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# The Effect of Differentiated Learning with the STAD Cooperative Learning Model on Mathematical Problem-Solving Skills and Self-Confidence of Students in Inclusive Classrooms

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## *Abstract*

This study aims to describe the effect of differentiated learning using the STAD cooperative learning model on mathematical problem-solving skills and student confidence in inclusive classrooms, as well as to describe the advantages of differentiated learning using the STAD cooperative learning model compared to differentiated learning using the expository model in terms of a) mathematical problem-solving skills; and b) students' self-confidence in inclusive classrooms. The research used a quasi-experimental method with a nonequivalent control group design. The research population consisted of all 10th grade students at MA Negeri 2 Sleman in the 2024/2025 academic year. The sampling technique used was cluster random sampling, consisting of 35 students from class X D as the experimental group who received differentiated learning with the STAD model, and 34 students from class X C as the control group with the expository model. Data were collected using a mathematical problem-solving ability test and a self-confidence questionnaire. The instruments were validated through content validity (expert judgment) and declared reliable with Cronbach's Alpha coefficient. Data analysis used Hotelling's T2 Test and Independent Sample t-Test at a significance level of $\alpha$ = 0.05. The results of the study show that: (1) differentiated learning with the STAD model has a significant effect on students' mathematical problem-solving abilities and self-confidence in inclusive classrooms; (2) the STAD model is significantly superior to the expository model in improving these two variables. These findings indicate that the integration of differentiated learning with the STAD model is effective when applied in inclusive classrooms to optimize students' cognitive and affective abilities.

***Keywords:*** *Differentiated; STAD Cooperative Model; Mathematical Problem-Solving Ability; Self-Confidence*

## *Introduction*

In Indonesia, the implementation of education is currently not only focused on formal and informal education. Inclusive education exists as a form of equalization of one of the rights of citizens that has not been fulfilled, namely the right to equal education (Ministry of Education and Culture, 2009). In this case, every citizen, whether normal or with special needs, can experience the same education in the same place (UNESCO, 1994). Inclusive schools are regular places that accommodate and implement inclusive education programs in Indonesia (Sopandi, 2013). Similar to regular education in general, inclusive schools also have a curriculum and educational tools.

However, what is slightly different is that in its implementation, this school combines normal students with students with special needs with the same treatment (Abdullah, 2013). Mathematics as part of the curriculum in inclusive schools plays an important role for students, especially in their survival (Suryawati, 2012). This is because through mathematics learning, students can acquire, improve, and develop various mathematical skills that are useful in everyday life, especially in this era of rapid technological development (PERMENDIKNAS, 2006). Of the various basic skills outlined by NCTM (2000), one of the basic skills that students must possess is mathematical problem-solving skills.

The National Council of Teachers of Mathematics (1989) states that problem-solving is at the heart of mathematics learning, because the process of solving mathematical problems requires knowledge of mathematical material. Considering the characteristics of mathematics itself, there are many difficulties and challenges in learning it in regular classes, especially in inclusive classes that have a variety of students with their own needs and abilities. This not only affects student learning outcomes, but also the ability and meaningfulness of mathematics learning itself. One factor that can affect students' mathematical abilities is the learning applied by teachers.

The application of learning models that are not yet fully effective in meeting the various needs and learning characteristics of students in inclusive classrooms is one of the main reasons for students' low problem-solving abilities. Research conducted by Nurhalisa and Kusmaryono (2025) revealed that before being given intervention with the RME approach and assisted by teaching aids, students in inclusive classrooms had low initial problem-solving abilities. The same thing was also found in research conducted by Hasibuan et al. (2022) that in general, slow learners in inclusive classrooms have significant difficulties in solving math problems, including the stages of understanding, planning, solving, and rechecking problems.

Low mathematical problem-solving abilities in inclusive classrooms are not only caused by cognitive factors and inappropriate learning methods, but are also related to students' affective factors, such as self-confidence. In mathematics learning, self-confidence plays an important role because it affects students' ability to face challenges, especially in material that is considered difficult. Students' self-confidence affects their problem-solving process in learning. The results of observations in a study conducted by Fitayanti et al. (2022) show that students' confidence levels in learning mathematics are still very low. This is also in line with the results of a study conducted by Wulandari (2017), which found that high mathematical problem-solving abilities are influenced by high student confidence, and vice versa.

Based on research conducted by Wulandari et al (2018), it is known that there is a relationship between self-confidence and the problem-solving abilities of high school students. The results obtained show that there is a strong relationship and a positive correlation. In line with this, research conducted by Martin (2022) validates the existence of a significant relationship between the two. This means that the higher the self-confidence of students, the higher their mathematical problem-solving abilities.

Seeing the importance of the relationship between mathematical problem-solving skills and self-confidence, mathematics learning should be designed to be meaningful and involve students' mental activities. Various innovations have been made to reduce the intimidating, uninteresting, and boring impression of mathematics learning, especially in inclusive classrooms consisting of students with different abilities, needs, and learning styles. This condition requires educators to prepare learning designs that can accommodate all needs, both for students with high academic abilities and students with special needs. One effective approach is differentiated learning.

Differentiated learning is an approach to learning that emphasizes the needs and abilities of diverse students in the classroom, such as in inclusive classrooms (Faiz et al., 2022). Teachers can adjust to the various learning needs of students in terms of content, process, product, and learning environment to optimize the learning process for students in the classroom. Through differentiated learning, students are involved, stimulating their interest and providing a satisfying experience. This is demonstrated by studies conducted by Garba & Muhammad (2015) and Kreitzer (2016) that differentiated learning can improve student learning achievement.

Differentiated learning can be combined with other learning models to improve the effectiveness of mathematics learning in inclusive classrooms, one of which is cooperative learning. There are various types of cooperative learning, one of which is Student Team Achievement Divisions (STAD). Student Team Achievement Divisions (STAD) is one of the simplest and best cooperative learning methods for novice teachers who use a cooperative approach. This learning model is considered suitable for classes that are not yet accustomed to or rarely engage in discussions or group learning. Based on its definition, the STAD type of cooperative learning model STAD type of cooperative learning model is suitable for inclusive classes. The diversity that exists in these classes can be optimally fulfilled through this cooperative learning. Student needs can be adjusted through differentiated learning combined with the STAD type of cooperative learning model.

Differentiated learning combined with the STAD cooperative learning model can be an alternative and innovative learning method that can meet the learning needs of students, especially in inclusive classrooms. Research conducted by Alfi Anjani (2023) revealed that the STAD learning model based on differentiated learning has an effect on students' cognitive learning outcomes in biology. It can also change the teacher-centered condition to a student-centered one in the learning process. This can also be applied in mathematics learning to improve students' mathematical abilities, one of which is problem-solving skills.

In this study, differentiation was applied in terms of content and process differentiation. This was based on the learning readiness of each student in the inclusive classroom. In practice, differentiated learning with the STAD cooperative learning model used the STAD learning stages or phases. These phases are adjusted to the aspects of mathematical problem-solving abilities. Where each aspect will be linked and its influence on the learning process will be observed. For example, in the phase of presenting or conveying information in STAD, it will be linked to the aspect of understanding problems and planning problem solving, and so on for other aspects.

In this learning process, aspects of mathematical problem-solving skills are reviewed from the perspective of one of the students' affective abilities, namely self-confidence. Self-confidence has a significant relationship and influence in helping students solve problems. Students' self-confidence can affect their ability to face challenges, especially in subjects such as mathematics, which is often considered difficult. Through differentiated learning with the STAD cooperative learning model, it is hoped that we can see how much influence students' self-confidence in inclusive classrooms has on their mathematical problem-solving skills.

## *Method*

This quasi-experimental research was conducted in the even semester of the 2024/2025 academic year, starting from April to May 2025, at MA Negeri 2 Sleman. The sample in this study was grade X students at MA Negeri 2 Sleman, selected based on cluster random sampling. This was based on the existence of students with disabilities who were not always evenly distributed across all classes. Two classes were selected as the subjects of this study, namely class X C and X D, which had 34 and 35 students, respectively. This study was conducted to answer the alternative hypothesis which states that there is an effect of differentiated learning with STAD-type cooperative learning on mathematical problem-solving skills and student self-confidence in inclusive classes.

Table 1. Research Design

| **Group** | **Pretest** | **Treatment** | **Posttest** |
|---|---|---|---|
| E | $O_1$ | X | $O_2$ |
| K | $O_3$ | Y | $O_4$ |

In Table 1, code E is a class with differentiated learning using the STAD cooperative learning model, while K is a class with differentiated learning using theexpository model. The research design used in this study was ampretest-posttest control group experimental design (Arikunto, 2014). In this study, the treatment given was mathematics learning with a differentiated approachusing the STAD cooperative model and mathematics learning with a differentiated approach using the expository model as the independent variables, while the observed variables or dependent variables were mathematical problem-solving skills and student self-confidence. The problem-solving ability of students in the experimental and control classes as research variables was assessed twice, namely before the learning process was carried out (pretest) and after the learning process was carried out, which is called the posttest.

The mathematical problem-solving test questions used as research instruments consisted of eight essay questions, namely three questions for the pretest and five questions for the posttest, which were based on predetermined indicators. Before being used in the research, the questions were first tested in classes XI A and XI B at MA Negeri 2 Sleman, which consisted of 33 and 34 students, respectively. The trial was conducted to determine the validity and reliability of the research instrument, in this case the problem-solving test questions.

Before conducting inferential and descriptive tests, validity and reliability were tested for both instruments. Instrument validity is the extent to which an instrument is able to accurately measure what it is supposed to measure, so that a test is considered valid if it truly measures the predetermined objectives (Allen, M.J., & Yen, 1979). In this study, the validity analysis performed was content validity or expert judgment. Content validity was determined through rational analysis of the test content, with subjective assessment based on individual considerations. The validation process was carried out with experts namely two lecturers from the Master of Mathematics Education program at Yogyakarta State University. Based on the content validity results, it was found that both instruments were declared valid by both validators.

Meanwhile, the reliability of an instrument or question is proven by evaluation results that are relatively consistent when the instrument is used on the same subjects. The following are the results of the reliability of test and non-test instruments conducted using R Studio software.

Table 2. Instrument Reliability Results

| **Variable** | **Treatment** | ***Cronbach's Alpha*** | **Description** |
|---|---|---|---|
| Mathematical Problem-Solving Ability | *Pre* | 0.66 | High |
| | *Post* | 0.67 | High |
| Self-Confidence. | *Pre & Post* | 0.83 | Very High |

Based on Table 2, it is known that all instruments, both tests and non-tests, are reliable and have a high level of reliability. The reliability coefficient for the problem-solving ability test before treatment was 0.66 and after treatment it became 0.67, both of which are in the high category. The reliability coefficient for self-confidence before and after the treatment was 0.83, which is in the very high category.

The data analysis techniques used in this study consisted of descriptive and inferential data analysis. Before testing the hypothesis, an assumption test was conducted first, which consisted of a normality test and a homogeneity test. Once the assumption test was fulfilled, further hypothesis testing could be conducted using Hotelling's test statistics and the Independent Sample t-Test.

## *Results and Discussion*

### Results

The following is a description of the data on mathematical problem-solving abilities and self-confidence of students in inclusive classes.

Table 3. Data on Mathematical Problem-Solving Abilities of Students in Inclusive Classes

| Description | Experimental Class | | Control Class | |
|---|---|---|---|---|
| | ***Pre-test*** | ***Post-test*** | ***Pre-test*** | ***Post-test*** |
| Students | 35 | 35 | 34 | 34 |
| Average score | 71,86 | 92,05 | 71,84 | 89,09 |
| Standard deviation | 18,95 | 5,85 | 18,63 | 6,39 |
| Ideal maximum score | 100,00 | 100,00 | 100,00 | 100,00 |
| Ideal minimum score | 0 | 70.00 | 0 | 70,00 |
| Maximum score | 100,00 | 100,00 | 100,00 | 100,00 |
| Minimum score | 36,36 | 78,18 | 33,33 | 78,18 |

Table 4. Student Self-Confidence Data in Inclusive Classes

| Description | Experimental Class | | Control Class | |
|---|---|---|---|---|
| | ***Pre-scale*** | ***Post-scale*** | ***Pre- scale*** | ***Post- scale*** |
| Students | 35 | 35 | 34 | 34 |
| Average score | 121,69 | 116,54 | 125,00 | 120,85 |
| Standard deviation | 10,10 | 8,75 | 9,68 | 8,96 |
| Ideal maximum score | 160 | 160 | 160 | 160 |
| Ideal minimum score | 32 | 32 | 32 | 32 |
| Maximum score | 141 | 140 | 144 | 140 |
| Minimum score | 105 | 98 | 109 | 104 |

Based on Table 3, we can see that the mathematical problem-solving abilities of students in the experimental and control classes showed improvement. The average increas in the class that used differentiated learning with the STAD cooperative learning model was higher than the average increase in the class that applied differentiated learning with the expository model, although the difference was not too significant. The average score of the experimental class increased by 20.19, while the average score of the control class increased by 17.25.

Based on Table 4, it is known that the pre-scale results show that students in both classes have relatively the same confidence, 121.69 and 125.00. After the learning process with different treatments was given, there was a decrease in the average post-scale score of students, the average decrease was not too significant, namely 5.15 for the experimental class and 4.15 for the control class. These results indicate that differentiated learning with the STAD cooperative learning model in the experimental class has a significant effect on the decrease in the average score of students' self-confidence. The same applies to differentiated learning with the expository model applied to the control class.

Next, the results of the average difference test are presented, both before and after the treatment was given, from the mathematical problem-solving ability test and the self-confidence of students in inclusive classes. This test was conducted after the assumption test, which consisted of the normality test and the homogeneity test, was fulfilled.

Table 5. Results of the Average Difference Test for Initial Ability

| ***Effect*** | $\mathbf{T^2}$ | $p-value$ |
|---|---|---|
| *Hotelling's Trace* | 2,013 | 0,365 |

Table 5 above shows that the significance value obtained is greater than 0.05, which means that H0 is accepted. This indicates that there is no difference in the average mathematical problem-solving ability or self-confidence of students from the experimental class and the control class before the treatment was given.

The results of the test of the difference in the average mathematical problem-solving ability and self-confidence after treatment in both classes are presented in Table 6 below.

Table 6. Results of the Test for Differences in Average Ability After Treatment

| ***Effect*** | $\mathbf{T^2}$ | $p-value$ |
|---|---|---|
| *Hotelling's Trace* | 7,912 | 0,019 |

Based on Table 6 above, the significance value obtained is 0.019 < 0.05, which means that $H_0$ is rejected. This indicates that there is a difference in the average post-test and post-scale scores of students in the experimental class that used differentiated learning with the STAD cooperative learning model and the control class that applied differentiated learning with the expository model. This means that differentiated learning with the STAD cooperative learning model has an effect on students' mathematical problem-solving abilities and self-confidence.

Thus, the first hypothesis in this study has been answered, namely that there is an effect of differentiated learning with the STAD cooperative learning model on students' mathematical problem-solving abilities and self-confidence in inclusive classrooms. In addition, to answer the second research question, the results of the univariate t-test can be analyzed. The univariate t-test is used to see the effect of the superior learning model on each variable partially. The results of the independent sample t-test for each variable are presented in Table 7 below.

Table 7. Independent Sample t-Test Results

| **Variabel** | **Uji t** | $p-value$ |
|---|---|---|
| Kemampuan Pemecahan Masalah Matematis | 2,0075 | 0,04873 |
| Kepercayaan Diri | -2,0211 | 0,04727 |

Based on the results shown in Table 7, it is known that in mathematical problem-solving ability, the value obtained is $p-value$ = 0.04873 < 0.05 and the t-value is 2.0075 > t$tabel$ = 1.668. This indicates that differentiated learning with the STAD cooperative learning model is superior to differentiated learning with the expository model in terms of mathematical problem-solving ability. It is also known that for the self-confidence variable, the value obtained is $p - t$ = 0.04727 < 0.05 and the t-value was $-2.0211 < t = 1.668$. This indicates that differentiated learning with the STAD cooperative learning model is superior to differentiated learning with the expository model in terms of self-confidence.

## *Discussion*

### 1. The Effect of Differentiated Learning with the STAD Cooperative Learning Model on Mathematical Problem-Solving Skills and Student Self-Confidence in Inclusive Classrooms

Based on the results of the pre-test and pre-scale, students in both the experimental and control classes were found to have the same average mathematical problem-solving skills and confidence levels. This is indicated by the results of the Hotelling's T2 test, which shows a value of $sig.$ 0.365 > 0.05, so H0 is accepted, which means that there is no significant difference between the initial abilities of students in the experimental class and the control class.

After treatment, the results of multivariate analysis conducted on post-test and post-scale data showed a value of $sig.$ 0.019, which is smaller than 0.05, meaning that the null hypothesis can be rejected. This shows that differentiated learning with the STAD cooperative learning model has an effect on students' mathematical problem-solving abilities and self-confidence in inclusive classrooms. The effect of differentiated learning with the STAD cooperative learning model has an effect on students' mathematical problem-solving abilities and self-confidence in inclusive classrooms. This indicates that differentiated learning with the STAD cooperative learning model has an effect on mathematical problem-solving abilities and student confidence in inclusive classrooms. The effect of differentiated learning with the STAD cooperative learning model tends to be positive or helps improve mathematical problem-solving abilities and student confidence.

This is supported by research by Ponijan (2020) and Alfi Anjani (2023), which reveals that STAD-type cooperative learning has a positive effect on students' mathematical problem-solving abilities compared to expository methods. In this study, the effect of differentiated learning with the STAD cooperative learning model on students' mathematical problem-solving abilities and self-confidence in inclusive classrooms was evident in its application in the classroom. Through this learning model and approach, students are encouraged to participate in order to develop their cognitive and emotional potential. It can also teach students to work together in groups, have a sense of responsibility, and help each other. Students can also convince themselves and others that the goals they want to achieve depend on their performance, not luck.

### 2. Differentiated Learning with the STAD Cooperative Learning Model Is Superior in Terms of Students' Mathematical Problem-Solving Abilities in Inclusive Classrooms

Based on the results of the Independent Sample t-Test analysis, a value of $p - vaulu = 0.04873 < 0.05$, indicating that differentiated learning with the STAD cooperative learning model is superior to differentiated learning with the expository model in terms of mathematical problem-solving skills. This can be seen from the average posttest score in the experimental class minus the average posttest score in the control class, which is positive. This is also in line with the results of the descriptive analysis, which shows that the average mathematical problem-solving ability of students with differentiated learning using the STAD cooperative learning model is higher than the average score of students with differentiated learning using the expository model.

Based on the average pre-test and post-test scores for each aspect of students' mathematical problem-solving skills, almost every aspect showed an increase of more than 10% in each indicator. Before the treatment, students were able to write down important information, determine the steps or formulas for solving problems, perform calculations correctly, and ensure the accuracy of their solutions.

Only the indicator of illustrating information in table or diagram form had the lowest percentage, namely 52.4%. The most significant improvement occurred in the indicator of writing down important information from the problem, with an increase of more than 20%.

The largest contribution to improvement after treatment came from phases 2 and 4 of learning, when researchers directed students to write down important information and model it mathematically, both individually and in groups. This accustomed students to thinking systematically. Meanwhile, improvement in other indicators remained stable because students' basic abilities in these aspects were already quite good before treatment. The following are excerpts from the answers of control and experimental class students on post-test question number 4.

Figure 1. Answers from Students in the Experimental Class

Figure 2. Answers from Students in the Control Class

Figures 1 and 2 show that the experimental and control classes had the same constraints, namely in the indicator “determining the steps or formulas used to solve problems.” However, students wrote down the form of the probability formula used even though they directly entered the values obtained. Also in this case, students did not write clear conclusions as a form of application of the fifth indicator.

Based on the overall excerpts of student responses from both the experimental class and the control class, it appears that both differentiated learning with the STAD cooperative learning model applied in the experimental class and differentiated learning with the expository model in the control class have the same potential to improve students' mathematical problem-solving skills in inclusive classes. These results are supported by research by Ramadhani et al (2022) and Wahyuni & Wahniati (2025), which revealed that the application of the STAD cooperative learning model is significantly more effective in improving mathematical problem-solving skills than the expository learning method.

**3. Differentiated Learning with the STAD Cooperative Learning Model Is Superior in Terms of Student Self-Confidence in Inclusive Classrooms**

Based on the results of the Independent Sample t-Test analysis, the value obtained is $p - value$ = 0.04727 < 0.05 and the value of $t\ hitung - 2.0211 < t\ tabel$ = 1.668. This indicates that differentiated learning with the STAD cooperative model applied in the experimental class had a significant negative effect on student confidence. This is indicated by the negative t-test value, which means that the average post-scale score of students in the experimental class was lower than the average post-scale score of students in the control class.

The average value of each indicator is influenced by the level of self-confidence, which includes thirteen indicators. The lowest indicator in the experimental class was "daring to face various situations and accept the consequences" (64.14%), while in the control class it was “having a positive self-concept” (70.59%). This shows that students in the experimental class were less prepared to face various situations, while students in the control class still had difficulty building a positive self-concept. Additionally, the indicators “appreciating one's own work” and “being tolerant” in the control class did not show improvement, and in the experimental class, they decreased by 6.29% and 4%, respectively.

Based on the above, it is known that the application of differentiated learning with the STAD cooperative learning model is superior in terms of student confidence, even though it has a negative effect. These results are supported by research by Hijrihani & Wutsqa (2015) and Suartika et al (2016), which found that the STAD learning model is not more effective than the Jigsaw learning model in terms of student confidence.

## *Conclusion*

Based on the results of the research and discussion described in the previous section, it can be concluded that differentiated learning with the STAD cooperative learning model has an effect on mathematical problem-solving skills and student confidence in the inclusive class at MA Negeri 2 Sleman on the subject of probability. Data analysis results show that differentiated learning with the STAD cooperative learning model is superior to differentiated learning with the expository model in terms of mathematical problem-solving skills and student self-confidence in the inclusive class at MA Negeri 2 Sleman on the subject of probability.

## *Recommendation*

Based on the conclusions obtained, there are several suggestions that can be given, namely the application of differentiated learning with the STAD cooperative learning model can be an alternative for teachers to improve students' mathematical problem-solving skills and self-confidence, especially in inclusive classrooms. Furthermore, future researchers can explore differentiated learning with the STAD cooperative learning model not only in terms of mathematical problem-solving skills and confidence but also in other relevant aspects, as well as its application to other mathematical materials.

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