

## Enhancing Communication and Connection Abilities through Differentiated Instruction and Writing to Learn in a Bilingual Context

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*Abstract: This study aimed to investigate the effectiveness of Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual context to improve students' communication and connection abilities in mathematics. This study used mixed methods as a quasi-experimental design with a non-randomized control group. The experimental class applied DI using WtL in a bilingual context, while the control class used the expository approach. Quantitative data were analyzed using multivariate tests, while qualitative data were also analyzed. The results showed DI using WtL in a bilingual context was more effective than the expository approach in enhancing these abilities. Compared to the control class, the experimental class had a higher number of students who met each indicator of communication and connection abilities. The study indicated that the majority of students preferred and benefitted from the DI method employing WtL within a bilingual context. The observation indicated that the teacher employed three forms of differentiation: content, process, and product. The differentiation was tailored to students' learning readiness and interests, and students participated in various activities. Therefore, it can be concluded that applying DI using WtL in a bilingual context may serve as an alternative strategy to improve students' communication and connection abilities in mathematics.*

**Keywords:** Differentiated instruction, writing to learn, bilingual, communication ability, connection ability, mathematics learning, data and diagrams.

### INTRODUCTION

Mathematical literacy refers to the capacity of individuals to create, employ, and comprehend mathematics in many situations (Ojose, 2011; She et al., 2018). The context may involve both the

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application of mathematical reasoning and the utilization of facts, concepts, methods, and principles to make predictions about a phenomenon. Having a solid understanding of mathematics enables individuals to make informed and rational judgments and decisions (Haara et al., 2021). Furthermore, possessing mathematical literacy enables individuals to acknowledge the significance of mathematics in their lives and to effectively apply mathematical concepts in many scenarios they encounter (Rizki & Priatna, 2019; Sitopu, 2024). Thus, the acquisition of mathematical literacy is a crucial skill that can be cultivated at an early stage.

Although mathematical literacy is essential for students, the mathematical literacy of students in Indonesia still needs improvement. This is evidenced by the outcomes of the Programme for International Student Assessment (PISA). Indonesia has participated in PISA multiple times. PISA is an evaluation conducted by the OECD to measure competency in reading, mathematics, and science. PISA has been conducted since 2003, with the most recent assessment held in 2022. Based on data published by the OECD (<https://www.oecd.org/pisa/publications/>), the average mathematical literacy of Indonesian students has fluctuated. The data indicate that the highest score was achieved in 2006, followed by minor decreases and increases that were not statistically significant. In 2018, the score reached only 379. Based on the 2018 data, the OECD stated that, on average, 71% of students in Indonesia still needed to reach the minimum standard in mathematics. Indonesian students struggled when faced with problems or situations requiring problem-solving abilities. One of the reasons contributing to these challenges was that the interaction between teachers and students in learning did not stimulate analytical and higher-order thinking skills. The learning tended to be the same for all students, and they did not have equal opportunities to develop knowledge that fit their needs. In 2022, the math literacy score increased by five ranks compared to PISA 2018. However, the average of students' math literacy scores dropped by 13 points from 2018. From these points, it is imperative to sustain learning enhancements that offer students the chance to cultivate knowledge according to their own needs.

Mathematical literacy encompasses both problem-solving skills and the capacity to articulate mathematical concepts with clarity and precision. Consequently, mathematical communication is essential to mathematical literacy, as it enables students to articulate ideas, elucidate mental processes, and relate mathematical concepts to real-world contexts. Research findings indicate a significant correlation between mathematical literacy and mathematical communication ability (Paroqi et al., 2020; Triana et al., 2019). Communication ability can enhance students' understanding of mathematical concepts and procedural knowledge, as well as foster problem-solving and metacognitive abilities (Paroqi et al., 2020; Triana et al., 2019). Through verbal and written communication of their ideas, students can deepen their understanding of diverse concepts and discover more effective methods for resolving mathematical issues (Santos & Semana, 2015; Sanusi Siregar et al., 2018). This procedure can enhance mathematical literacy. Furthermore, mathematical literacy involves the understanding and application of mathematical concepts, as well as the capacity to relate these concepts both internally and to other disciplines and real-world mathematical situations (Asfar et al., 2022;

Kenedi et al., 2019). Consequently, connection ability constitutes a vital component of mathematical literacy. Numerous studies indicate that individuals with strong mathematical connection ability exhibit superior numeracy and mathematical literacy, accurately resolve numeracy-related problems, and demonstrate a deeper understanding of mathematical concepts (Septian, 2022; Son, 2022). These findings indicate that connection ability is essential for students to enhance mathematical literacy. As essential abilities that contribute to the development and enhancement of mathematical literacy, communication and connection abilities must be cultivated within mathematics education. This instruction should provide opportunities for students to construct an understanding of mathematics through meaningful experiences (Lauria, 2010; Smale-Jacobse et al., 2019).

One approach that can foster these meaningful experiences is Differentiated Instruction (DI). DI represents an extension of best educational practices. (Chamberlin & Powers, 2010; Marks et al., 2021). Why is differentiation necessary? Two philosophical frameworks can be employed to explain this. Piaget categorized intellectual development into four stages. While these four stages are consistent for all students, the rate of development within each stage varies among individuals (Kamarulzaman et al., 2022). Therefore, teachers must design learning experiences that accommodate these differences. Additionally, each student's Zone of Proximal Development (ZPD) is unique, reflecting the diversity in the distance between their actual and potential levels of ability. (Bodrova & Leong, 2015; Yohanes, 2010). Teachers also need to consider this diversity when learning mathematics.

Differentiated Instruction (DI) must also be integrated with the Writing to Learn (WtL) approach. WtL is a process in which students write on paper to explain ideas, pose questions, determine solutions, develop and articulate arguments, as well as think critically, reflect, and describe subsequent steps (Finkenstaedt-Quinn et al., 2021; Nückles et al., 2020). In mathematics education, the Writing to Learn (WtL) approach encourages students to write effectively about a comprehensive understanding of the material or the steps involved in solving mathematical problems (Graham et al., 2020; Kenney et al., 2014). This indicates that numeracy and literacy cannot be separated when assessing students' mathematical achievements. Furthermore, Writing to Learn (WtL) can serve as a means of communication for students who experience math anxiety, particularly for those who feel unable to articulate mathematical concepts orally (Powell et al., 2021).

The integration of Differentiated Instruction (DI) and Writing to Learn (WtL) in education can address students' needs, enabling them to acquire maximum knowledge through writing activities. These activities are not limited to solving mathematical problems; they can also involve presenting solutions in the form of poems, short stories, rhymes, or articles. Through Writing to Learn, teachers can more accurately assess students' knowledge, identify misconceptions, and recognize areas of difficulty. The combination of DI and WtL is expected to enhance not only students' mathematical communication and connection abilities but also their ability to write with correct grammar. To further strengthen these skills and promote more robust mathematical literacy, the learning process is also delivered in a bilingual context (Garza Ayala, 2022; Sumarno et al., 2024). In this study, the

term ‘bilingual’ refers to students engaging in writing activities in either Indonesian or English. This is facilitated by tasks that students can complete using both languages. In the context of Differentiated Instruction (DI), bilingual instruction can help students develop broader skills that are relevant to global needs. It can also present students with challenges in learning mathematics (Bal, 2023; Hidayati, 2020; Kamarulzaman et al., 2022; Marks et al., 2021; Owusu-ansah et al., 2023; Owusu-Ansah & Apawu, 2022). For these reasons, the study aims to investigate the effectiveness of DI utilizing WtL in a bilingual setting to improve students’ communication and connection abilities in mathematics. This study addresses the following research questions:

- a. Is there a significant difference in students' communication and connection abilities between students who underwent Differentiated Instruction (DI) utilizing Writing to Learn (WtL) in a bilingual context and those in the expository approach?
- b. How many students from each group have met the indicators of communication and connection abilities?
- c. What are the students' perceptions of the Differentiated Instruction (DI) utilizing Writing to Learn (WtL) in a bilingual context?
- d. How was the Differentiated Instruction (DI) utilizing Writing to Learn (WtL) in a bilingual context implemented?

## LITERATURE REVIEW

### Differentiated Instruction (DI)

A literature review indicates a growing interest in the application of Differentiated Instruction (DI) in educational settings. The review reveals an increasing use of DI, as evidenced by the numerous research articles published on the topic (Shareefa & Moosa, 2020). A separate review on the implementation of Differentiated Instruction (DI) in mathematics education found it to be beneficial for developing mathematical skills (Kurnila et al., 2025). DI is employed across all levels of education, from early childhood to tertiary education. The review also highlights several important principles that should be applied to mathematics instruction: identifying students' learning readiness, interests, and learning profiles; differentiating content, processes, and products; ensuring the quality of tasks; and conducting continuous assessment. DI is a strategy to enhance meaningful learning experiences. It involves providing materials or tasks with varying levels of complexity, employing diverse scaffolding techniques, and organizing different groupings (Lauria, 2010; Smale-Jacobse et al., 2019).

In Indonesia, DI is integral to the *New Paradigm Learning*, which is a crucial element of the *Merdeka curriculum* introduced in 2021. The concept of new paradigm learning involves providing scaffolding through structured educational support to enhance students' individuality and potential. This distinctiveness and potential help educators identify and adapt instructional methods or interactions with students. The government has initiated the implementation of DI in the educational

process to facilitate the development of this concept. Curriculum modification, teacher training in differentiated instruction design, the provision of supportive facilities, and the implementation of DI have been launched nationwide. These processes are currently ongoing. One effect has been the emergence of enhanced literacy in mathematics learning compared to prior years. According to the 2023 report by the Ministry of Education and Culture-Ristek, the application of certain DI principles in mathematics education significantly contributed to this enhancement. Consequently, the government is progressively endorsing the integration of differentiated instruction in educational institutions. The government expects educators to implement differentiated instruction alongside other pedagogical methods, models, or strategies to enhance student engagement in learning.

### Writing to Learn (WtL)

Writing to Learn (WtL) is a pedagogical approach and method that employs writing exercises to enhance students' comprehension and cultivate their knowledge and critical thinking abilities. Unlike writing for assignments, which is evaluated for clarity and precision, WtL is informal, exploratory, and often unassessed. Its primary purpose is to enable students to utilize writing as a tool to investigate concepts, elucidate thoughts, and cultivate a deeper comprehension (Graham et al., 2020; Kenney et al., 2014). Research indicates that the WtL technique significantly enhances students' learning outcomes, cognitive abilities, and creative thinking, yielding substantial benefits. Additionally, the quality of students' writing enhances their cognitive capacity (Finkenstaedt-Quinn et al., 2021; Nückles et al., 2020). WtL is an educational methodology that incorporates writing as a fundamental instrument for learning and critical analysis, rather than as a formal writing assignment subject to evaluation, hence affording students the liberty and opportunity to cultivate their ideas and comprehension (Powell et al., 2021).

### Bilingual Context

A bilingual context in education refers to the use of two languages. The languages employed are Indonesian and English, which facilitate the initiation of the learning process. The bilingual context aims to enhance linguistic intelligence and expand global perspectives (Garza Ayala, 2022; Sumarno et al., 2024). In this study, a bilingual environment signifies that writing serves as a bridge between two languages, enabling pupils to investigate concepts, express comprehension, and transmit knowledge across linguistic boundaries. This context has several key characteristics. Initially, writing becomes a cognitive process, with students using writing to investigate, structure, and enhance their comprehension in both languages. Writing enables students to clarify experiences and views in both Indonesian and English. Secondly, the bilingual context becomes a translanguaging process, allowing students to dynamically employ both languages to structure ideas, select vocabulary, and complete writing assignments (Garza Ayala, 2022; Sumarno et al., 2024). This procedure fosters linguistic innovation and interlingual comprehension. Furthermore, it enhances linguistic abilities. Bilingual writing exercises enhance vocabulary learning, sentence construction, and expressive ability in both languages. Teachers employ a transitional methodology to facilitate this process, initially instructing in Indonesian and then in English.

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### **Communication Ability**

Communication ability enhances mathematical learning and strengthens students' metacognitive abilities. Students with this capability can deepen their comprehension of diverse topics and identify more effective methods or strategies for resolving mathematical problems (Paroqi et al., 2020; Triana et al., 2019). This capability encourages pupils to articulate their mathematical concepts both verbally and in writing. These concepts may manifest as symbols, images, graphs, diagrams, and text. In this study, researchers used several indicators of communication ability, including explaining the known and the unknown elements, conveying ideas by using mathematical symbols and terms in understanding the problem, conveying ideas using pictures, symbols, mathematical terms, or formulas in solving the problem, explaining relevant things to understand the problem, and presenting conclusions (Santos & Semana, 2015; Sanusi Siregar et al., 2018).

### **Connection Ability**

Connection ability links various mathematical concepts, procedures, and representations both internally and externally. This ability enables students to understand the relationships between mathematical topics and their application in other contexts, such as other sciences or everyday life (Asfar et al., 2022; Kenedi et al., 2019). This ability helps students develop open thinking, broad insight, and the ability to solve problems in an integrated manner using their existing knowledge. In this study, the researchers used several indicators of connection skills, including formulating the problem, identifying mathematical facts, concepts, and principles, finding relationships between mathematical principles and between mathematics and other sciences or disciplines used to solve problems, using these relationships to derive new formulas for problem-solving, and writing conclusions (Septian, 2022; Son, 2022).

## **METHOD**

### **Research Design**

This study employed a quasi-experimental design, comparing two different treatments applied to the research subjects. A nonrandomized Control Group Design was utilized. The experimental group received treatment through Differentiated Instruction (DI) with Writing to Learn (WtL) in a bilingual context, while the control group received treatment using the expository approach. An important preliminary step taken by the researcher was to obtain permission from the school to conduct the study. The researcher also engaged teachers who were willing to participate and ensured that students had received permission from their parents. The selection of students also considers the effective implementation of the bilingual context. Consequently, the researcher involved students proficient in both spoken and written English. The English teacher, familiar with the students' proficiency, facilitated the selection process. Furthermore, the researcher maintained the confidentiality of the identities of the teachers and students involved in the study. The identities of the teachers and students were not disclosed without their explicit consent.

The participants in this study were junior high school students aged 12 to 13 years. The study included 30 students in the experimental group and 30 students in the control group. These two groups were selected to possess similar characteristics in order to avoid bias. The groups included students with low, medium, and high learning readiness. These attributes are essential for the implementation of DI within the experimental group. Consequently, random assignment through a lottery was not feasible for the experimental and control groups. The researcher employed a proportionate matching procedure based on three kinds of learning readiness to ensure similar characteristics. Prior to matching, the researcher administered a diagnostic assessment to ascertain the learning readiness category of 90 students. The assessment results indicated that 26.7% of students exhibited low learning readiness, 53.3% showed moderate learning readiness, and 20% displayed high learning readiness. The researcher subsequently selected 30 students for the experimental group and 30 for the control group using a proportional matching process, ensuring that the percentage of students exhibiting high learning readiness was identical in both groups. Similarly, the percentage of students exhibiting other learning readiness categories was the same in both the experimental and control groups. The researcher applied the identical proportion as the diagnostic assessment outcomes in each category. Table 1 presents a summary of the percentage of students categorized by learning readiness.

Class	Percentage of students with low learning readiness	Percentage of students with medium learning readiness	Percentage of students with high learning readiness
Experimental	26.7%	53.3%	20%
Control	26.7%	53.3%	20%

Table 1. Percentage of students within each category of learning readiness.

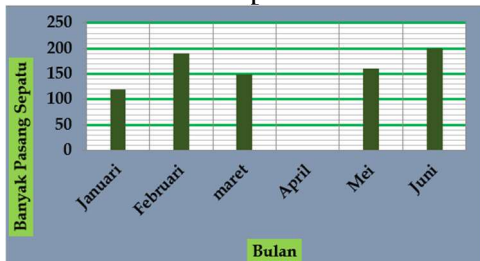
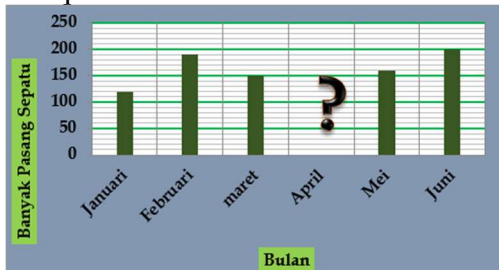
The research instrument utilized in this study was a test. The researcher developed four story problems for the test, adapting the questions from a mathematics reference book for junior high school teachers published by the government. The format of the problems was aligned with the indicators of communication and connection abilities. The researcher adapted the communication skill indicators from NCTM (2000) and the PISA Framework (2015). Simultaneously, the connection ability indicators were adapted from Coxford (1995) and NCTM (2000). The researcher integrated the indicators of each ability based on these sources. Furthermore, the indicators used in the tests are presented in Table 2.

Number	Indicators of Communication Ability	Indicators of Connection Ability
1.	Explaining the known and the asked elements	Formulating the problem
2.	Conveying ideas by using mathematical symbols and terms in understanding the problem.	Identifying mathematical facts, concepts, and principles

3.	Conveying ideas using pictures, symbols, mathematical terms, or formulas in solving the problem.	Finding relationships between mathematical principles and between mathematics and other sciences or disciplines, which are used to solve problems.
4.	Explaining relevant things to understand the problem	Using the relationships between mathematical principles and the relationships between mathematics and other sciences or disciplines in order to obtain a new formula for solving the problem
5.	Presenting conclusions	Writing conclusions

Table 2. Indicators of communication and connection abilities

Two validators assessed the test prior to its implementation in the study. The validators were university lecturers with expertise in primary and secondary school mathematics. Both validators also served as facilitators for teachers in the implementation of Differentiated Instruction (DI) in educational settings. They provided suggestions to enhance some of the illustrations in the story problems and recommended modifications to certain questions to better assess students' communication and connection abilities. The complete results of the validators' suggestions, along with the researcher's revisions to the questions intended for use in the study, are presented in Table 3, and the complete test is included in the appendix.

Validator	Validator's suggestions	Researcher's revisions
First validator	Take a look at this picture 	The picture was revised like this 
First validator	Take a look at the picture in the second question.	The picture was revised like this



Remove the percentage of football or basketball so that students are more critical in answering this question. Choose one.

The question needs to be changed; it is very simple. 'What is the number of students who like basketball and students who like football?'

Also, add a question so students can infer from the data.

The question was changed to 'What is the difference between the number of students who like basketball and the number of students who like football? What is the conclusion from the data?'

Second validator	<p>The following questions are simple; they cannot measure students' connection and communication skills. e.g., "How much did you weigh in April?" and "In what month did you weigh the most?"</p> <p>Replace with other questions.</p>	<p>The questions were changed to</p> <ol style="list-style-type: none"> <li>In which month did the baby experience weight loss?</li> <li>How much weight was lost during that month?</li> <li>When was the most significant increase in the baby's weight?</li> <li>What is your conclusion regarding Baby Alya?</li> </ol>
Second validator	<ol style="list-style-type: none"> <li>The first instruction is 'Present the data in the table above in a bar chart. Eliminate the shape of the diagram so that students can determine which diagram is appropriate to present this data.'</li> <li>Add a question allowing students to relate their mathematical knowledge to others.</li> </ol>	<ol style="list-style-type: none"> <li>The first instruction was changed to "Present the data in the table above in an appropriate diagram."</li> <li>Questions that have been added "If each shop must sell at least 80 pairs of men's shoes, which shop will suffer a loss? What is the percentage loss if one pair of shoes costs Rp.80,000?"</li> </ol>

Table 3. The validators' suggestions and the researcher's revisions to the test to be used in the study

In addition to tests, observation sheets and questionnaires were utilized in this study to provide a complete and comprehensive understanding of the research questions. Both instruments underwent

validation by the validators. The validators confirmed that the statements on the questionnaire and the descriptions of activities on the observation sheet were of acceptable quality; however, they suggested improvements to certain sentences to ensure compliance with the rules of the Indonesian language. Based on these recommendations, the researchers revised the observation sheets and questionnaires used in the study.

The data acquired in this study were evaluated quantitatively by Multivariate Analysis of Variance (MANOVA). The objective was to examine the simultaneous differences between the two dependent variables, communication and connection abilities, of the control and experimental groups. The researcher conducted a multivariate test following a series of learning activities and the administration of the post-test. The data utilized in this test comprised post-test results reflecting students' communication and connection abilities, collected from both the experimental and control classes. The purpose of this analysis was to determine whether there was a significant difference in the effectiveness of Differentiated Instruction (DI) utilizing Writing to Learn (WtL) in a bilingual context compared to the effectiveness of the expository approach in enhancing students' communication and connection abilities. Furthermore, the multivariate tests were conducted on the significance values of the F statistic, specifically Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root. This analysis was performed using SPSS. If the F value exceeded 5.00 or the significance value was less than 0.05, it indicated a difference between the effectiveness of Differentiated Instruction (DI) utilizing Writing to Learn (WtL) in a bilingual context and the effectiveness of the expository approach in enhancing students' communication and connection abilities. If a difference was identified, a t-test (independent samples test) would be conducted to ascertain which classes contributed to the overall difference. The criterion employed for this test was the Bonferroni criterion, with a significance level of 0.025, derived from dividing the degrees of freedom ( $\alpha = 0.05$ ) by 2.

Before conducting the multivariate test, the researchers performed prerequisite analyses, comprising normality test and homogeneity test. The normality test was conducted using a univariate approach with the Kolmogorov-Smirnov test. If the significance value from this test was greater than 0.05, the data were considered to be normally distributed. Subsequently, the homogeneity test was conducted for both communication and connection abilities using the Levene Test. Additionally, the homogeneity of the two abilities could be assessed together by applying Box's M Test. If the significance values obtained from both homogeneity tests, conducted individually and collectively, were greater than 0.05, it indicated that the variance-covariance matrix for the dependent variable was homogeneous.

The obtained data were analyzed both quantitatively using multivariate tests and qualitatively. The researcher conducted a qualitative analysis by determining the percentage of students who met each indicator of communication and connection ability. The percentage of these two abilities were calculated for both experimental and control groups. Additionally, the results of the learning observations were utilized to describe the implementation of the learning process. The observations were carried out by two members of the research team with experience in implementing DI. This procedure was conducted twice: once during the learning phase and once on the recorded learning results.

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This technique provides accurate information about teacher activities and student attitudes. Furthermore, the researcher administered a questionnaire to assess students' satisfaction with the implementation of learning through Differentiated Instruction (DI) utilizing Writing to Learn (WtL) in a bilingual context. Based on the 3-point Likert scale, nine questions were created to gauge students' opinions of the DI with WtL approach implemented in the experimental classroom. These three techniques were employed to provide a clearer understanding of the process of implementation of DI with WtL in a bilingual setting to enhance students' communication and connection abilities.

### **One Form of a Lesson Plan Utilizing Differentiated Instruction (DI) with Writing to Learn (WtL) in a Bilingual Context**

Firstly, the teacher presented the material on data and diagrams in a traditional manner, utilizing various media, including PowerPoint, videos, and images. The use of these media aimed to accommodate students with different learning styles, specifically visual, auditory, and kinesthetic. The teacher occasionally provided explanations in English, and some of the material presented through these media was also in English. The various media used for explanations by the teacher are illustrated in Figure 1.



Figure 1. The teacher provides explanations using various media.

At the beginning of the lesson, the teacher allowed the students to record what they already know about data and diagrams in the 'Know' column and what they wish to learn in the 'Want to Know' column. Students were permitted to write in either Indonesian or English, thereby accommodating those who are more proficient in English.

Secondly, following the classical explanation, the teacher provided students with a worksheet as a form of content differentiation based on learning readiness, which is categorized into three levels: high, medium, and low. Subsequently, the teacher designed assignments tailored to each category. The difficulty level of the tasks was adjusted according to students' learning readiness while remaining sufficiently challenging to stimulate their communication and connection abilities. This approach

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reflects the implementation of Piaget's and Vygotsky's theories. The application of these theories was also evident in collaborative activities, where teachers provide assistance to students, particularly those with low to moderate learning readiness, as they complete their assignments. This support included intensive help, instructional materials articulated in clear and accessible language, and the engagement of students as peer tutors for their counterparts. One example of an assignment on the worksheet for each learning readiness category is as follows:

1. For students with low learning readiness

Data on Mr Nadu's income over five years is presented in the following table.

Year	Income (in rupiah)
2016	16
2017	27
2018	20
2019	35
2020	45

- a. Present the data in the table above as a bar chart.
- b. How much was Mr Nadu income in 2017?
- c. Mr. Nadu's highest income was in the year ...
- d. How much was Mr. Nadu income in 2016 and 2020?
- e. What is the difference between Mr. Maicon's income in 2018 and 2019?
- f. Provide a conclusion based on the data.

2. For students with medium learning readiness

The following is data on students' math test scores.

85	90	70	75	90	80	85	95	100	75
70	75	80	80	85	95	100	75	85	90
75	85	80	85	90	70	85	90	80	85
90	90	75	80	80	85	95	90	95	100

- a. How many students took the math test based on the data in the table above?
  - b. Use a bar chart to Present the test score data in the table above.
  - c. Can this data be presented in the other types of diagrams?
  - d. How many students scored 95?
  - e. How many students scored 75?
  - f. If the Minimum Completeness Criteria is 78, how many students did not the criterion?
  - g. If the Minimum Completeness Criteria is 78, how many students met the criterion?
  - h. Provide a conclusion based on the data.
3. For students with high learning readiness

Visitor data for Cipi Watu Borong tourist attractions in one year is presented in the following table.

Month	Visitors
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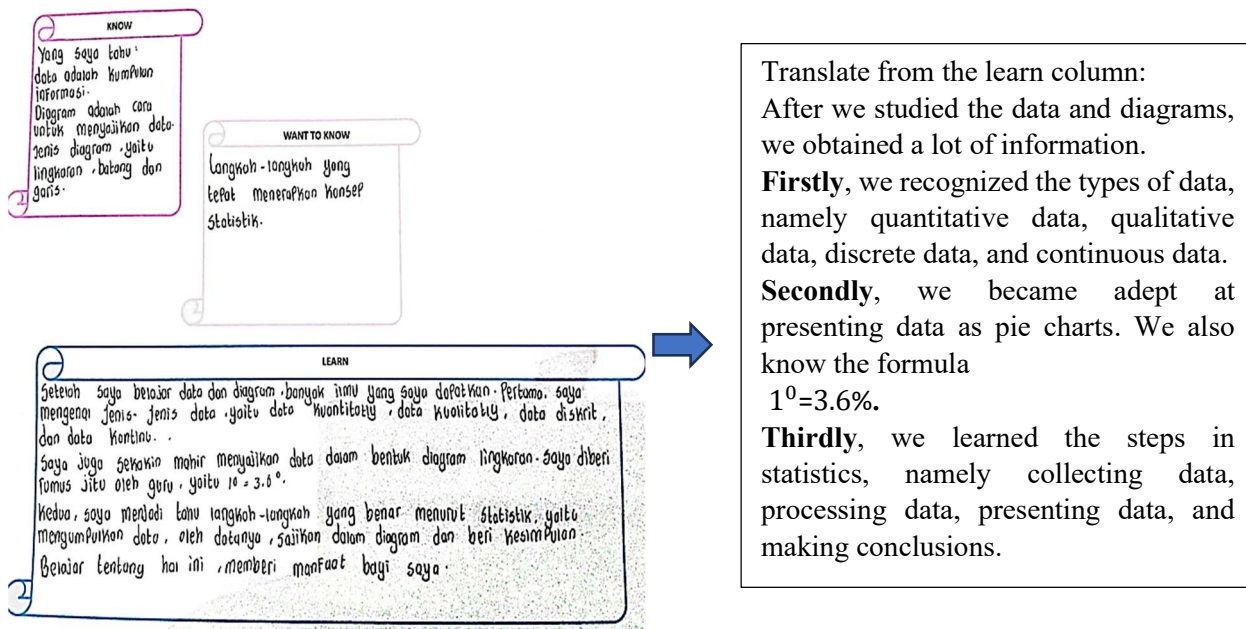
	Children	Adults
January	5%	15%
February	10%	20%
March	5%	10%
April	15%	5%
May	35%	25%
June	30%	25%

- Present the data in the table above in a diagram.
- If the total number of adult visitors in half a year is 2000 people, how many adult visitors in June?
- If the total number of child visitors in half a year is 500, how many adult visitors are there in February?
- If every visitor must pay an entrance ticket with the provisions of Children Rp.2000 and Adults Rp.5000, how much revenue is generated from the Cepi Watu Borong tourist spot in half a year?
- Provide a conclusion based on the data.

The difference among the three worksheets lies in the types of questions tailored to students' learning readiness. Students with low learning readiness received questions involving single data points, which can be presented in a bar chart. This data had already been organized into a table for single data points. Some of the questions in this section are relatively easy but are designed to help students establish connections in order to draw conclusions from the presented data. Students with medium learning readiness received questions involving a larger set of data that has not yet been organized into a table. This data was still random and not systematically arranged, requiring students to first organize the data into a table before proceeding with the questions. The table may contain either single data points or frequency distribution data. The questions are of medium difficulty and require students to connect the data values to the Minimum Completeness Criteria. Consequently, the conclusions drawn involve not only the data values but also their relation to the established Minimum Completeness Criteria. Students with high learning readiness received questions involving compound data, which was presented in percentage form. In these questions, students were not provided with specific instructions regarding which diagram to use for presenting the data; instead, they were permitted to select the most appropriate diagram for their presentation. These questions necessitate the use of more complex algorithms and require students to make connections between the total number of child and adult visitors, as well as the revenue generated based on visitor data.

Thirdly, when the students were completing the tasks on the worksheet, they were allowed to utilize various media, such as books, videos, and the internet. Students had the freedom to use media in either Indonesian or English. They were also allowed to solve problems in Indonesian, English, or a combination of both languages. After completing the tasks, students presented their results. Furthermore, they were free to present their findings in any language. Following the presentation and discussion, students filled in the 'Learned' column, where they recorded what they had learned during

the learning process. An example of how students filled in the three columns (in both Indonesian and English) is illustrated in Figure 2.



**KNOW**  
Yang saya tahu:  
data adalah kumpulan informasi.  
Diagram adalah cara untuk menyajikan data.  
jenis diagram, yaitu lingkaran, batang dan garis.

**WANT TO KNOW**  
Langkah-langkah yang tepat menerapkan konsep statistik.

**LEARN**  
Setelah saya belajar data dan diagram, banyak ilmu yang saya dapatkan. Pertama, saya mengenai jenis-jenis data, yaitu data kuantitatif, data kualitatif, data diskrit, dan data kontinu.  
Saya juga semakin mahir menyajikan data dalam bentuk diagram lingkaran. Saya diberi rumus jitu oleh guru, yaitu  $10 = 3.6^\circ$ .  
Kedua, saya menjadi tahu langkah-langkah yang benar menurut statistik, yaitu mengumpulkan data, oleh datanya, sajikan dalam diagram dan beri kesimpulan.  
Belajar tentang hal ini, memberi manfaat bagi saya.

Translate from the learn column:  
After we studied the data and diagrams, we obtained a lot of information.  
**Firstly**, we recognized the types of data, namely quantitative data, qualitative data, discrete data, and continuous data.  
**Secondly**, we became adept at presenting data as pie charts. We also know the formula  $10 = 3.6\%$ .  
**Thirdly**, we learned the steps in statistics, namely collecting data, processing data, presenting data, and making conclusions.

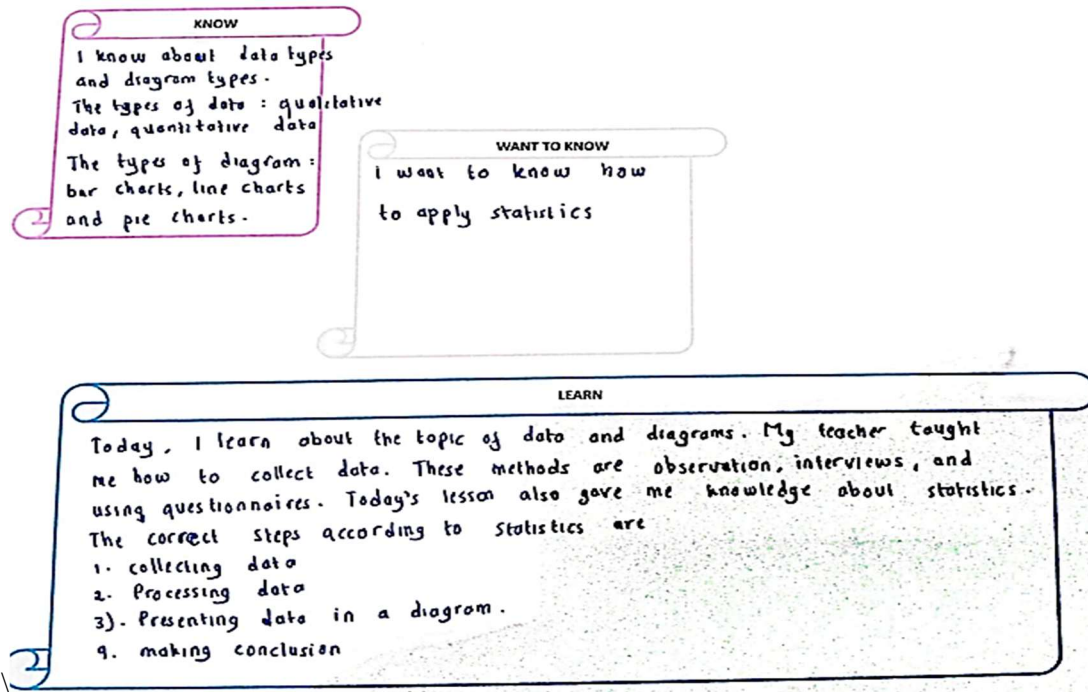


Figure 2: An example of how students fill in the three columns (in Indonesian and English)

Students were also free to write what they have learned in either Indonesian or English. This activity was then presented in a product created by the students, such as short stories, posters, poems, or other forms of artistic expression. The students and their products are illustrated in Figure 3.



Figure 3. The students and their products

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## RESULTS

### Results of Multivariate Test

The implementation of the learning activities was conducted five times for both the experimental and control classes. Subsequently, students in both classes received a post-test to measure their communication and connection abilities. The post-test results reflected the students' achievements in these two areas. Table 4 provides a concise overview of the test results.

Variable	Class	Mean	Standard Deviation	Highest score	Lowest score
Communication Ability	Experimental	83.11	3.82	93.5	69.67
	Control	75.89	3.12	89.5	63.33
Connection Ability	Experimental	79.43	3.10	89.3	72.3
	Control	73.37	3.16	80.5	69.3

Table 4. A concise overview of the test results

Table 4 displays the disparity in the mean scores of communication and connection abilities between the experimental and control classes. The experimental class exhibited a mean communication ability score of 83.11, while the control class demonstrated a mean score of 75.89. Additionally, the experimental class recorded a mean connection ability score of 79.43, whereas the control class achieved a mean connection ability score of 73.37.

The percentage of students in the experimental class who met the minimum criteria for both aspects of the communication and connection abilities assessment was 73.33%. In comparison, the percentage of students in the control class who met the minimum criteria for these two aspects was 60%. The results of the students' recapitulation based on the minimum criteria are presented in Table 5.

Class	Percentage of the number of students who reached the minimum criteria before treatment	Percentage of the number of students who reached the minimum criteria after treatment	The Improvement
Experimental	16.7%	73.33%	56.6%
Control	14.2%	60%	45.8%

Table 5. Percentage of students who met the minimum criteria before and after the treatment and the improvement

Table 5 indicates that the number of students who met the minimum criteria increased in both the experimental and control classes. However, the improvement was more pronounced in the experimental class compared to the control class.

Based on Tables 4 and 5, the experimental class demonstrated higher communication and connection abilities than the control class. Nevertheless, these results were insufficient to conclude that there

was a significant difference between the effectiveness of Differentiated Instruction (DI) utilizing Writing to Learn (WtL) in a bilingual context and the effectiveness of the expository approach in enhancing students' communication and connection abilities. Therefore, the next step involved conducting a multivariate test.

Prior to utilizing the multivariate test, it was essential to conduct normality and homogeneity tests. Once these two criteria were satisfied, the researchers could proceed with the multivariate tests to address the research questions. The normality test employed the Kolmogorov-Smirnov test. The test results obtained using SPSS indicated that the communication ability had a significance value (Sig.) of 0.092, while the connection ability had a significance value of 0.064. Since the p-values were greater than 0.05, the researcher concluded that the data on communication and connection abilities followed a normal distribution. The comprehensive results of the normality test conducted using SPSS are presented in Table 6.

Variable	Statistic	df	Sig.
Communication Ability	0.106	60	<b>0.092</b>
Connection Ability	0.111	60	<b>0.064</b>

Table 6. Results of normality test with Kolmogorov Smirnov using SPSS

The homogeneity test in this study employed Box's M test, which evaluated the similarity of the variance-covariance matrix. The computation results indicated that the significance value (Sig.) was 0.629. Since the significance value exceeded 0.05, the researchers concluded that the covariance variance matrix of the two populations was homogeneous. The results of the homogeneity test conducted using Box's M test in SPSS are presented in Table 7.

Box's M	F	df1	df2	Sig.
1.802	0.578	3	605520.000	<b>0.629</b>

Table 7. Homogeneity test results with Box's M test using SPSS

The Levene test was employed to conduct homogeneity testing on the two abilities. The calculation results indicated that the significance value (Sig.) for communication ability was 0.139, while the significance value (Sig.) for connection ability was 0.953. Since the significance values for both abilities were greater than 0.05, the researchers concluded that the variance matrices were the same. Consequently, the data in this study exhibited homogeneity. The results of the homogeneity test conducted using the Levene test in SPSS are presented in Table 8.

Variable	F	df1	df2	Sig.
Communication Ability	2.246	1	58	<b>0.139</b>
Connection Ability	0.004	1	58	<b>0.953</b>

Table 8. The results of the homogeneity test with Levene test using SPSS

After the data met the criteria for normality and homogeneity, the researchers tested the effectiveness of both Differentiated Instruction (DI) utilizing Writing to Learn (WtL) in a bilingual context and

the expository approach on students' communication and connection abilities. This test employed a one-sample t-test. The calculation results indicated that the t-value for the communication ability of the experimental class was 4.785, while the t-value for the communication ability of the control class was 2.046. Additionally, the t-value for the connection ability of the experimental class was 7.824, and the t-value for the connection ability of the control class was 2.371. The t-values for all abilities were greater than 2.045. Thus, the DI using WtL in a bilingual context effectively improved both students' communication and connection abilities. Similarly, the expository approach also effectively enhanced both students' communication and connection abilities. Based on these results, the DI using WtL in a bilingual context and the expository approach were equally effective in improving these two abilities. The effectiveness test results from the one-sample t-test conducted using SPSS are presented in Table 9.

Variable	t	df	Sig. (2-tailed)	Mean Difference
The communication ability of the experimental class	<b>4.785</b>	29	0.000	11.11100
The communication ability of the control class	<b>2.046</b>	29	0.049	3.88833
The connection ability of the experimental class	<b>7.824</b>	29	0.000	4.43333
The connection ability of the control class	<b>2.371</b>	29	0.025	1.36667

Table 9. The effectiveness test results from the One-Sample t-test using SPSS

Furthermore, the testing employed a multivariate test. This test utilized the significance values of Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root, as well as the F value. The calculation results indicated that the significance value (Sig.) was 0.001, and the F value was 9.097. Since the significance value was less than 0.05 and the F value exceeded 5.00, there was a significant difference in the effectiveness of Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual context compared to the effectiveness of the expository approach in improving students' communication and connection abilities. The complete results of the multivariate test conducted using SPSS are presented in Table 10.

Test	Value	F	Hypothesis df	Error df	Sig.
Pillai's Trace	0.242	<b>9.097</b>	2	57	<b>0.001</b>
Wilks' Lambda	0.758	<b>9.097</b>	2	57	<b>0.001</b>
Hotelling's Trace	0.319	<b>9.097</b>	2	57	<b>0.001</b>
Roy's Largest Root	0.319	<b>9.097</b>	2	57	<b>0.001</b>

Table 10. Results of Multivariate test using SPSS

Due to the differences in the effectiveness of Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual context compared to the expository approach, the researchers conducted a t-test to determine which specific groups contributed to the overall differences. The t-test was performed on each ability, beginning with communication ability. The calculation results indicated that the significance value (Sig. 2-tailed) was 0.019, and the t value was 2.407. Since the significance value was less than 0.025 and the t value exceeded 2.386, it was concluded that DI using WtL in a bilingual context was more effective than the expository approach in improving communication ability. Thus, the DI using WtL in a bilingual context was found to be superior in enhancing communication ability compared to the expository approach. The results of the t-test analysis on communication ability conducted using SPSS are presented in Table 11.

Variable					Sig.	Mean Difference	Std. Error Difference
	F	Sig.	t	df	(2-tailed)		
Communication ability	2.246	0.139	<b>2.407</b>	58	<b>0.019</b>	2.16667	0.90009

Table 11. t-test results on communication ability using SPSS

Second, the test was conducted to measure students' connection ability. The calculation results indicated that the significance value (Sig. 2-tailed) was 0.001, and the t value was 3.794. Since the significance value was less than 0.025 and the t value exceeded 2.386, it was concluded that Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual context was more effective than the expository approach in improving students' connection ability. Thus, the DI using WtL in a bilingual context was found to be superior in enhancing connection ability compared to the expository approach. The complete results of the t-test on connection ability, conducted with the assistance of SPSS, are presented in Table 12.

Variable					Sig.	Mean Difference	Std. Error Difference
	F	Sig.	t	df	(2-tailed)		
Connection ability	0.004	0.953	<b>3.794</b>	58	<b>0.001</b>	3.06667	0.80824

Table 12. t-test results on connection ability using SPSS

### The Evaluation Results Based on Each Indicator of Communication and Connection Abilities

According to the results of the multivariate analysis, Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual context is more effective than the expository approach in improving communication and connection abilities. Descriptively, the data for these two abilities were evaluated according to their respective indicators. The researcher calculated the percentage of students who met each indicator for these two abilities. The percentage was determined by dividing the number of students who fulfilled specific indicators across all questions by the total number of students, then multiplying by 100%.

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Number	Indicators of Communication Ability	Experimental Class	Control Class
1.	Explaining the known and the asked elements	93.3%	83.3%
2.	Conveying ideas by using mathematical symbols and terms in the process of understanding the problem.	83.3%	73.3%
3.	Conveying ideas using pictures, symbols, mathematical terms, or formulas in the process of solving the problem.	76.7%	66.7%
4.	Explaining relevant things to understand the problem	76.7%	63.3%
5.	Presenting conclusions	66.7%	56.7%
	Average	79,34%	68,66%

Table 13. Percentage of students who fulfill each indicator of communication ability

Table 13 presents the percentage of students who met the communication ability indicators. The experimental class exhibited a higher percentage than the control class for each communication ability indicator. This result indicates that the implementation of Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual context is more effective in enhancing communication ability. The opportunity for students to write about what they know, what they want to know, and what they have learned actively engages them in the learning process. Students who may lack oral communication skills are motivated to express their ideas in writing. They can present a short paragraph using mathematical language in the form of symbols, pictures, graphs, diagrams, and words. The differentiation process is based on students' prior knowledge and their learning objectives, allowing the topics covered to be appropriately adjusted.

After learning a topic, students can articulate what they have learned through the concept of free writing. This approach provides a clear representation of the mathematical ideas that students possess, as well as their correct use of symbols, images, graphs, or diagrams. The subsequent step involves students presenting their work, which accommodates those with oral communication abilities. The use of both Indonesian and English further supports the learning process. Employing these two languages can enhance student engagement during instruction. Students with an interest in English are encouraged to express mathematical ideas using this language, which also motivates them to seek broader information from English-language media or teaching materials. This information can be shared with peers through group activities, allowing them to complement each other's knowledge.

From the five indicators of communication ability, the lowest percentage was observed in indicator 5. This trend was evident not only in the experimental class but also in the control class. Some students were able to identify the problem and articulate the relevant information; however, their

conclusions required correction. Generally, students in the experimental class demonstrated the ability to solve problems with clear writing and presentations, and their argumentation was appropriate. In contrast, while some students in the control class presented good ideas for solving the problem, their opportunities for exploration were still limited, resulting in incomplete solutions to the problems.

Number	Indicators of Connection Ability	Experimental Class	Control Class
1.	Formulating the problem	93.3%	83.3%
2.	Identifying mathematical facts, concepts, and principles	80%	70%
3.	Finding relationships between mathematical principles and between mathematics and other sciences or disciplines, which are used to solve problems.	76.7%	70%
4.	Using the relationships between mathematical principles and the relationships between mathematics and other sciences or disciplines in order to obtain a new formula for solving the problem	73.3%	60%
5.	Writing conclusions	66.7%	56.7%
	Average	78%	68%

Table 14. Percentage of students who fulfill each indicator of connection ability

Table 14 presents the percentage of students who met the connection ability indicators. The experimental class exhibited a higher percentage than the control class for each connection ability indicator. Specifically, the percentage of students who met indicator 2 was 76.7% higher than that of the control class, while the percentage of students who met indicator 3 was 73.3% higher than that of the control class. This indicates that the implementation of Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual context is more effective in enhancing connection ability. One of the key characteristics of DI is the provision of quality tasks. In the experimental class, tasks were tailored to align with students' learning readiness. Although the tasks were adjusted to accommodate individual learning levels, they all required students to find connections between mathematical topics or between mathematics and other sciences, and to apply these connections in solving mathematical problems.

Writing to Learn (WtL) activities are integrated into these tasks through exercises that involve writing about what is known and what is desired to be known regarding the relationships between mathematical topics or between mathematics and other sciences. Furthermore, students engage in writing about what they have learned through the products they create. These products take the form of poems, news reports, or stories, which are tailored to align with each student's learning style and interests. Some students present their products in Indonesian, while others use English. Table 14

also indicates that only 60% of students in the control class fulfilled the fourth indicator. Some students were not yet able to connect mathematics with other sciences when solving problems related to the tasks.

Of the five indicators of connection ability, the lowest percentage was observed in indicator 5. This trend was evident not only in the experimental class but also in the control class. In the experimental class, students who did not meet this indicator tended to make connections effectively but drew incorrect conclusions. Conversely, in the control class, students who did not fulfill this indicator tended to make incorrect connections, which resulted in errors in their conclusions.

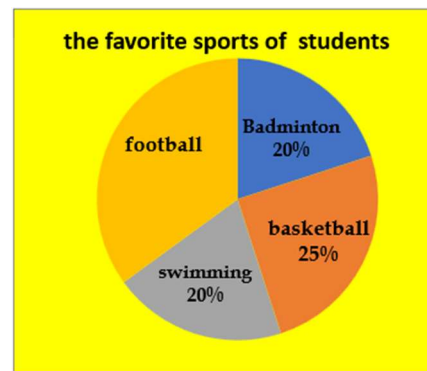
One of the students' answers to a question on the test.  
Question:

*Take a look at the pie chart.*

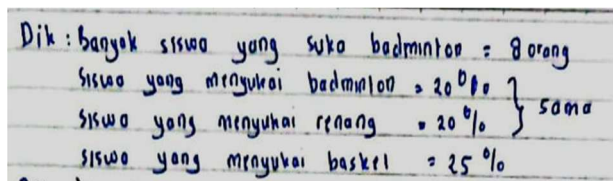
*Data on the favorite sports of seventh-grade students are shown in the pie chart beside the questions. Eight students like badminton.*

*What is the difference between the number of students who like basketball and those who like football?*

*Can students who like football make two groups of players in a football match?  
What is the conclusion from the data?*



Student's answer:



Dik: banyak siswa yang suka badminton = 8 orang  
siswa yang menyukai badminton = 20%  
siswa yang menyukai renang = 20%  
siswa yang menyukai basket = 25% } sama



Known:  
Number of students who like badminton = 8 people.  
Percentage of students who like badminton = 20%, like swimming = 20%, and like basketball = 25 %

Asked: the difference between the number of students who like basketball and those who like football  
Answer (The first Question)

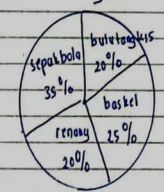
- Like Badminton = 20% = 8 people, and like swimming = 20%. So, like swimming = 8 people.
- Like Basket ball = 25%, so the

Dit: a) selisih jumlah siswa yang menyukai basket dan yang menyukai sepak bola  
Jawab:  
 \* Yang suka badminton = 20% = 8 orang  
 \* Yang suka renang = 20% = 8 orang } sama  
 \* Yang suka basket = 25% = 5  
 Jadi siswa yang suka basket =  $\frac{25\%}{20\%} \times 8 = \frac{25}{20} \times 8 = 10$  orang

$$\frac{25\%}{20\%} \times 8 = \frac{25}{20} \times 8 = 10 \text{ orang}$$

\* Yang suka sepak bola = ?? (ari terlebih dahulu)  
 Yang suka sepak bola =  $100\% - (20\% + 25\% + 20\%)$   
 $= 100\% - 65\% = 35\%$   
 siswa yang suka sepak bola =  $35\% \times 8 = \frac{35}{100} \times 8 = 28$   
 $= 7 \times 8 = 14$  orang

gambar diagram



\* Jadi, selisih jumlah siswa yang menyukai basket dan yang menyukai sepak bola =  $14 - 10 = 4$

- Like football = ??

Firstly, find the percentage of students who like football

$$= 100\% - (20\% + 25\% + 20\%)$$

$$= 100\% - 65\% = 35\%$$

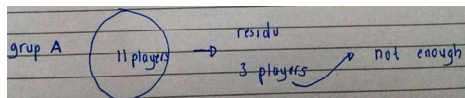
Second, Number of students who like football

$$= 35\% \times 8 = \frac{35}{100} \times 8 = 28$$

$$= 7 \times 8 = 14 \text{ orang}$$

Answer (The second question)

Can't, there are not enough students to make two groups of football players.



Answer (The Third Question)

Favourite sport is football

b) Tidak bisa, karena jumlah siswanya tidak cukup untuk membuat dua kelompok sepak bola

grup 11 orang - siswanya 3 orang tidak cukup.

c) Yang paling disukai olahraga sepak bola

Figure 4 The students' answers to a question on the test

Figure 4 illustrates the responses of students with medium learning readiness. Based on the indicators of communication ability, the answers reveal several important points. First, students are able to explain what is known and what is being asked in the problem, incorporating these two elements at the beginning of their responses. They describe relevant information according to the narrative presented in the problem and the accompanying pie chart. Second, students employed various symbols to interpret the problem when answering the first and second questions. In the first response, the student used curly braces to indicate that the percentage of students who like badminton is equal to the percentage of students who like swimming. This symbol was used to conclude that the number of students who like badminton is the same as those who like swimming. Additionally, students utilized symbols such as arrows, percentages, and slashes to express the simplification of fractions when calculating the number of students who like basketball and football. Furthermore, students redrew the pie chart, providing more comprehensive information than the initial diagram. While students attempted to use several symbols, some were not appropriate, such as the curly braces. In addition to symbols, students employed various mathematical terms to clarify the problem, specifically what is known and what is being asked. Third, students applied the correct formula to solve the problem. In the first response, the student utilized a formula to determine the number of students who like basketball and football, incorporating comparison, multiplication, division, and fraction simplification. In the second response, the student represented a group of football players with a circle and used an arrow to indicate that the remaining three individuals were insufficient to form another group of football players. Fourth, the student included relevant information to address the first question. The response initially presented information regarding the number of students who liked badminton, followed by information on the number of students who liked swimming. However, one of these pieces of information could determine the number of students who like basketball and football. The initial answer to this question indicates that students have not yet been able to sort through the relevant information necessary to solve the problem, as the solution only requires one piece of information: the number of students who like badminton. Fifth, students mentioned only one conclusion derived from the data displayed on the pie chart, although additional conclusions could be drawn from the data.

Based on the indicators of connection ability, Figure 4 highlights several important points. First, students are able to formulate the problem by determining what is known and what is being asked. With these two pieces of information, students can proceed correctly to the next step of the solution. Second, students include relevant facts, such as the number of students who like badminton and the percentage of students according to their favorite sports as depicted in the diagram. In addressing this problem, students also apply various arithmetic concepts, including the associative principle when determining the percentage of students who like football. Third, students utilized the correct formula to ascertain the number of students who like basketball and football. This formula involves operations of multiplication, division, and comparison or ratio. When applying this formula, students

effectively connected multiplication, division, and the simplification of fractions. They also used slashes to express the simplification of fractions when calculating the number of students who like basketball and football. These processes demonstrate that students can identify and employ appropriate connections among several mathematical principles. Fourth, while the student provided the correct answer to the second question, they did not explicitly explain why the number of students was insufficient to form two groups of football players. The student merely described the information with a visual representation without clarifying that one football group comprises 11 players. Despite this lack of explicit explanation, the student demonstrated an understanding of the relationship between mathematics and sports science. Fifth, students mentioned only one conclusion derived from the data displayed on the pie chart, although additional conclusions could be drawn by connecting the first, second, and third responses.

### Results of the Survey on Students' Opinions

Following the implementation of the learning activities in the experimental class, the researcher administered a questionnaire to gather students' opinions regarding the use of Differentiated Instruction (DI) with Writing to Learn (WtL) in a bilingual context. Through this questionnaire, the researcher obtained insights into students' feelings about the learning process and its effects on them. These opinions are summarized through the results of student feedback corresponding to the statements in the questionnaire. The answer choices in the questionnaire included "Agree," "Neutral," and "Disagree." The percentage for each answer choice was determined by dividing the number of students who selected a particular response for each statement by the total number of students, then multiplying by 100%. The results of the questionnaire are presented in Table 15.

Items	Agree	Neutral	Disagree
I feel happy to participate in learning about data and diagram topics.	83.3%	16.7%	0%
For me, learning about this topic is interesting.	83.3%	16.7%	0%
If there is similar learning in other subjects, I am eager to engage those subjects as well.	83.3%	16.7%	0%
Although my assignment was different from my friends', it helped me to understand the topic of data and diagrams better.	76.7%	13.3%	10%
Through writing activities, I can explore and increase my knowledge about data and diagrams.	83.3%	16.7%	0%
The freedom to use either Indonesian or English motivates me to learn more about data and diagrams.	73.3%	0%	26.7%
This learning model gives me the confidence to communicate my mathematical knowledge to others.	90%	0%	10%
This learning model helped me understand the relationship between data, diagrams and statistics.	76.7%	23.3%	0%

With this learning model, I know the benefits of learning about data and diagrams in everyday life.	90%	10%	0%
-----------------------------------------------------------------------------------------------------	-----	-----	----

Table 15. Students' opinions in experimental class

Table 15 indicates that the majority of students appreciated learning through Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual setting, with 83.3% expressing positive feedback. Additionally, 83.3% of students found the learning experience engaging. Furthermore, most students (83.3%) expressed eagerness to participate in future lessons utilizing a similar learning model. However, 16.7% of students did not express an opinion on these three aspects. Table 15 reveals that a significant majority of students (76.7%) agreed with the concept of receiving different assignments from their peers. Despite the variations in assignments, students remained enthusiastic about learning the material related to data and diagrams. Nonetheless, 13.3% of students did not provide an opinion on this matter, and a small percentage (10%) disagreed with the differentiation of tasks. Based on brief interviews with these students, the researcher identified them as having lower abilities. They expressed that when their tasks were different and easier than those of their peers, it diminished their confidence. They expressed a desire for more challenging tasks.

Table 15 also indicates that the majority of students enjoyed writing activities during learning, with 83.3% expressing positive feedback. Observations revealed that students wrote about what they knew, what they wanted to know, and what they had learned with enthusiasm and diligence. They were particularly motivated when given the freedom to present their ideas or mathematical solutions in the form of poems or short stories, which they found both unique and challenging. However, 16.7% of students did not express an opinion on this matter, viewing writing activities as a normal part of the learning process. Additionally, Table 15 shows that most students appreciated the bilingual learning package in both Indonesian and English, with 66.7% indicating their preference. Observations indicated that students were enthusiastic about this approach. They demonstrated confidence in expressing their opinions and writing in both Indonesian and English. When working in pairs or groups, students actively translated or shared information in both languages. However, 26.7% of students disagreed with the bilingual learning approach, stating that they were more accustomed to using Indonesian in their studies.

Table 15 reveals that the majority of students reported that learning through Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual setting enhanced their confidence in communicating their mathematical knowledge, both orally and in writing, with 90% expressing this sentiment. However, 10% of students disagreed with this assertion. Observations and interviews with the teacher who conducted the lesson indicated that the students who disagreed tended to experience high levels of anxiety. These students often remained silent during lessons and lacked the courage to express their opinions verbally. Additionally, Table 15 indicates that most students believed that learning with DI using WtL in a bilingual context helped them understand the relationship between data, diagrams, and statistics, with 76.7% affirming this belief. However, 23.3% of students did not assess this statement. Furthermore, Table 15 also shows that a significant majority of students (90%) stated that learning with DI using WtL in a bilingual setting taught them the practical benefits of

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data and diagrams in everyday life. This was evident during the learning process, as students were able to provide examples of the application of data and diagrams in various fields, such as education, economics, and health. Some students were able to explain in detail the steps involved in collecting and interpreting data presented in diagram form. Nevertheless, a small percentage of students (10%) did not provide an assessment of this statement.

In general, Table 15 indicates that the majority of students preferred and benefited from the Differentiated Instruction (DI) approach using Writing to Learn (WtL) in a bilingual context. This learning method enhanced students' enthusiasm and motivation to engage with the topics of data and diagrams.

### The Observation Results of Learning Process in Experimental Class

In addition to employing the student opinion questionnaires, the researchers also conducted observations in the experimental classes focusing on two factors: teacher activities and student attitudes. These observations aimed to obtain an overview of the activities undertaken by teachers and the attitudes indicated by students during learning with Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual context. Table 16 presents a summary of the teacher activities and student attitudes observed in the experimental class.

Factor	Experimental Class
Teacher activities	<p>Begin by providing an apperception and motivating students about their surrounding environment by positioning themselves in front of students who differ in nature and background.</p> <p>Convey learning objectives by understanding students' interests and how to facilitate them, as well as the contextual scope of the material.</p> <p>Inspire students to be the best version of themselves.</p> <p>Provide sparking questions to start from their initial understanding and give all students the opportunity to respond (the teacher begins using WtL with the activity of writing what students know and want to know about data and diagrams. Students are given the freedom to write either in Indonesian or English).</p> <p>Provide varied reading and observational materials and allowing freedom to explore by utilizing various learning resources (e.g. bilingual reading materials and information from the internet)</p> <p>Encourage students to discuss in groups, collaborate, and position themselves as students' "friends."</p> <p>Reflect on the preliminary results from their exploration of the concepts they have discovered.</p> <p>Quickly respond to students' problems, and when needed, act as a mentor, coach, and partner for students.</p>

Factor	Experimental Class
<b>Student attitudes</b>	<p>Invite students to visualize their findings in various forms of visual works, offering them choices (the teacher uses WtL activities by asking students to write what the students have learned through several products, such as poems, short stories, posters or other art products presented in either Indonesian or English)</p> <p>Allow students to express their ideas as their best work.</p> <p>Invite students to demonstrate their visual works.</p> <p>Conduct each sequence of activities in class with no abrupt transitions.</p> <p>Provide opportunities for students to ask questions and express their opinions about other students' visual work.</p> <p>Be an active listener (with empathy) when students share their work or opinions.</p> <p>Praise students in public and provide constructive feedback (<i>feedback on the ladder</i>).</p> <p>Ensure fairness in determining student achievement targets using authentic assessment</p> <p>Plan and assign meaningful homework activities, avoiding tasks that lack purpose.</p> <p>Show enthusiasm and provide moral messages that will benefit students in the future.</p> <p>Students demonstrate their activeness in the classroom by participating in various activities, such as lively discussions, expressing opinions effectively in either Indonesian or English, and engaging in serious thinking activities, either individually or in groups. Students also show their creativity by producing some interesting products. Students are also more motivated in learning because they have the opportunity to develop their ability to use English alongside Indonesian.</p>

Table 16. Observation results of teacher activities and student attitudes during learning in the experimental class.

Based on the results of statistical tests, the learning conducted in both the experimental and control classes was equally effective in improving connection and communication abilities. However, further analyses indicated that the learning in the experimental class was more effective than in the control class for these two abilities. The observation results presented in Table 16 illustrate this effectiveness, showing the number of positive activities in the experimental class—activities that not only enhanced students' academic abilities but also contributed to their character development. Teachers used three distinctions, namely content, process and product. Moreover, the learning approach accommodated students' needs according to their learning readiness and interests. This approach increased students' comfort during the learning process, motivating them to engage more actively in mathematical thinking activities. As a result, students in the experimental class demonstrated superior communication and connection abilities compared to those in the control class.

## DISCUSSION

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Communication and connection abilities are two essential skills for students, as they significantly support mathematical literacy. Communication ability enhance students' understanding of concepts and the correct procedures for solving mathematical problems. Meanwhile, connection ability deepen students' comprehension of both internal and external relationships within mathematics. Therefore, it is imperative for teachers to implement meaningful learning experiences that encourage students' interest in seeking information, learning, and exploring the field of mathematics. Such an approach can effectively support the enhancement of both students' communication and connection abilities.

The study adopted the Differentiated Instruction (DI) approach to make learning more meaningful and enjoyable for students. The DI approach provides opportunities for students to explore according to their individual abilities. Each student acquires knowledge through a learning process tailored to their ability patterns, allowing them to leverage their strengths while addressing their weaknesses (Lauria, 2010; Smale-Jacobse et al., 2019). This learning pattern strongly supports students' communication and connection processes. Students actively engage in mathematics learning by demonstrating curiosity, asking questions, making discoveries, critically analyzing topics, and utilizing both prior and additional knowledge to solve problems. This process can be implemented through various approaches or perspectives to facilitate the development of students' communication and interpersonal skills (Kamarulzaman et al., 2022; Kërënghi & Gjoci, 2015). In this study, DI was combined with the Writing to Learn (WtL) approach, which emphasized students' practices of writing definitions and journals, understanding the material, and explaining the steps involved in solving mathematical problems. As previously mentioned, DI offers several advantages. Many prior studies (Hapsari, 2018; Herner-Patnode & Lee, 2021; Maula et al., 2024; Nurasiah et al., 2020; Prast et al., 2018) across various educational levels have demonstrated the effectiveness of DI. These studies found that the implementation of DI resulted in improvements in mathematical ability, engagement in learning, interest in learning, problem-solving skills, communication, and cooperation. Furthermore, the findings indicated that DI fostered an enjoyable classroom environment for both students and teachers in the context of learning mathematics (Marks et al., 2021; Shodiq et al., 2024). In this study, students' worksheets and certain tasks were presented in a bilingual format to facilitate the introduction of two languages: Indonesian and English. Students were also given the opportunity to engage in the WtL process in one of these languages. Thus, it can be concluded that utilizing DI in conjunction with WtL in a bilingual context not only enhances communication and connection abilities in mathematics but also contributes to proficiency in both languages.

This study indicated that both the Differentiated Instruction (DI) approach using Writing to Learn (WtL) in a bilingual context and the expository approach were effective in improving communication and connection abilities in mathematics. However, there were notable differences in the effectiveness of these two approaches regarding the enhancement of students' communication and connection abilities. In this study, the implementation of DI utilized three forms of differentiation: content, process, and product. These distinctions were based on three factors: learning readiness, interest, and learning profile. To facilitate effective communication in mathematics and to help students connect various mathematical concepts, the researchers integrated DI with WtL. WtL activities in mathematics learning proved beneficial for students, who received a worksheet containing three

columns labeled "Know," "Want to Know," and "Learned." The activity began with the teacher distributing the worksheet and instructing students to complete the first two columns, specifically the "Know" and "Want to Know" columns. Through the responses provided by the students, the teacher could easily assess their initial knowledge and interests. During the learning process, students explored a new topic and wrote a short paragraph summarizing their understanding of the material. At the conclusion of the activity, students filled in the third column as evidence of their learning progress. This writing activity was conducted in a bilingual format, utilizing both Indonesian and English, with the teacher occasionally providing explanations in English. Furthermore, the expository approach to mathematics learning in this study was primarily characterized by the teacher's direct explanations. The teacher provided numerous explanations regarding concepts for solving mathematical problems, interspersed with questions and answers between the teacher and the students. However, the teacher's explanations were delivered exclusively in a monolingual format, specifically in Indonesian.

Furthermore, this study showed that the Differentiated Instruction (DI) approach using Writing to Learn (WtL) in a bilingual context was more effective than the expository approach in enhancing students' communication abilities. One form of DI implementation observed in this study involved the differentiation of processes tailored to various learning styles. The teacher employed several media to accommodate these learning styles, including PowerPoint presentations, images, and educational videos. This differentiation was conducted in a classical format, interspersed with explanations and question-and-answer sessions. Moreover, one of the WtL activities integrated into this differentiation occurred when the teacher sensed that the students were struggling to understand the lesson. The teacher paused the instruction and encouraged the students to articulate their difficulties. Students were able to write about what they knew in the "Know" column and what they wanted to learn in the "Want to Know" column. They could express their mathematical understanding using mathematical language, symbols, images, graphs, diagrams, and words. Based on this writing, the teacher could identify both easy and difficult material, as well as the sources of students' errors in understanding mathematical concepts. Additionally, the teacher could uncover any misconceptions held by the students. The subsequent process allowed students to gain distinctions based on the information derived from their writing. This differentiation encouraged students to enhance their comprehension of mathematical subjects according to their readiness and desire to learn. The teacher integrated this differentiation with tasks that involved solving mathematical problems, which stimulated a deeper understanding of the material covered in the lesson. The teacher then arranged the students in pairs and allowed each pair to "free write" about the mathematical concepts they had understood and how to apply them to solve mathematical problems. Furthermore, the students were asked to communicate their written work to their classmates. This learning style effectively stimulated students to improve their communication abilities in mathematics. These results are supported by several studies (Nurasiah et al., 2020; Sukri, A., Rizka, M. A., Purwanti, E., Ramdiah, S., & Lukitasari, 2022) that utilized DI in mathematics education. The findings of these studies indicated that implementing personalized instruction based on individual characteristics could enhance students' engagement in learning mathematics. Moreover, students exhibited curiosity, asked questions, explored novel concepts, engaged in critical thinking, sought solutions, and utilized prior knowledge

to solve mathematical problems. This engagement, in turn, stimulated students to communicate mathematical concepts effectively during learning. Furthermore, previous studies (Graham et al., 2020; Miller, 2020) demonstrated that integrating WtL into learning further stimulated students' mathematical communication abilities in writing. According to these studies, students' communication skills became more organized in terms of general grammar and mathematical language. Although WtL primarily focused on improving written communication, its integration within DI also positively impacted students' oral communication abilities. Additionally, employing a bilingual approach in the learning process using DI with WtL not only improved students' mathematical communication in Indonesian but also in English.

The study also indicated that the Differentiated Instruction (DI) approach using Writing to Learn (WtL) in a bilingual context was more effective than the expository approach in enhancing students' connection abilities. One form of DI implementation in this study involved the use of quality tasks, which were presented differently based on students' learning readiness. The categories of students' learning readiness were classified as low, medium, and high. Although the tasks varied, they were designed to be more challenging and slightly above the students' current levels of readiness, thereby pushing them out of their comfort zones (Chamberlin & Powers, 2010; Hapsari et al., 2018; Hidayati, 2020; Mellroth et al., 2021; Prast et al., 2018; Rasheed & Wahid, 2018; Shodiq et al., 2024). In this study, one characteristic of the challenging tasks was to identify connections between mathematical topics or between mathematics and other scientific disciplines, and then to use these connections to solve mathematical problems. WtL activities were integrated into this task. Each student was encouraged to write about what they knew and what they wanted to learn regarding the relationships between mathematical topics or between mathematics and other disciplines. Furthermore, students worked on the tasks in pairs. Initially, they were asked to complete a task using the essential facts, concepts, and principles necessary for its completion. Subsequently, in pairs, the students created connections between mathematical topics or between mathematics and other disciplines based on their prior knowledge and inquiries. They then applied these connections to solve mathematical problems. The outcomes of these activities were presented in the form of short paragraphs, poems, or stories, which students created in Indonesian, English, or both languages. When completing their products, students utilized various media, such as books, videos, or social media, in both languages. The assessment of these products focused not only on the connections made between mathematical topics or between mathematics and other disciplines but also on the coherence of sentences, vocabulary usage, and proper spelling. This type of learning activity effectively enhanced students' connection abilities in mathematics. Additionally, these results are supported by several studies (Canque et al., 2021; Kamarulzaman et al., 2022; Maula et al., 2024), which indicate that DI can facilitate students in connecting ideas or concepts when solving mathematical problems. When learning is combined with WtL, students' connection abilities improve. Another study (Kenney et al., 2014) also demonstrated that WtL is an effective strategy for helping students establish relationships between mathematics and other subjects or disciplines. Although the process is conducted through writing, it can still stimulate both systematic and connective thinking processes. Moreover, WtL can assess students' understanding and provide valuable support for learning mathematical concepts.

Additionally, this study showed that 79.34% of students in the experimental class met the communication ability indicators, compared to 68.66% in the control class. The experimental class exhibited a higher percentage across all indicators of communication ability. These findings suggest that the implementation of Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual context is more effective in enhancing students' communication abilities. Providing students with opportunities to write about what they know, what they want to know, and what they have learned actively engages them in the learning process. Students who may struggle with oral communication are encouraged to express their ideas through writing. Moreover, the integration of both Indonesian and English further supports and enriches the learning experience. Employing these two languages enhances student engagement during instruction. Students interested in English are encouraged to express mathematical ideas in this language, which also motivates them to seek broader information from English-language media or teaching materials. This information can be shared with peers through group activities, allowing them to complement each other's knowledge. Additionally, this study indicated that 78% of students in the experimental class met the connection ability indicators, compared to 68% in the control class. The experimental class exhibited a higher percentage than the control class for each connection ability indicator. This indicates that the implementation of Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual context is more effective in enhancing connection ability. A key characteristic of DI is the provision of quality tasks. In the experimental class, tasks were tailored to align with students' learning readiness. Although adjusted to accommodate individual learning levels, all tasks required students to find connections between mathematical topics or between mathematics and other sciences, and to apply these connections in solving mathematical problems. Writing to Learn (WtL) activities were integrated into these tasks through exercises involving writing about what is known and what is desired to be known regarding these relationships.

The study also showed that the majority of students appreciated learning through Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual setting, with 83.3% expressing positive feedback. Observations indicated that the teacher implemented three forms of differentiation: content, process, and product, tailored to students' learning readiness and interests. The findings also suggest that most students enjoyed writing activities during learning. Observational data revealed that students wrote enthusiastically and diligently about what they knew, what they wanted to know, and what they had learned. They were particularly motivated when given the freedom to present their ideas or mathematical solutions in the form of poems or short stories, which they found both unique and challenging. Additionally, this study indicates that most students appreciated the bilingual learning package in both Indonesian and English, with 66.7% expressing preference for this approach. Observations revealed that students were enthusiastic, demonstrating confidence in expressing their opinions and writing in both languages. During pair or group activities, students actively translated and shared information in both Indonesian and English. The majority of students reported that learning through Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual setting enhanced their confidence in communicating mathematical knowledge both orally and in writing. Overall, these findings indicate that the majority of students preferred and benefited from the Differentiated Instruction (DI) approach incorporating Writing to Learn (WtL) in a

bilingual context. This learning method enhanced students' enthusiasm and motivation to engage with the topics of data and diagrams.

Based on these research findings, the DI approach incorporating WtL in a bilingual context positively influences the mathematics learning process in the classroom. Therefore, teachers should consider applying this approach to other mathematical concepts or to enhance other mathematical skills. Furthermore, several important principles demonstrated by the application of this approach include the necessity for learning to accommodate student characteristics, the effectiveness of learning through social interaction, the encouragement for students to design their activities or products during the learning process, and the importance of exploring various student perspectives to deepen their understanding of mathematical concepts.

There are several notable contributions to bilingual learning, particularly the use of two languages in the educational process, which strengthens communication skills in both Indonesian and English. Students can also enrich their English vocabulary through this approach. Additionally, bilingual learning stimulates students' willingness to explore more information from various learning media in both languages, thereby enhancing their knowledge of mathematics. This type of learning encourages students to think more flexibly and to integrate mathematical concepts from both languages. These contributions suggest that students engaged in bilingual learning may benefit more than those involved in monolingual learning. Furthermore, if the activities designed for bilingual learning are applied to monolingual students, they may experience improved understanding of mathematical concepts. This study has several limitations. First, the conclusions are based on a limited set of research results derived from tests and observations. Future studies could benefit from integrating feedback from students or teachers to provide a more accurate representation of the research findings. Second, the sample size in this study was small, which restricts the generalizability of the results. The students involved in this study were aged 12 to 13 years. Third, the school classification selected for this study falls within the high category; thus, the results may differ for schools classified at medium or low levels. Fourth, other mathematical skills, such as critical thinking and problem-solving, are essential for supporting students' communication and connection abilities. Enhancing these mathematical skills will positively impact students' communication and connection abilities, which, in turn, will influence their mathematical literacy. Therefore, critical thinking and problem-solving skills should also be considered in future studies aimed at improving students' mathematical literacy.

Students also encounter challenges during the learning process. Specifically, they often struggle to identify writing topics and to connect mathematical concepts with everyday life in their writing. Additionally, teachers face difficulties when implementing Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual context, particularly in modifying writing activities to meet students' needs. Therefore, it is essential to develop potential solutions to address these challenges in the future. First, the approach should be integrated with Problem-Based Learning (PBL) to enable students to analyze real-world problems and report their findings in writing. Second, the use of concept maps can facilitate students in formulating writing topics. Lastly, teachers should conduct brainstorming sessions prior to class to openly explore students' ideas or to compile a list of potential topics, thereby making it easier to design writing activities that align with students' needs. This

solution represents a crucial component that must be considered when implementing this approach in the future.

## CONCLUSION

Based on the research findings, four key conclusions can be drawn. First, both Differentiated Instruction (DI) using Writing to Learn (WtL) in a bilingual context and the expository approach effectively improved students' communication and connection abilities in mathematics. However, there were notable differences in the effectiveness of the two approaches. DI using WtL in a bilingual context was more effective than the expository approach in improving both students' communication ability. DI using WtL in a bilingual context was also found to be more effective than the expository approach in enhancing students' connection ability. Second, 79.34% of students in the experimental class met the communication ability indicators, compared to 68.66% in the control class. Additionally, 78% of students in the experimental class met the connection ability indicators, while 68% did so in the control class. Third, the majority of students preferred and benefited from the Differentiated Instruction (DI) approach using Writing to Learn (WtL) in a bilingual context. This learning method enhanced students' enthusiasm and motivation to engage with the topics of data and diagrams. Fourth, the observation revealed that the teacher employed three forms of differentiation: content, process, and product, all tailored to students' learning readiness and interests. To further enhance learning engagement, educators used the WtL method in a bilingual context. The observation also indicated that students participated in various activities during the learning process, guided by their requirements or interests. According to the study results, the application of DI using WtL in a bilingual context can serve as an alternative strategy for improving students' communication and connection abilities in mathematics. A critical component of this alternative strategy is the appropriate integration of DI, WtL, and bilingualism within the mathematics learning process to ensure coherence rather than overlap. Additionally, teachers must address potential challenges faced by both educators and students when employing this approach. For instance, integrating the approach with Problem-Based Learning (PBL), utilizing concept maps to assist students in identifying writing topics, and conducting brainstorming sessions prior to lessons to openly explore students' ideas can facilitate the design of writing activities that align with students' needs.

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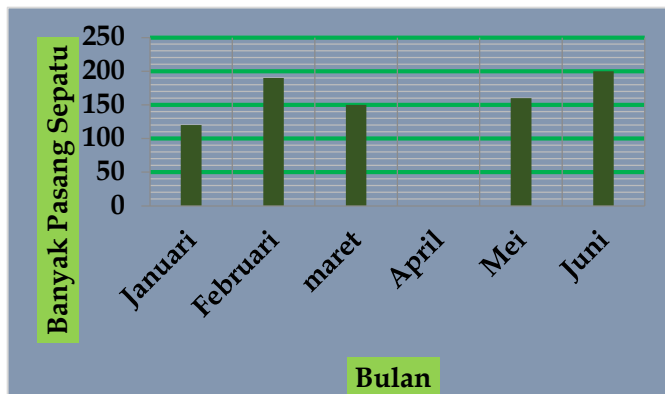
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## APPENDIX

### The Test Given to Students (in Indonesian and English)

#### In Indonesian

1. Berikut ini adalah diagram batang mengenai penjualan sepatu di Toko Murah.



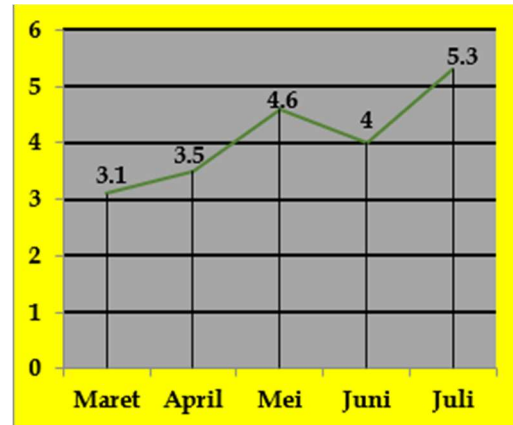
Jika penjualan sepatu selama 6 bulan tersebut adalah 900 pasang sepatu, maka banyaknya penjualan sepatu pada bulan April adalah ... Bagaimana kesimpulan dari data tersebut?

2. Perhatikan diagram lingkaran  
Data olahraga kegemaran siswa kelas 7 ditunjukkan dalam diagram lingkaran di samping. Banyak siswa yang menyukai bulu tangkis adalah 8 orang.  
Berapakah selisih jumlah siswa yang menyukai basket dan jumlah siswa yang menyukai sepak bola?  
Apakah siswa yang menyukai sepakbola dapat membuat dua grup pemain pada pertandingan sepakbola?  
Bagaimana kesimpulan dari data tersebut?



3. Perhatikan diagram berat badan bayi Alya berikut ini.

- Pada bulan apa terjadi penurunan berat badan bayi?
- Berapa besar penurunan berat badan yang terjadi di bulan tersebut?
- Kapan terjadi peningkatan berat badan bayi yang terbesar?
- Bagaimana kesimpulanmu tentang bayi Alya?



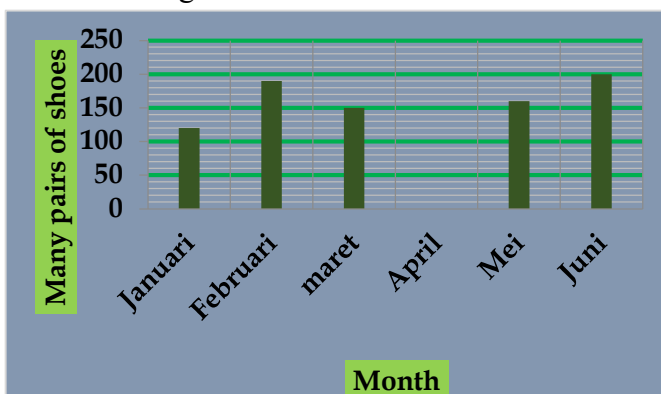
4. Data penjualan sepatu pria dan wanita dari empat toko yang berbeda dalam seminggu ada pada tabel.

Toko A		Toko B		Toko C		Toko D	
Pria	Wanita	Pria	Wanita	Pria	Wanita	Pria	Wanita
90 psg	70 psg	100 psg	80 psg	80 psg	50 psg	45 psg	90 psg

- Sajikan data pada tabel di atas dalam diagram yang tepat.
- Berapa selisih penjualan sepatu pria di toko A dan C?
- Berapa selisih penjualan sepatu wanita di toko B dan C?
- Jika tiap toko wajib menjual paling sedikit 80 pasang sepatu pria, manakah toko yang mengalami kerugian? Berapa persen kerugiannya, jika satu pasang sepatu harganya Rp.80.000.
- Buatlah kesimpulan dari data ini.

### In English

1. The following is a bar chart of shoe sales at Toko Murah.



If the sales of shoes during the 6 months is 900 pairs, then the number of shoes sold in April is ...

What is the conclusion from the data?

2. Take a look at the pie chart.

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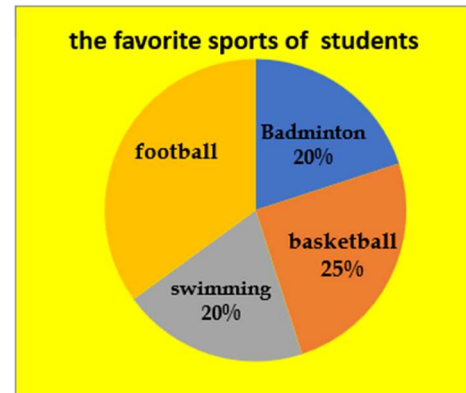


Data on the favorite sports of seventh-grade students are shown in the pie chart beside the questions. Eight students like badminton.

What is the difference between the number of students who like basketball and those who like football?

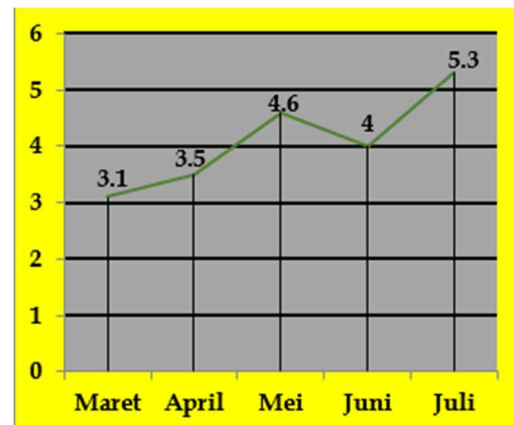
Can students who like football make two groups of players in a football match?

What is the conclusion from the data?



3. Take a look at baby Alya's weight chart.

- In which month did the baby experience weight loss?
- How much weight was lost during that month?
- When was the most significant increase in the baby's weight?
- What is your conclusion regarding Baby Alya?



4. The sales data for men's and women's shoes from four shops in a week are in the table.

Shop A		Shop B		Shop C		Shop D	
Men	Women	Men	Women	Men	Women	Men	Women
90 psg	70 psg	100 psg	80 psg	80 psg	50 psg	45 psg	90 psg

- Present the data in the table above in an appropriate diagram.
- What is the difference between the sales of men's shoes in stores A and C?
- What is the difference in sales of women's shoes at stores B and C?
- If each shop must sell at least 80 pairs of men's shoes, which shop will suffer a loss? What is the percentage loss if one pair of shoes costs Rp.80,000?
- Draw conclusions from this data.