



Development of an agroindustry-based contextual interactive e-worksheet to improve students' understanding of statistics learning

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Abstract:

The digital transformation of Statistics learning is crucial in the technology era, as the subject's abstract nature often limits students' comprehension without contextual support. Leveraging Jember Regency's agroindustrial potential provides a meaningful context to make statistical concepts more concrete. This study aimed to develop an interactive agroindustry-based electronic worksheet (*e-worksheet*) integrated into the Wizer.me platform to enhance Statistics learning on measures of central tendency and measures of dispersion. Using Borg and Gall's Research and Development (R&D) model, the study involved students at SMP Negeri 4 Jember. Three experts validated both the research instruments and the developed e-worksheet. The research instruments included diagnostic and summative assessments, teacher response questionnaires, and student response questionnaires. The e-worksheet achieved validity scores of $V_a = 3.84$ (*very valid*) and practicality scores of $V_{us} = 83.42\%$ and $V_{au} = 96.67\%$ (*high practicality*). A paired t-test revealed a significant improvement of 25.39 points in student outcomes at the 95% confidence level, while the N-Gain score of 0.57 indicated moderate effectiveness. These results confirm that the interactive e-worksheet developed meets the criteria for validity, practicality, and effectiveness in supporting Statistics learning, while also fostering contextual learning, enhancing students' understanding, and serving as an enjoyable and engaging learning medium through an innovative digital platform.

Keywords: Agroindustry; e-Worksheet; Statistics Learning; wizer.me.

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Introduction

Learning in the digital era requires persistent adaptation to technological developments to support students' 21st-century competencies, particularly data



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literacy. Learning is fundamentally an activity organized by teachers to facilitate students in constructing knowledge relevant to current needs (Afif, 2019). The rapid development of digital technology has accelerated educational transformation, making technology integration a necessity rather than a complement in modern classrooms (Dinata et al., 2024). Recent studies also indicate that adaptive digital learning programs can significantly improve students' mathematics achievement by supporting mastery of concepts, bridging learning gaps, and providing personalized instruction for different learners (Cartwright et al., 2025). In this context, statistics learning becomes strategically important because it equips students to analyze data, interpret information, and make well-informed decisions in real-life situations (Maswar et al., 2022). However, at the junior high school level, statistics learning still faces major challenges. Topics such as measures of central tendency and dispersion are abstract and are frequently perceived as difficult by students (Sari et al., 2025). Students frequently find it difficult to interpret data representations and apply statistical concepts meaningfully. Strengthening statistical competence at this level is therefore essential to support the development of lifelong learning skills and data-driven reasoning.

One potential approach to surmounting these challenges is contextual learning grounded in authentic local data. Learning based on real-life contexts has been shown to improve students' conceptual understanding (Pangemanan, 2020). In Jember Regency, the agroindustry sector provides rich, measurable empirical data on production, processing, distribution, pricing, and environmental conditions (Pahlevy et al., 2024). Agroindustry activities improve agricultural productivity through technological modernization and value-added processing (Tasya & Novitasari, 2020), making them highly relevant as meaningful contexts for statistics instruction (Wahyuni et al., 2023). Pedagogically, the agroindustry context is highly relevant for statistics learning because it provides authentic numerical data that naturally aligns with core statistical concepts, such as measures of central tendency and dispersion. Real agroindustry data, including production quantities, price fluctuations, and distribution volumes, allow students to analyse variability, compare datasets, and interpret averages in meaningful ways. This contextual approach reduces the abstract nature of statistics and supports deeper conceptual understanding through real-world problem-solving.

Nevertheless, the effectiveness of contextual learning depends on the availability of appropriate learning media. Learning media function as tools to convey information and attract students' attention in the learning process (Harahap et al., 2022). Previous studies have developed environment-based printed worksheets that meet validity, practicality, and effectiveness criteria (Mayangsari et al., 2024). Research on e-modules also reports positive contributions to students' understanding (Puspitasari et al., 2021). Other digital media, such as interactive videos and gamified platforms, improve engagement but commonly lack integration with local contexts (Zahari et al., 2023). Similarly, Articulate Storyline-based media are considered feasible and practical but require substantial storage capacity and are rarely contextualized with agroindustry content (Alhadi & Cholik, 2021). Taken together, these studies show a growing trend toward digital and interactive learning media in statistics education; however, most existing designs still prioritise either technological interactivity or context-based learning, resulting in limited empirical evidence on learning media that systematically integrate interactive digital features with meaningful local contexts, particularly agroindustry-based contexts.

However, to date, few studies have specifically developed interactive e-worksheets that are simultaneously designed according to Problem-Based Learning (PBL) syntax and grounded in local agroindustry contexts for junior high school statistics learning. Existing studies tend to focus on the effectiveness of digital interactivity or contextualized learning independently, without systematically embedding PBL stages into interactive digital worksheets that use authentic local agroindustry data. Such research indicates a clear research gap in the design and empirical validation of PBL-based interactive e-worksheets that integrate digital interactivity with meaningful local contexts in statistics education.

Interactive e-worksheets offer an effective alternative to bridge this gap. Platforms such as Wizer.me enable teachers to design multimedia-based interactive worksheets with automated assessment features (Nildasari & Nur, 2024; Oktaviani et al., 2023). The integration of interactive e-worksheets with the Problem-Based Learning (PBL) approach emphasizes structured problem-solving through stages of orientation, investigation, presentation, and evaluation (Tiara et al., 2024). This approach has been shown to improve students' conceptual understanding and analytical problem-solving skills (Widiartini & Sudiatmika, 2025). Previous studies have shown that implementing PBL can improve students' problem-solving beliefs and provide meaningful opportunities for students to participate in authentic problem-based activities (Shongwe, 2024). In this study, the developed e-worksheet is explicitly structured according to PBL syntax, making sure that each learning activity systematically guides students through problem identification, data analysis, solution development, and evaluation.

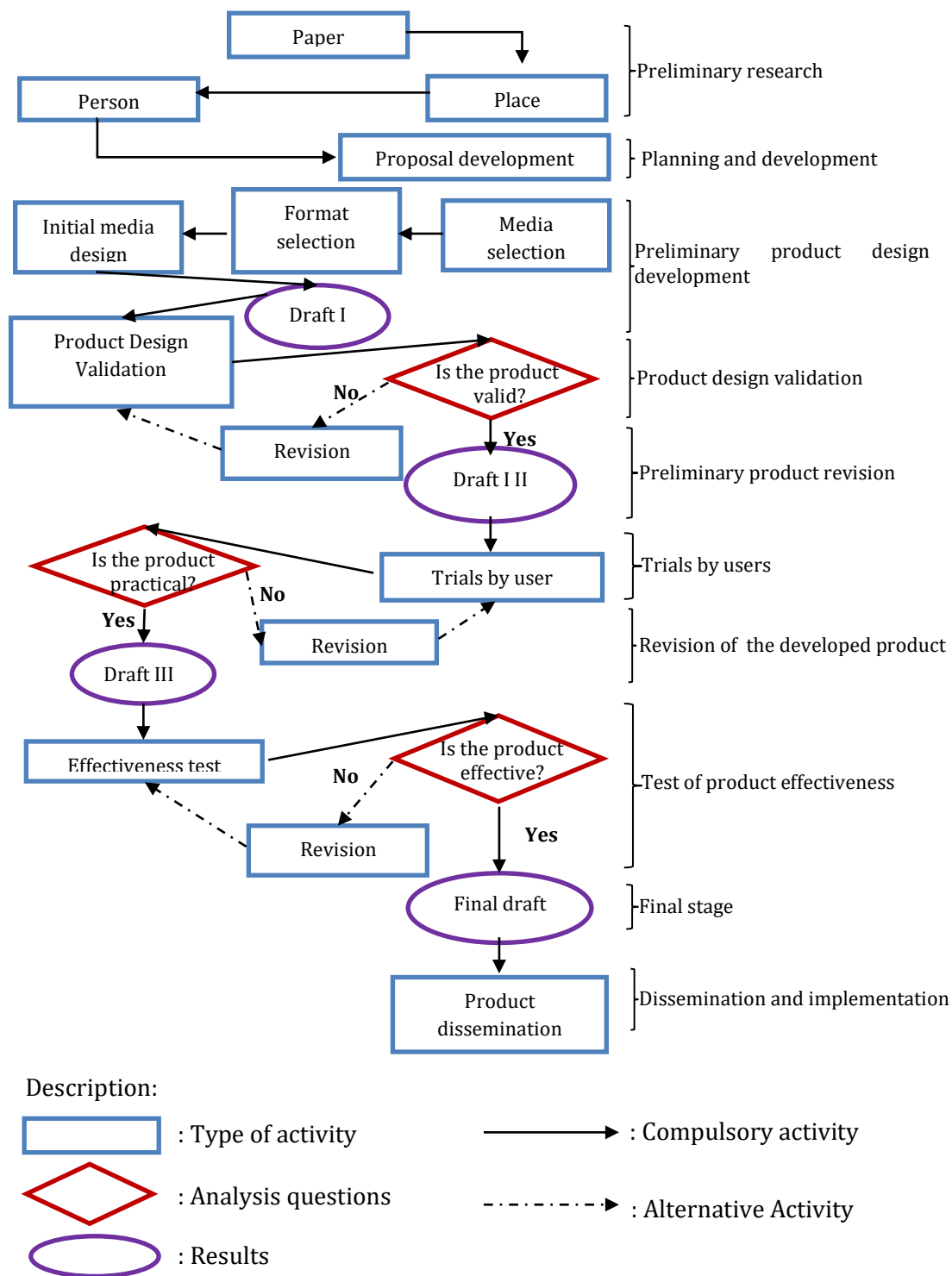
The novelty of this study lies in the systematic integration of Problem-Based Learning (PBL) syntax into an interactive digital e-worksheet explicitly grounded in local agroindustry contexts for junior high school statistics learning. Unlike previous studies that tend to emphasize either digital interactivity or contextualized learning independently, this study combines interactive digital features, authentic agroindustry data, and structured PBL stages into a single instructional design. Furthermore, this study offers empirical evidence on the validity, practicality, and effectiveness of the developed e-worksheet, thereby providing a comprehensive contribution to the development of contextual, technology-integrated statistics learning media.

Based on preliminary observations at SMP Negeri 4 Jember, statistics learning has not yet utilized interactive platforms such as Wizer.me nor integrated agroindustry-based local contexts. This condition reveals a gap between instructional needs and existing classroom practices. Therefore, this study aims to develop an interactive agroindustry-based e-worksheet using the Wizer.me platform, integrated with Problem-Based Learning (PBL) syntax, to support meaningful, context-based statistics learning at the junior high school level. The expected outcome of this study is the production of an interactive e-worksheet that meets validity, practicality, and effectiveness criteria, and that contributes pedagogically to the development of contextual statistics learning models based on local agroindustry potential through interactive digital media.

Research Methods

This research uses the Research and Development (R&D) method, which entails creating or developing products and testing their effectiveness through a scientific

process (Okpatrioka, 2023). This study adopts a 10-stage framework developed by Borg and Gall, comprising the following stages: preliminary research, planning and development, preliminary product design development, product design validation, preliminary product revision, trials by users, revision of the developed product, test of product effectiveness, final stage, dissemination and implementation (Prihandini et al., 2023; Waruwu, 2024).



Picture 1. Borg and Gall Modified Research Procedures

The Borg and Gall model was selected because it supports the development of educational products that are adaptive, relevant, and based on real-world needs, making it widely applicable in educational research (Rahmatin et al., 2025; Umar et al., 2023). Picture 1 illustrates the research procedure. This research aims to develop agroindustry-based interactive learning media using the Wizer.me platform, which has been assessed for validity, practicality, and effectiveness in supporting Statistics learning, particularly in the topics of measures of central tendency and measures of dispersion.

The research was conducted from January 17 to September 30, 2025, at SMP Negeri 4 Jember. The research instruments included diagnostic and summative test items, a student response questionnaire, and a teacher response questionnaire. The Preliminary research stage was conducted through interviews with the principal and mathematics teachers to explore the implementation of statistics learning at the school. At the planning and development stage, a research proposal was prepared to guide the implementation and secure alignment with the research objectives. The preliminary product design development stage involved creating material drafts, designing learning media, developing interactive digital learning designs, and preparing drafts of diagnostic and summative test items, a student response questionnaire, and a teacher response questionnaire, which resulted in Draft I.

The product design validation stage was conducted with three expert validators from the University of Jember, all faculty members of the Mathematics Education Study Program. These validators comprised one professor, one doctoral degree holder, and one master's degree holder in mathematics education. They were assigned to evaluate the feasibility and content quality of the developed product, which included drafts of diagnostic and summative assessments, a student response questionnaire, a teacher response questionnaire, and the e-worksheet. The preliminary product revision stage was carried out based on the feedback from the three experts, resulting in Draft II.

The user trials stage, involving one mathematics teacher and 16 grade VIII students at the school during the 2024/2025 academic year, was designed to determine the practicality of the product in real learning situations. This stage was carried out through a questionnaire completed by both teachers and students. The revision of the developed product stage was conducted based on practicality tests. The researcher carried out revisions to improve the product, making it better suited to the users' needs and characteristics, before further testing or implementation. This stage resulted in Draft III. The effectiveness test stage is conducted for grade IX students in the 2025/2026 academic year, involving 24 students. This stage aims to measure the extent to which the development product positively impacts student learning outcomes. Effectiveness data are collected through diagnostic and summative assessments for evaluating improvements in conceptual understanding before and after using the product.

To optimize testing effectiveness, the implementation aligned with the Problem-Based Learning (PBL) model. The PBL syntax was operationalized as structured learning activities embedded in the e-worksheet across five systematic stages. First, students were oriented toward contextual agroindustry-based statistical problems presented at the beginning of the e-worksheet. Second, students were organized for learning through individual and small-group work, using guided instruction and digital worksheet features. Third, the e-worksheet facilitated both individual and collaborative

investigation through exploratory questions, data analysis tasks, and structured prompts. Fourth, students developed and presented their problem-solving outcomes by completing interactive response sections and reflecting on their findings. Finally, the e-worksheet guided students in analyzing and evaluating the problem-solving process through self-reflection activities. This procedurally based integration ensured that the PBL stages were systematically implemented in the e-worksheet to promote active learning, critical thinking, and collaborative knowledge construction during the effectiveness testing phase. The e-worksheet was implemented across three instructional meetings, consisting of a diagnostic test and introduction to the Wizer.me platform (2 × 40 minutes), the implementation of the e-worksheet in classroom learning (3 × 40 minutes), and a summative assessment administered through Wizer.me (2 × 40 minutes). The final stage is completing the Final Draft of the learning media product. The last stage of research is the dissemination and implementation of the product. According to Hobri (2010), the instrument's validation level is determined using the following formula.

$$I_i = \frac{\sum_{j=1}^n V_{ji}}{n} \tag{1}$$

wherein:

- I_i = average score of the i -th indicator
- V_{ji} = score given by the j -th validator on the i -th indicator
- j = validator 1. 2. , , , . n
- i = indicator 1, 2, ... (as many indicators as assessed)
- n = total number of validators

The overall average validation value for all aspects can be determined using the following formula:

$$A_p = \frac{\sum_{i=1}^m I_{ip}}{m} \tag{2}$$

wherein:

- A_p = average score of the p -th aspect
- I_{ip} = average score of the p -th aspect on the i -th indicator
- i = indicator 1. 2. , , , . m
- p = aspect 1, 2, ... (as many aspects as assessed)
- m = total number of indicators

The next step is to calculate the total average validation value for all aspects using the following formula.

$$V_a = \frac{\sum_{p=1}^k A_p}{k} \tag{3}$$

wherein:

- V_a = The overall average validity score across all aspects
- A_p = average score of the p -th aspect
- p = aspects assessed 1. 2. 3. , , , . k
- k = total number of aspects assessed

The instrument validity criteria are presented in Table 1.

Table 1. Instrument validity criteria

Value of V_a	Category
$3.5 \leq V_a \leq 4$	Very Valid
$2.5 \leq V_a < 3.5$	Valid
$1.5 \leq V_a < 2.5$	Less Valid
$1 \leq V_a < 1.5$	Not Valid

Source: Asfar et al. (2022)

According to Akbar (as cited in Irawan & Hakim, 2021), the practicality test is conducted by analyzing questionnaire data (audience) and student (user) perception questionnaire data. Teacher perception data (individual) are analyzed using the following formula:

$$V_{au} = \frac{TS_{em}}{TS_{exp}} \times 100\% \quad (4)$$

wherein:

- V_{au} = audience validation
- TS_{em} = total empirical score
- TS_{exp} = total expected score

The formula for analyzing the student perception questionnaire data is as follows.

$$V_{us} = \frac{TS_{em}}{TS_{exp}} \times 100\% \quad (5)$$

Wherein:

- V_{us} = user validation
- TS_{em} = total empirical score
- TS_{exp} = total expected score

The practicality criteria of learning media are presented in Table 2 below.

Table 2. Instrument practicality criteria

Criterion	Category
$80\% \leq (V_{au} \text{ or } V_{us}) \leq 100\%$	Very Practical
$60\% \leq (V_{au} \text{ or } V_{us}) < 80\%$	Practical
$40\% \leq (V_{au} \text{ or } V_{us}) < 60\%$	Quite Practical
$20\% \leq (V_{au} \text{ or } V_{us}) < 40\%$	Impractical
$0\% \leq (V_{au} \text{ or } V_{us}) < 20\%$	Very Impractical

Source: Ramadhan et al. (2020)

This study used a quantitative, pre-experimental design, specifically the one-group pretest–posttest design. In this design, a single group of participants is administered a pretest before the intervention and a posttest after the intervention to examine the treatment effect. The structure of this design is represented as $O_1 \rightarrow X \rightarrow O_2$, where O_1 represents the pretest, X the treatment, and O_2 the posttest (Creswell & Creswell, 2023). In this study, the pretest was used as a diagnostic assessment, and the posttest as a summative assessment. The comparison between diagnostic and summative assessment scores was then analyzed to determine the effectiveness of the intervention. In this study, both descriptive and inferential statistical analyses were conducted using PSPP software. PSPP is a free and open-source statistical software package written in C that provides essential tools for statistical analysis in academic and research contexts. It offers a wide range of procedures, including descriptive statistics, Independent and Paired Sample t-tests, one-way and two-way ANOVA, MANOVA, generalized linear models, normality tests, regression, robust data handling, and multiple data analysis (Machendranath & Naik, 2019).

The descriptive statistics included the mean, standard deviation, minimum, maximum, and normalized gain (*N-Gain*) scores. The inferential statistics consisted of the outlier test, the normality test, and the paired *t*-test. A paired *t*-test was applied when the difference between diagnostic and summative assessment values was normally distributed (Talikan et al., 2024). If the difference in values was not normally distributed, the Wilcoxon Signed Rank test was employed (Afifah et al., 2025; Ahmad & Indah, 2025). The normality test was conducted using the Shapiro–Wilk test because the dataset was relatively small, with fewer than 50 observations (Ahadi & Zain, 2023; Salim et al., 2024). The level of significance was set at $\alpha = 0.05$.

In this study, the hypotheses for the normality test are stated as follows:

- H₀: Data are normally distributed
- H₁: Data are not normally distributed

The test statistic for this procedure is

$$W = \frac{1}{\sum_{i=1}^n (D_i - \bar{D})^2} [\sum_{i=1}^n a_i (D_{n-i+1} - D_i)]^2 \quad (6)$$

where

$$\bar{D} = \frac{\sum_{i=1}^n (y_i - x_i)}{n} \quad (7)$$

$$D_i = y_i - x_i \quad (8)$$

$$D_{n-i+1} = y_{n-i+1} - x_{n-i+1} \quad (9)$$

wherein:

- W = test statistic of the Shapiro-Wilk test
- a_i = coefficients of the Shapiro-Wilk test
- x_i = students' diagnostic assessment scores of the *i*-th student
- y_i = students' summative assessment scores of the *i*-th student
- n = Total number of students

The variables $k = \frac{n}{2}$ for an even number of n , and $k = \frac{n-1}{2}$ for an odd number of n . The test criterion states that H_0 is rejected H_0 if $p < \alpha$ or if $sig. < \alpha$, where p is obtained from Shapiro-Wilk's quantile table (Salim et al., 2024).

The hypotheses for the paired t-test are as follows:

- H_0 : There is no significant difference in the average scores between diagnostic and summative assessments.
 H_1 : There is a significant difference in the average scores between diagnostic and summative assessments.

The level of significance used was $\alpha = 0.05$. The statistical values for the paired t-test are:

$$t_{count} = \frac{\bar{D}}{S_D/\sqrt{n}} \quad (10)$$

with

$$\bar{D} = \frac{\sum_{i=1}^n (y_i - x_i)}{n} \quad (11)$$

$$S_D = \sqrt{\frac{n(\sum_{i=1}^n D_i^2) - (\sum_{i=1}^n D_i)^2}{n(n-1)}} \quad (12)$$

wherein:

- x_i = students' diagnostic assessment scores of the i -th student
- y_i = students' summative assessment scores of the i -th student
- n = Total number of students
- \bar{D} = The average difference between diagnostic and summative assessment scores

The test criterion states that H_0 is rejected if $t_{count} < -t_{\frac{\alpha}{2};(n-1)}$ or $t_{count} > t_{\frac{\alpha}{2};(n-1)}$ or if $sig. < \alpha$ (Salim et al., 2024).

The normalized gain (N-Gain) indicates the degree of improvement achieved after administering the learning media. According to Hake (as cited in Farida et al., 2022), the N-Gain formula is as follows.

$$N - Gain_i = \frac{y_i - x_i}{Maximum\ score - x_i} \quad (13)$$

where:

- $N - Gain_i$ = N-Gain of the i -th student
- x_i = students' diagnostic assessment scores of the i -th student
- y_i = students' summative assessment scores of the i -th student

The maximum score in this study was 100. The individual N-Gain ($N-Gain_i$) was calculated to measure each student's improvement from the diagnostic assessment to the summative assessment. The mean N-Gain (g) represents the average gain of the group, and its interpretation criteria are shown in Table 3.

Table 3. Interpretation Criteria for Mean N-Gain (g)

Criterion	Category
$g \geq 0.7$	High
$0.3 \leq g < 0.7$	Medium
$g < 0.3$	Low

Source: Hake in Wulandari et al. (2019)

Results and Discussions

Research result

The research and development process followed ten systematic stages: (1) preliminary research; (2) planning and development; (3) preliminary product design; (4) product design validation; (5) preliminary product revision; (6) trials by users; (7) revision of the developed product; (8) test of product effectiveness; (9) final stage; and (10) dissemination and implementation. Progressing through each stage sequentially ensured that the developed e-worksheet was valid, practical, and effective.

Preliminary research

The preliminary research stage was carried out through direct interviews with the principal and mathematics teachers at SMP Negeri 4 Jember. The results of the interviews indicated that teachers had never used the Wizer.me platform in classroom learning activities. Digital-based learning has already been implemented using platforms such as Liveworksheets. Although the platform already provides interactive practice questions, it does not enable teachers to administer automated assessments and lacks support for presenting contextual, in-depth content. The teacher noted that Statistics learning had never been connected to the agroindustry context. This context offers local opportunities in the students' surrounding environment. A contextual approach that links subject matter to students' real-life experiences is seen as capable of raising engagement and improving conceptual understanding.

The information obtained in the preliminary research stages reinforces the urgency of developing an interactive e-worksheet tailored to the local agroindustry context to enhance the relevance and meaningfulness of students' learning experiences. The integration of the agroindustry context into the Statistics material is expected to facilitate a deeper, more practical understanding of the concept.

Planning and development

In the planning and development stage, the researcher prepares a research proposal that serves as the primary document guiding the implementation of the entire research process. By preparing the proposal, the researcher ensures that each stage of the activities is carried out systematically and in alignment with the research's primary goal: to develop an agroindustry-based, contextually interactive e-worksheet to improve students' understanding of Statistics. Following this, the researcher determines the

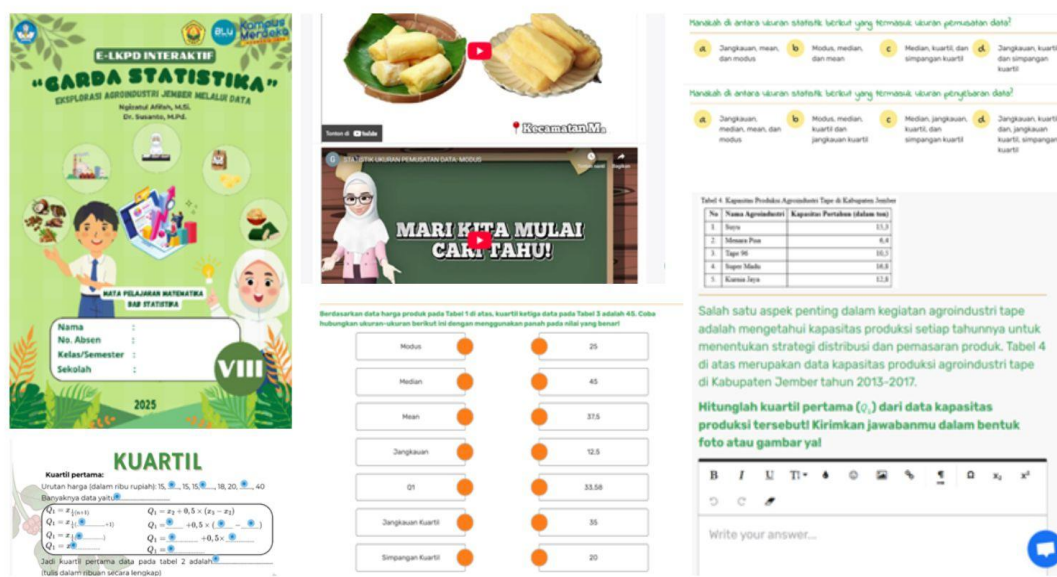
schedule of activities, the resources required, and the instruments to be used in the data collection process.

The results of teacher interviews served as the basis for developing a learning media design relevant to the local context, specifically the agroindustry surrounding Jember. The free version of the Wizer.me platform was chosen as the e-worksheet development medium because it offers ease of access, interactive features that support automatic assessment, and flexibility in designing instructional content.

Preliminary product design development

In the preliminary product design development stage, the researcher prepares a draft of learning materials customized to the predetermined basic competencies and learning objectives. The preparation of the material is conducted with attention to pedagogical principles, contextual content, and the integration of mathematical concepts with the agroindustry theme that characterizes Jember Regency. An engaging visual approach is applied through communicative, aesthetically designed elements, using the Canva platform as the primary medium. The design's attractive appearance is expected to increase students' attention and interest in the learning process.

The materials were subsequently developed and integrated into the Wizer.me platform as an interactive e-worksheet. The platform enables the incorporation of various interactive features, including Open Question, Multiple Choice, Matching, Text, Video, and the Ability to import a Canva design, to enhance active engagement and promote learners' deep understanding of the concepts being taught. The preparation of this e-worksheet also considers the logical sequence of learning and the diversity of activities that encourage active student participation. The results of this entire process are referred to as Draft I, which is prepared for validity by expert validators.



Picture 2. Interactive e-Worksheet Interface Displays

Product design validation

To begin with, the design validation process was carried out for five components: e-worksheet, diagnostic assessment, summative assessment, teacher response

questionnaire, and student response questionnaire. Each component was evaluated using a 4-point Likert scale. Subsequently, the average score for each aspect was calculated, followed by the overall validity score (V_a).

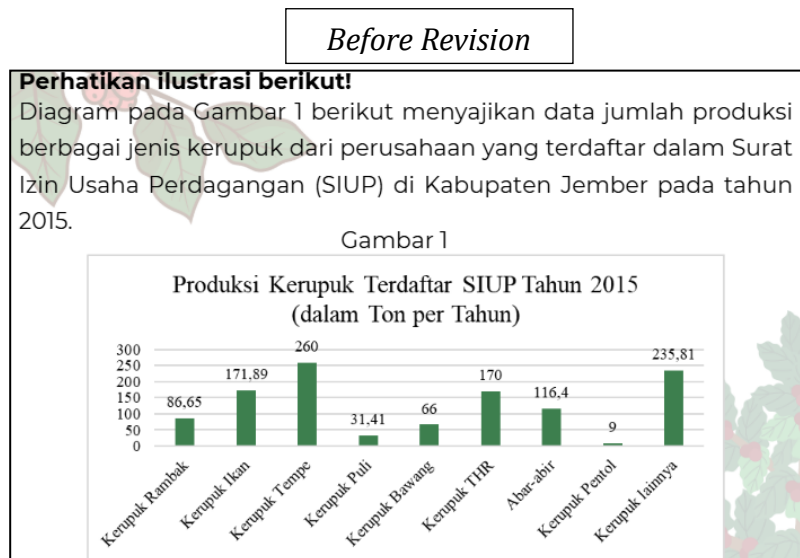
Table 4. The instrument validation results

Instrument	Validity Score	Category
e-Worksheet	3.84	Very valid
Diagnostic Assessment	3.73	Very valid
Summative Assessment	3.77	Very valid
Teacher Response Questionnaire	3.89	Very valid
Student Response Questionnaire	3.81	Very valid

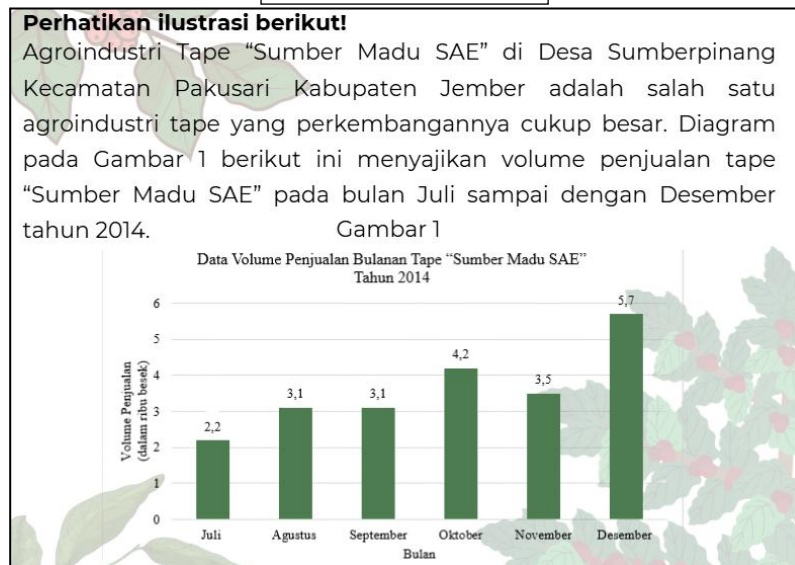
The validation results indicate that all developed instruments fall into the very valid category. The e-worksheet achieved an average score of 3.84, demonstrating its appropriateness in terms of format, content, and language. The diagnostic assessment obtained an average score of 3.73. In contrast, the summative assessment reached 3.77, which was classified as very valid, indicating that the test items are suitable for identifying students' initial understanding and evaluating their overall learning outcomes. In addition, the teacher response questionnaire received the highest score of 3.89, and the student response questionnaire obtained 3.81, both in the very valid category, confirming their reliability in capturing teachers' and students' perceptions. Collectively, these results affirm that the developed instruments are valid and feasible for application in both learning and research contexts. Nevertheless, the validators also provided suggestions for minor revisions to the e-worksheet and research instruments to further enhance their quality.

Preliminary product revision

Building on these findings, the preliminary product revision stage was carried out based on input from validators, resulting in Draft II, an improved version of the e-worksheet developed in Draft I. The revisions involved modifying the examples to align with the topic of mode while using the agro-industrial theme. The following section presents the results of the revision based on the validator's directions, as shown in Picture 3.



After Revision



Picture 3. Mode Topic Content Revision

In the diagnostic and summative assessments, the validators recommended revisions to items numbers 4 and 5. The improvements were directed toward strengthening the contextual link between the mathematical concepts and the agro-industrial theme, so that the questions not only assess students' understanding of the topic but also reflect the relevance of mathematics in real-life agro-industrial practices. The following section explains:

1. Diagnostic assessments revision

a. Diagnostic assessments before revision

1. What is meant by agroindustry?
2. Name the various types of agro-industrial activities in Jember Regency! (Just three)

a. Diagnostic assessments after revision

CV Sumber Sari in Jember Regency is an agro-industrial business engaged in coconut fibre processing. This business produces cocopeat and cocofiber. The business owner wanted to analyze revenue data to determine the most effective sales strategy. Total revenue from 2011 to 2015 was:

2011: Rp 1.27 billion

2012: Rp 1.97 billion

2013: Rp 2.36 billion

2014: Rp 2.76 billion

2015: Rp 3.07 billion

Question:

1. What was the average total revenue per year from 2011 to 2015?
2. What is the median of the total revenue data?
3. What is the range of the total revenue data?
4. What is the first quartile (Q_1) of the data?

2. Summative assessments revision
 - a. Summative assessments before revision
 1. What is meant by agroindustry?
 2. Name the various agro-industrial activities in Jember Regency! (Just three)
 - b. Summative assessments after revision
-

Table 2. Price Data for Tempe Sumber Mas Business Products

No	Types of Tempeh Products	Price (in thousand rupiah)
1	350 grams of tempeh	5
2	450 grams of tempeh	6
3	650 grams of tempeh	8
4	800 grams of tempeh	10
5	1.200 grams of tempeh	15

A home-based agroindustry business produces tempeh in various sizes, as shown in Table 2. Each size is priced differently. The business owner wants to analyze product pricing data to determine an appropriate sales strategy.

Question:

1. Calculate the average price of the tempeh product!
 2. Determine the median value of the data!
 3. What is the price range of the tempeh product?
 4. Calculate the first quartile (Q_1) of the price data.
-

Additionally, the validators suggested adding an agroindustrial integration aspect to both the teacher and student response questionnaires. This enhancement was designed to ensure that these instruments not only captured perceptions of the learning process but also reflected the integration of mathematics with agroindustrial practices. In the teacher response questionnaire, this aspect was added as shown below.

- a. The material or context in the e-worksheet is linked to the real world of agroindustry.
 - b. The questions in the e-worksheet involve data or problems relevant to the local agroindustry.
 - c. The e-worksheet fosters students' understanding of the role of statistics in the agroindustry sector.
-

Correspondingly, the student response questionnaire was also revised to include the agroindustrial integration aspect below.

- 6.a. The material in the e-worksheet is related to the real world of agroindustry.
 - 6.b. The questions in the e-worksheet involve data or problems relevant to the agroindustry.
 - 6.c. The e-worksheet has enhanced my understanding of the role of statistics in the agroindustry sector.
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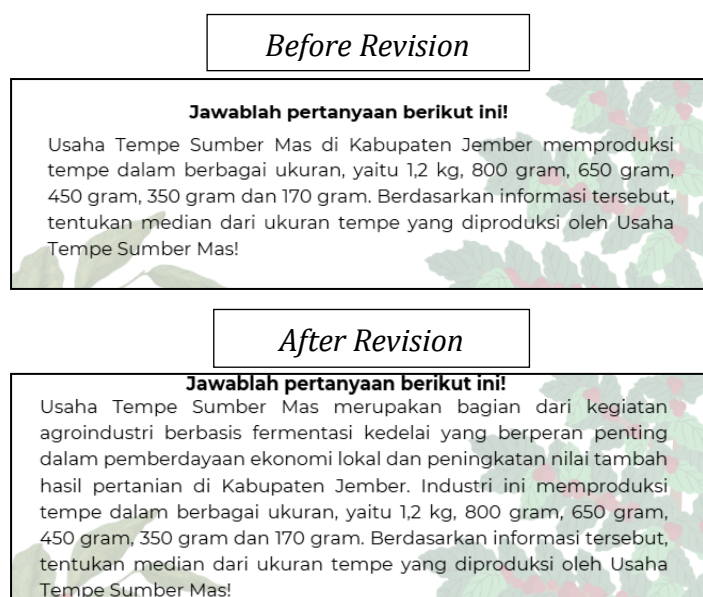
Table 5. Practicality test results

Respondent	Total Empirical Score Obtained	Total Expected Score	Validation Score	Category
Teacher	58	60	96,67%	Very Practical
Students	961	1152	83.42%	Very Practical

The teacher response questionnaire covered appearance, feasibility of content, usefulness, language, and agroindustry integration. Based on the teacher's practicality questionnaire, a score of 58 out of 60 was obtained, with a practicality coefficient of 96,67%, placing it in the very practical category. It indicates teachers found the developed media highly practical and supportive of learning. The student response questionnaire included appearance, content, benefits, language, interactivity, and integration with agroindustry. A practicality questionnaire was also administered to 16 students. Across six aspects, the total score was 961 out of 1152, corresponding to 83.42%, also classified as very practical. These findings indicate the e-worksheet meets practicality criteria for classroom use.

Revision of the developed product

Although user trials showed that the e-worksheet media was already considered very practical, minor revisions were made to further improve it. Specifically, introductory editorial sentences were added to clarify that the illustrated activities represent agro-industrial practices. For the topics of median, mean, and range, sentences were inserted to explicitly connect the activity descriptions in the story-based questions to agro-industrial contexts in Jember Regency. The revised materials are displayed in Pictures 4, 5, and 6.



Picture 4. Median Topic Content Revision

Before Revision

Formula Mean

$$\bar{x} = \sum_{i=1}^n x_i$$

Keterangan:
 n = banyaknya data
 x_i = data ke- i

Tabel 1

Tahun	Penerimaan
2014	2,76
2015	3,04
2016	4,04
2017	4,61
2018	3,25

Tabel 1 di atas merupakan total penerimaan dari agroindustri sabut kelapa CV Sumber Sari di Kabupaten Jember selama periode tahun 2014 dan tahun 2018.

Hitunglah rata-rata (mean) total penerimaan agroindustri sabut kelapa dari tahun 2014 hingga 2018! Tahun-tahun manakah yang memiliki total penerimaan di atas rata-rata?

After Revision

Formula Mean

$$\bar{x} = \sum_{i=1}^n x_i$$

Keterangan:
 n = banyaknya data
 x_i = data ke- i

Tabel 1

Tahun	Penerimaan
2014	2,76
2015	3,04
2016	4,04
2017	4,61
2018	3,25

Jawablah pertanyaan berikut ini!
 CV Sumber Sari adalah satu-satunya agroindustri pengolahan sabut kelapa di Kabupaten Jember yang mampu bertahan dan berproduksi secara berkelanjutan. Tabel 1 di samping merupakan total penerimaan dari sabut kelapa CV Sumber Sari di Kabupaten Jember selama periode tahun 2014 dan tahun 2018.

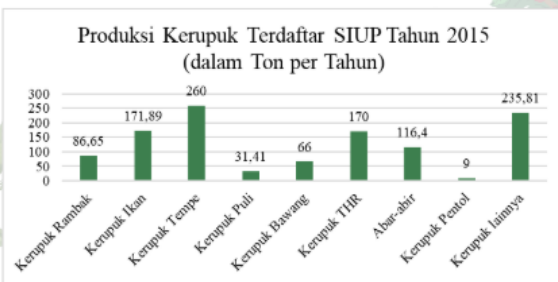
Hitunglah rata-rata (mean) total penerimaan agroindustri sabut kelapa dari tahun 2014 hingga 2018! Tahun-tahun manakah yang memiliki total penerimaan di atas rata-rata?

Picture 5. Mean Topic Content Revision

Before Revision

Gambar 1

**Produksi Kerupuk Terdaftar SIUP Tahun 2015
(dalam Ton per Tahun)**



Berapakah jangkauan data berdasarkan diagram pada gambar 3 di atas?

After Revision



Picture 6. Range Topic Content Revision

Test of product effectiveness

The e-worksheet was developed according to the Problem-Based Learning (PBL) framework and applied during the user trial stage. In the orientation stage, students were introduced to agroindustry problems, such as production data or product marketing prices, which encouraged them to identify relevant statistical concepts. During the organizing stage, students were guided to plan learning activities by analyzing agroindustry case data provided in the e-worksheet. During the guided investigation stage, they worked individually and collaboratively to process agroindustry datasets, conduct statistical analyses, and solve context-based problems, with teachers acting as facilitators. In the developing and presenting stage, students synthesized findings, reported their solutions through the e-worksheet, and presented agroindustry-related interpretations for peer discussion. Finally, in the analysis and evaluation stage, both teachers and students reflected on the problem-solving process, validated the accuracy of the statistical solutions, and connected the results to real-world agroindustry practices.

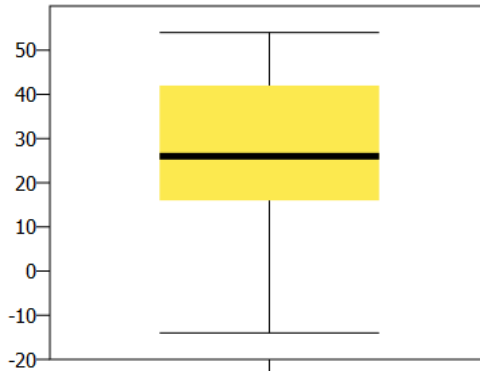
The product effectiveness test was conducted on 24 grade IX students in the 2025/2026 academic year at SMP Negeri 4 Jember. At this stage, a student response questionnaire was also administered to 24 participants to evaluate the developed e-worksheet. The results showed a total score of 1556 out of a maximum of 1728, yielding a percentage of 90.04%. Table 6 presents descriptive statistics for the effectiveness test data, including measures of central tendency and dispersion (Afifah & Salim, 2021).

Table 6. Statistics descriptive of effectiveness tests

Variabel	N	Mean	Std. Dev	Minimum	Maximum
Diagnostic Tests	24	53.38	19.44	10	84
Summative Tests	24	78.75	20.64	37	100
Difference	24	25.38	18.33	-14	54
Valid N (listwise)	24				
Missing N (listwise)	0				

Based on the results of descriptive statistics as shown in Table 6, the average score increased by 25.38 points. Descriptively, this indicates that scores improve after using the learning media. However, to determine whether this increase was statistically significant and not merely coincidental, a paired t-test was required. The measured difference was obtained by subtracting the diagnostic assessment score from the summative assessment score.

Additionally, as shown in Picture 5, the measured difference contained no outliers, making the data suitable for further analysis using the Shapiro-Wilk normality test.



Picture 7. Boxplot of Measured Differences

Based on the Shapiro-Wilk Quantile Table, the value of $W = 0.96$ with $n = 24$ in Table 7 falls between 0.930 and 0.963, which indicates that the value of p lies between 0.1 and 0.5. By interpolation, it was determined to be 0.46. Since $p > 0.05$, the decision is to fail to reject the null hypothesis. Supported by the significance value ($sig. = 0.51$), which is $sig. > 0.05$. Therefore, the null hypothesis is not rejected, indicating that, at the 95% confidence level, the difference between summative and diagnostic assessment scores is normally distributed and thus meets the requirements for proceeding with the paired t-test.

Table 7. Shapiro-Wilk test

Variabel	Statistik	Df	Sig.
Difference	0.96	24	0.51

Table 8 shows that $t_{count} = 6.78$, which is greater than $t_{(0.05;23)} = 2.06$. The decision is to reject the null hypothesis. A similar decision was also supported by the significance level ($sig. = 0.00$), which is less than the $\alpha = 0.05$ threshold. Thus, the null hypothesis is rejected. At the 95% confidence level, it was determined that there is a significant difference between the diagnostic and summative assessment scores. Therefore, the use of an agro-industry-based interactive e-worksheet developed on the Wizer.me platform effectively improves students' ability to learn statistics.

Table 8 Paired t-test results

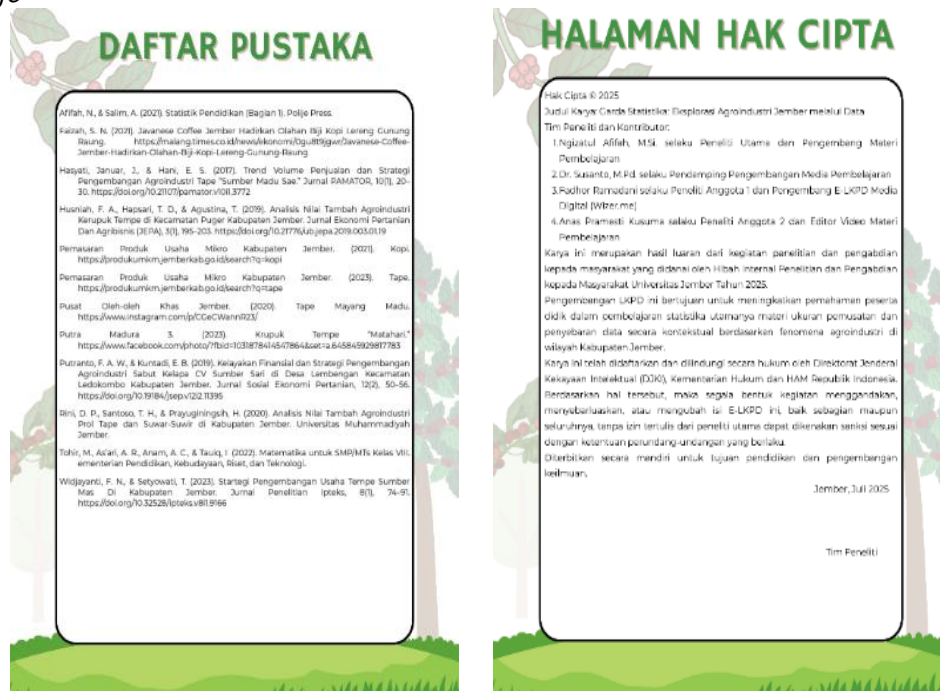
Test Pairs	Mean	Std. Deviation	Std. Error Mean	95% CI Lower	95% CI Upper	T	df	Sig. (2-tailed)
Summative Test – Diagnostics Test	25.38	18.33	3.74	17.63	33.12	6.78	23	0

The final test conducted was the N-Gain test. The obtained $g = 0.57$, as shown in Table 9, falls within the medium category. These findings demonstrate that the interactive learning medium effectively supports learning, though further improvements could enhance its impact. In conclusion, the results of both the t-test and the N-Gain test confirm that the developed interactive e-worksheet has met the effectiveness criteria as a learning medium.

Table 9 N-Gain test

Statistic	g
N (Valid)	24
Missing	0
Mean	0.57

Final stage



Picture 8. Addition of Supporting Pages

At this stage, the learning medium was refined for wider use. The improvements included adding a bibliography of the sources used during development, thereby

strengthening its scientific foundation. Furthermore, the e-worksheet included a copyright page and was registered with the Direktorat Jenderal Hak Kekayaan Intelektual (HKI) under registration number **EC002025107154**, titled *Garda Statistika: Eksplorasi Agroindustri Jember Melalui Data*.

Dissemination and implementation

Based on the previous stages, it was concluded that the developed learning media had met the criteria of validity, practicality, and effectiveness, and had undergone the necessary final revisions. At this stage, the implementation was limited in scope at SMP Negeri 4 Jember, where the developed learning media was used by teachers at the school. The dissemination process involved preparing a user manual, distributing the access link (<https://tinyurl.com/GardaStatistika>) to two teachers at SMP Negeri 4 Jember, and ensuring that the e-worksheet could be accessed freely and without cost via Wizer.me with a simple account registration. In addition, dissemination was strengthened by publishing the product and its research findings in an academic journal, thereby expanding access to the wider educational and scholarly community.



Picture 9. User Manual

Discussions

The research problem of this study was to determine whether the agroindustry-based interactive e-worksheet developed using the Wizer.me platform and integrated with Problem-Based Learning (PBL) syntax is valid, practical, and effective for junior high school statistics learning. The findings of this study confirm that the developed e-worksheet fulfills all three criteria, as detailed below.

- Validity : The product's validity was evaluated by three experts, who gave an average score of 3.84 (very valid), indicating that the construct, content, and language are appropriate for classroom use. All research instruments were also validated and declared suitable for this study.
- Practicality : Teacher responses reached 96,67% and student responses 83.42%, both categorized as very practical, indicating that the e-worksheet is easy to use and supports learning.
- Effectiveness : Students' average scores improved from 53.38 (diagnostic test) to 78.75 (summative test) with an N-Gain of 0.57 (medium improvement). Positive student responses also indicate that the e-worksheet effectively supports learning in statistics.

The findings regarding the validity, practicality, and effectiveness of the developed e-worksheet warrant further discussion in relation to previous research. These results are consistent with prior studies reporting that digital interactive media can enhance students' understanding, engagement, and independent learning (Hakim et al., 2023; Salsabila et al., 2025; Widiari & Wiarta, 2024). In the present study, this improvement is reflected in increased students' learning outcomes from the diagnostic test to the summative assessment, as well as in the N-Gain value in the medium category. Furthermore, the use of the term "development" in this study is supported by statistical analyses, including expert validation scores to assess product validity, teacher and student response percentages to evaluate practicality, and paired-samples t-tests and N-Gain analyses to evaluate effectiveness. These analyses confirm that the developed agroindustry-based interactive e-worksheet meets the criteria of a valid, practical, and effective instructional medium for statistics learning.

The agroindustry context proved pedagogically relevant by connecting abstract statistical concepts to students' real-life experiences, thereby facilitating deeper conceptual understanding. This result aligns with studies emphasizing that learning becomes more meaningful when linked to authentic local contexts (Susanto et al., 2024; Wulandari et al., 2019). Similar findings were reported by Cahayu et al. (2024), who found that implementing a Problem-Based Learning (PBL) model grounded in local wisdom significantly improved students' critical thinking skills, indicating that contextual, locally relevant learning environments can enhance students' engagement and learning outcomes.

Beyond its local implementation in Jember, this study contributes to broader educational practice by presenting an interactive e-worksheet that integrates PBL syntax, a local agroindustry context, and the Wizer.me platform. The effectiveness of the developed e-worksheet can be explained by integrating interactive digital features with the Problem-Based Learning (PBL) process. The interactive tasks on the Wizer.me platform encourage students to analyze datasets, interpret statistical information, and receive immediate feedback, thereby supporting the development of statistical reasoning and conceptual understanding. This finding is consistent with Tsabita et al. (2024), who reported that Wizer.me can enhance student engagement and participation through its interactive digital learning features. Furthermore, the agroindustry context functions as an authentic problem source within the PBL framework, where students identify problems, analyze agroindustry-related data, and formulate conclusions using

statistical measures such as central tendency and dispersion. This contextual problem-solving process allows students to connect statistical concepts with real-world situations, thereby strengthening meaningful learning and improving their understanding of statistics. Although the effectiveness level reached the medium category, the results indicate meaningful learning gains and positive student engagement. However, these findings should be interpreted with consideration of several limitations in the present study.

Several limitations of this study should be acknowledged. The learning media was developed using the free version of the Wizer.me platform, which limited access to several interactive features, learning analytics, and diverse evaluation formats that could enhance the learning experience. In addition, the agroindustry data used in this study were secondary sources from scientific articles and websites, which may not fully reflect the agroindustry's actual conditions. Therefore, future studies are recommended to expand implementation across different schools and learning contexts, to use primary agroindustry data through interviews or field observations, and to explore advanced digital learning features to support further interactive and personalized statistics learning.

Conclusions and Suggestions

This study concludes that the development of an agro-industry-based interactive e-worksheet using the Wizer.me platform successfully produces a learning media that is valid, practical, and effective for supporting statistics learning at the secondary education level. The e-worksheet is designed to integrate a Problem-Based Learning (PBL) approach, enabling students to engage with contextual problems in agroindustry and actively participate in the learning process. Through its interactive features and contextual learning design, the media facilitates students' understanding of statistical concepts, enhances statistical reasoning, and increases motivation to learn. Therefore, the developed e-worksheet can serve as an alternative digital learning resource that integrates interactive technology, real-world contexts, and problem-based learning to support meaningful learning in statistics.

For educators and practitioners, it is recommended to integrate this e-worksheet with appropriate instructional strategies and to consider using the premium version of the Wizer.me platform to access more advanced interactive features, richer feedback systems, and learning analytics that support more personalized and effective learning experiences. Future researchers are also encouraged to expand the use of this media across different subjects and educational levels, and to incorporate authentic data obtained directly from agroindustry settings to strengthen the contextual relevance of statistics learning.

This study concludes that the development of an agro-industry-based interactive e-worksheet using the Wizer.me platform successfully produces a learning media that is valid, practical, and effective for supporting statistics learning at the secondary education level. The e-worksheet is designed to integrate a Problem-Based Learning (PBL) approach, enabling students to engage with contextual problems in agroindustry and actively participate in the learning process. Through its interactive features and contextual learning design, the media facilitates students' understanding of statistical concepts, enhances statistical reasoning, and increases motivation to learn. Therefore, the developed e-worksheet can serve as an alternative digital learning resource that

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