that integrate technology, learning models, and local wisdom. However, research specifically focusing on the development of an E-Student Worksheet for the topic of measurement based on Inquiry Learning, integrated with the local wisdom of West Sumatra, and designed around Facione's critical thinking indicators remains limited. Measurement has distinctive characteristics that allow students to conduct direct observations, use measuring instruments, and explore concepts closely related to everyday life. Therefore, this study not only incorporates critical thinking indicators but also aligns them with the characteristics of the measurement topic and the cultural context of West Sumatra.

Based on the problems identified and the limitations of previous studies, there is a need to develop learning materials that integrate digital technology, Inquiry Learning, and local wisdom into measurement learning. Physics learning based on local wisdom has the potential to support student learning outcomes; therefore, integrating local wisdom can provide a relevant context for developing physics learning materials [16]. Accordingly, this study aims to analyze learning needs, develop an E-Student Worksheet on Measurement based on Inquiry Learning

integrated with Minangkabau local wisdom, and determine its validity and practicality. The E-Student Worksheet is designed to facilitate students' critical thinking skills.

II. METHOD

This study employed a Research and Development (R&D) approach to develop an E-Student Worksheet on measurement based on Inquiry Learning and integrated with local wisdom to facilitate students' critical thinking skills, using the Four-D (4D) model proposed by [17]. The development procedure consisted of three stages: Define, Design, and Develop, while the Disseminate stage was not carried out because the scope of the study was limited to the product development stage. The study was conducted at SMAN 1 Lubuk Sikaping during the first semester of the 2026/2027 academic year. The Define stage involved one physics teacher and 32 Grade X students in Phase E. In the Develop stage, five lecturers with relevant expertise served as validators to evaluate the E-Student Worksheet, while one physics teacher and 36 students participated in the practicality test. The selection of one teacher and one Grade X class was based on the research implementation conditions, as the measurement topic was being taught during the study and the school provided the class for student analysis and the practicality testing of the E-Student Worksheet.

In the define stage, front-end analysis, learner analysis, task analysis, concept analysis, and learning objective analysis were conducted. Front-end analysis was carried out to identify problems in physics learning and the teaching materials used. Learner analysis was conducted to determine the characteristics of Grade 10 students as users of the E-Student Worksheet. Data on student characteristics were collected using a questionnaire consisting of five aspects and a total of 29 statements. Furthermore, students' critical thinking skills were assessed using a test consisting of three questions developed based on the critical thinking skill indicators proposed by [3] and the results were expressed as percentage scores. Task analysis was conducted to identify the competencies and learning activities that students were expected to master. Concept analysis was performed to determine the concepts related to measurement that would be presented in the E-Student Worksheet. In addition, learning objective analysis was conducted to establish the learning objectives that served as the basis for developing the content, activities, and exercises in the E-Student Worksheet.

The design stage involved designing the E-Student Worksheet based on the results of the define stage. The E-Student Worksheet was designed by integrating the Inquiry Learning model and six critical thinking indicators, namely interpretation, analysis, evaluation, inference, explanation, and self-regulation. The learning activities in the E-Student Worksheet were organized according to the stages of Inquiry Learning, which include orientation, conceptualization, investigation, and conclusion. The designed product was then developed into an E-Student Worksheet.

The development stage aimed to produce a valid and practical E-Student Worksheet. At this stage, the validation instrument was first validated by four validators to ensure the suitability of its aspects, indicators, and assessment items. The validated instrument was then used to assess the validity of the E-Student Worksheet by five validators. The validators evaluated seven aspects: content substance, visual communication design, E-Student Worksheet components, software utilization, implementation of the Inquiry Learning model in the E-Student Worksheet, critical thinking skills, and integration of local wisdom. Each validation aspect consisted of several assessment items, and the data were collected using the rating scale proposed by [18]. Furthermore, a practicality test was conducted to assess the practicality of the E-Student Worksheet based on evaluations by a physics teacher and students as product users. The practicality assessment covered four aspects: ease of use and readability, efficiency, presentation, and usefulness. Each aspect also consisted of several assessment items, and the data were collected using the rating scale proposed by [18].

The research data consisted of needs analysis, validity, and practicality data for the E-Student Worksheet. The needs analysis results were used as the basis for developing the E-Student Worksheet in accordance with students' characteristics and learning objectives. The developed E-Student Worksheet was then validated by experts. The validity of the instruments and the E-Student Worksheet was analyzed using Aiken's V validity index. The Aiken's V value was calculated using the following formula:

$$V = \frac{\sum s}{n\,(c-1)} \qquad (1)$$

$$S = r - l_0 \qquad (2)$$

In the formula, r represents the score assigned by the validators, l_0 represents the lowest possible score, which is 1, c represents the highest possible score, and n represents the number of validators. The resulting Aiken's

V value is then interpreted based on the validity criteria presented in Table 1.

Table 1. Aiken's V Validity Categories

Interval	Category
V ≥ 0.8	Valid
V < 0.8	Invalid

(Source: Ref[19])

Thus, the product is considered valid and suitable for use if its validity score falls within the valid category.

The practicality analysis was conducted based on questionnaire responses from teachers and students. The practicality percentage was calculated using the following formula:

$$Score = \frac{score\ obtained}{maximum\ score}\ x\ 100\% \qquad (3)$$

The practicality percentage was subsequently interpreted based on the categories proposed by [20], as follows: 0–20% was classified as not practical, 21–40% as less practical, 41–60% as moderately practical, 61–80% as practical, and 81–100% as highly practical.

Furthermore, the study was conducted after obtaining permission from the school and fulfilling the applicable school requirements and regulations. Teacher and student participation was voluntary after the research objectives, procedures, and use of the data had been clearly explained. Participants' identities were kept confidential, and the data were used solely for research purposes.

III. RESULTS AND DISCUSSION

Result

Needs Analysis

The define stage was conducted to identify the needs and problems in physics learning as the basis for developing an Inquiry Learning-based E-Student Worksheet. The results of the front-end analysis indicated that the teaching materials currently used did not specifically incorporate critical thinking skills indicators or optimally integrate the syntax of the learning model. Interviews with the physics teacher also revealed that learning was still dominated by lecture methods, while the implementation of Problem-Based Learning (PBL), STEM, and other scientific approaches had not been optimal. Furthermore, the use of instructional media and learning resources remained limited, making the learning process less engaging for students.

Furthermore, the student analysis was conducted by distributing a student characteristics questionnaire and analyzing the critical thinking skills of 32 students. The questionnaire results showed that 86.71% of students found physics easier to understand after engaging in hands-on practice, experiments, or physics-related activities. Furthermore, 73.44% of students reported that they found it easier to understand and analyze physics lessons through real-life experiences and situations related to everyday life. In addition, 80.46% of students found it easier to remember learning materials through pictures, animations, or videos. Meanwhile, 85.94% of students reported that digital learning was easier to understand than printed textbooks. These findings indicate that students tend to need learning experiences involving hands-on activities, contextual phenomena, visual media, and digital technology

The results of the analysis of critical thinking skills for each indicator are presented in Table 2.

Table 2. Results of Students' Critical Thinking Skills Analysis

Indicator	Percentage (%)	Category
Interpretation	23%	Weak
Analysis	20%	Very Weak
Evaluation	33%	Weak
Inference	11%	Very Weak
Explanation	17%	Very Weak

The results indicate that students' critical thinking skills at the school remain relatively low. Although the initial test did not include the self-regulation indicator, this indicator will still be integrated into the design of the E-Student Worksheet.

Task analysis was conducted based on the Learning Outcomes (CP), Learning Objectives (TP), and Learning Objective Sequence (ATP). The learning objectives were designed by integrating the stages of Inquiry Learning, as described in [9]. Through these stages, students are guided to engage in scientific activities integrated with local wisdom in a systematic manner, from observing phenomena to obtaining and drawing conclusions from the results of their investigations. Furthermore, content analysis was conducted to identify the main concepts or materials to be presented in the E-Student Worksheet on measurement. This analysis resulted in three main content areas: physical quantities and units, unit conversion and scientific notation, and length-measuring instruments. These three content areas are arranged sequentially and interconnected to establish students' understanding of the measurement system.

The learning objectives were formulated based on the learning outcomes specified in the Merdeka Curriculum and the characteristics of the students. They are directed toward enabling students to apply measurement systems in scientific investigations to explain phenomena in everyday life logically and scientifically. These learning objectives serve as the basis for determining learning activities and designing the tasks presented in the E-Student Worksheet. Overall, the results of the define stage indicate the need to develop an E-Student Worksheet on measurement that provides more interactive, systematic, contextual, and student-oriented learning materials. These findings subsequently serve as the foundation for the design stage, which determines the structure, content, activities, and presentation of the E-Student Worksheet.

Results of E-Students Worksheet Planning

This stage resulted in the initial design of an electronic student worksheet integrated with local wisdom, developed using TopWorksheets. The E-Student Worksheet consists of several components designed to support the effective presentation of learning materials and activities. These components include a cover page, foreword, learning instructions, product description, competencies, supporting information, work procedures, assessment, author information, and references.

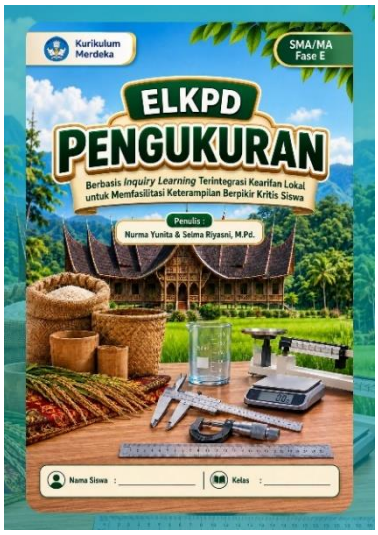


Figure 1. Cover

Figure 1 shows the cover of the E-Student Worksheet, which includes several components, such as the title, fields for the student's name and class, theme information, and images relevant to the learning material. The logos of Universitas Negeri Padang and Tut Wuri Handayani are displayed in the upper-left corner.



Figure 2. Preface

Figure 2 presents the preface, which provides an overview of the purpose of developing the E-Student Worksheet, the benefits of using the E-Student Worksheet in learning, and the hope that the developed learning medium will help students understand measurement concepts and improve their critical thinking skills.

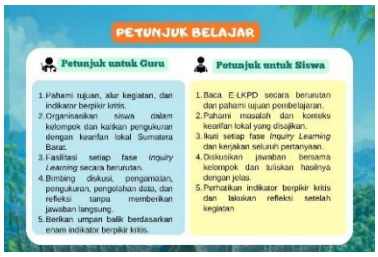


Figure 3. Learning Instructions

Figure 3 presents the learning guidelines, which provide information on how to use the E-Student Worksheet, including the procedures to follow and the steps that teachers and students should take during the learning process.



Figure 4. Product Description

Figure 4 shows the product description page, which provides an overview of the developed E-Student Worksheet. This section explains that the product is an E-Student Worksheet based on Inquiry Learning and integrated with local wisdom for the topic of Measurement. It is divided into three topics: physical quantities and units, unit conversion and scientific notation, and length-measuring instruments.



Figure 5. Competencies

Figure 5 shows the competencies section, which includes the Learning Outcomes, Learning Objectives, Learning Objective Sequence, and Indicators of Learning Objective Achievement that students are expected to attain after participating in learning activities using the E-Student Worksheet on Measurement.



Figure 6. Supporting Information

Figure 6 shows the supporting information page, which contains brief explanations of the material, images, formulas, and contextual information. This information is intended to help students understand the concepts before solving the problems related to measurement presented in the E-Student Worksheet.



Figure 7. Work Procedures

Figure 7 illustrates the procedural steps, which consist of learning activities organized according to the Inquiry Learning syntax and incorporate critical thinking skills indicators. In this section, students complete the activities step by step in accordance with the stages of the Inquiry Learning model presented in the E-Student Worksheet.



Figure 8. Assessment

Figure 8 shows the assessment page, which contains evaluation questions designed to measure students' conceptual understanding and critical thinking skills after completing all learning activities. The assessment is developed in accordance with the established learning indicators and objectives.



Figure 9. Author Information

Figure 9 shows the author's identity section, which contains biographical information about the author of the E-Student Worksheet.

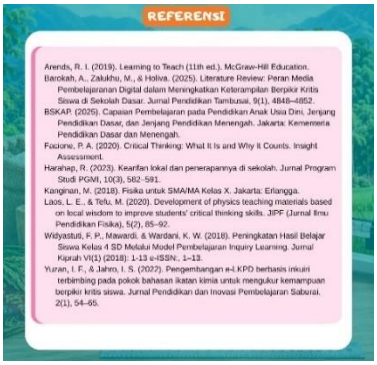


Figure 10. References

Figure 10 shows the reference page containing a list of sources used in developing the E-Student Worksheet, including relevant books, scientific articles, and digital resources.

The concise mapping of the developed E-Student Worksheet is presented in Table 3.

Table 3. Mapping of the Designed E-Student Worksheet Content

Worksheet	Local Wisdom Context	Measurement Concepts	Inquiry Learning Activities	Critical Thinking Indicators
1	Rumah Gadang and Alua Jo Patuik	Physical quantities, units, base and derived quantities, standard and non-standard units	Identifying quantities and units used in Rumah Gadang construction and evaluating the classification results	Interpretation, analysis, inference, evaluation, explanation, self-regulation
2	Sukek, Belek, Kambuik, Pikua, and Saameh	Unit conversion, SI units, and scientific notation	Converting traditional units into SI units and scientific notation, and verifying the calculation results.	Interpretation, analysis, inference, evaluation, explanation, self-regulation
3	Jengkal, Hasta, and Depa	Length measurement, measuring instruments, precision, and measurement uncertainty	Comparing traditional measurement results with those obtained using a ruler, vernier caliper, and micrometer screw gauge	Interpretation, analysis, inference, evaluation, explanation, self-regulation

Validity of the E-Students Worksheet

The product validity analysis yielded an average Aiken's V validity index of 0.93. The assessed aspects included content substance, visual communication design, E-Student Worksheet components, software utilization, the implementation of the Inquiry Learning model, critical thinking skills, and the integration of local wisdom. The scores ranged from 0.89 to 0.96, indicating that the product was categorized as valid according to[19] as presented in Table 4.

Table 4. Product Validation Results

Aspect	V	Category
Content Substance	0,91	Valid
Visual Communication Design	0,95	Valid
E-Student Worksheet Components	0,95	Valid
Software Utilization	0,96	Valid
Implementation of the Inquiry Learning Model	0,92	Valid
Critical Thinking Skills	0,94	Valid
Integration of Local Wisdom	0,89	Valid
Average	**0,93**	**Valid**

Based on the product validation results, the aspect of local wisdom integration received the lowest score compared to the other aspects. This was due to the need for greater accuracy and further consideration in selecting and integrating local wisdom into physics measurement concepts. During the product validation stage, all comments and suggestions were addressed through revisions to the recommended aspects of the E-Student Worksheet.

Practicality of the E-Students Worksheet

After the validation and revision processes were completed, a valid E-Student Worksheet product was obtained. The next stage was to assess its practicality. The practicality assessment consisted of two stages: an assessment by teachers and an assessment by students. The analysis of the practicality results based on the teacher response questionnaire yielded a score of 94%, which was categorized as highly practical according to the criteria in [20]. The results are presented in Table 5.

Table 5. Results of Teacher Practicality Assessment

Aspect	Percentage (%)	Category
Ease of Use and Readability	93%	Highly Practical
Presentation	95%	Highly Practical
Efficiency	88%	Highly Practical
Benefits	100%	Highly Practical
Average	**94%**	Highly Practical

In addition to the practicality assessment conducted by teachers, students were also involved in evaluating the practicality of the product. The analysis of practicality data obtained from 36 Grade X Phase E students at SMAN 1 Lubuk Sikaping yielded an average score of 88%, which was categorized as very practical according to the criteria in [20]. The results are presented in Table 6.

Table 6. Results of the Student Practicality Assessment

Aspect	Percentage (%)	Category
Ease of Use and Readability	87%	Highly Practical
Presentation	87%	Highly Practical
Efficiency	88,9%	Highly Practical
Benefits	89,1%	Highly Practical
Average	**88%**	Highly Practical

Discussion

Based on the results of the preliminary analysis of physics learning at SMAN 1 Lubuk Sikaping, several problems were identified in the learning process. The analysis was conducted during the define stage, in which the front-end analysis revealed that physics learning still predominantly relied on lecture-based methods, causing students to mainly receive and take notes on the teacher's explanations. Consequently, opportunities for students to analyze information, connect concepts, and draw conclusions remained limited. In addition, simple laboratory activities had not been optimally implemented, as students still required guidance in using equipment and materials and following experimental procedures. The teaching materials also did not specifically incorporate critical thinking indicators, were not systematically organized according to the learning model's syntax, and rarely connected the subject matter to real-life contexts and local wisdom. Therefore, teaching materials are needed to encourage active student participation, present learning activities systematically, and facilitate critical thinking skills through contextual learning activities.

The results of the student analysis indicated that students' characteristics supported the use of interactive digital teaching materials in physics learning. Students demonstrated characteristics that were conducive to technology-assisted learning and interactive teaching materials. They also tended to understand physics concepts more easily through real-life experiences and visual presentations, such as images, animations, and videos. These characteristics were taken into consideration in developing the E-Student Worksheet to ensure that the teaching materials aligned with students' needs and learning preferences. Furthermore, students' critical thinking skills still needed to be facilitated, as the analysis revealed that their average critical thinking performance remained low. The preliminary test showed that the inference indicator accounted for only 11%. This finding indicates that students' ability to draw conclusions based on available information and evidence still needs to be supported. Therefore, learning activities should provide opportunities for students to interpret information, analyze problems, evaluate information and evidence, draw conclusions, provide explanations, and reflect on their thinking processes. These findings indicate that teaching materials should not merely present information but should also include activities that encourage active student participation in thinking and inquiry processes. However, the teaching materials are designed to facilitate critical thinking skills rather than demonstrate an improvement in students' abilities, as this study has not yet examined the effectiveness of the developed product.

Furthermore, task and material analysis provides the basis for determining the activities and scope of the content to be developed. The integration of the six stages of Inquiry Learning provides a structured framework for students to engage in scientific inquiry systematically. These stages are linked to local wisdom, allowing measurement concepts to be learned through contexts that are familiar and relevant to students' daily lives. The material, which covers physical quantities and units, unit conversion and scientific notation, and length-measuring instruments, is organized sequentially and interconnectedly to support students' understanding of measurement systems. Finally, learning objective analysis serves as the basis for determining the direction of the activities developed in the E-Student Worksheet. The learning objectives focus on students' ability to apply measurement systems through scientific inquiry to explain everyday phenomena logically and scientifically. This indicates that learning is directed not only toward conceptual mastery but also toward the application of concepts through scientific activities. The results of the define stage provide the foundation for the design stage, in which an interactive, systematic, contextual, Inquiry Learning-based E-Student Worksheet is designed to incorporate activities that facilitate students' critical thinking skills.

During the design stage, the local-wisdom-integrated Inquiry Learning-based E-Student Worksheet was designed using an appropriate development process and writing structure. The components of the E-Student Worksheet include the title, learning instructions, competencies, supporting information, tasks or working procedures, and assessment [21]. The structure of the local-wisdom-integrated Inquiry Learning-based E-Student Worksheet was then adapted to the following phases: (1) orientation, (2) conceptualization, (3) investigation, and (4) conclusion. Furthermore, each activity in the E-Student Worksheet was designed to strengthen the six critical thinking skills indicators proposed by Facione, namely interpretation, analysis, inference, evaluation, explanation, and self-regulation [3]. After the local-wisdom-integrated Inquiry Learning-based E-Student Worksheet was developed, the product was evaluated before implementation through expert validation to assess its alignment with the learning objectives, measurement content, and critical thinking skills indicators. Subsequently, a practicality test was conducted during the development stage, involving one physics teacher and students as respondents.

The development stage was conducted to ensure the quality of the Inquiry Learning-based E-Student Worksheet integrated with local wisdom on the topic of measurement. Two activities were carried out at this stage: validity testing and practicality testing. The validity test involved five physics experts from the Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang (FMIPA UNP), who assessed the feasibility of the product. The validation covered seven aspects: content substance, visual communication design, E-Student Worksheet components, software utilization, implementation of the Inquiry Learning model, critical thinking skills, and the integration of local wisdom. The validation results indicated that the developed E-Student Worksheet met the validity criteria across all assessed aspects. The content substance aspect was assessed based on four indicators: accuracy, material coverage, currency, and readability. The material presented in the E-Student Worksheet was based on accurate physics concepts, aligned with the learning objectives and Indicators of Learning Objective Achievement (IKTP), provided appropriate coverage, reflected developments in science and the Merdeka Curriculum, and used language that was easy to understand. These results indicate that the content of the E-Student Worksheet was systematically organized and aligned with learning needs. This finding is supported by [22], which highlights the importance of material relevance, content quality, and language in ensuring that an E-Student Worksheet can be effectively used as a learning resource.

In the visual communication aspect, the assessment covers navigation, typography, media, color, and layout. The E-Student Worksheet provides clear navigation and instructions, uses readable font styles and sizes, incorporates images that support information delivery, and features a balanced combination of colors and layout. These findings are supported by [23], which indicates that the arrangement of visual elements, including appearance, illustrations, and readability, contributes to effective information presentation in E-Student Worksheets and supports their usability for students. Therefore, these visual elements help clarify information and improve readability, enabling students to follow the learning activities more easily. In the E-Student Worksheet components aspect, the assessment covers the title, learning instructions, competencies, supporting information, work procedures, assessment, author information, and references. The validation results indicate that all components are included and organized according to learning needs, resulting in a complete and systematic structure. These findings are supported by[24], which indicates that E-Student Worksheets containing complete learning components provide a structured sequence of activities that supports a more organized learning process. Thus, the completeness of the E-Student Worksheet components is an important aspect of ensuring the systematic presentation of learning activities.

In the software utilization aspect, the assessment covers the indicators of interactivity, software support, and originality. This aspect is relevant to the characteristics of the developed product, as the E-Student Worksheet is

designed as an electronic teaching material that utilizes technology to support learning activities. The findings indicate that the use of TopWorksheets in the E-Student Worksheet is highly appropriate for supporting the presentation of digital teaching materials and enhancing student interactivity. Software utilization enables the E-Student Worksheet to be presented interactively and to incorporate various learning components, such as supporting information, images, work procedures, and activities that students can complete online. This finding is supported by study [25], which explains that the integration of digital technology into E-Student Worksheets enables students to engage in interactive and exploratory learning activities. Therefore, optimal software utilization not only supports the digital presentation of E-Student Worksheets but also facilitates more interactive and systematic learning activities while encouraging student engagement in the learning process.

In terms of the implementation of the Inquiry Learning model, the assessment covers the alignment of E-Student Worksheet activities with the stages of orientation, conceptualisation, investigation, and conclusion. The activities in the E-Student Worksheet are organized according to these stages, guiding students through a gradual inquiry process, from understanding phenomena to drawing conclusions based on the results of their activities. Therefore, systematically organizing activities in accordance with the learning model is essential to ensure that each learning stage provides students with clear and structured guidance. This finding is supported by [26], which explains that implementing the Inquiry Learning model through systematic stages and interactive features provides opportunities for students to actively engage in discovering and constructing their own understanding independently.

In terms of critical thinking skills, the assessment covers interpretation, analysis, inference, explanation, evaluation, and self-regulation. The activities and procedures in the E-Student Worksheet are designed to help students understand information, analyze relationships between concepts or data, draw conclusions, justify their reasoning, evaluate information or solutions, and reflect on their thinking processes. This finding is supported by [27], which demonstrates that E-Student Worksheets can be designed to facilitate critical thinking skills through learning activities that actively engage students in the thinking process. Thus, the activities in the E-Student Worksheet not only guide students toward obtaining answers but also provide opportunities for them to apply their thinking processes in problem-solving. Finally, the local wisdom aspect assesses the relevance of the content to the culture of West Sumatra, its integration with measurement concepts, the clarity of its presentation, and its contribution to contextual learning and critical thinking skills. In the development of the E-Student Worksheet, local wisdom serves as a context for connecting measurement concepts with students' daily lives and cultural environments, thereby making the concepts more meaningful. This finding is supported by [28], which indicates that integrating local wisdom into physics teaching materials can connect physics concepts with cultural contexts familiar to students, thereby supporting contextual

Furthermore, a practicality test was conducted at SMAN 1 Lubuk Sikaping to assess the practicality of the product, involving one physics teacher and 36 students. The practicality of the E-Student Worksheet was assessed across four aspects: ease of use and readability, presentation, time efficiency, and usefulness. The practicality results showed that usefulness was the highest-rated aspect based on responses from both the teacher and students. This indicates that the E-Student Worksheet helps students engage in learning activities in a more structured manner, understand the learning material, and study independently. This finding is supported by study [29], which demonstrated that the usefulness of an E-Student Worksheet can help students learn and understand physics concepts. Therefore, the E-Student Worksheet was considered beneficial by its users in supporting the learning process.

This study has several limitations. The practicality evaluation involved only one physics teacher and students from one class at a single school; therefore, the findings cannot be widely generalized. Furthermore, the practicality assessment was based on teacher and student responses, which reflect users' perceptions of the product. This study also did not include an effectiveness test to determine changes in students' critical thinking skills after using the E-Student Worksheet. Therefore, the findings are limited to evaluating the product's feasibility and practicality.

The findings suggest that the E-Student Worksheet based on inquiry learning and integrated with local wisdom can be considered an alternative digital teaching material for the topic of measurement, connecting physics concepts with local cultural contexts. Future research is recommended to examine its effectiveness across more diverse samples and schools by measuring students' critical thinking skills before and after using the E-Student Worksheet.

IV. CONCLUSION

Based on the research findings, the Electronic Student Worksheet (E-Student Worksheet) on Measurement, developed using an Inquiry Learning model integrated with local wisdom to facilitate the critical thinking skills of Grade X (Phase E) students, was found to be valid, with an Aiken's V coefficient of 0.93, and highly practical, achieving practicality scores of 94% and 88% based on teacher and student assessments, respectively. The E-Student Worksheet was designed systematically and contextually by integrating the Inquiry Learning model with six indicators of critical thinking skills: interpretation, analysis, inference, evaluation, explanation, and self-regulation. This integration enables the E-Student Worksheet to serve as a teaching material that supports systematic and contextual learning activities while facilitating students' critical thinking skills. However, its effectiveness in improving students' critical thinking skills cannot yet be concluded, as an effectiveness test has not been conducted. Therefore, future research is recommended to evaluate the effectiveness of the E-Student Worksheet by assessing students' critical thinking skills before and after its implementation and involving more diverse samples and schools.

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