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# Comparative Effectiveness of Learning Starts with a Question and Question Students Have Strategies on Junior Secondary Students' Mathematics Achievement

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**ABSTRACT**

**Purpose of the study:** This study examined the comparative effectiveness of two question-based active learning strategies, namely Learning Starts with a Question and Question Students Have, on junior secondary students' mathematics achievement.

**Methodology:** A quasi-experimental non-equivalent control group design was employed involving two Grade Eight classes. One class was taught using the Learning Starts with a Question strategy and the other using the Question Students Have strategy. Mathematics achievement was measured using validated essay tests administered as pretest and posttest. Data were analysed using descriptive statistics and independent samples t-test after normality and homogeneity assumptions were met.

**Main Findings:** Both strategies improved students' mathematics achievement. The class taught using the Learning Starts with a Question strategy obtained a higher posttest mean score of 84.16 compared to the class taught using the Question Students Have strategy with a mean score of 79.72. Independent samples t-test indicated a significant difference between the two classes with a probability value of 0.009. The increase in scores from pretest to posttest was also higher in the Learning Starts with a Question class, indicating greater improvement in mathematics learning outcomes.

**Novelty/Originality of this study:** The Learning Starts with a Question strategy is more effective than the Question Students Have strategy in improving junior secondary students' mathematics achievement. Initiating mathematics instruction with student-generated questions enhances cognitive readiness and supports conceptual understanding.



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## 1. INTRODUCTION

Mathematics learning is a crucial component of education because it plays a role in developing students' logical, analytical, critical, and systematic thinking skills [1], [2]. However, in practice, mathematics is still considered a difficult subject and is unpopular among most students [3], [4]. This impacts the low mathematics learning outcomes achieved by students at various levels of education, including junior high school (madrasah tsanawiyah). These low learning outcomes are often attributed to the teacher-centered learning process and the lack of student involvement [5], [6]. Therefore, learning strategies are needed that can increase student active engagement in the mathematics learning process.

One effort to improve mathematics learning outcomes is through the implementation of active learning strategies that position students as the subjects of learning [7], [8]. Active learning strategies encourage students to engage mentally and physically in understanding the concepts being studied [9], [10]. In mathematics learning, asking questions is an important indicator of student cognitive engagement because it demonstrates the process of thinking and curiosity [11], [12]. Strategies that facilitate students' questioning are believed to help them develop a deeper understanding of concepts. Therefore, question-based strategies are a relevant alternative for improving students' mathematics learning outcomes.

The Learning Starts With a Question strategy is a learning strategy that emphasizes beginning learning activities with students asking questions about the material to be studied [13], [14]. Through this strategy, students first read or observe the material, then write down questions about anything they don't understand before the lesson begins. This activity helps students build learning readiness and activate prior knowledge before receiving the teacher's explanation [15], [16]. This allows students to more easily grasp the mathematical concepts being taught because the learning process begins with their own learning needs [17], [18]. Therefore, Learning Starts With A Question is considered capable of improving the quality of students' understanding and mathematics learning outcomes.

In addition to Learning Start With A Question, the Question Student Have strategy is also an active learning strategy that emphasizes student questioning during the learning process [19], [20]. In this strategy, students write down questions related to material they haven't yet understood during the lesson, then collect these questions and discuss them together. This strategy provides an opportunity for all students to express learning difficulties without having to speak directly in front of the class [21], [22]. With student-generated questions, learning becomes more interactive and focused on student learning needs. Therefore, Question Student Have also has the potential to improve student engagement and mathematics learning outcomes [23], [24].

Although both strategies are based on student questioning, there are fundamental differences in the timing and mechanism of questioning. Learning Start With A Question places questioning activities early in the learning process so that students have conceptual readiness before receiving the material. Meanwhile, Question Student Have places questioning activities during the learning process so that questions arise after students begin receiving information [25], [26]. These different characteristics are thought to influence students' cognitive processes and understanding of mathematics material [27], [28]. However, research directly comparing the effectiveness of these two strategies on student mathematics learning outcomes at the Madrasah Tsanawiyah level is still limited.

The limitations of comparative research between Learning Start With a Question and Question Student Have, particularly in the context of mathematics learning in madrasas, indicate a research gap that requires further study. Most previous studies tended to examine the effectiveness of each strategy separately, rather than comparing the two in comparable learning conditions. Furthermore, few studies have examined differences in mathematics learning outcomes based on the timing of student questioning activities during learning [29], [30]. This suggests that empirical evidence regarding the most effective question-based strategies for improving mathematics learning outcomes remains weak [31], [32]. Therefore, comparative research between Learning Start With a Question and Question Student Have is crucial to provide a scientific basis for selecting mathematics learning strategies.

This research is urgent because low student mathematics learning outcomes remain a real problem at the junior high school level. Teachers need proven effective learning strategies to optimally improve students' understanding of mathematical concepts. Furthermore, the results of this study are expected to provide practical contributions for teachers in determining active learning strategies that are appropriate to student characteristics. Theoretically, this study also provides novelty in the form of a direct comparison between two question-based learning strategies that differ in the timing of student questioning activities in mathematics learning. This study aims to compare the mathematics learning outcomes of eighth-grade students taught using the Learning Start With A Question strategy and the Question Student Have strategy at MTs. Abnaul Amir Moncobalang, Gowa Regency.

## 2. RESEARCH METHOD

### 2.1. Type and Design of Research

This study employed a quasi-experimental non-equivalent control group design because intact classrooms were used and random assignment was not feasible in the school setting [33], [34]. Two Grade Eight classes were assigned as Experimental Group One taught using the Learning Starts with a Question strategy and Experimental Group Two taught using the Question Students Have strategy. Both groups received pretest and posttest to measure mathematics achievement. The research design used in this study was a non-equivalent control group design . This design is similar to a one-group pretest-posttest design, but does not involve random assignment of subjects to groups. The two groups are given a pretest, then a treatment, and finally a posttest. The design can be seen in Table 1:

Table 1. Research Design

| Group | Pre-test | Treatment | Post-test |
|---|---|---|---|
| Experiment 1 (Learning Starts With a Question) | $O_1$ | $X_1$ | $O_2$ |
| Experiment 2 (Question Students Have) | $O_3$ | $X_2$ | $O_4$ |

Information:
$X_1$ = Experimental Treatment 1
$X_2$ = Experimental Treatment 2
$O_1$ = Experimental group 1's score before being taught with the Learning Start With A Question strategy (pretest score of experimental group 1)
$O_2$ = Experimental group 1's score after being taught with the Learning Start With A Question strategy (posttest score of experimental group 1)
$O_3$ = The value of experimental group 2 before being taught with the Question Student Have strategy (pretest value of experimental group 2)
$O_4$ = The value of experimental group 2 after being taught with the Question Student Have strategy (posttest value of experimental group 2)

### 2.2. Research Population and Sample

The population consisted of all Grade Eight students with a total of 102 students. Two classes were selected purposively based on similar academic characteristics and taught by the same teacher to ensure instructional consistency. One class was assigned as the Learning Starts with a Question group and the other as the Question Students Have group.

### 2.3. Data Collection Methods

The data collection technique used in this study was a test. The test format used was a descriptive/essay. The test questions given to experimental group 1 and experimental group 2 were designed the same, referring to the indicators for assessing conceptual understanding.

### 2.4. Research Instruments

Based on previous data collection methods, the instrument for this study is a mathematics learning achievement test [35], [36]. The learning achievement test is an objective test to measure students' cognitive abilities. There are two types of tests in this study: a pretest and a posttest. The material used is class VIII Semester 2 material, namely circles, cubes, and rectangular prisms, with essay questions. The outline of the problem-solving ability test instrument is as follows:

Table 2. Pretest Instrument Grid

| Basic competencies | Achievement Indicators | Number of Items |
|---|---|---|
| 1. Derive formulas to determine the circumference and area of a circle related to contextual problems. | 1.1 Calculating the circumference and area of a circle. | 5 Item |
| 2. Using the relationship between central angle, arc length, sector area in problem solving. | 2.1 Determine the length of the arc, the area of the ring and the area of the section.<br>2.2 Using the relationship between central angle, arc length, sector area in problem solving. | |
| 3. Calculate the length of the common tangent line between two circles and how to draw it. | 3.1 Explain the tangent to the interior and area of two circles. | |

Table 3. Posttest Instrument Grid

| Basic competencies | Achievement Indicators | Number of Items |
|---|---|---|
| 1. Differentiate and determine the surface area and volume of cubes and cuboids. | 1.1 Using formulas to calculate the surface area and volume of cubes and cuboids. | 5 Item |
| 2. Solve problems related to the surface area and volume of cubes and blocks and their combinations. | 2.1 Calculating the change in volume of cubes and cuboids if the size of their edges changes. | |
| 3. Determine the relationship between the space diagonal, the plane diagonal and the plane diagonal. | 3.1 Calculating the diagonal area of a space, diagonal area of a plane and diagonal area of a plane. | |

## 2.5. Data Analysis Techniques

Several tests were performed on inferential statistics for hypothesis testing purposes. First, basic tests were conducted, namely the normality test and the homogeneity of variance test, followed by an independent sample t-test for hypothesis testing purposes. The data normality test is intended to determine whether the data is normally distributed or not [37], [38]. This test is also conducted to determine whether the data to be obtained can be tested with parametric or nonparametric statistics. The criteria for normality testing with SPSS processed results are: if the sign > α, the data is normally distributed, and if the sign < α, the data is not normally distributed. Homogeneity testing is conducted because researchers will generalize the research results or hypotheses ($Ho$ or $H_1$) achieved in the sample to the population. In other words, if the data obtained is homogeneous, then the sample groups come from the same population. This test is also conducted to determine the comparative t-test that will be used. The testing criteria are if $F_{\text{Count}} < F_{\text{Table}}$ at the real level with $F_{\text{Table}}$ obtained from the F distribution with degrees of freedom each according to the dk of the numerator and dk of the denominator at the level $\propto = 0.05$.

Hypothesis testing is used to determine temporary assumptions or temporary answers formulated in the research hypothesis using a two-tailed test. If $t_{\text{Count}} < t_{\text{Table}}$ or the significance level < $\alpha$ (sign value < 0.05) then $HO$ is rejected and $H1$ is accepted. This means that there is a difference in mathematics learning outcomes taught using the Learning Start With A Question strategy with those taught using the Question Student Have strategy in class VIII students of MTs. Abnaul Amir Moncobalang. If $t_{\text{count}} < t_{\text{Table}}$ or the significance level > $\alpha$ (sign value > 0.05) then $H_o$ is accepted and $H_1$ is rejected. So, it means that there is no difference in mathematics learning outcomes taught using the Learning Start With a Question strategy with those taught using the Question Student Have strategy in class VIII students of Madrasah Tsanawiyah Abnaul Amir Moncobalang.

## 3. RESULTS AND DISCUSSION

Hypothesis testing is used to determine temporary assumptions or temporary answers formulated in the research hypothesis using a two-tailed test. In order to determine the comparison of students' mathematics learning outcomes with the implementation of the Learning Start With A Question strategy and the Question Student Have strategy, a statistical test with an independent samples test technique will be used. The purpose of the statistical test is to determine the average value of student learning outcomes using both Learning Start With A Question and Question Student Have strategies and will be tested for significant differences with the provisions if Sig. (2-tailed) <0.05 then there is a significant difference, but if otherwise Sig. (2-tailed) >0.05, then there is no significant difference. The results are as follows:

Table 4. Average Mathematics Learning Outcomes of Students

| | N | Minimum | Maximum | Sum | Mean | Std. Deviation | Variance |
|---|---|---|---|---|---|---|---|
| Posttest Learning Start With A Question | 25 | 78 | 95 | 2104 | 84.16 | 5.383 | 28.973 |
| Posttest Question Student Have | 25 | 70 | 88 | 1993 | 79.72 | 6.052 | 36.627 |
| Valid N (listwise) | 25 | | | | | | |

Based on the results above, it is known that the result of $\mu1$ = Average learning outcomes of students taught with the Learning Start With A Question strategy is 84.16. While for $\mu2$ = Average learning outcomes of students taught with the Question Student Have strategy is 79.72.

## 3.1. Normality Test

Normality testing was used to determine whether the mathematics learning outcome data obtained from both experimental class I and experimental class II were normally distributed. In this study, data normality testing was conducted using the Kolmogorov-Smirnov test at a significance level of α = 0.05. The results of the normality test for this research data can be seen in the following table:

Table 5. Normality Test for Experimental Class I and Experiment II
One-Sample Kolmogorov-Smirnov Test

| | | Pretest Learning Start With A Question | Posttest Learning Start With A Question | Pretest Question Student Have | Posttest Question Student Have |
|---|---|---|---|---|---|
| N | | 25 | 25 | 25 | 25 |
| Normal Parameters[a,b] | Mean | 64.52 | 84.16 | 64.76 | 79.72 |
| | Std. Deviation | 6.659 | 5.383 | 7.236 | 6.052 |
| Most Extreme Difference | Absolute | .191 | .216 | .135 | .130 |
| | Positive | .191 | .216 | .129 | .102 |
| | Negative | -.129 | -.138 | -.135 | -.130 |
| Kolmogorov-Smirnov Z | | .956 | 1.079 | .677 | .651 |
| Asymp. Sig. (2-tailed) | | .320 | .194 | .750 | .790 |

a. Test distribution is Normal.
b. Calculated from data.

Based on the results of the normality test using Kolmogorov–Smirnov, the statistical value for the pretest data of experimental class I was 0.956 with a significance value of 0.320 greater than 0.05 so that $H_0$ was accepted or not significant. This shows that the pretest data of experimental class I was normally distributed. Furthermore, for the posttest data of experimental class I, the Kolmogorov–Smirnov statistical value was 1.079 with a significance value of 0.194 greater than 0.05 so that $H_0$ was also accepted, which means that the posttest data of experimental class I was normally distributed. In experimental class II, the results of the pretest data normality test showed a Kolmogorov–Smirnov statistical value of 0.677 with a significance value of 0.750 greater than 0.05 so that $H_0$ was accepted, which shows that the pretest data of experimental class II was normally distributed. Similarly, the results of the normality test of the posttest data for experimental class II showed a Kolmogorov–Smirnov statistical value of 0.651 with a significance value of 0.790 greater than 0.05 so that $H_0$ was accepted, so it can be concluded that the posttest data for experimental class II was also normally distributed. Overall, the results of the normality test showed that all pretest and posttest data in both experimental classes were normally distributed so that they met the requirements for parametric statistical analysis.

### 3.2. Homogeneity Test

Homogeneity testing was conducted on the pretest and posttest data of both samples, namely in experimental class I and experimental class II. Based on the results of the homogeneity test using SPSS Version 20 on the pretest and posttest values of both classes, the following results were obtained:

Table 6. Homogeneity Test for Pretests in Experimental Class I and Experimental Class II
Test of Homogeneity of Variances

| Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|
| .190 | 1 | 48 | .665 |

ANOVA

| | Sum of Squares | Df | Mean Square | F | |
|---|---|---|---|---|---|
| Between Groups | .720 | 1 | .720 | .015 | .903 |
| Within Groups | 2320.800 | 48 | 48.305 | | |
| Total | 2321.520 | 49 | | | |

Based on the analysis results in the Test of Homogeneity of Variances table, Levene = 0.190; df1 = 1; df2 = 48; and Sig = 0.665 > 0.05 or H0 is accepted. Thus, the pretest data of learning outcomes from both groups are homogeneous. Meanwhile, in the ANOVA table, the value of F = 0.015 and Sing = 0.903 > 0.05 is obtained, which gives meaning to the insignificant difference in the average mathematics learning outcomes.

Table 7. Homogeneity Test for Posttest of Experimental Class I and Experimental Class II
Test of Homogeneity of Variances

| Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|
| .465 | 1 | 48 | .498 |

ANOVA

| | Sum of Squares | Df | Mean Square | F | |
|---|---|---|---|---|---|
| Between Groups | 246.420 | 1 | 246.420 | 7.513 | .009 |
| Within Groups | 1574.400 | 48 | 32.800 | | |
| Total | 1820.820 | 49 | | | |

Based on the analysis results in the Test of Homogeneity of Variances table, F = 0.465; df1 = 1; df2 = 48; and Sing = 0.498 > 0.05 or H0 is accepted. Thus, the posttest data of learning outcomes from both groups are declared homogeneous. Meanwhile, in the ANOVA table, the value of F = 7.513 and Sig = 0.009 < 0.05 is obtained, which gives meaning to the significant difference in the average mathematics learning outcomes.

### 3.3. Hypothesis Testing

Hypothesis testing using the t-test aims to determine whether there is a significant difference between the mathematics learning outcomes achieved by students in experimental class I and experimental class II. Hypothesis testing was conducted on the posttest results of experimental group I and experimental group II. Based on the previous prerequisite tests, the data were normally distributed and homogeneous. Hypothesis testing using the SPSS 20 application uses parametric statistics, namely the t-test (Independent-Samples T-test).

Tabel 8. Group Statistics

| | STrategi | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Nilai | | 25 | 84.16 | 5.383 | 1.077 |
| | Start With Student Have | | | | |
| | | 25 | 79.68 | 6.122 | 1.224 |

Table 9. Independent Samples Test Results

Independent Samples Test

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | T | df | Sig. (2-tailed) | Mean Difference | Std. Error Differenc e | 95% Confidence Interval of the Difference | |
| | | F | Sig. | | | | | | Lower | Upper |
| Value | Equal variances assumed | .465 | .498 | 2.741 | 48 | .009 | 4.440 | 1.620 | 1.183 | 7.697 |
| | Equal variances not assumed | | | 2.741 | 47.355 | .009 | 4.440 | 1.620 | 1.182 | 7.698 |

Based on the data processing results in the Equal variances assumed column, F = 0.465 was obtained with a significant figure of 0.498 > 0.05, which means the population variance of both groups is the same or homogeneous. Therefore, the formula used in the (t) test is Polled Variance. Because the data variance is homogeneous, the t value is 2.741, the Sig value (2-tailed) = 0.009. Thus, H0 is rejected and H1 is accepted because Sig (2-tailed) < α or (0.009 < 0.05). Thus, the proposed hypothesis is tested by the data, so it can be concluded that there is a difference in the average mathematics learning outcomes of grade VIII students at MTs. Abnaul Amir Moncobalang, Gowa Regency, who are taught using the Learning Start With A Question strategy and the Question Student Have strategy.

The results indicate that both Learning Starts with a Question and Question Students Have strategies enhance mathematics achievement, confirming the importance of student questioning in active mathematics learning. However, the significantly higher achievement in the class taught using the Learning Starts with a Question strategy suggests that initiating instruction with student-generated questions provides stronger cognitive benefits than questioning during instruction.

From a mathematics learning perspective, the Learning Starts with a Question strategy facilitates activation of prior knowledge before new concepts are introduced [39], [40]. Early questioning encourages students to recall related mathematical ideas and identify conceptual gaps, which prepares cognitive structures for integrating new information. This readiness supports deeper conceptual understanding and more efficient problem solving. In contrast, the Question Students Have strategy places questioning after partial exposure to content, which mainly functions as clarification rather than initial conceptual activation.

The greater improvement observed in the Learning Starts with a Question class also indicates that pre-instruction questioning helps focus students' attention on essential mathematical relationships and learning objectives. When students enter learning with self-generated questions, they engage more actively in meaning-making processes such as reasoning, connecting concepts, and verifying understanding [41], [42]. These processes are central to mathematics learning and explain the higher achievement gains in the class taught using the Learning Starts with a Question strategy.

These findings highlight the pedagogical importance of the timing of questioning in mathematics instruction. Questioning at the beginning of learning not only increases engagement but also enhances conceptual readiness, which is crucial for understanding abstract mathematical ideas [43], [44]. Therefore, incorporating pre-instruction questioning strategies such as Learning Starts with a Question can strengthen mathematics learning effectiveness in junior secondary classrooms.

The findings of this study have important pedagogical implications for mathematics instruction at the junior secondary level. The evidence that the Learning Starts with a Question strategy produces higher achievement gains suggests that the timing of student questioning is a critical element in effective mathematics teaching [45], [46]. Initiating lessons with student-generated questions can help teachers diagnose prior knowledge, identify misconceptions, and align instruction with students' cognitive readiness. This approach supports more meaningful engagement with mathematical concepts and may contribute to improved conceptual understanding and achievement. Therefore, mathematics teachers and curriculum designers are encouraged to incorporate structured pre-instruction questioning activities as part of student-centred mathematics learning practices.

Despite its contributions, this study has several limitations. The research was conducted in a limited number of classes within one school context, which may restrict the generalisability of the findings to broader educational settings. The quasi-experimental design without random assignment also means that uncontrolled classroom variables may have influenced the results. In addition, mathematics achievement was measured primarily through written tests, so the study did not capture other important aspects of mathematics learning such as reasoning processes or mathematical communication. Future research is recommended to involve larger and more diverse samples, apply randomised designs, and examine the effects of questioning strategies on multiple dimensions of mathematical competence.

## 4. CONCLUSION

This study demonstrates that the Learning Starts with a Question strategy is more effective than the Question Students Have strategy in improving junior secondary students' mathematics achievement. Both strategies enhance learning outcomes, but initiating mathematics instruction with student-generated questions results in greater improvement. The findings suggest that early questioning activates prior knowledge and promotes conceptual readiness, leading to better mathematical understanding. Mathematics teachers are therefore encouraged to integrate pre-instruction questioning strategies to support active engagement and improve students' achievement in mathematics. Further research is recommended to involve a larger and more diverse sample and use an experimental design with random assignment to ensure stronger generalizability of the results. Furthermore, future research should examine the effect of the Learning Starts with a Question and Question Students Have strategies on other aspects of mathematical ability, such as mathematical reasoning, problem solving, and mathematical communication.

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