*26 (4), 2025, 2171-2190*

**Jurnal Pendidikan MIPA**

e-ISSN: 2685-5488 | p-ISSN: 1411-2531

https://jpmipa.fkip.unila.ac.id/index.php/jpmipa

# Enhancing Statistical Literacy Using ChatGPT-Assisted E-Worksheets: A Differentiated Learning Approach Based on Adversity Quotient

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**Abstract: Enhancing Statistical Literacy Using ChatGPT-Assisted E-Worksheets: A Differentiated Learning Approach Based on Adversity Quotient. Objective:** The research aims to develop an innovative, ChatGPT-assisted e-worksheet in differentiated learning that meets valid, practical, and effective criteria to enhance students' statistical literacy skills. **Methods:** The study involved 98 grade VII junior high school students. The research and development method adopted the 4D design, consisting of define, design, develop, and disseminate stages. Data were collected by interviews, observations, questionnaires, and statistical literacy tests. Data analysis employed descriptive statistics and inferential tests, including mean values, normality tests, homogeneity tests, and ANCOVA tests. The learning design includes experimental and control classes. Both classes were taken using a simple random sampling technique. **Findings:** The results indicated that the ChatGPT-assisted e-worksheet met the standards of validity and practicality. The validity experts obtained a validity score of 94.27%, which falls within the valid category, and the practicality test achieved a score of 84.21%, which is categorized as practical. In addition, the e-worksheet product ChatGPT is effective in improving statistical literacy skills. The results of the statistical literacy ability test met the normality and homogeneity criteria, and the ANCOVA test showed a significance value of 0.000 < 0.05, indicating a statistically significant effect. The results confirm that the experimental class achieved higher statistical literacy scores than the control class. **Conclusion:** The e-worksheet product effectively improved learning achievement, particularly in literacy and statistics skills. The e-worksheet was developed according to the learning needs of students, specifically those with the adversity quotient (AQ) type. Each type of AQ climber, camper, and quitter has a different worksheet, making it easier for students to learn. The AQ differentiated approach resulted in a significant increase in literacy scores. ChatGPT-assisted e-worksheet could be applied in statistical learning as an educational technology innovation that enhances student achievement. The learning atmosphere becomes more fun and meaningful for students.

**Keywords:** chatgpt, differentiated learning, e-worksheet, statistical literacy skills.

## ▪ INTRODUCTION

In the Independent Curriculum, educators designed learning to support the holistic development of students' potential by providing freedom in choosing materials, methods, and approaches according to their interests and needs (Pui, 2016). The rapid development of technology and information affected various fields, including education, where artificial intelligence (AI) has been widely used to solve problems and improve time efficiency in learning (Nguyen et al., 2023; OECD, 2023). Through AI-assisted learning, students experienced tailored learning processes that encouraged them to explore concepts independently, increasing their autonomy and motivation (Delima et al., 2024). Although AI could provide information efficiently, users needed to strengthen their grammatical abilities to ensure relevance. One of the AI technologies is ChatGPT, which was developed by OpenAI using internet-based text data that had the potential to serve as

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DOI: http://dx.doi.org/10.23960/jpmipa.v26i4.pp2171-2190
Received: 13 September 2025
Accepted: 27 October 2025
Published: 06 November 2025

a teacher's assistant and a virtual tutor for students (Lo, 2023). ChatGPT improved students' mathematical abilities by supplying foundational knowledge from various topics (Wardat et al., 2023). A case study conducted by Mudkanna Gavhane and Pagare (2024) also found the role of AI in assessing and improving the adversity quotient. The use of AI can improve students' cognitive development broadly, and learning independence is well-formed. Delima et al. (2024) also found significant differences in independent mathematics learning between students who used ChatGPT and those who did not; students who used ChatGPT showed greater motivation and more active participation. ChatGPT further supported concept exploration and enriched the learning process (Karakose & Tülübas, 2023).

In modern society, individuals need not only the ability to read reports but also to understand, analyze, and critically interpret data (Lipič & Ovsenik, 2020). Statistical literacy, therefore, played a key role in developing critical thinking to distinguish between accurate and misleading information. Students required statistical literacy to think critically and draw conclusions based on data (Riwayani et al., 2024). This skill prepared them to face data-driven arguments in contemporary life (Lipič & Ovsenik, 2020). Statistical literacy encompasses the ability to understand, interpret, and communicate statistical information clearly and accurately (Callingham & Watson, 2017; Sabbag et al., 2018). Its indicators included data orientation, data processing, interpretation, and evaluation (Radermacher, 2021). Data orientation refers to understanding information and identifying core questions in a problem. Data processing involved applying solutions and explaining completion steps in detail (Wolff et al., 2019). Data interpretation involved drawing conclusions and communicating results, whereas data evaluation entailed re-examining the process and outcomes (Gunawan et al., 2022). Statistical literacy skills are also relevant to developments in the modern era, including in terms of big data (François et al., 2020). Not everyone can understand and pay attention to big data, so it is necessary to strengthen statistical literacy in order to build constructive and reflective thinking about the challenges of the times.

Beyond statistical literacy, students also needed the ability to face adversity, known as the adversity quotient (AQ). AQ described how individuals responded to obstacles, overcame challenges, and recovered from failure (Saxena & Rathore, 2025). Puspitacandri et al. (2020) demonstrated that AQ influenced learning behavior, as students employed different problem-solving techniques based on their individual characteristics. The AQ category consists of three types: quitters, campers, and climbers. Quitters gave up easily, campers showed enthusiasm but lacked persistence, while climbers demonstrated resilience and strong motivation. Differences in AQ levels affected learning outcomes (Muhtarom et al., 2021). Students with higher AQ tended to show stronger motivation and enthusiasm for learning. Furthermore, students with high AQ also find it easier to communicate their solutions effectively.

To meet the needs of 21st-century learning, teachers must effectively apply differentiated learning (Hidayat & Patras, 2024). Dalila et al. (2022) found that differentiated learning improved achievement, outcomes, and motivation, creating an effective and creative environment. Innovation in learning materials, such as worksheets, is essential to accommodate students' diverse profiles and backgrounds (Farman et al., 2021). As learning media, worksheets encouraged student engagement and independence and reduced boredom (Putra & Agustiana, 2021). Worksheets also helped students

discover concepts through practicums, experiments, and problem-solving tasks (Noprinda & Soleh, 2019). Their use improved argumentation skills and had a positive influence on learning outcomes (Iffah, 2021; Putra et al., 2024). Multimedia innovations, such as digital worksheets (e-worksheets), provide interactive media that is accessible anytime via laptops or mobile devices.

Despite these benefits, initial observations indicated that the worksheets used in classrooms did not consider students' diverse characteristics and needs. Teachers used the same worksheets for all students, reducing their effectiveness in meeting learning goals. To address this gap, the present study integrated ChatGPT into e-worksheets and differentiated learning based on AQ. The researchers designed three types of worksheets according to AQ categories: quitter, camper, and climber. They implemented learning based on AQ differentiation and provided students access to ChatGPT for exploring information, data, and concepts. This approach supported students who struggled with data comprehension and offered alternative solutions. The process enriched students' knowledge, strengthened concepts, promoted interaction, and created meaningful learning experiences (ElSayary, 2024). Teachers can utilize the ChatGPT application throughout every learning series, from planning and implementation to reflection and evaluation.

Preliminary observations suggest that the worksheets used in the classroom do not adequately address the diverse characteristics and needs of students, resulting in less meaningful learning experiences. Teachers use the same worksheets for all students, which results in a lack of effectiveness in achieving learning goals. The researcher designed three different types of worksheets based on learning needs, specifically the adversity quotient (AQ) type, namely the worksheet for quitters, the worksheet for campers, and the worksheet for climbers. The researcher applies learning based on AQ type differentiation and provides limited access to ChatGPT for students to explore information and formulate solutions. To ensure students use ChatGPT only for exploration and not to search for final answers, teachers implement special protocols that include proper usage guidelines. Orally, before the discussion began, the teacher also informed students that the use of ChatGPT was intended solely for information exploration, aimed at finding the right solution. Additionally, teachers supervise the use of ChatGPT during the group discussion process. To make learning more interactive, this study integrated ChatGPT into each e-worksheet. The use of ChatGPT supports students who have difficulty understanding data and offers alternative solutions, enriching students' knowledge, reinforcing concepts, encouraging interaction, and creating meaningful learning experiences. The integration of these three elements, ChatGPT, differentiated learning based on AQ type, and e-worksheet, can provide a more comprehensive solution that shows differences from previous research.

The selection of the adversity quotient (AQ) as the basis for differentiated learning is because AQ is directly related to how students respond to challenges and setbacks in the learning process. Students categorized as AQ climber, camper, and quitter types exhibit different levels of resilience and motivation, which are important factors in academic success (Zhao et al., 2022). By tailoring the learning experience to these diverse student profiles, educators can foster a more supportive environment that encourages perseverance in the face of adversity. AQ's differentiated approach equips students with the skills necessary to effectively solve academic and real-world challenges. Therefore,

using AQ as a differentiating variable is not only relevant but also important for maximizing student engagement and achievement, making it a great choice to achieve learning goals.

Several prior studies informed this work. Lindenbauer and Lavicza (2021) mengembangkan digital worksheet sebagai media evaluasi berbasis digital yang mampu meningkatkan kemampuan konseptual matematis siswa. Farman et al. (2021) created online worksheet innovations as solutions during the COVID-19 pandemic, reporting significant improvements in learning outcomes. Hidayat and Aripin (2023) showed that integrating e-worksheets with scientific approaches improved students' communication skills. Widodo et al. (2022) detailed the position of AQ, which is more positive for educators' professional competence and student proficiency compared to emotional intelligence. The results of the study motivated the development of interactive learning media to increase AQ. Gouia-Zarrad and Gunn (2024) demonstrated that using ChatGPT increased students' enthusiasm and participation, making learning more interactive. Similarly, Wahba et al. (2024) and Xing (2024) found that ChatGPT significantly improved statistical literacy and fostered positive attitudes during statistics learning.

Based on this background, the study addressed the research question: Does a ChatGPT-assisted e-worksheet applied to differentiated learning meet valid, practical, and effective aspects in improving students' statistical literacy skills?

## ▪ METHOD

### Participants

The subjects of this study were seventh graders at SMP Negeri 2 Mandiraja, a junior high school in Semarang, Central Java, Indonesia, which comprises nine classes at this level. The limited trial for the practicality of the e-worksheet included all 34 students from class VII I. For the effectiveness test, the researchers employed a two-class design, comprising a control class and an experimental class, both of which were selected using a simple random sampling technique. This technique ensured that participants were chosen randomly from the available seventh-grade classes. The technical procedure of randomization is carried out using the interactive application Spiner because each class has the same opportunity. Class VII G served as the control group and Class VII H as the experimental group, with a total of 64 students. The experimental class utilized ChatGPT-assisted e-worksheets within a problem-based learning (PBL) model, employing a differentiated approach. In contrast, the control class followed a differentiated PBL approach without utilizing either ChatGPT-assisted electronic worksheets or conventional worksheets. Both groups used interactive PowerPoint slides as teaching materials. Another potential that can affect statistical literacy ability or confounding variables is prior knowledge. A person's success in solving problems is influenced by their experience and the level of knowledge they have gained beforehand. The knowledge he has acquired plays a crucial role in the development of mathematical thinking processes (Newton et al., 2020). In this case, the student's ability to identify information and problems and formulate solutions in a statistical context can also be influenced by the level of understanding and knowledge gained previously.

The research population consists of grade VII students at SMP Negeri 2 Mandiraja, Banjarnegara, which has nine classes at this level. The research sample consisted of three classes taken by a simple random sampling technique. All three classes are used for the product practicality test and the effectiveness test. The limited trial of the practicality of

the e-worksheet involved all 34 students of Grade VII I. For the effectiveness test, the research was applied to two different classes, comprising a control class and an experimental class. Class VII G served as the control group, and Class VII H as the experimental group, comprising a total of 64 students. The experimental class utilized ChatGPT-assisted electronic worksheets in a problem-based learning (PBL) model with a differentiated approach. In contrast, the control class employed a differentiated PBL model with conventional worksheets only.

**Research Design and Procedures**

This research used research and development (R&D) methods to develop a ChatGPT-assisted e-worksheet. Researchers develop new products or modify existing products to make them more valid, practical, and effective (Azizah & Atun, 2025). The research and development model employs a 4D approach, comprising the stages of define, design, development, and dissemination. This model provides clear and systematic measures that facilitate the collection of data. The research period lasted four months.

In the define stage, the researchers analyzed student characteristics, identified problems in the learning process, determined development goals, and conducted diagnostic tests on the adversity quotient and statistical literacy. In the design stage, they prepared instruments, selected media and tools, determined formats, and created product prototypes. They adjusted the choice of media to learning objectives, student characteristics, and school conditions. The e-worksheet design included covers, instructions, materials, and student activities that reflected statistical literacy indicators while also aligning with students' adversity quotient levels and integrating ChatGPT to support learning.

At the development stage, experts in mathematics, education, and interactive media validated the product to ensure its quality matched students' needs and characteristics. After validation, a practicality test was conducted to evaluate how easily students used the e-worksheets. The results were used to refine the product and ensure it was feasible for classroom use. The researchers then applied ChatGPT-assisted e-worksheets in both experimental and control classes to measure their effectiveness in improving statistical literacy.

Finally, in the dissemination stage, the researchers shared the ChatGPT-assisted e-worksheet product with the wider community. They involved all junior high school mathematics teachers in the Mathematics Teacher Forum in the Cilacap district, Central Java, to encourage its adoption in classrooms and to enhance students' statistical literacy. Figure 1 illustrates the research procedure by outlining the development stages, which range from defining to disseminating.

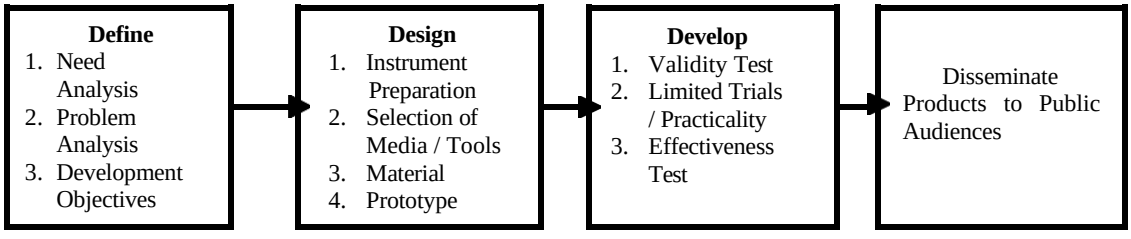



**Figure 1.** 4D development research procedure

**Instrument**

The data collection instruments included student response questionnaires, adversity quotient questionnaires, and statistical literacy skills tests. When compiling test questions, each question item is based on statistical literacy indicators, which encompass data orientation, data processing, data interpretation, and evaluation (Radermacher, 2021). Table 1 describes each indicator of statistical literacy skills.

**Table 1.** Description of statistical literacy skills indicators

| Indicators | | Description |
|---|---|---|
| Data Orientation | 1. | Explaining key issues |
| | 2. | Writing the given information |
| Data Processing | 1. | Writing a solution |
| | 2. | Applying solutions to problems |
| Data Interpretation | 1. | Writing a conclusion |
| | 2. | Explaining the analysis of the conclusions |
| Evaluation | | Re-examining the process and the final result |

To test the validity aspect of the product, the researchers used expert validation sheets. The researchers also used student response questionnaires to obtain practicality data. In the product effectiveness test on statistical literacy skills, the researchers used an observation sheet to assess the implementation of the learning process in the experimental and control classes. In addition, at the end of the learning, the researchers administered a statistical literacy skills test to all students to collect data on the effectiveness of the ChatGPT e-worksheet product.

The validity and reliability of the Adversity Quotient questionnaires, student response questionnaires, and statistical literacy tests were analyzed using SPSS statistical software. Table 2 explains the results of the validity and reliability tests of the three instruments.

**Table 2.** Results of instrument validity and reliability tests

| Aspects | Statistical Literacy Test Questions | | | | Adversity Quotient Questionnaire | Student Response Questionnaires | Category |
|---|---|---|---|---|---|---|---|
| | Question 1 | Question 2 | Question 3 | Question 4 | | | |
| Validation Test | • $r_{count}$ = 0.751 > $r_{table}$ = 0.423<br>• Sig. (2-tailed) = 0.000 < 0.05 | • $r_{count}$ = 0.425 > $r_{table}$ = 0.423<br>• Sig. (2-tailed) = 0.04 < 0.05 | • $r_{count}$ = 0.639 > $r_{table}$ = 0.423<br>• Sig. (2-tailed) = 0.001 < 0.05 | • $r_{count}$ = 0.699 > $r_{table}$ = 0.423<br>• Sig. (2-tailed) = 0.000 < 0.05 | • $r_{count}$ = 0.875 > $r_{table}$ = 0.423<br>• Sig. (2-tailed) = 0.012 < 0.05 | • $r_{count}$ = 0.572 > $r_{table}$ = 0.423<br>• Sig. (2-tailed) = 0.002 < 0.05 | Valid |
| Reliability Test | Cronbach Alpha Values = 0.701 > 0.70 | | | | Cronbach Alpha Values = 0.716 > 0.70 | Cronbach Alpha Values = 0.831 > 0.70 | Reliable |

The adversity quotient questionnaires, student response questionnaires, and statistical literacy tests are considered valid if the r-count score is greater than the r-table value and the significance value is less than 0.05. Likewise, the three instruments meet the reliability aspect if the Cronbach Alpha Values are more than 0.70 (Taber, 2017). The

test results in Table 2 indicate that each instrument has a score of rcount > rtable (0.423) and a significance value of $p < 0.05$. For reliability results, the Cronbach's Alpha values of the three instruments were all more than 0.70. Thus, the instruments used are valid and reliable.

**Data Analysis**

The analysis of research data includes qualitative, descriptive, and quantitative descriptive.

***Qualitative Descriptive Analysis***

This analysis technique is applied to process initial data, expert responses, and student responses. Initial data include an analysis of the characteristics of initial abilities, the need for teaching materials, and classroom problems. The qualitative results of this data serve as the basis for developing e-worksheet product innovations. Comments and suggestions from experts, as well as students' responses, are analyzed through the steps of collecting data, translating written and verbal data, selecting and classifying, and formulating conclusions for consideration in the next stage.

***Quantitative Data Analysis***

Quantitative analysis includes validity test data, practicality test, and effectiveness test. The validation assessment involved three experts: two lecturers and one mathematics teacher. They assessed the product using a Likert scale of 1 to 4, where 1 indicated 'disagree', 2 indicated 'less agreement', 3 indicated 'sufficient agreement', and 4 indicated 'agree'. Validity data is processed in the form of percentage scores. Table 3 presents the criteria for average scores.

**Table 3.** Validity test categorization

| Average | Category |
|---|---|
| $Score \leq 25\%$ | Invalid |
| $25\% < Score \leq 50\%$ | Less Valid |
| $50\% < Score \leq 75\%$ | Mostly Valid |
| $Score > 75\%$ | Valid |

The researchers considered ChatGPT-assisted e-worksheets valid if the score exceeded 75%. They measured product validity using three criteria: content feasibility, language, and media. Table 4 presents the analysis of the practicality test in relation to the specified criteria. Practicality data was obtained from the analysis of students' responses to the use of the e-worksheet. This data is analyzed in the form of an average percentage score.

**Table 4.** Analysis of practicality test scores

| Average (%) | Category |
|---|---|
| Score > 60 | Practical |
| 40 < Score ≤ 60 | Mostly Practical |
| 20 < Score ≤ 40 | Less Practical |
| 0 < Score ≤ 20 | Impractical |

Table 4 presents ChatGPT-assisted e-worksheets that met the practicality criteria when students achieved an average score of 60% or higher. For effectiveness, the researchers analyzed the data using SPSS with analysis of covariance (ANCOVA). This analysis technique was employed to assess the impact of the ChatGPT e-worksheet intervention on statistical literacy skills in the experimental class.

## ▪ RESULT AND DISSCUSSION

This section presents the findings on the development of ChatGPT-assisted e-worksheets based on the four stages of the development model: define, design, develop, and disseminate. The define stage reported the results of the needs analysis, the initial statistical literacy test, and the adversity quotient diagnosis. The design stage described the initial prototype of the ChatGPT e-worksheet. The development stage yielded results from validity, practicality, and effectiveness tests. The dissemination stage outlined the distribution of the product to junior high school mathematics teachers and their responses.

### Define Stage

The Adversity Quotient Questionnaire revealed varied levels of Adversity Quotient among seventh graders. Table 5 presents the recapitulation of the diagnostic results.

**Table 5.** Student adversity quotient category

| Category | (%) |
|---|---|
| Climber | 25 |
| Camper | 43.75 |
| Quitter | 31.25 |

Table 5 shows that 25% of students fell into the climber category, 43.75% into the camper category, and 31.25% into the quitter category. The largest proportion of students belonged to the camper category. The initial statistical literacy test revealed that students' literacy level was still relatively low, with an average score of 45.75. Table 6 presents the average score for each statistical literacy indicator.

**Table 6.** Preliminary statistical literacy skills

| Indicators | Average Score (%) |
|---|---|
| Data Orientation | 61.4 |
| Data Processing | 52.3 |
| Data Interpretation | 42.6 |
| Evaluation | 26.7 |

The evaluation indicator received the lowest score of 26.7%. Students failed to recheck their problem-solving process and final answers, which caused mismatches between the questions and their solutions. In contrast, the data orientation indicator achieved the highest score of 61.4%, but it still fell into the low category.

Interviews with teachers and students confirmed that most students struggled to understand statistical material with the existing worksheets. The worksheets commonly used in class were too general and did not adequately accommodate the diverse learning needs of students. The data also showed that 85.7% of teachers had never designed a

statistical worksheet, and all teachers (100%) had never designed a worksheet based on students' adversity quotient levels. Teachers reported that existing teaching materials lacked flexibility and efficiency. These findings demonstrated the urgent need for worksheets tailored to students' learning needs and accessible in digital form. The following section presents excerpts from interviews with students.

*"During statistics lessons, teachers usually used worksheets provided by the school, and we often completed them independently. The teacher first explained the material, then instructed us to work on the tasks, and finally reviewed the answers together. I understood the material better when the teacher explained it than when I studied it independently through worksheets. The instructions in the worksheets were often unclear. For example, they asked us to open a certain page in the mathematics package book, but the statistical material was not there. This made solving the problems difficult. I still want to use worksheets in the future, but I hope they are adjusted to my abilities because unclear instructions make it harder for me to solve the problems" (Interview with students, July 20, 2025).* Teachers' interviews also highlighted issues with the media and teaching materials.

*"When teaching statistics, I usually use the package book and worksheets. I designed the worksheets uniformly without considering students' skill profiles. I had tried using PowerPoint in lessons, and students responded positively because they were more focused when I explained the material. However, limited time to prepare content and the lack of LCD facilities prevented me from using it regularly. I also had to print worksheets in large numbers, which was inefficient and impractical. These practices do not align with technological developments in education. In my view, teaching materials should be accessible flexibly and accommodate diverse student abilities" (Interview with teachers, July 20, 2025).*

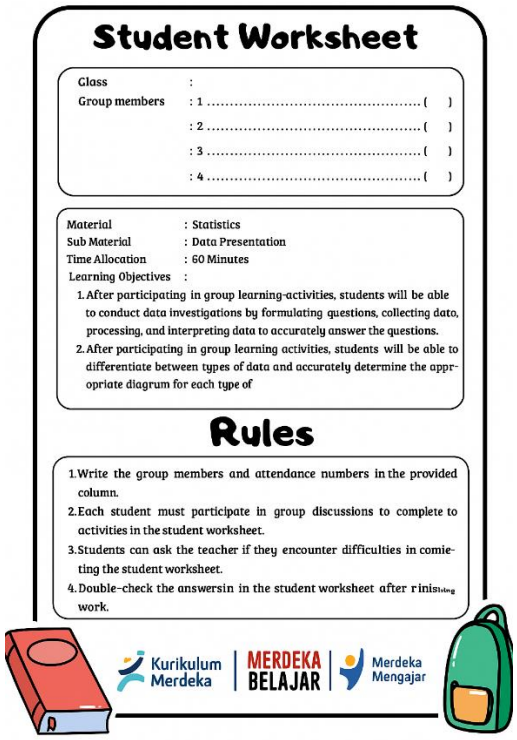
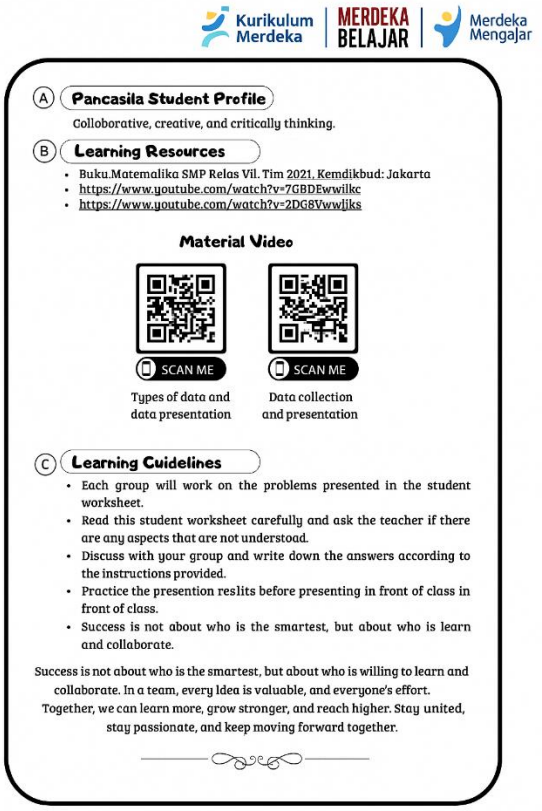
These findings highlighted the urgency of developing worksheets aligned with students' learning needs. Given their familiarity with technology, students also expressed a need for more accessible digital worksheets. Such materials would help them learn in a fun, active, and meaningful way, while improving their achievement, particularly in statistical literacy. This aligns with the essence of differentiated worksheets, which provide more interactive and meaningful resources. Previous studies have confirmed that technology-integrated worksheets in differentiated learning support active and enjoyable learning processes, enhancing student literacy (Dalila et al., 2022; Putra & Agustiana, 2021).

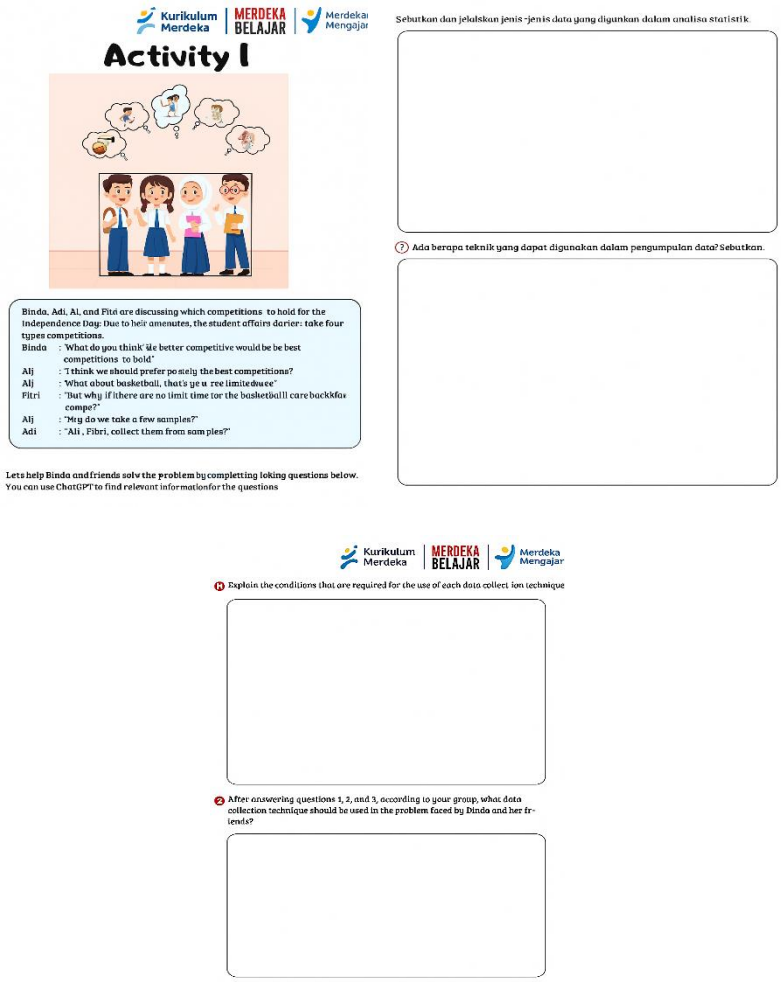
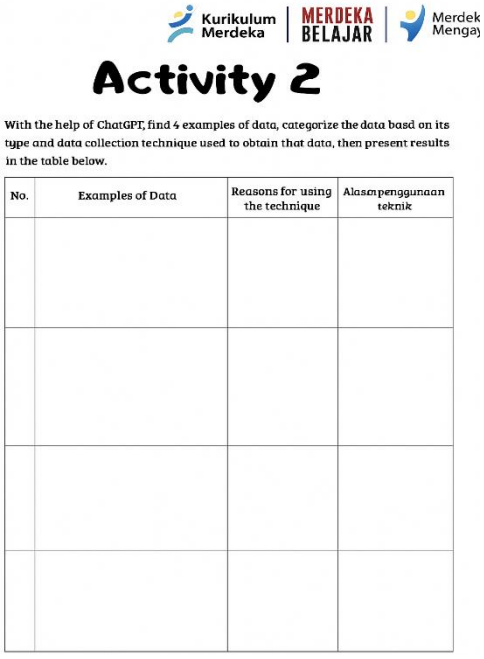
**Design Stage**

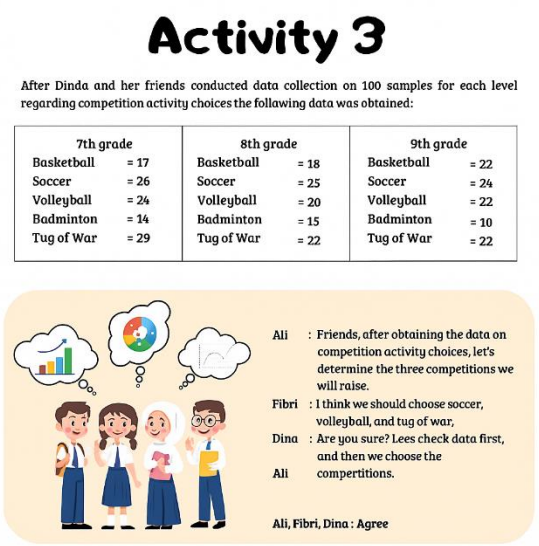
The product developed in this study was a ChatGPT-assisted e-worksheet. The activities in the worksheet integrated ChatGPT for both material exploration and problem-solving. The design aligned with four statistical literacy indicators: data orientation, data processing, data interpretation, and evaluation. Table 7 presents the

design of the ChatGPT e-worksheet, which includes the cover page, group identity, learning objectives, material links, ChatGPT integration, statistical literacy processes, and contextual problems related to statistics.

**Table 7.** ChatGPT-assisted e-worksheet design

| No | Element | Information |
|---|---|---|
| 1 |  | E-worksheet homepage, student group identity, learning objectives, and work rules |
| 2 |  | *Pancasila* student profile information, learning resources, and study instructions |

| | | |
|---|---|---|
| 3 |  | Statistical literacy process |
| 4 |  | ChatGPT app integration for problem exploration |

| | | |
|---|---|---|
| 5 |  | Contextual problems related to statistics |

The worksheet also applied a differentiation approach based on students' adversity quotient levels. It consisted of three types: climber, camper, and quitter. Figure 2 illustrates the differences in activities for each type according to their learning characteristics.

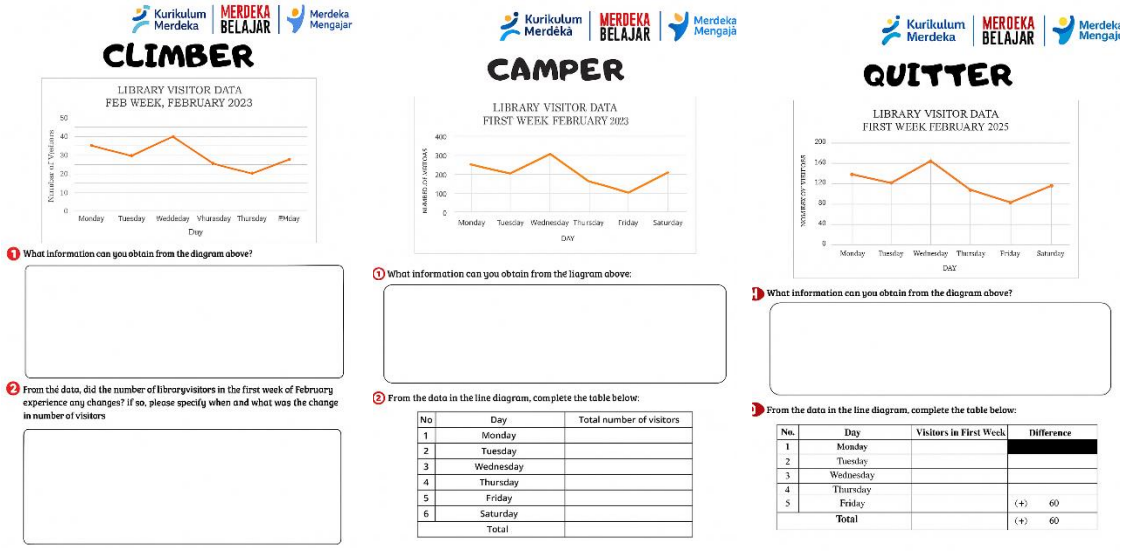



**Figure 2.** E-worksheet by adversity quotient type

Climber-type worksheets, designed for students with strong motivation to learn, presented complex problems without scaffolding. Students identified the information in the questions, developed problem-solving strategies, and expressed opinions based on the provided data. Camper-type worksheets offered visual aids, such as connecting lines between graphs and target values, along with supporting tables to help map the data for students who tended to be satisfied with their current situation. These features aimed to

make problems easier to understand. Quitter-type worksheets, intended for students who gave up, included extensive support in the form of additional information and guiding notations in tables to assist in data processing.

These differentiated designs reflected the effort to meet the diverse learning needs of students with varying adversity quotient levels, allowing each type to engage with challenges at an appropriate level.

**Development Stage**

In the development stage, the researchers conducted validation, limited trials, and effectiveness tests of the ChatGPT e-worksheet. Three experts participated in the validation: one in interactive learning media, one in mathematical concepts and evaluation, and one in differentiated learning instruments. Table 8 presents the results of the validity test.

**Table 8.** The validity test results for the feasibility of the content

| No | Components | Total Score | Average | Ideal Score | Percentage (%) | Information |
|---|---|---|---|---|---|---|
| 1 | Competency suitskills | 24 | 8 | 8 | 100 | Valid |
| 2 | Material suitskills | 41 | 13.67 | 16 | 85.42 | Valid |
| 3 | Connection to real life | 24 | 8 | 8 | 100 | Valid |
| | Amount | 34.25 | 29.67 | 32 | 92.71 | Valid |

Table 8 shows that the expert validators gave a total score of 34.25, with an average of 29.67 and a percentage of 92.71%. Based on the validation criteria, the ChatGPT e-worksheet was valid in terms of content feasibility. Table 9 presents the validation results for the language feasibility aspect.

**Table 9.** The validity results of the language feasibility aspect

| No | Components | Total Score | Average | Ideal Score | Percentage (%) | Information |
|---|---|---|---|---|---|---|
| 1 | Language compatibility | 24 | 12 | 12 | 100 | Valid |
| 2 | Accuracy | 22 | 11 | 12 | 91.67 | Valid |
| | Amount | 46 | 23 | 24 | 95.83 | Valid |

Table 9 shows that the validators assigned a total score of 46, with an average of 23 and a percentage of 95.83%. Thus, the ChatGPT e-worksheet was valid in terms of language feasibility. Combining the results of both aspects produced an average score of 26.33 and an overall percentage of 94.27%, confirming that the ChatGPT e-worksheet met the validity criteria. The researchers then conducted a practicality test with 34 students in a limited trial class. This test assessed technical aspects, visual display, and material content. Table 10 presents the results of the practicality test.

**Table 10.** Practicality test results

| No | Components | Total Score | Average | Ideal Score | Percentage (%) | Information |
|---|---|---|---|---|---|---|
| 1 | Technique of use | 337 | 112.33 | 136 | 82.60 | Practical |
| 2 | Appearance and visuals | 339 | 113 | 136 | 83.09 | Practical |
| 3 | Media eligibility | 240 | 120 | 136 | 88.23 | Practical |
| 4 | Material content | 231 | 115.5 | 136 | 84.93 | Practical |
| | Average | 286.75 | 115.21 | 136 | 84.21 | Practical |

Table 10 shows that the average practicality test score reached 286.75, or 84.21% of the ideal score. These results confirmed that the worksheet met the practical criteria. For classroom use. The steps and instructions for using the ChatGPT e-worksheet were clearly written, making it easier for students to apply. Its attractive and contextual visual display motivated students to learn mathematics, especially statistics. The inclusion of graphs and tables clarified conditions and real data, which helped students understand the material more effectively. These findings align with Noprinda & Soleh (2019), who explain that interactive worksheets equipped with attractive visuals and relevant context increase motivation and mastery of concepts, leading to improved learning outcomes. The integration of engaging visuals and structured content has a profound influence on cognitive thinking processes, creating an environment that encourages students to engage in higher-order thinking skills (HOTS). This relationship suggests that when students find content visually appealing and contextually relevant, students are more likely to invest cognitive resources in learning, thereby improving their analytical and evaluative skills. Such an environment encourages students not only to memorize information but also to critically analyze and apply concepts in new situations, which is crucial for their overall academic development. Therefore, the practical effectiveness of ChatGPT-based e-worksheets extends beyond their usefulness. This fosters a learning environment that promotes active engagement and deeper understanding, ultimately leading to improved educational outcomes and preparing students for real-world challenges where problem-solving and critical thinking are essential components. ChatGPT's media integration in the worksheet yielded the highest percentage of responses in the media feasibility component, underscoring its crucial role in expanding insights and facilitating independent information exploration. This integration also made students more active and deepened their understanding by giving them the flexibility to locate relevant information. Prior studies supported this finding, showing that ChatGPT encouraged independent learning, facilitated comprehensive information exploration, and improved basic comprehension skills, enabling students to identify solutions and solve problems systematically, especially in statistics (Wardat et al., 2023; Delima et al., 2024; Karakose & Tülübas, 2023; Mudkanna Gavhane & Pagare, 2024).

To evaluate the effect of ChatGPT electronic worksheets on statistical literacy, the researchers compared the control and experimental classes through differentiated learning. The experimental class employed a differentiated PBL model with ChatGPT-assisted electronic worksheets, whereas the control class utilized a differentiated PBL model with conventional worksheet media. An ANCOVA test was used to analyze the effectiveness of the e-worksheet in enhancing literacy skills, after verifying normality and

homogeneity. Tables 11 and 12 present the results of the normality and homogeneity tests, respectively.

**Table 11.** Normality test

| Variable | Class | Shaphiro - Wilk | | |
|---|---|---|---|---|
| | | Statistic | df | Sig. |
| Pretest | Control | 0.129 | 0.129 | 0.129 |
| | Experimental | 0.083 | 0.083 | 0.083 |
| Posttest | Control | 0.155 | 0.155 | 0.155 |
| | Experimental | 0.168 | 0.168 | 0.168 |

**Table 12.** Homogeneity test

| Variable | Levene | Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| Posttest | Based on Mean | 0.659 | 3 | 124 | 0.579 |

Table 11 shows that the posttest significance values were 0.124 for the control class and 0.164 for the experimental class, both of which are above 0.05, indicating that the data are normally distributed. Table 12 shows an average significance value of 0.579, also above 0.05, confirming homogeneity. Since both conditions were met, the researcher proceeded with the ANCOVA test. Table 13 presents the average pre-test and post-test scores of each experimental and control class, while Table 15 shows the results of the ANCOVA test.

**Table 13.** Descriptive statistical test

| Variable | Class | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pretest | Control | 32 | 51.91 | 11.329 | 2.003 |
| | Experimental | 32 | 51.56 | 11.986 | 2.119 |
| Posttest | Control | 32 | 69.53 | 14.389 | 2.544 |
| | Experimental | 32 | 81.41 | 12.064 | 2.133 |

Table 13 shows that the control class's post-test results achieved an average score of 69.53, whereas the experimental class achieved an average score of 81.41. Similarly, the pre-test results showed a difference of 0.35 in the average score between the experimental and control classes. Thus, the experimental class outperformed the control class in terms of statistical literacy. In more detail, Table 14 illustrates the data on the results of the statistical literacy test of each type of AQ in the experimental and control classes.

**Table 14.** Results of statistical literacy of adversity quotient (AQ) type in experimental and control classes

| Type of AQ | Average score | | Difference in Score |
|---|---|---|---|
| | Control Class | Experimental Class | |
| Climber | 83.889 | 95 | 11.111 |
| Camper | 66.667 | 80 | 13.333 |
| Quitter | 60.909 | 73.75 | 12.841 |

Table 14 presents a comparison of the average scores for statistical literacy ability across each type of AQ in the control and experimental classes. The most significant score difference was in the type of camper, with an average score difference of 13.333. Additionally, in the climber type, the average score of the experimental class was also 11.111 higher. Meanwhile, in the quitter type, the experimental class recorded an average score of 12.841 higher than the control class. This suggests that teaching methods in experimental classrooms have the potential to positively impact students' statistical literacy across all types of AQ. Teaching interventions using ChatGPT-based e-worksheet with a differentiated approach were more effectively applied to camper-type students, who showed the most significant improvement.

Using 70 as the minimum completeness score for mathematics, 15 students (46.87%) in the control class achieved the standard, compared to 28 students (87.50%) in the experimental class. More students in the experimental class met the minimum criteria than in the control class.

**Table 15.** Results of the ANCOVA test

| Univariate Test | | | | | | |
|---|---|---|---|---|---|---|
| Dependent variable: Posttest | | | | | | |
| **Sum of Squares** | | **df** | **Mean Square** | **F** | **Sig.** | **Partial Eta Square** |
| Contrast | 2391.429 | 1 | 2391.429 | 69.766 | 0.000 | 0.534 |
| Error | 2090.943 | 61 | 34.278 | | | |

Table 15 presents the results of the ANCOVA test, which shows a significance value of 0.000 < 0.05. This finding demonstrates a significant impact of ChatGPT's e-worksheet treatment on the results of statistical literacy skills. These results align with those of Farman et al. (2021) and Lindenbauer and Lavicza (2021), who found that digital worksheets enhanced learning activities, improved conceptual understanding, and had a positive influence on statistical literacy. For further clarity, Figure 3 displays visual data on the average N-Gain pre-test and post-test values for each experimental and control class, as well as for each statistical literacy indicator.

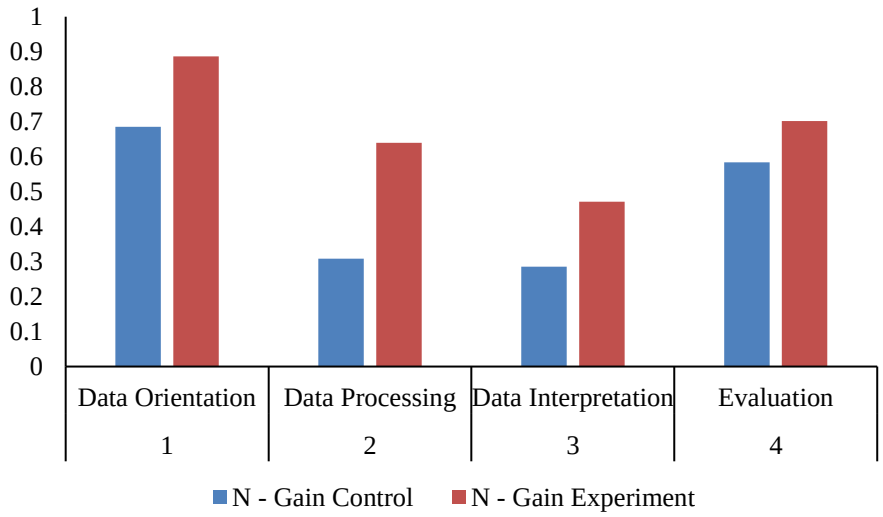



**Figure 3.** Average N-gain of pre-test and post-test

In Figure 3, each indicator of statistical literacy ability shows the difference in the average n-gain value between the control and experimental classes. For each indicator, the average value of the experimental class n-gain is higher than the dick class. This condition demonstrates that the treatment given to the experimental class has a positive impact on all indicators of statistical literacy ability. Different worksheet designs accommodate students' diverse learning needs, particularly in terms of difficulty levels, which helps students learn statistical materials more deeply and communicate their results effectively (Muhtarom et al., 2021). The worksheet's learning steps aligned with the characteristics of each AQ type, facilitating students' thinking processes and boosting their motivation. ChatGPT further enriched the process by supporting problem exploration. Similarly, Wahba et al. (2024) and Xing (2024) demonstrated that integrating ChatGPT into worksheets enabled students to explore problems more effectively and identify relevant solutions, ensuring accurate resolution of statistical literacy tasks.

**Disseminate Stage**

At this stage, the researchers disseminated the developed products to Islamic junior high school mathematics teachers across Cilacap Regency. They conducted the activity offline through presentations and question-and-answer sessions. Afterward, all teachers completed a response questionnaire and provided recommendations for implementation in their respective classes. Table 16 presents a summary of the teachers' responses.

**Table 16.** Results of teachers' responses in dissemination activities

| No | Aspects | Precentage |
|---|---|---|
| 1 | Attractive and communicative | 80.45% |
| 3 | Innovative solutions | 87% |
| 4 | Flexibility in access | 90.2% |
| 5 | Improved learning outcomes | 89.4% |

Table 15 shows that the highest-rated aspect was ease of access, with a score of 90.2%, indicating that teachers considered the product accessible at any time and from anywhere, in line with the digital era. The product also received an 89.4% score for its potential to improve student learning outcomes, particularly statistical literacy. These results suggest that junior high school mathematics teachers should incorporate the ChatGPT e-worksheet into interactive learning to enhance students' literacy skills.

## ▪ CONCLUSION

Differentiated learning answers the needs and characteristics of students while providing flexibility in the learning process. The results and discussion show that ChatGPT-assisted e-worksheet meets the criteria of validity and practicality. The content and language aspects achieve scores in the valid category. The practicality test yielded an average score of 84.21%, indicating practical application in mathematics learning. In statistical learning, the ChatGPT-assisted e-worksheet is more effective in enhancing statistical literacy skills than conventional media. The worksheet used is tailored to meet learning needs based on the Adversity Quotient (AQ) profile and the use of ChatGPT, which helps students explore problems and formulate solutions. This design supports

more meaningful and enjoyable learning. Additionally, the experimental class achieved a higher average score in statistical literacy than the control class.

The development of ChatGPT-based e-worksheet products should be continued for further research, as it has some limitations in material aspects and target variables. First, this research is limited to statistical material. The product developed only focuses on statistical material, so it needs to be improved with other materials, such as contextual social artificial intelligence, to support students' literacy and numeracy. Second, the improvement in learning outcomes is limited to the cognitive aspect, specifically statistical literacy skills. The need for affective aspects that can be developed but are still relevant to the use of the ChatGPT application, for example, learning independence. Students' learning independence needs to be further reviewed to ensure it does not contradict the use of ChatGPT. The combination of cognitive and affective aspects presents an interesting package that can be further developed.

The following are some suggestions for future research. First, the integration of the deep learning approach with the ChatGPT e-worksheet product. Every student activity in the worksheet meets the aspect of deep learning. The results of this development can be applied in learning to create a more joyful and meaningful learning atmosphere. Second, experimental research can be conducted to determine the correlation between learning independence, literacy skills, and ChatGPT e-worksheet products. The results of this experimental research can help determine the significance of these variables more comprehensively and serve as a reference for improving students' numeracy literacy.

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