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Influence Interaction Semester and Type Sex to Science Learning Outcomes: A Quasi-Experimental Study of Fifth Grade Students in Jakarta

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Abstract
This study aims to analyze the influence of semester, gender, and their interaction on the science learning outcomes of fifth-grade students in Jakarta. The study used a quasi-experimental design with a 2x2 factorial design. The sample consisted of 28 students selected through non-probability sampling, with a balanced composition based on semester and gender. Data were collected using a validated multiple-choice science learning outcome test. The analysis showed that semester significantly influenced science learning outcomes ($F = 4445.354$; $\eta^2 = 0.988$), with higher achievement in the even semester. Gender also had a significant effect ($F = 3965.297$; $\eta^2 = 0.987$), with female students demonstrating higher learning outcomes. Furthermore, there was a significant interaction effect between semester and gender ($F = 5985.992$; $\eta^2 = 0.991$). A Tukey HSD follow-up test showed significant differences between male and female students in the odd semester and between the odd and even semesters for both genders. These findings indicate that the improvement in learning outcomes from the odd to the even semester was greater for female students.
Keywords: *Science Learning Outcomes, Semester, Gender, Interaction, Elementary School Students.*

Abstrak
Penelitian ini bertujuan menganalisis pengaruh semester, jenis kelamin, dan interaksi keduanya terhadap hasil belajar sains siswa kelas V di Jakarta. Penelitian menggunakan desain quasi-eksperimen dengan rancangan faktorial 2×2. Sampel berjumlah 28 siswa yang dipilih melalui nonprobability sampling, dengan komposisi seimbang berdasarkan semester dan jenis kelamin. Data dikumpulkan melalui tes hasil belajar sains berbentuk pilihan ganda yang tervalidasi. Hasil analisis menunjukkan bahwa semester berpengaruh signifikan terhadap hasil belajar sains ($F = 4445{,}354$; $\eta^2 = 0{,}988$), dengan capaian lebih tinggi pada semester genap. Jenis kelamin juga berpengaruh signifikan ($F = 3965{,}297$; $\eta^2 = 0{,}987$), di mana siswa perempuan menunjukkan hasil belajar lebih tinggi. Selain itu, terdapat pengaruh interaksi signifikan antara semester dan jenis kelamin ($F = 5985{,}992$; $\eta^2 = 0{,}991$). Uji lanjut Tukey HSD menunjukkan perbedaan signifikan antara siswa laki-laki dan perempuan pada semester ganjil serta antara semester ganjil dan genap pada kedua jenis kelamin. Temuan ini menunjukkan bahwa peningkatan hasil belajar dari semester ganjil ke semester genap lebih besar pada siswa perempuan.
Kata Kunci: *Hasil Belajar Sains, Semester, Jenis Kelamin, Interaksi, Siswa Sekolah Dasar.*

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INTRODUCTION

Education is a conscious and planned effort aimed at developing human potential holistically, encompassing physical, spiritual, intellectual, and social aspects, in order to improve the quality of life for individuals and society (Whitehead, 2024). In the context of formal education, science is one of the core subjects that plays a vital role in equipping student with knowledge base about natural universe as well as ability think logical, critical, and scientific since elementary school level (Amelia et al., 2025; Susanti et al., 2025; Hariyanti et al., 2024).

Students' science learning outcomes are influenced by various factors, both internal and external. Factor internal covers characteristics individual like motivation, ability beginning, and types sex, whereas factor external covering environment Study, method learning, and time or period learning (Fernando et al., 2024; Siregar, 2024). In between various Of these factors, gender and semester of study are two variables that are often studied because they have significant potential to influence students' academic achievement.

Gender is often associated with differences in learning styles, interests, motivation, and cognitive strategies in understand the material lessons (Rahmi et al., 2024). Meanwhile, the semester as representation time learning own characteristics Which different, Good from aspect material load, students' psychological conditions, and the learning strategies implemented by teachers. The odd semester is generally an adaptation phase after a long holiday, while the even semester often time functioning as period consolidation And evaluation end year (Amrulloh et al., 2024; Hasan et al., 2024).

More carry on, interaction between type sex And semester allows emergence partially unexplained combined effect. The learning performance of male and female students can show variation Which different on every semester, influenced by psychological and social factors, as well as suitability for the learning methods and materials used (Ningsih et al., 2024; Istiningsih, 2024; Aprilia, 2024). By Because That, study about The interaction of these two variables is important to obtain a more comprehensive picture of the determinants of students' science learning outcomes.

However, based on the results of the literature review, research specifically examining the interaction between semester and gender on elementary school students' science learning outcomes is still relatively limited.

Most previous studies have examined the effects of gender or semester separately, without examining both simultaneously (Listiani et al., 2025; Rachman, 2024; Lestari, 2025; Susanti et al., 2025). This limitation indicates a research gap that needs to be filled.

Based on these conditions, this study aims to analyze the influence of semester, type of sex, as well as interaction both of them to results Study science student class V school base in Jakarta. The research results are expected to provide theoretical contributions to the development of research studies. results Study science as well as contribution practical for Teacher And stakeholders interest education in designing learning strategies that are more adaptive, effective, and responsive to student characteristics.

METHOD

1. Research Design and Approach

This study employed a quantitative research approach using a quasi-experimental method with a 2 × 2 factorial design. This design was selected because the study involved two independent variables—semester (odd and even) and gender (male and female)—and one dependent variable, namely students' science learning outcomes. The factorial design enabled the analysis of both the main effects of each independent variable and their interaction effect on learning outcomes.

2. Population and Sample

The population of this study consisted of all fifth-grade students of SDN Ulujami 02 Pesanggrahan, South Jakarta, during the 2024/2025 academic year, totaling 48 students. The sample was selected using a non-probability sampling technique by considering the equivalence of curriculum implementation, learning facilities, and teacher background. Based on these considerations, a total of 28 students were selected as research participants, consisting of students from both odd and even semesters with a balanced distribution of male and female students.

Using a 2 × 2 factorial design, the study involved two independent variables, each with two levels, resulting in four experimental groups. The distribution of participants in each group is presented in Table 1.

Table 1. Factorial Design Grouping

Factor B (Gender)	A1 (Odd Semester)	A2 (Even Semester)
B1 (Male)	A1B1	A2B1
B2 (Female)	A1B2	A2B2

Each group consisted of seven students, resulting in the sample distribution shown in Table 2.

Table 2. Sample Distribution

Semester	Male	Female	Total
Odd	7	7	14
Even	7	7	14
Total	14	14	28

3. Research Variables

The variables in this study are defined as follows:

- **Independent Variables:**
  - Semester (odd and even)
  - Gender (male and female)
- **Dependent Variable:**
  - Students' science learning outcomes

4. Data Collection Techniques

Data were collected using the following instruments:

a. **Learning Outcome Test:** A multiple-choice test designed to measure students' science learning outcomes. The instrument was validated and tested for reliability prior to use.

b. **Documentation:** Official school records were used to obtain data related to students' gender and semester classification.

5. Data Analysis Techniques

The collected data were analyzed using inferential statistics, specifically a two-way analysis of variance (Two-Way ANOVA) based on a 2 × 2 factorial design. This analysis was conducted to examine:

1. The main effect of semester on science learning outcomes,
2. The main effect of gender on science learning outcomes, and
3. The interaction effect between semester and gender on science learning outcomes.

Before conducting the ANOVA, prerequisite tests were performed to ensure data suitability, including:

1. **Normality Test:** Using the Shapiro–Wilk test at a significance level of 0.05 ($\alpha = 0.05$).
2. **Homogeneity of Variance Test:** Using Bartlett's test at a significance level of 0.05 ($\alpha = 0.05$).

Only data that met these assumptions were included in the subsequent ANOVA analysis.

RESULTS AND DISCUSSION

Results

This study was conducted to determine the influence of semester, gender, and the interaction of the two on the science learning outcomes of grade V elementary school students in Jakarta. The data obtained was analyzed using the two-way ANOVA test. The following are the findings based on data processing:

1. Description of Science Learning Outcomes Data

Here is data on science learning outcomes by semester and gender:

Table 3. Description of Student Science Score Statistics

Statistics	A1B1	A2B1	A1B1	A2B2
Mode	70	90	79	90
Median	74	90	79	87.5
Red	75.000	86.786	81.071	85.571
Std. Deviation	5.87	4.87	4.411	5.185
Variance	34.46	23.72	19.456	26.879
Shapiro-Wilk	0.782	0.659	0.653	0.811
P-value of Shapiro-Wilk	0.003	<.001	<.001	0.007
Minimum	70	78	78	76
Maximum	89	90	90	90

Table 3 above shows that the odd semester student group of women (A_{1B2}) had the highest science score of the other group with a mean of 86,786 and the group of odd semester students of men (A_{1B1}) had the lowest science score of the other group with an average (mean) of 75,000

2. Analysis Prerequisites Test

a. Normality Test

For the Shapiro-Wilk test based on table 3 of the 7th row above the overall group with a p-value of < 0.05, this shows that the data is not normally distributed.

b. Variance Homogeneity Test with Barlett Test

Table 4. Variance Homogeneity Test

Groups	db	S2	Log S2	db. Log S2	db (S^2)
A1B1	13	34.46	1.53731527	19.9850986	447.98
A2B1	13	23.72	1.37511468	17.8764909	308.36
A1B2	13	19.456	1.28905356	16.7576962	252.928
A2B2	13	26.879	1.42941311	18.5823704	349.427
Jml	52	104.515		73.2016	1358.7

Calculation:

$s^2G = \frac{\sum db\ (s^2)}{db} = \frac{1358.7}{52} = 26.128$

B = log s^2G ∑db = (log 26.128)(52) = (1.417) (52) = 73.684

$\chi 2_{\text{count}}$ = (lon 10) (B - ∑ db. Log S2) = (2.3026) (73.2684) - (73.2016)

= 0.153

So the value χ^2_{count} = 0.153 compared to χ^2_{table} for α 0.05 and db =3 is obtained 7.82. Since χ^2_{count} = 0.153 < $\chi 2_{\text{table}}$ = 7.82, thus the four data groups have the same or homogeneous variance.

Table 5. Two Way ANOVA

Variant source	JK	db	RJK	Calculation	Ftable (α; 0.05)	η2
Antar A	116152.678	1	116152.678	4445.354	7.03	0.988
Antar B	103609.250	1	103609.250	3965.297	7.03	0.987
Antar AB	156408.000	1	156408.000	5985.992	7.03	0.991
In	1358.714	52	26.129			
Total	-	-	-	-	-	-

Statistical hypotheses;

$H_0 : \mu_{A1} \geq \mu A2$ $H_0 : \mu b_1 \geq \mu b2$ $H_0 : A\ xB = 0$

$H_1 : \mu A1 \leq \mu A2$ $H_1 : \mu b_1 \leq \mu b_2$ $H_1 : A\ xB \neq 0$

Interpretation of Results:

a. The Influence of Semester (A) on Students' Science Learning Outcomes

In table 6 above for the semester variable (A) shows the value of $F_{calculated}$ as > F_{table} 4445.354 > 7.03 at a significant level of 5% thus receiving H_0, meaning

that the semester has a significant effect on the science learning outcomes of students. A value of η^2 (Eta Square) of 0.988 indicates that semester (A) accounts for 98.8% of the total variation in learning outcomes, which means that the contribution of semester (A) is very large to the science learning outcomes of grade V students in Jakarta

b. Influence of Gender (B) on Students' Science Learning Outcomes
In table 6 above for gender (B) shows the value of $F_{calculated}$ as > F_{table} 3965.297 > 7.03 at a significant level of 5% thus receiving H_0, meaning that gender (B) has a significant effect on students' science learning outcomes. A value of η^2 (*Eta Square*) of 0.987 indicates that gender (B) explains 98.7% of the total variation in learning outcomes, which means that the contribution of gender (B) is very large to the science learning outcomes of grade V students in Jakarta

c. Effect of Semester x Gender Interaction (A x B)
In table 6 above, the value of $F_{calculating}$ the interaction between semester (A) and gender (B) 5985,992 > 7.03 at a significant level of 5 % thus receiving H_0, meaning that the interaction of semester x gender (A x B) has a significant effect on students' science learning outcomes. With a value of η^2 of 0.991, the interaction of semester x gender (A x B) accounted for 99.1% of the total variation in science learning outcomes, indicating that the interaction had the greatest influence between semesters and students' gender on the science learning outcomes of grade V students in Jakarta

3. Further Test (*Post Hoc Tukey HSD*)

Post hoc testing is a special finding outside of the proposed objectives and hypotheses. The purpose of this test is to complement the general purpose of the research and also so that the school or teachers can be used as recommendation material in learning activities, especially science lessons as follows:

a. Comparison of Group A_{1B1} vs A2B1

Post hoc test Tukey HSD to find out which group is significantly different with the condition of accepting H_0 if the value $t_{is\ calculated} \geq t_{table}$ at a 5% error level.

$$t_{hitung\ A1B1\ VS\ A2B1} = \frac{\overline{y_1} - \overline{y_2}}{\sqrt{RJK(\text{D(galat)})\left[\frac{1}{n_1}+\frac{1}{n_2}\right]}} = \frac{75.000 - 86.785}{\sqrt{(26.641)\left[\frac{1}{14}+\frac{1}{14}\right]}} = -\frac{-11.785}{1.950} = 6{,}043$$

Statistical Interpretation:

The results of Tukey HSD's follow-up test showed a significant difference between the A1B1 group (odd-semester male students) and A2B1 (even-semester male students). The average score of learning outcomes for the A1B1 group was 75.00, while the A2B1 group was 86.785.

The calculated t-value obtained was −6.038, which indicates that the average learning outcomes of male students in odd semesters were lower compared to male students in even semesters. With a free degree of 26 and a significance level of 0.05, a table value of 1.706 was obtained. Since the calculated absolute value < is greater than the table (−6.038 > 1.706), the difference between the two groups is statistically significant.

Thus, it can be concluded that the learning semester has an effect on the science learning outcomes of male students, where the learning outcomes in even semesters are higher than in odd semesters.

b. Comparison of Group A_{1B2} vs A2B2

$$t_{hitung\ A1B2\ VS\ A2B2} = \frac{\overline{y_1} - \overline{y_2}}{\sqrt{RJK(\text{D(galat)})\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}} = \frac{81.071 - 85.571}{\sqrt{(26.641)\left[\frac{1}{14} + \frac{1}{14}\right]}} = -\frac{-4.500}{1.950} = 2{,}307$$

Statistical Interpretation:

The results of Tukey HSD's follow-up test showed a significant difference between the A1B2 group (odd-semester female students) and A2B2 (even semester female students). The average score of science learning outcomes for the A1B2 group was 81.07, while the A2B2 group was 85.57.

The calculated t-value of −2.307 indicates that the average learning outcomes of female students in odd semesters are lower than those of female students in even semesters. With a free degree of 26 and a significance level of 0.05, a table t-value of 1.706 was obtained. Since the absolute value of $t_{is\ calculated}$ to be greater than the t_{table} (−2.307 > 1.706), the difference between the two groups is statistically significant.

Thus, it can be concluded that the learning semester has an effect on the science learning outcomes of female students, where the learning outcomes in even semesters are higher than in odd semesters.

c. Comparison of Group A_{1B1} vs A1B2

$$t_{hitung\ A1B1\ VS\ A1B2} = \frac{\overline{y_1} - \overline{y_2}}{\sqrt{RJK(\text{D(galat)})\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}} = \frac{75.000 - 81.071}{\sqrt{(26.641)\left[\frac{1}{14} + \frac{1}{14}\right]}} = = -\frac{-6.071}{1.950} 3.113$$

Statistical Interpretation:

The results of Tukey HSD's follow-up test showed a significant difference between the A1B1 group (odd-semester male students) and A1B2 (odd-semester female students). The average score of science learning outcomes in the A1B1 group was 75.00, while the A1B2 group was 81.07.

The calculated t-value of −3.113 indicates that the average learning outcomes of male students in the odd semester are lower than those of female students in the same semester. With a free degree of 26 and a significance level of 0.05, a table t-value of 1.706 was obtained. Since the absolute value of $t_{\text{is calculated}}$ to be greater than the t_{table} (−3.113 > 1.706), the difference between the two groups is statistically significant.

Thus, it can be concluded that in odd semesters there is a difference in science learning outcomes based on gender, where female students show higher learning outcomes than male students.

d. Comparison of Group A_{2B1} vs A2B2

$$t_{hitung\ A2B1\ VS\ A2B2} = \frac{\overline{y_1} - \overline{y_2}}{\sqrt{RJK(\text{D(galat)})\left[\frac{1}{n_1}+\frac{1}{n_2}\right]}} = \frac{86.785 - 85.571}{\sqrt{(26.641)\left[\frac{1}{14}+\frac{1}{14}\right]}} = = \frac{-1.214}{1.950} 0.622$$

Statistical Interpretation:

The results of the Tukey HSD follow-up test showed that there was no significant difference between the A2B1 group (even semester male students) and A2B2 (even semester female students). The average score of science learning outcomes for the A2B1 group was 86.79, while the A2B2 group was 85.57.

The calculated t-value of 0.622 shows that the average learning outcomes of male students in even semesters are slightly higher than those of female students. However, with a free degree of 26 and a significance level of 0.05, a table t-value of 1.706 was obtained. Because the$_{\text{t-value of the calculation}}$ is smaller than the$_{\text{t-table}}$ (0.622 < 1.706), the difference between the two groups is not statistically significant.

Thus, it can be concluded that in the even semester there is no difference in science learning outcomes based on gender, because both male and female students show relatively equal learning outcomes.

Discussion

The results of the study showed that semester, gender, and interaction between the two had a significant effect on the science learning outcomes of grade V students in Jakarta. These findings confirm that science learning

outcomes are not only influenced by one factor separately, but also by a combination of learning time characteristics and individual student characteristics. The discussion of each finding is described as follows.

1. The Influence of Semester on Science Learning Outcomes

The results of the analysis showed that students' science learning outcomes in even semesters were significantly higher compared to odd semesters. This finding can be explained through the difference in learning characteristics in each semester. In even semesters, students generally have gone through the adaptation phase to the learning environment, materials, and teachers' teaching styles, so that learning readiness becomes more optimal.

The results of this study are in line with the findings of Kurniawati et al. (2025) who stated that each semester has a different duration, material load, and academic pressure, so that the physical and psychological conditions of students also vary. In addition, odd semesters often function as a transition period after long holidays, while even semesters are more oriented towards consolidating and evaluating learning outcomes (Puspita & Sugiyanto, 2025). These differences in characteristics have direct implications for students' learning readiness and academic achievement (Lestari & Mahrus, 2025; Purwoka, 2025). Thus, the timing of learning implementation (semester) is an important factor that contributes to the temporal variation of students' science learning outcomes.

2. The Influence of Gender on Science Learning Outcomes

The results of the analysis also showed that female students had higher science learning outcomes than male students, both in odd semesters and even semesters. These findings indicate that there are differences in learning characteristics based on gender that affect students' academic achievement.

Empirically, the results of this study support a number of previous studies that suggest that female students tend to have a more verbal and reflective learning style, and are more comfortable with reading, writing, and discussion activities (Fitriansyah & Adi, 2025; Cahyana & Masithoh, 2025). In addition, female students generally pay more attention to the learning process in detail in communicating (Sultan & Jariah, 2025), have learning motivation that is influenced by personal responsibility and satisfaction (Driandra et al., 2025), and

show a higher level of discipline and consistency in completing academic tasks (Bahri & Nugroho, 2025).

These findings also provide a critical perspective on some of the results of previous research that stated that male students excel in mathematics and science, while female students excel in language (Meilinda et al., 2025; Cahyani & Friyatmi, 2025). In the context of this study, the superiority of female students in science learning outcomes shows that differences in academic achievement are not universal, but are greatly influenced by the learning context and characteristics of students. These results are consistent with the view of Hyde and Linn (2006) who stated that the difference in cognitive abilities between boys and girls is relatively small, but in primary education, female students often show academic excellence due to social influences and more stable learning styles.

3. The Effect of Interaction between Semester and Gender on Science Learning Outcomes

The results of the study also showed that there was a significant influence of interaction between semester and gender on science learning outcomes. These findings indicate that the influence of semesters on learning outcomes is not uniform, but varies based on the gender of the students. In particular, the increase in learning outcomes from odd semesters to even semesters was greater in female students than in male students.

These findings reinforce the view that the effectiveness of learning time cannot be separated from individual characteristics of students. Variations in academic pressure, psychological readiness, and evaluation demands in each semester can interact with students' learning styles, motivation, and discipline levels based on gender (Kurniawati et al., 2025; Puspita & Sugiyanto, 2025). Therefore, semester as a learning period is an important factor in explaining temporal variations in learning outcomes (Lestari & Mahrus, 2025; Purwoka, 2025).

In addition, the results of this study are in line with the findings of Anjani et al. (2025) who affirm that gender is a significant variable in educational studies because it affects the way of learning, the speed of understanding, and students' interest in certain subjects. Thus, the interaction between semester and gender

provides a more comprehensive picture of the dynamics of science learning outcomes of elementary school students.

CONCLUSION

This study demonstrates that both semester and gender significantly affect the science learning outcomes of fifth-grade students in Jakarta. Students in even semesters achieve higher learning outcomes than those in odd semesters, indicating that learning timing plays an important role in students' academic readiness. In addition, female students outperform male students in science achievement, suggesting that differences in learning strategies, motivation, and accuracy contribute to achievement disparities. Importantly, the interaction between semester and gender is also significant, indicating that the effect of semester on learning outcomes varies by gender, and vice versa. These findings highlight the necessity of instructional approaches that simultaneously consider temporal factors and gender-based learner characteristics to improve science learning effectiveness.

Based on these findings, it is recommended that teachers adopt adaptive and gender-responsive instructional strategies, particularly during odd semesters, by emphasizing learning orientation and adjustment activities. Schools should implement regular semester-based evaluations and provide continuous professional development focused on inclusive and differentiated instruction. Parental involvement is also essential, especially in supporting students' learning adaptation at the beginning of the academic term. Future research is encouraged to expand the sample size and explore additional interacting variables, such as instructional methods, learning motivation, and parental support, to enhance the generalizability and depth of these findings.

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