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# Enhancing Junior High School Students' Mathematical Connections Through Problem-Based Learning Assisted by Padlet

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Abstract

Mathematical connection skills are among the abilities students need to apply mathematical concepts effectively when solving real-world problems. Therefore, it is important to improve junior high school students' mathematical connection skills through innovative teaching methods. This study aims to test the effectiveness of Problem-Based Learning (PBL) assisted by Padlet on students' mathematical connection skills. This study employed a quantitative approach using a pretest-posttest control group design, to compare 64 junior high school students in Semarang. Data were collected through a mathematical connection skills test and subsequently analyzed using descriptive and inferential statistical tests, such as the t-test and z-test. The results indicate that the mathematical connection skills of students in the experimental group, who received Problem-Based Learning supported by Padlet, were significantly higher ($M_{Pretest} = 33.98$; $M_{Posttest} = 88.02$) than the control group ($M_{Pretest} = 29.81$; $M_{Posttest} = 80.72$). This effectiveness was demonstrated by the acceptance of the alternative hypothesis, as evidenced by the mean mathematical connection ability scores exceeding the minimum competency threshold of 75, a classical mastery rate exceeding 75%, the experimental group's mean mathematical connection ability scores being higher than those of the control group, and the experimental group's learning mastery rate being higher than that of the control group.

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## 1. Introduction

Mathematical connections are an important factor in a person's life and are therefore a goal in mathematics education (Baiduri et al., 2020; Baki et al., 2009; Pambudi et al., 2020). Mathematical connection skills can be defined as a student's ability to connect or relate different mathematical concepts or ideas, mathematics to other subject areas, or mathematics to real-life situations (Kiliç & Özgen, 2025). In line with this statement, García-garcía & Dolores-flores (2018) assert that mathematical connections reflect real-world relationships among mathematical elements and their applications beyond mathematics. In mathematics learning, students must not only understand but also be able to interpret, relate, and make connections in order to gain a deeper understanding (Altay et al., 2017; Joswick et al., 2025). NCTM (2000) also states that in mathematics learning, there are essential pillars of competence, including mathematical communication, mathematical reasoning, mathematical representation, mathematical problem-solving, and mathematical connections. Therefore, the knowledge gained in mathematics lessons needs to be applied in real life, and individuals need to reason, connect concepts, and apply knowledge; in other words, they need to possess the ability to make mathematical connections.

However, the importance of mathematical connection skills in supporting mathematical understanding and problem-solving has not yet been fully reflected in students' classroom abilities (Son, 2022). This is

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because students' mathematical connection skills in the classroom are still relatively low; under these conditions, students are only able to connect related material (Fatharani et al., 2024; Wiharso & Susilawati, 2020). The low level of mathematical connection skills is reflected in the 2022 PISA results regarding reading, mathematics, and science literacy. According to the OECD (Organization for Economic Co-operation and Development), there are 8 levels of mathematical thinking. Most Indonesian students are still at levels 1 through 3, while only 0.5% of students reach level 4, and none have reached levels 5 or 6 (OECD, 2022). Meanwhile, according to the description of mathematical proficiency levels in PISA 2022, Level 4 is the level at which students can use fairly advanced mathematical reasoning, such as evaluating the plausibility of results, selecting and integrating various representations (symbolic, graphical, or numerical), and relating them to real-world contexts. Pambudi et al. (2020) state that solving PISA problems requires mathematical connections, as students must be able to link concepts, procedures, and facts. Thus, the 0.5% of students at Level 4 in the PISA results indicates that students' ability to relate various representations needs further improvement.

Every mathematical skill certainly has indicators that serve as the basis for assessing the mastery of that skill. The same applies to mathematical connection skills; these skills also include several indicators. Riyanto et al., (2024) explain that indicators of mathematical connection skills serve as a basis or benchmark for assessing students' ability to understand relationships among mathematical concepts, between mathematical concepts and fields outside mathematics, and between representations of mathematical concepts and procedures. If a student possesses strong mathematical connection skills, they will find it easier to understand mathematical concepts, solve problems, and apply them in daily life. The mathematical connection skills used in this study are indicators according to the NCTM (2000) namely: 1) recognizing and using connections among mathematical ideas; 2) understanding how mathematical ideas are interconnected and build upon one another to produce a holistic and coherent understanding; 3) recognizing and applying mathematics in contexts outside of mathematics. These indicators were selected because the NCTM indicators are comprehensive and relevant standards for measuring students' ability to relate mathematical concepts both conceptually and practically. Therefore, these indicators were deemed more appropriate for assessing students' mathematical connection skills in this study.

Students' performance in mathematical connections necessitates the development of appropriate instructional innovations (Son, 2022). Mathematical connections still face challenges due to conventional teaching methods that may not facilitate students' ability to connect concepts to real-world contexts (Asare, 2026). This was reflected in a preliminary study by the researcher, which found that students' ability to make mathematical connections was not yet optimal because instruction relied on lectures that emphasized instrumental understanding but did not foster a true grasp of concepts or their application. Previous research confirms that engaging students through problem-solving-based teaching methods can foster a deeper understanding of the subject matter (Anugraheni et al., 2025; Ho & Huang, 2024). Learning activities that encourage students to collaborate in solving problems provide opportunities for students to socialize, negotiate, and enhance their intellectual abilities (Baiduri et al., 2020; Osuna & Munson, 2024). Furthermore, a learning approach that integrates mathematical contexts into everyday life enhances students' ability to connect their mathematical understanding to real-world situations. One study that employed a PBL model integrated with real-world cultural contexts effectively optimized student engagement, thereby positively influencing their learning outcomes (Hutauruk et al., 2024, 2025). The PBL model aims to help students cope with real-life situations and learn how adults function (Arends, 2012).

The PBL model can be integrated with technology (Setyani et al., 2025). The integration of technology and the PBL model can optimize learning and adapt to the needs of both teachers and students (Baran & Sozbilir, 2018; Kwon & Lee, 2025). Hutauruk et al. (2025) noted significant improvements in outcomes when the PBL model and technology are implemented. One technology that can be utilized in the mathematics learning process is Padlet. Padlet is a digital application-based learning tool that can be used for various learning activities, such as discussions, sharing materials, and collecting assignments. This aligns with the view of Kasih et al. (2023) who explain that Padlet is a digital application that can facilitate discussions and store learning activities. Aisyah et al. (2022) also explain that Padlet is a web-based learning platform for creating interactive boards where students can share ideas and information, in the form of text, images, or videos. In line with this, Dewi & Budiarsa (2024) state that using Padlet within the Problem-Based Learning model effectively supports student engagement and the systematic implementation of learning stages. Therefore, the use of Padlet is relevant and appropriate for improving students'

mathematical reasoning skills, as it serves as a medium for sharing ideas and information. Furthermore, Padlet can integrate various forms of learning representations, such as text, images, videos, links, and students' work, into a single collaborative digital board.

The integration of various contextual problems into Padlet also provides students with the opportunity to connect mathematical concepts to real-world situations outside of mathematics. Padlet is a digital platform with blank pages that can be filled with various types of content. In line with this, according to Funchs, as cited in Wahidin & Jaafar (2024) Padlet is a versatile interactive platform that fosters real-time engagement between students and teachers, thereby increasing participation from all students in the classroom. Furthermore, Funchs also explains that Padlet is a platform that allows users to post various types of content such as text, images, videos, files, or links within a single shared digital space. This explanation aligns with Djumadi et al., (2017) who state that using Padlet can help students evaluate and analyze the relationships between existing ideas. Additionally, Septriani et al. (2024) stated that, through real-time collaborative boards used to present contextual problems, Padlet is an effective tool for supporting the development of students' mathematical connection skills, particularly their ability to link mathematical concepts to non-mathematical contexts. The findings indicate that Padlet's features, which allow students to examine various representations, compare problem-solving strategies, and connect mathematical concepts to real-world contexts, can facilitate and encourage the development of mathematical connection skills.

Previous research has identified a gap that can be addressed by implementing Padlet-assisted PBL to enhance students' mathematical connections. Previous studies have found that students' mathematical connection skills improve through the application of the PBL model (Nugraha et al., 2025; Sulistiani & Lusiana, 2024). The study by Syarofah et al., (2024) on the application of a Padlet-based PBL model to enhance students' interest in learning and cognitive learning outcomes is similar to this study, as both employ the PBL model and use Padlet as a technology-based learning medium. Although previous research has examined the impact of Padlet on students' learning outcomes or affective domains, a gap remains regarding whether integrating the PBL model with technology such as Padlet can enhance students' mathematical connections (Nugraha et al., 2025; Sulistiani & Lusiana, 2024; Syarofah et al., 2024). This study examines cognitive abilities, specifically mathematical connection skills. The PBL model used in this study will follow a 5-stage framework (Arends, 2012). Padlet is integrated into each stage of the PBL model. Therefore, this study aims to test the effectiveness of the Padlet-assisted PBL model in improving mathematical connection skills. This study makes a theoretical contribution by highlighting Piaget's concepts of collaborative learning, such as active learning, learning through social interaction, and learning through personal experience (Piaget, 1971). Additionally, this study expands on the theory of meaningful learning by demonstrating that presenting students with contextual problems can foster understanding (Darmayanti et al., 2023). Group discussions and the use of technology will demonstrate that problem-based learning processes support students' cognitive development, particularly their mathematical connection skills (Yusof, 2021).

The effectiveness of a learning model can be assessed by comparing outcomes before and after implementation. Effectiveness can be measured by individual learning achievement, the percentage of students who achieve mastery, and the difference in post test scores between the experimental and control groups (Setiawan et al., 2024). Furthermore, in the study by Hutauruk et al. (2025), which implemented the PBL model, higher achievement levels than those observed in the minimum competency threshold or *Kriteria Ketercapaian Tujuan Pembelajaran* (KKTP) were observed. Therefore, in this study, the hypotheses to be tested to assess the effectiveness of Padlet-assisted PBL are: (1) the average mathematical connection ability of students in the Padlet-assisted PBL model achieves individual mastery; (2) the proportion of students' mathematical connection ability in the Padlet-assisted PBL model exceeds that of the classical model; (3) the average mathematical connection ability of students in the Padlet-assisted PBL model exceeds the average mathematical connection ability of students in the control group, and (4) the proportion of students achieving mastery on the mathematical connection ability test in the Padlet-assisted PBL model exceeds the proportion of students achieving mastery on the mathematical connection ability test in the control group.

## 2. Methods

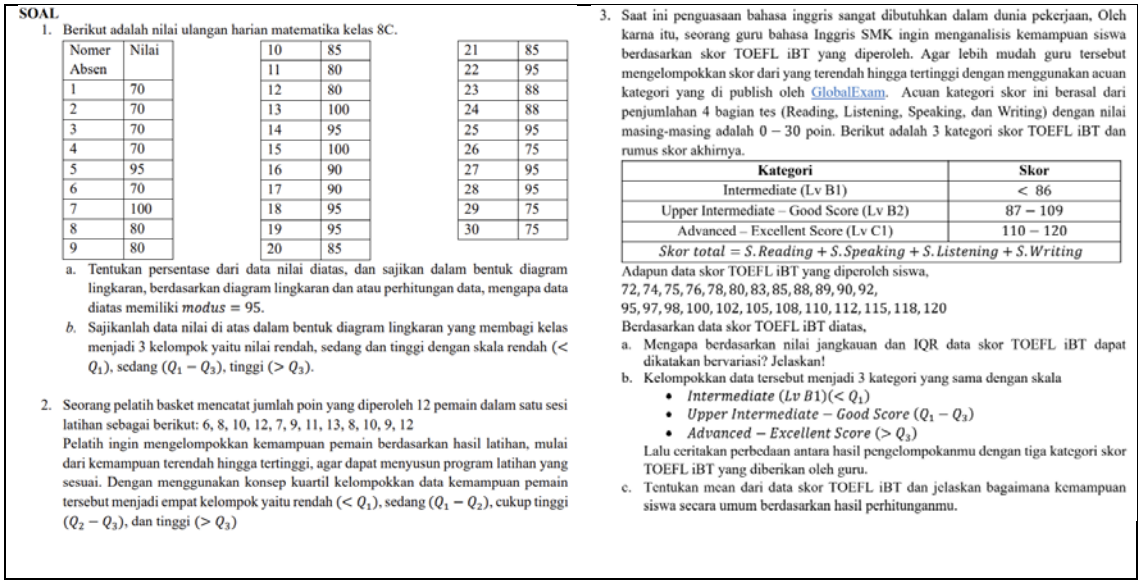
### *2.1. Research Design*

This study employed a quantitative experimental design. The experimental quantitative research design used was a quasi-experimental design with a non-equivalent control group (Creswell & Creswell, 2018). The use of a pretest-posttest control group design helps evaluate the results of implementing the Padlet-assisted PBL model. Thus, there are two groups: the experimental group, which learns using the Padlet-assisted PBL model, and the control group, which uses the PBL model alone to maintain focus on mathematical connections. The sampling technique used in this study is random sampling. This study was conducted with eighth-grade students, with 32 students in both the experimental and control groups. The data collection method used in this study involved tests as a source of quantitative data.

Before randomly assigning students to the experimental and control groups, the researchers verified that students had similar baseline abilities and comparable teaching characteristics. To avoid bias due to differences in the teaching abilities of the teachers implementing the intervention, both the experimental and control groups will be taught directly by the researchers to control for this variable. This approach can specifically highlight differences in mathematical connections by examining learning strategies, thereby providing a more rigorous test of their effectiveness..

### *2.2. Data Collection*

To collect research data, a mathematical connection ability test was used. The mathematical connection ability test consists of mathematical problem-solving questions related to the material presented. The researcher developed the test items based on the indicators of mathematical connection ability used. The results of the item development are shown in Figure 1. Additionally, the mathematical connection ability test instrument was pilot-tested in a pilot class to measure the validity, reliability, difficulty level, and discriminative power of each test item. Based on calculations using Microsoft Excel, all test items were found to be valid and reliable. Furthermore, the difficulty-level results for each test item indicated that the mathematical connection ability test comprised 2 items in the easy category, 3 in the moderate category, and 1 in the difficult category. The discriminative power results for each test item show that items 1a, 1b, and 3a have “good” discriminative power; item 3b has “very good” discriminative power; and items 2 and 3c have “adequate” discriminative power.



**SOAL**

1. Berikut adalah nilai ulangan harian matematika kelas 8C.

| Nomer Absen | Nilai |
|---|---|
| 1 | 70 |
| 2 | 70 |
| 3 | 70 |
| 4 | 70 |
| 5 | 95 |
| 6 | 70 |
| 7 | 100 |
| 8 | 80 |
| 9 | 80 |
| 10 | 85 |
| 11 | 80 |
| 12 | 80 |
| 13 | 100 |
| 14 | 95 |
| 15 | 100 |
| 16 | 90 |
| 17 | 90 |
| 18 | 95 |
| 19 | 95 |
| 20 | 85 |
| 21 | 85 |
| 22 | 95 |
| 23 | 88 |
| 24 | 88 |
| 25 | 95 |
| 26 | 75 |
| 27 | 95 |
| 28 | 95 |
| 29 | 75 |
| 30 | 75 |

   a. Tentukan persentase dari data nilai diatas, dan sajikan dalam bentuk diagram lingkaran, berdasarkan diagram lingkaran dan atau perhitungan data, mengapa data diatas memiliki $modus = 95$.
   b. Sajikanlah data nilai di atas dalam bentuk diagram lingkaran yang membagi kelas menjadi 3 kelompok yaitu nilai rendah, sedang dan tinggi dengan skala rendah ($< Q_1$), sedang ($Q_1 - Q_3$), tinggi ($> Q_3$).

2. Seorang pelatih basket mencatat jumlah poin yang diperoleh 12 pemain dalam satu sesi latihan sebagai berikut: 6, 8, 10, 12, 7, 9, 11, 13, 8, 10, 9, 12
   Pelatih ingin mengelompokkan kemampuan pemain berdasarkan hasil latihan, mulai dari kemampuan terendah hingga tertinggi, agar dapat menyusun program latihan yang sesuai. Dengan menggunakan konsep kuartil kelompokkan data kemampuan pemain tersebut menjadi empat kelompok yaitu rendah ($< Q_1$), sedang ($Q_1 - Q_2$), cukup tinggi ($Q_2 - Q_3$), dan tinggi ($> Q_3$)

3. Saat ini penguasaan bahasa inggris sangat dibutuhkan dalam dunia pekerjaan, Oleh karna itu, seorang guru bahasa Inggris SMK ingin menganalisis kemampuan siswa berdasarkan skor TOEFL iBT yang diperoleh. Agar lebih mudah guru tersebut mengelompokkan skor dari yang terendah hingga tertinggi dengan menggunakan acuan kategori yang di publish oleh GlobalExam. Acuan kategori skor ini berasal dari penjumlahan 4 bagian tes (Reading, Listening, Speaking, dan Writing) dengan nilai masing-masing adalah $0 - 30$ poin. Berikut adalah 3 kategori skor TOEFL iBT dan rumus skor akhirnya.

| Kategori | Skor |
|---|---|
| Intermediate (Lv B1) | $< 86$ |
| Upper Intermediate – Good Score (Lv B2) | $87 - 109$ |
| Advanced – Excellent Score (Lv C1) | $110 - 120$ |
| $Skor\ total = S.Reading + S.Speaking + S.Listening + S.Writing$ | |

   Adapun data skor TOEFL iBT yang diperoleh siswa,
   72, 74, 75, 76, 78, 80, 83, 85, 88, 89, 90, 92,
   95, 97, 98, 100, 102, 105, 108, 110, 112, 115, 118, 120
   Berdasarkan data skor TOEFL iBT diatas,
   a. Mengapa berdasarkan nilai jangkauan dan IQR data skor TOEFL iBT dapat dikatakan bervariasi? Jelaskan!
   b. Kelompokkan data tersebut menjadi 3 kategori yang sama dengan skala
      - $Intermediate\ (Lv\ B1) (< Q_1)$
      - $Upper\ Intermediate - Good\ Score\ (Q_1 - Q_3)$
      - $Advanced - Excellent\ Score\ (> Q_3)$

      Lalu ceritakan perbedaan antara hasil pengelompokanmu dengan tiga kategori skor TOEFL iBT yang diberikan oleh guru.
   c. Tentukan mean dari data skor TOEFL iBT dan jelaskan bagaimana kemampuan siswa secara umum berdasarkan hasil perhitunganmu.

**Figure 1.** Mathematical connection test instrument

### *2.3. Data Analysis*

Several hypotheses were tested, including: (1) Hypothesis 1 was tested to determine whether students’ mathematical connection skills, after the implementation of Problem-Based Learning aided by Padlet,

achieved individual mastery. The definition of achieving individual mastery is that the average test score for students' mathematical connection skills reaches the minimum competency threshold or *Kriteria Ketercapaian Tujuan Pembelajaran* (KKTP) of at least 75; (2) Hypothesis 2, the classical mastery test, was used to determine whether the proportion of students in the experimental class whose mathematical connection skills test scores exceeded the minimum competency threshold had reached the target proportion or not. The classical learning proportion is 75%; (3) Hypothesis Test 3, a t-test was conducted to determine whether the average mathematical connection ability of students in the Padlet-assisted Problem-Based Learning (PBL) model is higher than that of students in the standard Problem-Based Learning (PBL) model; and (4) Hypothesis Test 4, a test of the difference between two proportions was conducted to determine whether the proportion of students achieving mastery of mathematical connection skills in the Padlet-assisted Problem-Based Learning model is higher than the proportion of students achieving mastery of mathematical connection skills in the standard Problem-Based Learning model.

*2.4. Procedure*

This study used a Padlet-assisted Problem-Based Learning model in the experimental class, while the control class implemented the Problem-Based Learning model. Data collection was conducted through six face-to-face learning sessions, comprising four instructional sessions and two sessions for administering the pretest, posttest, and questionnaire. The study involved Class VIII E, comprising 32 students, as the experimental class, and Class VIII F, comprising 32 students, as the control class. Table 1 below shows the stages for the experimental and control groups.

**Table 1.** Learning steps in experimental group and control group

| No | Problem Based Learning Assisted by Padlet | Problem-Based Learning |
|---|---|---|
| Step 1: Orient students to the problem | The teacher presents a contextual problem via Padlet. Students identify relevant concepts and jot down initial ideas on the discussion board. | Students are given contextual math problem-solving activities related to the material. |
| Step 2: Organize students for study | Padlet is used as a real-time interactive discussion board. Students share, respond to, and connect the various ideas that emerge. | Students are allowed to discuss with their groups |
| Step 3: Group investigation | Padlet is not used directly. Students work in groups to develop strategies and establish connections between concepts to solve the problem. | Students work with their groups to solve problems and explore the material |
| Step 4: Develop and present solution | Presentation of discussion results (may be supported by documentation from Padlet) | Students present the results of their group discussions, and other students provide feedback. |
| Step 5: Evaluate the problem-solving process | Reflection and evaluation are conducted via Padlet. Students write down their conclusions and respond to other groups' solutions. | Students and the teacher evaluate the problem-solving results, reinforce understanding of the material, and reflect on the learning process. |

**Table 2.** Schedule for implementing the padlet-supported problem-based learning model in the experimental group

| Session | Date | Learning Activities |
|---|---|---|
| 1 | Wednesday, April 8, 2026 | Measures of central tendency (mean, mode, and median) |
| 2 | Monday, April 13, 2026 | Measures of dispersion (quartiles and range) |
| 3 | Wednesday, April 15, 2026 | Measures of data dispersion (quartile range and interquartile range) |
| 4 | Monday, April 20, 2026 | Contextual problems involving measures of data dispersion (quartiles, range, quartile range, and interquartile range) |

In Class VIII E, the experimental class, instruction was conducted using a Problem-Based Learning approach supported by Padlet. The instructional materials used in this process included the Learning Objective Flowchart (*ATP*), teaching modules, Student Worksheets (*LKPD*), and Padlet as a learning medium. The implementation of the Padlet-supported Problem-Based Learning model took place over four sessions. The detailed schedule for the experimental class is presented in Table 2.

During the introductory activities, the teacher began the lesson by greeting the students, leading a prayer, and taking attendance to ensure student presence. Before the main activities began, students were asked to complete a non-cognitive diagnostic assessment via Google Forms to assess their physical and psychological condition and their readiness to participate in the lesson. Based on the assessment results, all students were in good health and ready to participate in the learning process. Next, the teacher presented the material to be covered (which varied for each of sessions 1–4). Figure 2 shows the discussion and teacher guidance activities based on the Padlet-assisted PBL model.

In Phase 1, during the student orientation to the problem, the teacher first explains the learning objectives, then motivates students to learn through a video shown using PPT. The video aims to boost motivation and foster students' enthusiasm for participating in the lesson. Next, the teacher explains the application and benefits of the mean, median, and mode in daily life—such as calculating average monthly expenses, determining a home's price based on the median value of the data, and identifying the most frequently occurring value under a given condition. After the initial presentation of the material, students completed a cognitive diagnostic assessment via Google Forms to assess their baseline understanding of measures of central tendency. The teacher then posed a warm-up question via PPT to activate students' prior knowledge before moving on to the core learning activities.



**Figure 2.** (a) discussion session; (b) use of Padlet in learning using the PBL model

In Phase 2, to organize student learning, the teacher divides the students into several groups, each consisting of four to five students. Each group is instructed to discuss how the concepts of mean, median, and mode relate to the given contextual problem, and then determine the most appropriate measure of central tendency for solving the problem. The teacher guides the discussion to ensure that every group member actively participates in exchanging ideas and developing problem-solving strategies. Next, the teacher distributes the worksheet as a guide for the inquiry activity and explains the procedure to help students work systematically.

In Phase 3, which involves guiding both individual and group investigations—as shown in Figure 3—students collaborate to solve the problems on the worksheet by calculating the mean, median, and mode, and then analyzing the appropriateness of each measure of central tendency in the context of the given problem. The teacher guided the inquiry process by observing each group's activities and asking probing questions to help students explain the reasons for their choice of concepts. Throughout the inquiry process, students recorded their calculations and the reasons for their concept choices on their worksheets as a form of accountability for their mathematical thinking. Based on observations during the activity, most students correctly determined the mean, median, and mode for routine problems. However, in this first session, students' mastery of indicators 1 and 3 of the mathematical connection skills still appeared suboptimal. Some students remained confused about how to connect mathematical concepts in statistics (measures of central tendency and data presentation). In addition, when faced with contextual problems, some students still had difficulty linking data characteristics to the selection of the most appropriate measure of central

tendency. This indicates that students' ability to relate various mathematical concepts and apply them to real-world situations still varies from student to student.

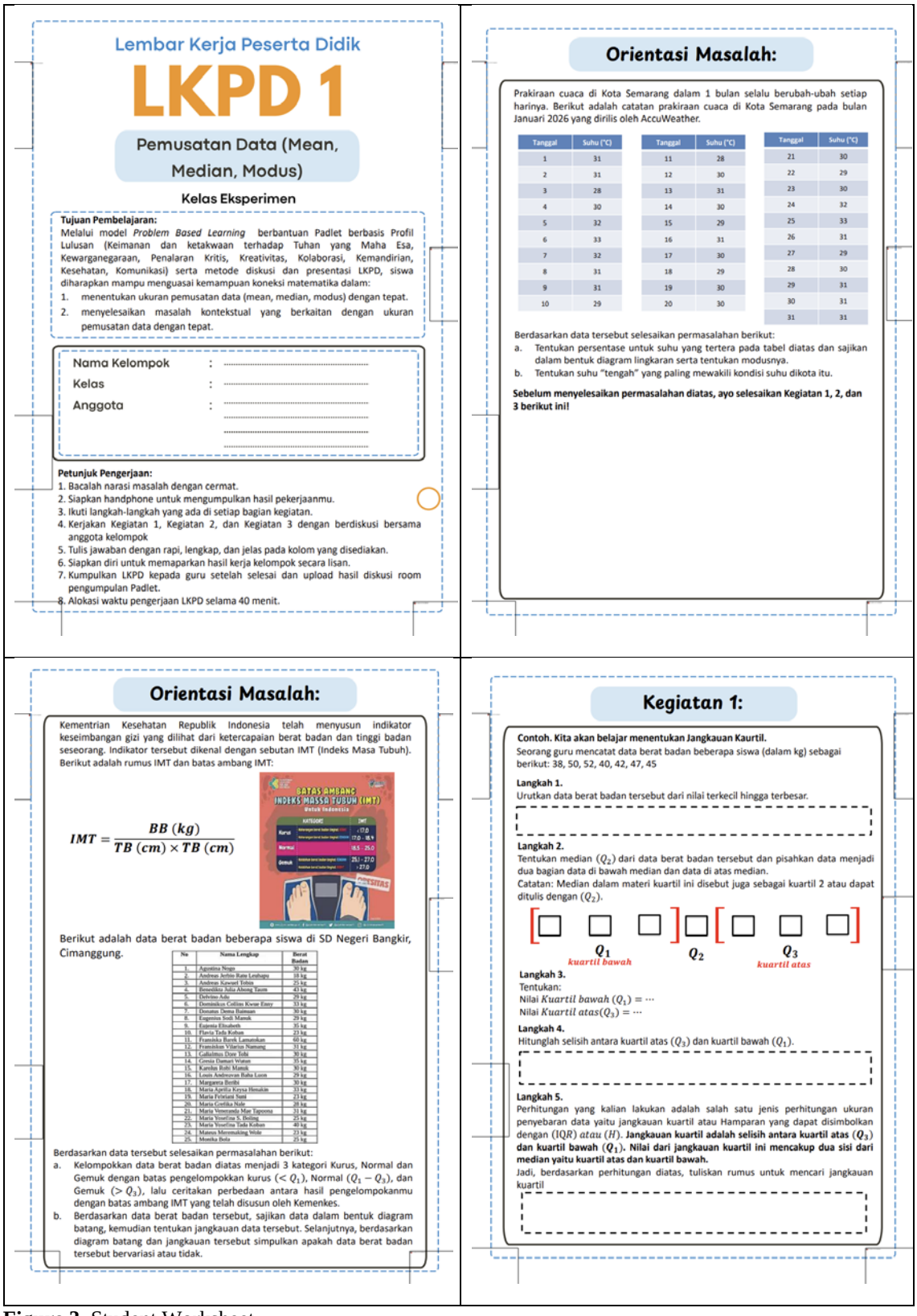



**Figure 3.** Student Worksheet

In Phase 4, “Developing and Presenting Work,” each group compiles a report detailing the process of calculating the mean, median, and mode, along with the rationale for the concepts used. Next, a group representative presents the results of their discussion to the class. Other groups are given the opportunity to ask questions, offer feedback, or provide input on the presented solutions. The teacher facilitates the discussion by reinforcing students’ answers and reaffirming the relationship between the concepts of mean, median, and mode. Additionally, the teacher explains that the choice of measures of central tendency must be tailored to the characteristics of the data and the purpose of the analysis so that the results accurately reflect the data. Based on the presentations, most groups arrived at the correct solutions. However, some groups still struggled to provide logical reasoning for their choice of measures of central tendency.

In Phase 5, while analyzing and evaluating the problem-solving process, the teacher and students reflect on the entire learning process that has taken place. This reflection involves revisiting the appropriateness of choosing the mean, median, and mode based on the characteristics of the data and their relationship to solving contextual problems. The teacher allows students to ask questions related to the results of the discussion. Next, students are asked to conclude the concepts of mean, median, and mode, along with the benefits of using them in daily life. Based on the reflection, most students understood that each measure of central tendency serves a different function, so its use must be tailored to the data's characteristics and the purpose of the analysis. However, some students still needed guidance in providing more comprehensive reasoning when determining the appropriate measure of central tendency to solve contextual problems. In the closing activity, the teacher and students conducted a learning reflection using the reflection questions provided on Google Forms. The reflection covered their learning experiences, their level of conceptual understanding, and the difficulties they encountered during the lesson. Next, the teacher outlined the material to be covered in the next session—quartiles and range—and encouraged the students to review the material in preparation for the next class. The class then concluded with a group prayer and closing remarks.

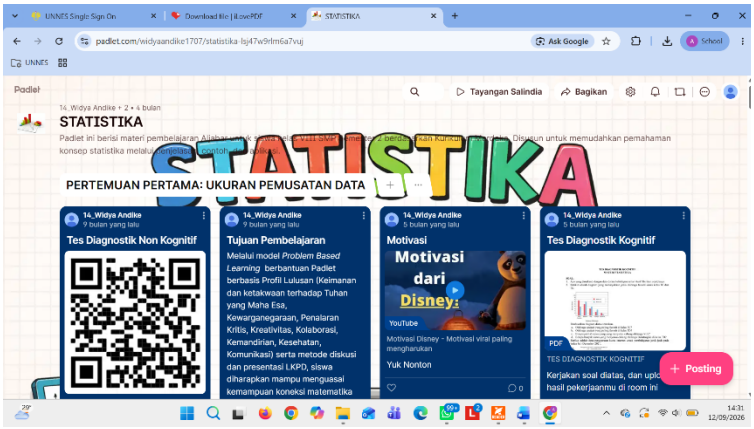



**Figure 4.** (a) Padlet display ; (b) QR code padlet

## 3. Results & Discussions

Table 3 below presents data for the experimental and control groups. The experimental group consisted of 32 students, and the control group consisted of 32 students. Descriptive analysis was conducted to assess progress before proceeding with further inferential testing. Prior to the intervention, the students’ mathematical connections in both groups were comparable, as indicated by pretest means of 33.98 (SD = 8.54) for the experimental group and 29.81(SD = 10.48) for the control group. Furthermore, after implementing the Padlet-assisted PBL model and the PBL model alone, both groups showed an increase in test scores; however, the experimental group outperformed the control group. Table 3 shows that the experimental group’s average pretest score was 33.98, while the average posttest score was 88.02 (SD = 7,46), indicating a more even distribution of data. On the other hand, the control group’s average pretest score was 29.81, and its average posttest score was 80.72 (SD = 8.51) out of a maximum score of 100.

**Table 3.** The Descriptive Statistics Results

| | N | Min | Max | Mean | Std. Dev |
|---|---|---|---|---|---|
| Pretest of Experimental Group | 32 | 20.83 | 54.17 | 33.9850 | 8.54016 |
| Pretest of Control Group | 32 | 12.50 | 62.50 | 29.8178 | 10.48247 |
| Posttest of Experimental Group | 32 | 75.00 | 100.00 | 88.0206 | 7.46472 |
| Posttest of Control Group | 32 | 58.33 | 95.83 | 80.7291 | 8.51627 |

Before testing the hypothesis, preliminary tests were conducted, consisting of a normality test and a homogeneity test. Since the number of students in each group was less than 50, the Shapiro-Wilk test was used to assess normality. The table shows the results of the normality test for the pretest and posttest data of the experimental and control groups. Table 6 presents the results of the Shapiro-Wilk normality test. Based on the SPSS results in Table 4, it was found that the sig. values for Asymp. Sig. (2-tailed) were 0.111; 0.078; 0.067; 0.126. The data are considered to be normally distributed in the regression equation if the p-value for the unstandardized residuals is greater than 0.05. Since these values are greater than 0.05, the normality assumption is deemed valid.

**Table 4**. Normality test results

| Shapiro-Wilk | Statistic | df | Sig. |
|---|---|---|---|
| Pretest of Experimental Group | 0.946 | 32 | 0.111 |
| Pretest of Control Group | 0.941 | 32 | 0.078 |
| Posttest of Experimental Group | 0.938 | 32 | 0.067 |
| Posttest of Control Group | 0.948 | 32 | 0.126 |

Next, a homogeneity test was conducted using Levene's test on the posttest data for both groups. The p-value of 0.800 was greater than 0.05 in the homogeneity test for the posttest data of the experimental and control groups, indicating that the variances were homogeneous. Based on the descriptive statistics table, the standardized scores of each group were similar, thus fulfilling the assumption that the experimental and control groups were homogeneous.

Next, a hypothesis test was conducted on the data sets that met the prerequisite tests. The results indicate that the mathematical connection skills of students in the experimental group, who received Problem-Based Learning supported by Padlet, were significantly higher ($M_{Pretest} = 33.98$; $M_{Posttest} = 88.02$) than the control group ($M_{Pretest} = 29.81$; $M_{Posttest} = 80.72$). Table 5 presents a summary of the hypothesis testing for this study and its interpretation.

**Table 5.** Hypothesis Test Results

| Hypothesis | Test Type | Test Results | Conclusion |
|---|---|---|---|
| First | One Sample t Test | $t_{table} = 1.695,\ t_{count} = 9{,}86$ $t_{count} > t_{table}$ | the average posttest results of mathematics connection of experimental group students have reached minimum competency threshold namely 75 |
| Second | Z Test | $z_{count} = 3.26, z_{table} = 1.65$ $z_{count} > z_{table}$ | the percentage of complete learning of experimental group students is more than 75% |
| Third | Independent Sample t Test | $t_{count} = 4.092, t_{table} = 1.999$ $t_{count} > t_{table}$ | the average posttest score of mathematical connection of experimental group students is more than the control group |
| Fourth | Z Test | $z_{count} = 1.77;\ z_{table} = 1.65$ $z_{count} > z_{table}$ | the percentage of students achieving proficiency in numeracy through PBL assisted by Padlet, is higher than the percentage of students using the Problem-Based Learning model. |

Figure 5 shows a graph of the difference in mathematical connection scores between the experimental (EG) and control groups (CG). Based on the figure, both groups had relatively similar starting points ($M_{EG} = 33.98$; $M_{CG} = 29.81$). and final scores ($M_{EG} = 88.02$; $M_{CG} = 80.72$). However, after implementing learning with different strategies, the experimental group that used Padlet-assisted PBL showed a steeper learning curve compared to the group that used only PBL. This also indicates that the use of learning innovations such as Padlet enhances the potential of the PBL model. This difference visually and descriptively supports the results of the inferential statistical test, which indicates a significant effect following the implementation of the Padlet-assisted PBL model.

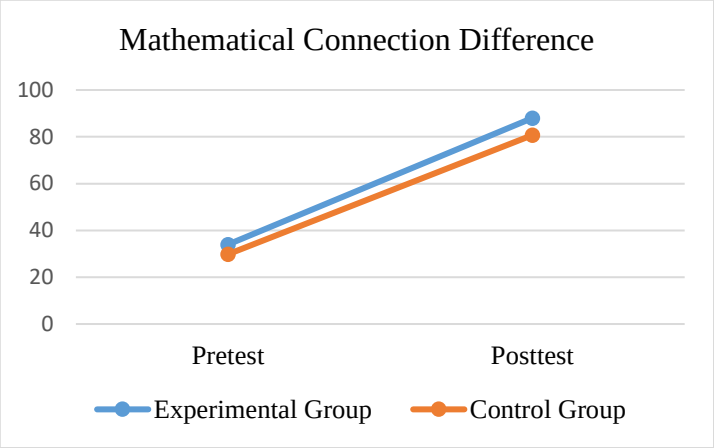



**Figure 5.** Mathematical Connection Growth Chart

These results indicate that implementing a Padlet-assisted Problem-Based Learning model effectively helps students achieve the expected competencies in statistics. This success is influenced by the characteristics of Problem-Based Learning, which presents contextual problems as the starting point for learning, thereby encouraging students to identify information, connect relevant mathematical concepts, and develop problem-solving strategies through discussion and inquiry. These activities provide students with the opportunity to actively build their understanding, so that they not only understand each concept separately but also see the connections between concepts and apply them to solve problems. This finding aligns with research by Farmah & Nindiasari (2025) which states that implementing Problem-Based Learning can improve mathematical connection skills by training students to connect various concepts during the problem-solving process. Additionally, Hutauruk et al. (2024) suggest that problem-based learning is more effective at developing mathematical connection skills than teacher-centered learning.

In addition to the instructional model used, Padlet supports the development of students' mathematical connection skills. Padlet is utilized as a collaborative platform that allows students to upload discussion outcomes, exchange opinions, provide feedback on other groups' work, and reflect on the problem-solving strategies they used. Through these activities, students have the opportunity to compare alternative solutions, leading to a more comprehensive understanding of the relationships among mathematical concepts. Thus, the use of Padlet not only facilitates the sharing of discussion outcomes but also encourages interaction and reflection that strengthen students' conceptual understanding. These findings are supported by the research of Nugraha et al. (2025) which shows that Problem-Based Learning can enhance mathematical connection skills through problem-solving activities involving the interrelationships among various concepts. In line with this, Kasih et al. (2023) and Aisyah et al. (2022) also state that the use of digital media in problem-based learning can increase student participation, strengthen collaboration, and help students build a more meaningful conceptual understanding. This study provides empirical evidence for several grand theories related to collaborative, meaningful learning, and social interaction in students' cognitive development. In mathematics instruction, using a contextual approach and encouraging group discussions will help students understand the material (Agustyaningrum et al., 2022). As previous research has shown, a learning approach that incorporates support and active social interaction in the classroom can improve students' average learning outcomes and achievement (Janaris et al., 2024).

Based on the results of the effectiveness and implementation tests of the Padlet-assisted PBL model, Padlet provides a space for students to upload discussion outcomes, observe various problem-solving strategies from other groups, provide feedback, and reflect on the problem-solving process they have undertaken. These activities enable students to gain a broader understanding through the exchange of ideas and learning experiences among groups. Consequently, students who previously struggled can improve their understanding through discussions and feedback, leading to more students achieving mastery of mathematical connections. The Problem-Based Learning model consistently has a positive impact on mathematical connection skills by encouraging students' active engagement in exploring and connecting various mathematical concepts throughout the learning process. This study shows that the use of collaborative digital learning media can increase student participation, strengthen interactions during learning, and support improved mathematics learning outcomes.

## 4. Conclusion

This study concludes that the Padlet-assisted PBL model is effective in improving students' mathematical connection skills. Based on the results of the students' mathematical connection tests, the experimental group had a higher mean than the control group, as evidenced by descriptive statistics and several t-tests and z-tests. Learning that emphasizes conceptual understanding and real-life application enables students to make connections between mathematical problems and their solutions. This study has a limitation in that the intervention was conducted at only one school, thereby reducing the external validity regarding the implementation of the Padlet-assisted PBL model. Future research could develop instructional innovations related to the PBL model or to the use of Padlet to improve students' mathematical connection skills.

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