

DIFFERENCES IN ELECTRONIC FUEL INJECTION (EFI) LEARNING OUTCOMES BASED ON FIELD DEPENDENT AND FIELD INDEPENDENT COGNITIVE STYLES OF GRADE X STUDENTS OF SMK PGRI 3 MALANG

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Abstract

This study aims to (1) describe the pre-test and post-test results of students with field dependent (FD) and field independent (FI) cognitive styles on Electronic Fuel Injection (EFI) material; (2) compare the post-test scores of the two groups; and (3) compare the changes in pre-test to post-test scores between groups. The individual scores of 68 grade X students of SMK PGRI 3 Malang (34 FD and 34 FI) were analyzed using descriptive statistics, paired t-test, independent t-test, and Welch's t-test. For the first objective, the mean FD increased from 58.38 (pre-test) to 74.71 (post-test), while the mean FI increased from 56.62 to 76.91. The mean increase for each group was 16.32 points on FD and 20.29 points on FI; both were statistically significant ($p < 0.001$). For the second objective, the FI post-test mean was 2.21 points higher than the FD, but the difference was not significant, $t(66) = -0.75$, $p = 0.455$, 95% CI [-8.06; 3.65]. For the third objective, the FI mean increase was numerically 3.97 points greater than the FD, but the difference in increase between groups was also not significant, $t(62.16) = -0.75$, $p = 0.458$, 95% CI [-14.59; 6.65]. Descriptively, the FI showed higher final results and mean increase.

Keywords: *Electronic Fuel Injection; Cognitive Style; Field Dependent; Field Independent; Learning Outcomes.*

A. INTRODUCTION

Vocational education is aimed at preparing students with the knowledge and skills relevant to their field of work. In automotive expertise programs, learning requires not only conceptual mastery but also the ability to understand the relationships between components and apply technical procedures correctly. Electronic Fuel Injection (EFI) is one topic that requires systematic understanding, as it covers the air system, fuel system, electronic system, injection system types, and component functions. Difficulty understanding these concepts can impact students' readiness to participate in practical learning and complete diagnostic tasks.

Learning outcomes are one indicator of the achievement of learning objectives. These outcomes are formed through the interaction of various factors, including student characteristics, the learning environment, prior experiences, teaching strategies, and the nature of the material. Educational literature cited in the sources suggests that both internal and external factors are related to the learning process (Parni, 2017; Samsudin, 2020). Therefore, differences in learning outcomes should not be directly explained by a single factor without considering the research design and evidence.

One of the individual characteristics discussed in educational research is field-dependent and field-independent cognitive styles. Cognitive style refers to an individual's tendency to organize and process information. Field-dependent learners tend to pay more

attention to context and environmental cues, while field-independent learners tend to more easily separate pieces of information from the overall context and analyze them independently. These characteristics should not be understood as fixed ability labels or as a basis for limiting student learning opportunities, but as possible variations in information processing that need to be examined contextually.

Previous studies listed in the source discuss the relationship between cognitive style and problem-solving and learning outcomes in mathematics and other academic fields. Mailili (2018), Sundari, Alghadari, and Arifannisa (2020), and Azahra and Subekti (2024) identify cognitive style as a relevant aspect for understanding variations in student performance. Giancola, D'Amico, and Palmiero (2023) also discuss the role of field-dependent/field-independent cognitive styles in relation to working memory and divergent thinking. However, findings from other contexts do not necessarily apply to EFI learning in vocational high schools.

In vocational learning, demonstrations can help students observe the sequence of procedures and the relationship between concepts and real objects or systems. Lectures can be used to deliver structured explanations, but their success depends on the quality of the explanation, student activity, supporting media, and the characteristics of the material. This study associates the FD group with demonstration learning and the FI group with lecture learning. However, because the source reports are not clear enough in separating the placement of cognitive style and learning method, the resulting comparison cannot definitively indicate whether differences in results stem from cognitive style, method, or a combination of the two.

This issue is important to examine, prioritizing measurement and analysis accuracy. Pre-test scores reflect initial abilities, while post-test scores reflect achievement after a series of learning sessions. Comparisons of final scores between two groups should consider initial equivalence, while changes within the same group can be analyzed through the difference between pre-test and post-test scores. If individual data is available, testing can be conducted transparently, and results can be compared with reported summary statistics.

This study aims to (1) describe the pre-test and post-test results of students with FD and FI cognitive styles on EFI material; (2) compare the post-test scores of the two groups; and (3) compare the changes in pre-test to post-test scores between groups. This focus maintains the core problem of the source research, while using the individual data listed to examine the inferential results. The contribution of this article lies in reporting results that can be traced back to the source scores and interpretations that take into account the limitations of the design.

B. LITERATURE REVIEW

1. Field dependent and Field Independent Cognitive Styles

Cognitive style describes relatively stable tendencies in receiving, organizing, and processing information. In the field dependence–independence approach, the primary distinction relates to the extent to which individuals are influenced by the context surrounding information and the extent to which they can isolate specific elements from a complex background. FD learners tend to utilize external context, cues, and support; FI learners tend to use more focused and independent analysis. These differences represent tendencies, not grade categories or measures of intelligence.

Previous research cited in the sources indicates that cognitive styles have been studied in mathematical problem solving, concept mastery, and divergent thinking (Asdar, 2015; Mailili, 2018; Nugraha & Awalliyah, 2016; Giancola et al., 2023). Azahra and Subekti (2024) examined mathematical problem-solving ability based on cognitive styles. This literature supports the relevance of questions about cognitive variation, but it is insufficient to establish that one style is always superior across all materials or methods.

2. Learning Outcomes on EFI Material

The learning outcomes in this study were operationalized through a written test on EFI competency. The source grid included the differences between conventional/carburetor and injection gasoline fuel systems, EFI types, air systems, fuel systems, electronic systems, and the functions of EFI components. These six aspects indicate that mastery of the material involves conceptual knowledge of the system and component functions. Test scores provide an indicator of achievement in the material tested, but do not by themselves describe the full range of practical competencies, diagnostic abilities, or work performance in the workshop.

Automotive learning can utilize a variety of strategies, including lectures and demonstrations. Lectures allow teachers to organize concepts and terms, while demonstrations provide opportunities to observe objects, work sequences, or technical processes. The choice of method should be based on learning objectives and evidence of achievement, not solely on the assumption that a particular method is appropriate for a particular cognitive type. In this study, methods and cognitive styles were reported intertwined, so interpretation of group differences should be cautious.

3. Framework of Thought and Hypothesis

The research framework positions FD and FI cognitive styles as distinguishing characteristics of the groups, EFI learning outcomes as outcomes, and demonstration and lecture methods as learning conditions mentioned in the sources. Analytically, differences in final scores and changes in scores can be compared. However, when learning methods are applied simultaneously with cognitive style categories without a factorial design or adequate controls, the contribution of each factor cannot be identified separately.

Final score comparison hypothesis: H₀ states that there is no difference in the mean post-test scores between the FD and FI groups; H_a states that there is a difference in the mean post-test scores between the two groups. Additional analysis of score changes tested whether the mean increase in the FD group was different from the mean increase in the FI group.

C. METHOD

The source stated that the study used a quasi-experimental approach with a Nonequivalent Control Group Design. The study was conducted at SMK PGRI 3 Malang on 10th grade students, with data collection reportedly starting on February 20, 2025, and lasting approximately two weeks. The source identified two classes, namely 1 JEC and 1 DEC, each with 34 students. In each class, there were 17 students classified as FD and 17 as FI, so the total data listed was 68 students: 34 FD and 34 FI.

Table 1. Composition Of Participants Based on Class and Cognitive Style

Class	Number of students	FD	FI
1 JEC	34	17	17
1 DEC	34	17	17
Total	68	34	34

The outcome variable was the written test score for the EFI material. Cognitive style grouping was conducted using the Group Embedded Figures Test (GEFT), as mentioned in the source data collection section. The source also describes the use of the demonstration method in the FD group and the lecture method in the FI group. Because details of implementation per class, the order of treatment, the duration of each method, and the way students were placed were not fully and consistently reported, this article does not add procedural details that were not available.

The procedures identifiable from the sources include initial measurements (pre-test), learning on EFI material, and final measurements (post-test). The test covers six competency indicators: (1) differences between carburetor and EFI systems; (2) EFI types; (3) air systems;

(4) fuel systems; (5) electronic systems; and (6) EFI component functions. Individual pre-test and post-test scores are available in two source data tables and form the basis for statistical recalculations in this article.

The learning outcome instrument is a written test on the EFI. The source lists a grid of 20 items across six indicators, but information on the final number of items analyzed, a detailed scoring rubric, evidence of validity, and reliability of the instrument is not adequately reported in the auditable results section. Therefore, the article maintains the listed scores without making any new claims regarding the instrument's psychometric quality.

Data were analyzed from individual scores listed in the data tables for grades 1 JEC and 1 DEC. Each pre-test score was matched with the post-test score for the same student in the source table. Student names are not reproduced in the article; the analysis uses group numerical values. Recalculations were performed to obtain descriptive statistics, paired t-tests within each group, independent t-tests on the pre-test and post-test, and comparisons of score changes between groups.

Descriptive statistics include the number of participants, mean, standard deviation, minimum, and maximum values. The mean is calculated using the following equation.

$$\bar{X} = \frac{\sum_{i=1}^n X_i}{n}$$

Figure 1. Average score formula

The sample standard deviation is calculated to describe the variation in scores around the mean.

$$s = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}}$$

Figure 2. Sample standard deviation formula

To assess changes in scores for the same participant, the individual difference $D_i = X_{\text{post},i} - X_{\text{pre},i}$ is calculated, and then a paired t-test is performed. The test statistic is determined by the mean of the difference, the standard deviation of the difference, and the number of complete pairs.

$$t = \frac{\bar{D}}{s_D / \sqrt{n}}, \quad D_i = X_{\text{post},i} - X_{\text{pre},i}$$

Figure 3. Paired t-test formula

The 95% confidence interval for the mean difference is calculated as the mean difference plus or minus the critical value of the t-distribution multiplied by the standard error. The effect size of the change in the group is calculated using d_z , which is the mean difference divided by the standard deviation of the difference.

$$IK_{95\%} = \bar{D} \pm t_{0.975, n-1} \frac{s_D}{\sqrt{n}}$$

Figure 4. 95% confidence interval formula for the mean difference.

$$d_z = \frac{\bar{D}}{s_D}$$

Figure 5. Pairwise effect size formula d_z

To compare the means of two independent groups, an independent t-test was used, assuming equal variances, as in the approach used in the source. The t-test on post-test scores examines differences in final scores, while the t-test on pre-test scores provides an overview of differences in baseline conditions. Comparisons of score changes between groups were performed using a Welch t-test on difference scores because the standard deviations of the changes between the two groups differed. All tests used a significance level of 0.05. P-values

are interpreted as statistical evidence within the framework of the test model, not as effect sizes or causal evidence.

$$t = \frac{\bar{X}_{FD} - \bar{X}_{FI}}{s_p \sqrt{1/n_{FD} + 1/n_{FI}}}$$

Figure 6. Independent t-test formula assuming equal variances.

D. RESULT AND DISCUSSION

Based on the individual scores listed in the source table, each group consisted of 34 students. The FD group obtained a pre-test mean of 58.38 and a post-test mean of 74.71. The FI group obtained a pre-test mean of 56.62 and a post-test mean of 76.91. Thus, the FI post-test mean was slightly higher than the FD, while an increase in the mean from pre-test to post-test was seen in both groups.

Table 2. Descriptive Statistics of Pre-Test and Post-Test Scores Based on Cognitive Style

Group	Measurement	n	Average	SD	Min.	Max.
Field dependent	Pre-test	34	58.38	16.91	25	95
Field dependent	Post-test	34	74.71	13.42	50	100
Field independent	Pre-test	34	56.62	16.50	15	90
Field independent	Post-test	34	76.91	10.59	55	100

A change in the mean doesn't necessarily mean every student improved. In the FD group, individual scores decreased, so the group mean doesn't reflect the overall pattern. Therefore, change needs to be analyzed using paired scores, not simply by comparing two means separately.

Table 3. Changes in Paired Scores in Each Group

Group	n	Δ average	IK 95%	t statistics	p	d _z
Field dependent	34	16.32	7.78 to 24.86	t(33) = 3.89	0.00046	0.67
Field independent	34	20.29	13.67 to 26.92	t(33) = 6.23	4.88e-07	1.07

Paired t-tests calculated from individual scores showed mean increases in both groups. For FD, the mean increase was 16.32 points, 95% CI [7.78; 24.86], t(33) = 3.89, p < 0.001, d_z = 0.67. For FI, the mean increase was 20.29 points, 95% CI [13.67; 26.92], t(33) = 6.23, p < 0.001, d_z = 1.07. These results indicate that post-learning scores were higher than initial scores in each group. However, within-group tests do not in themselves prove that a particular learning method is superior to another.

Table 4. Independent T-Test on Pre-Test and Post-Test Scores

Measurement	Contrast	Average Difference	Test Statistics	p	IK 95% Difference
Pre-test	FD – FI	1.76	t(66) = 0.44	0.665	-6.33 to 9.85
Post-test	FD – FI	-2.21	t(66) = -0.75	0.455	-8.06 to 3.65

At pre-test, the mean difference in FD–FI was 1.76 points and was not significant, t(66) = 0.44, p = 0.665. The 95% confidence interval for the mean difference includes zero. At post-test, the mean difference in FD–FI was -2.21 points, meaning the mean FI was approximately 2.21 points higher; this difference was not statistically significant, t(66) = -0.75, p = 0.455, 95% CI [-8.06; 3.65]. Therefore, the available individual data do not provide statistical evidence that mean post-test scores differed between the FD and FI groups.

Table 5. Comparison of score increases between groups

Contrast of Change	Difference in Increase in FD–FI	Test Statistics	p	IK 95%
Post-test score minus pre-test	-3.97	t(62.16) = -0.75	0.458	-14.59 to 6.65

The difference in mean increase in FD–FI was -3.97 points, meaning the mean increase in FI was numerically greater. However, this difference in increase was not significant, $t(62.16) = -0.75$, $p = 0.458$, 95% CI $[-14.59; 6.65]$. Because the confidence interval includes zero and the p -value is greater than 0.05, these data do not support the conclusion that the change in learning outcomes was statistically different between the two groups.

The main finding of this study indicates that the field independent (FI) group obtained a higher post-test mean than the field dependent (FD) group, namely 76.91 compared to 74.71. This difference of 2.21 points is not statistically significant, $t(66) = -0.75$, $p = 0.455$, 95% CI $[-8.06; 3.65]$. Therefore, the results only support the descriptive conclusion that the final score of the FI is higher, not that the FI is statistically proven superior. The confidence interval that includes zero indicates that the estimate of the difference is still imprecise and the data do not rule out the possibility that the population difference is small or in the opposite direction. Interpretation of the results should consider the effect estimate, confidence interval, study context, and p -value together, rather than using the significance threshold as the sole basis for decisions (Wasserstein & Lazar, 2016).

For the first objective, both groups experienced mean increases from pre-test to post-test. The FD group increased by 16.32 points, while the FI group increased by 20.29 points; paired t -tests indicated that each increase was statistically different from zero (both $p < 0.001$). However, paired t -tests address whether scores within each group changed, not whether the FI group's change was greater than that of the FD group. Therefore, significant results in both groups cannot be used alone to assert superiority over one group or method. Furthermore, without adequate comparison groups and clear documentation of treatment implementation, score increases cannot be fully attributed to one instructional method. Quasi-experimental designs require caution regarding baseline differences, class grouping, and alternative explanations for changes in outcomes (Kim & Steiner, 2016).

For the third objective, the mean gain for FI was 3.97 points greater than for FD, but a direct test of the difference in change was not significant, $t(62.16) = -0.75$, $p = 0.458$, 95% CI $[-14.59; 6.65]$. This result is important because comparing gains between groups directly tests whether the changes in scores differ. Therefore, the available data do not provide sufficient evidence that the gains in FI learning outcomes were statistically greater than those for FD. The wide confidence intervals also indicate uncertainty about the magnitude of the possible differences. Future research should report estimates of differences along with appropriate confidence intervals and effect sizes to allow readers to assess the direction, magnitude, and precision of the findings (Lakens, 2013; Wasserstein & Lazar, 2016).

This pattern of results can be compared with the study by Ubuza and Aydinierb (2019), which examined project-based geometry learning in students with different cognitive styles. That study found a significant effect of time on achievement, but no significant main effect of cognitive style after controlling for related factors. This similarity in patterns suggests that improvements during learning are not always accompanied by significant differences between cognitive style categories. However, that study took place on different geometry materials and in different school contexts, and therefore cannot be treated as direct evidence of EFI competence. These findings are more appropriate to support caution in interpreting cognitive style as the sole determinant of learning outcomes.

Xie et al.'s (2025) meta-analysis, compiling 42 studies, reported a positive relationship between the field dependence–independence cognitive style and academic achievement, but also found that the strength of the relationship varied by measurement instrument, subject area, and type of academic achievement. The EFI study's findings do not necessarily contradict that meta-analysis. Meta-analyses estimate average patterns across studies, whereas this study compared two groups in a single learning context and used specific test scores. Furthermore, the meta-analysis primarily included elementary and junior high school students;

generalizations to vocational high school students and automotive technical competencies should be made with caution. Afifah and Nafi'an's (2019) systematic review of statistical problem understanding based on cognitive style also emphasized that differences in comprehension processes need to be examined in specific tasks and contexts, rather than assumed to apply uniformly to all fields.

From a vocational education perspective, these results do not support rigidly classifying students or assigning learning methods solely based on FD/FI labels. EFI material encompasses mastery of component terms and functions, understanding the relationships between sensors and actuators, and applying knowledge to examination and diagnostic procedures. Learning needs may vary depending on the task at hand; therefore, verbal explanations, system diagrams, demonstrations, structured exercises, and problem-solving can be combined based on competency objectives and formative assessment evidence. These recommendations represent plausible pedagogical implications, not effects directly tested by this study's data. To conclude that a method is more appropriate for FD or FI students, research would need to examine the interaction between cognitive style and method with both student categories represented in each learning condition.

The most significant limitation is the unclear relationship between class, cognitive style, and learning method in the source report. The source mentions two classes with equal numbers of participants and associates FD with demonstration and FI with lecture, but the allocation and implementation details are insufficient to determine whether the methods were applied to class, cognitive style category, or a combination of both. If these factors are intertwined, their respective effects cannot be isolated. Further research should assign FD and FI students to each method condition, document equivalence in initial ability and learning implementation, and use analyses appropriate to the data structure. These considerations align with the principles of quasi-experimental evaluation, which require accounting for potential selection bias and confounding factors before drawing causal conclusions (Kim & Steiner, 2016).

The quality of inferences is also limited by incomplete instrument information. The report mentions the Group Embedded Figures Test (GEFT) and the EFI learning outcome test, but fails to adequately describe the FD/FI classification thresholds, the distribution of GEFT scores, the number of final items, the scoring procedure, and evidence of the validity and reliability of the EFI test in the sample. This lack of information does not necessarily invalidate the instrument, but it does reduce the reader's ability to evaluate measurement accuracy and replicate the study. Future studies should report the administration and classification procedures of the GEFT, the measurement quality of the EFI test, the duration and content of each learning condition, and the anonymized data and analysis syntax. Transparent reporting would strengthen the interpretation of the results and facilitate comparison with previous research.

Overall, the results of the study answered all three objectives by showing that scores increased in both groups, with FI having a higher post-test mean and a higher mean increase descriptively, but neither the post-test difference ($p = 0.455$) nor the difference in score increase ($p = 0.458$) were significant. Therefore, there is insufficient statistical evidence to state that FI is superior to FD in EFI learning outcomes. This conclusion is limited to the test scores analyzed and does not prove the equivalence of the two groups or the irrelevance of cognitive styles in other contexts. The contribution of the study lies in presenting results recalculated from individual scores and in emphasizing the need for more transparent designs to separate the relationships between cognitive styles, learning methods, and learning outcomes.

E. CONCLUSION

Based on the analysis results, both groups showed an increase in EFI learning outcomes from pre-test to post-test. The field dependent (FD) group experienced an average increase of 16.32 points, from 58.38 to 74.71, with a significant paired t-test result, $t(33) = 3.89$, $p < 0.001$. Meanwhile, the field independent (FI) group experienced an average increase of 20.29 points, from 56.62 to 76.91, which was also significant, $t(33) = 6.23$, $p < 0.001$. Descriptively, the FI group showed a greater average increase than the FD group. In the post-test score comparison, the FI group obtained an average of 76.91, 2.21 points higher than the FD group which obtained an average of 74.71. However, the difference was not statistically significant, $t(66) = -0.75$, $p = 0.455$, 95% CI $[-8.06; 3.65]$. This result indicates that the FI group had a higher final score numerically, but there is not yet sufficient statistical evidence to state that the learning outcomes of the two groups are different. In line with this, a comparison of score changes shows that the mean increase in the FI group was 3.97 points greater than the FD group. However, the difference in increase was also not statistically significant, $t(62.16) = -0.75$, $p = 0.458$, 95% CI $[-14.59; 6.65]$. Thus, based on the three research objectives, it can be concluded that both groups experienced an increase in learning outcomes, while the FI group showed higher final achievement and mean increase descriptively.

REFERENCES

- Afifah, D. S. N., & Nafi'an, M. I. (2019). Analyzing of field independent and dependent students' understanding in solving statistical problems based on ontosemiotic approach. *Journal of Physics: Conference Series*, 1321(2), 022100. <https://doi.org/10.1088/1742-6596/1321/2/022100>
- Artaya, I. P. (2018). *Metode Analisis Penelitian Kualitatif*. <https://doi.org/10.13140/RG.2.2.25160.57604>
- Asdar, S. A. A. R. (2015). Students' mathematical problem-solving profiles reviewed from the cognitive style and self-efficacy of the top VIII grade students of SMPN 1 Watampone. *Mathematical Power: Journal of Mathematics Education Innovation*, 3(1), 20. <https://doi.org/10.26858/jds.v3i1.1313>
- Azahra, M., & Subekti, F. E. (2024). Mathematical problem-solving ability based on students' cognitive styles. *Proximal: Journal of Mathematics Research and Mathematics Education*, 7(1), 475-484. <https://doi.org/10.30605/proximal.v7i1.4117>
- Delucchi, M. (2019). Using a quasi-experimental design in combination with multivariate analysis to assess student learning. *Journal of the Scholarship of Teaching and Learning*, 19(2). <https://doi.org/10.14434/josotl.v19i2.24474>
- Ghozali, I. (2018). *Application of multivariate analysis with IBM SPSS 25 program (9th Edition)*. Diponegoro University.
- Giancola, M., D'Amico, S., & Palmiero, M. (2023). Working memory and divergent thinking: The moderating role of field-dependent-independent cognitive style in adolescence. *Behavioral Sciences*, 13(5). <https://doi.org/10.3390/bs13050397>
- Gulo, F., Harefa, AO, & Telaumbanua, YN (2022). Analysis of mathematics learning outcomes in terms of cognitive style based on the revised Bloom's taxonomy in students at SMK Negeri 1 Mandrehe. *Formosa Journal of Applied Sciences*, 1(5), 625–636. <https://doi.org/10.55927/fjas.v1i5.1365>
- Kim, Y., & Steiner, P. (2016). Quasi-experimental designs for causal inference. *Educational Psychologist*, 51(3–4), 395–405. <https://doi.org/10.1080/00461520.2016.1207177>
- Mailili, WH (2018). Description of mathematics learning outcomes of students with field-independent and field-dependent cognitive styles. *ANARGYA: Scientific Journal of Mathematics Education*, 1(1). <http://jurnal.umk.ac.id/index.php/anargya>

- Nugraha, M. G., & Awalliyah, S. (2016). Analysis of field-dependent and field-independent cognitive styles on the mastery of physics concepts of seventh-grade students. *Proceedings of the National Physics Seminar (E-Journal) SNF2016*, *V*, 71–76. <http://snf-unj.ac.id/kumpulan-prosiding/snf2016/>
- Parni. (2017). Internal and external factors of learning. *Tarbiya Islamica*, *5*(1), 17–30.
- Pishchik, V., Azarko, E., & Sinko, T. (2024). Study of use and perception of Internet information by young people with a field-dependent/field-independent cognitive style for decision making for sustainable development. *BIO Web of Conferences*, *84*. <https://doi.org/10.1051/bioconf/20248404030>
- Putri, A. D., Hilmi, R. S., Almaliyah, S., & Permana, S. (2023). Application of the T-test in experimental research. *Lebesgue: Scientific Journal of Mathematics Education, Mathematics and Statistics*, *4*(3), 1978–1987. <https://doi.org/10.46306/lb.v4i3>
- Samsudin, M. (2020). Factors influencing learning. *Eduprof: Islamic Education Journal*, *2*(2), 162–186. <https://doi.org/10.47453/eduprof.v2i2.38>
- Sudijono, A. (2017). *Introduction to Educational Evaluation*. Depok: Raja Grafindo Persada.
- Sugiyono. (2015). *Quantitative, qualitative, and R&D Research Methods*. Bandung: Alfabeta.
- Sundari, F., Alghadari, F., & Arifannisa. (2020). The relationship between students' cognitive styles and mathematics learning outcomes in exponents and logarithms. *Journal of STKIP Kusuma Negara*, 10–16.
- Ubuza, B., & Aydinyerb, Y. (2019). Project-based geometry learning: Knowledge and attitude of field-dependent/independent cognitive style students. *The Journal of Educational Research*, *112*(3), 285–300. <https://doi.org/10.1080/00220671.2018.1502138>
- Wasserstein, R. L., & Lazar, N. A. (2016). The ASA's statement on p-values: Context, process, and purpose. *The American Statistician*, *70*(2), 129–133. <https://doi.org/10.1080/00031305.2016.1154108>
- Xie, Q., Yang, K., Ji, R., Qian, Y., Tong, L., Chao, CNG, & Sin, KFK (2025). Cognitive Style and Students' Academic Achievement: A Meta-Analysis. *Frontiers in Education*, *10*, 1606625. <https://doi.org/10.3389/educ.2025.1634732>