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The Application of Guided Inquiry with a Deep Learning Approach in Improve Students' Cognitive Abilities on Heat Material

Devi Eliviani[1*], Muslim[1], Ridwan Efendi[1], Dhea Kamelia Fauziah[1]

[1] Department of Physics Education, Faculty of Mathematics and Natural Sciences Education (FPMIPA), Universitas Pendidikan Indonesia, Bandung, Indonesia.

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Correspondence:

Devi Eliviani

Phone:

Abstract: The teaching of physics, specifically the topic of heat, is essentially aimed at facilitating a deep understanding of concepts and enhancing pupils' higher-order cognitive skills. However, the results of a preliminary field study indicate that the learning process is still hampered by the presentation of abstract concepts, meaning that pupils tend to simply memorise formulas without meaningful understanding. This study aims to analyze students' cognitive abilities through the application of a guided inquiry learning model with a deep learning approach to the topic of heat. The research method used was a quantitative method with a between-group design, specifically a quasi-experimental research design. The specific research design employed was a pretest-posttest design with a non-equivalent control group. The research instrument used was a cognitive ability test consisting of thirteen items. Data analysis utilized the N-Gain score and the Mann-Whitney U test, which met the prerequisites of normality and homogeneity. The results showed that the N-Gain scores in the experimental class were higher than those in the control class, with values of 0.67 and 0.57, respectively. These results were supported by the Mann-Whitney U test, which yielded an Asymp. Sig. (2-tailed) value of 0.029 under the assumption of unequal variances (0.029 < 0.05). This indicates a significant difference in the improvement of students' cognitive abilities between the experimental and control classes. Therefore, the guided inquiry learning model with a deep learning approach can serve as an alternative solution for enhancing students' cognitive abilities.

Keywords: Deep Learning; Guided Inquiry; Heat; Cognitive Ability; Climate Change

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Introduction

As technology and information continue to advance, Indonesia's education system is undergoing reform with the implementation of the "Merdeka" curriculum. This initiative aims to develop 21st-century skills and produce students who can adapt to the changing times. Twenty-first-century education emphasizes student-centered, collaborative, and meaningful learning, as well as the integration of technology as a learning tool to improve the quality of education (Mardhiyah et al., 2021). In addition, students are also expected to possess high cognitive abilities as one of the competencies required to face global challenges (Mardhiyah et al., 2021).

Cognitive abilities are fundamental skills that are crucial for developing other skills, such as the four core competencies of 21st-century education: critical thinking, communication, collaboration, and creativity (Sinaga et al., 2025). These four competencies are essential for educational success, enabling students to

Email: devieliviani04@upi.edu

compete in the 21st century (Alwanda et al., 2024). Students with high cognitive abilities will find it easier to understand and solve various problems in physics. One area of physics that can help develop students' cognitive abilities is the topic of heat. This topic is closely related to daily life, so it is important to teach it to students (Cristiana et al., 2021). In physics education, higher-order thinking skills are not developed through a learning process that is limited to memorizing concepts; rather, students must be actively engaged in the learning process to have a meaningful learning experience. This aligns with research conducted by Alhebaishi et al. (2025), which found that innovative teaching methods and the integration of technology that engage students in the learning process can enhance cognitive abilities. Consequently, the education system in Indonesia must equip students with advanced cognitive skills so they are prepared to face global challenges.

However, based on field observations conducted by the researchers during the preliminary study, it was found that teachers faced difficulties in explaining the abstract and complex concept of heat. This situation was also experienced by students, who did not have a deep understanding of the material, as they merely memorized formulas without grasping the underlying concepts. This is evidenced by the low average score on the students' cognitive test on the topic of heat, which was 52 out of a total of 64 students, with the highest score being 80 and the lowest 20. The average score remains below the Minimum Proficiency Criteria (KKM) set by the school, indicating that students' cognitive abilities regarding this material are still low and have not yet reached the expected proficiency standards. Upon further analysis, the test results on the topic of heat showed that, on average, students could only answer questions at cognitive levels C1–C3 and struggled with higher-order thinking skills (HOTS) questions. As a result, only 8% of students achieved scores above the KKM, while the rest scored below the KKM.

Based on a preliminary study, the cause of these low cognitive abilities is that the learning process does not sufficiently engage students, as it focuses on the teacher delivering material (teacher-centered instruction); teachers face difficulties explaining the abstract concept of heat because they lack supporting media and experimental tools; and an approach that enables students to engage in deep learning has not yet been implemented. This situation is corroborated by previous research, which indicates that students' lack of experience in engaging in meaningful learning processes capable of fostering higher-order cognitive skills stems from teachers' failure to provide opportunities for students to actively participate (Li et al., 2023; Qoiriah & Febrianto, 2025). Consequently, students perceive the topic of heat as abstract and difficult (Sundari & Sarkity, 2021; Astiti & Yusuf, 2018). As a result, students struggle to connect physics concepts with phenomena in daily life, which in turn leads to low levels of cognitive ability.

To address these issues, an appropriate learning model is needed so that the learning process becomes meaningful and can enhance students' cognitive abilities. The guided inquiry model was chosen because it offers several advantages, one of which is its ability to encourage students to actively participate in the learning process and develop 21st-century skills such as collaboration, critical thinking, creativity, and communication. Furthermore, the guided inquiry learning model encourages students to think critically and analytically to find their own answers to the problems posed, through targeted guidance from the teacher (Sanjaya, 2016). This is consistent with research conducted by Almira et al. (2023), which found that the guided inquiry learning model provides students with opportunities for self-discovery, reflection, and investigation.

Although the guided inquiry learning model is effective in improving students' abilities, to achieve truly deep understanding, this learning model needs to be integrated with an approach that emphasizes reflective and constructive thinking processes. One suitable approach is the deep learning approach, which is a development of the Merdeka Curriculum.

According to the academic paper 'Deep Learning Towards Quality Education for All', the deep learning approach is an empowering approach that emphasises the creation of a learning process and a learning environment that are meaningful, mindful and inspiring through the integrated development of the mind, heart, emotions and physical well-being (Permendikdasmen, 2025). This is in line with research conducted by Albani (2025), which found that deep learning is an educational approach that emphasises in-depth understanding, critical thinking and complex problem-solving through the integration of 21st-century skills, thereby equipping learners with the competencies required in the digital age. It is hoped that this approach will boost learners' motivation, making them more keen to contribute to the learning process, thereby producing learners who possess critical thinking skills (Hasanah et al., 2025). Furthermore, this deep learning approach is implemented to enable learners to gain a deep understanding of the subject matter through a comprehensive learning experience, thereby fostering reflective and meaningful learning (Atmojo et al., 2025).

Thus, the implementation of the guided inquiry model can support the realisation of a deep learning approach, as both require active engagement, reflection and cognitive skills on the part of learners. Consequently, if these three elements are integrated, the learning process can be oriented towards deep conceptual understanding, in line with the demands of 21st-century education and the Merdeka Curriculum. This is in line with research conducted by Pakpahana & Suyanti (2025), which found that the integration of the guided inquiry model with the deep learning approach is capable of enhancing learners' higher-order thinking skills (HOTS). Consequently, the integration of this learning model and approach offers great potential for comprehensively enhancing learners' cognitive abilities.

However, research on the application of the guided inquiry learning model integrated with the deep learning approach remains limited and has not been extensively studied, particularly in physics topics such as heat. Therefore, this study differs in several ways from previous research. In the study conducted by Pakpahana & Suyanti (2025), the subject matter used was chemistry, specifically the topics of elements, compounds, and mixtures. Additionally, the study by An & Gao (2023) focused on the topic of ideological and political education. In contrast, this study focuses on the topic of heat, which is abstract in nature and demands a high level of cognitive understanding. Another difference lies in the methods used; this study employs a quantitative quasi-experimental design, unlike the study by Indraganti (2017), which used action research, and the study by An & Gao (2023), which employed a mixed-methods approach. A further difference lies in the sample tested: the study by Pakpahana & Suyanti (2025) targeted seventh-grade junior high school students, whereas this study targeted eleventh-grade senior high school students.

Based on the problem identification, causal analysis, and alternative solutions presented, this study aims to analyze the improvement in cognitive abilities of students learning using the guided inquiry learning model with a deep learning approach compared to students using the guided inquiry learning model alone, as well as to measure the magnitude of the impact of implementing the guided inquiry model with a deep learning approach on improving students' cognitive abilities in the topic of heat. Therefore, the implementation of a guided inquiry learning model integrated with a deep learning approach is expected to bring innovation to the design of learning strategies for complex physics topics, focusing not merely on memorizing formulas but on deep understanding, and to instill deep learning habits in students.

Method

This study employed a quantitative method using a between-groups design, specifically a quasi-experimental research design. The specific research design used was a pretest-posttest design with a non-equivalent control group. The research design used is shown in Table 1.

Tabel 1. *Desain* Non-equivalent Control Group

Group	Pretest	Treatment	Posttest
Experiment	O_1	X_1	O_2
Control	O_3	X_2	O_4

Notes:
O_1 *dan* O_2 = *Pretest and posttest for the experimental group*
O_3 *dan* O_4 = *Pretest and posttest for the control group*
$X_1 =$ Guided inquiry learning model with a deep learning approach
$X_2 =$ Guided Inquiry Learning Model

The population for this study consisted of all 11th-grade students at a public high school in Bandung, while the sample comprised 64 students, selected using purposive sampling. This technique was chosen because both classes had similar initial abilities and were taught by the same teacher. Both groups—the experimental class (N=32) and the control class (N=32)—were administered a pre-test to measure their initial cognitive abilities. They were then subjected to different treatments: the experimental class received a guided inquiry learning model with a deep learning approach, while the control class will be taught using a guided inquiry learning model. The study will conclude with a post-test to measure differences in cognitive ability improvement between the two classes.

The instruction conducted in both classes was divided into five sessions: one pretest session, three sessions dedicated to the learning process, and a final session in which students took a posttest. During each learning session—in both the experimental and control classes—students engaged in laboratory activities designed based on the Learning Objectives (LO) for each session. These practical activities were carried out using laboratory equipment provided by the school to help students discover physics concepts on their own and directly observe the phenomena of temperature, heat, and heat transfer.

Data collection in this study involved testing students' cognitive abilities. The instrument used to assess these cognitive abilities consisted of 13 multiple-choice questions developed in accordance with the learning objectives and based on indicators in Bloom's cognitive domain. Before use, the test instrument underwent expert validation and limited pilot testing to measure its validity, reliability, discriminative power, and item difficulty using Microsoft Excel and Winstep, until it was proven suitable for use as a measure of cognitive ability.

The data analysis techniques used in this study involved descriptive and inferential statistical analysis. The improvement in students' cognitive abilities was calculated descriptively using the Normalized Gain (N-Gain) formula, which refers to Hake's criteria, to determine the improvement categories for both classes. Subsequently, a normality test using the Shapiro-Wilk test was conducted as a prerequisite because the sample size in each class was relatively small (N < 50), and a homogeneity test using Levene's Test was performed on the obtained data scores. Based on the results of the preliminary tests, the posttest data for both classes were not normally distributed; therefore, a nonparametric statistical test the Mann-Whitney U test at a significance level of 0.05 was used to compare cognitive abilities between classes.

Result and Discussion

The findings of this study include the results of the analysis of prerequisite tests—specifically, tests of normality and homogeneity—hypothesis testing, and N-Gain analysis. After the intervention, there was an improvement in the cognitive abilities of the students in both research classes: the experimental class and the control class. In the experimental class, the guided inquiry learning model was implemented using a deep learning approach. In the control class, instruction was conducted using only the guided inquiry model.

In this study, data on students' cognitive abilities were obtained from the results of pretest and posttest multiple-choice questions, consisting of 13 items. To determine the quantitative improvement in students' cognitive abilities, an N-Gain score analysis was used, calculated based on the difference between the pretest and posttest scores for each individual student. The purpose of this analysis was to determine the extent of the change in students' cognitive abilities following the intervention. The results of the calculations for the average N-Gain scores for students' cognitive abilities are presented in Table 2.

Table 2. Average N-Gain Scores for Cognitive Abilities

Group	Pre-test Mean	Post-test Mean	Mean N-Gain	N-Gain Criteria
Experiment	46,50	82,65	0,67	Medium
Control	45,34	76,75	0,57	Medium

Based on the data presented in Table 2, the average N-Gain score for the experimental class was 0.67. This means that the improvement in student learning outcomes in the experimental class after being taught using the guided inquiry learning model with a deep learning approach is categorized as "moderate" according to Hake (1998). The average N-Gain in the control class was 0.57, meaning that the improvement in student learning outcomes in the control class after being taught using the guided inquiry learning model is categorized as "moderate" according to Hake (1998). In general, both the experimental and control classes showed an improvement in cognitive abilities, with average N-Gain scores falling into the moderate category. Nevertheless, it can be concluded that the improvement in students' cognitive abilities in the experimental class—after being exposed to the guided inquiry learning model with a deep learning approach—yielded higher results compared to the control class, which was only exposed to the guided inquiry learning model.

After conducting the analysis and calculating the average N-Gain scores for the experimental and control classes, the N-Gain analysis was then continued by examining each cognitive aspect. The cognitive skills taught to the students were based on Bloom's revised taxonomy (Anderson & Krathwohl, 2010), specifically C2 (understanding), C3 (applying), C4 (analyzing), and C5 (evaluating). The improvement in each cognitive aspect of the students regarding the topic of heat can be seen in Figure 1.

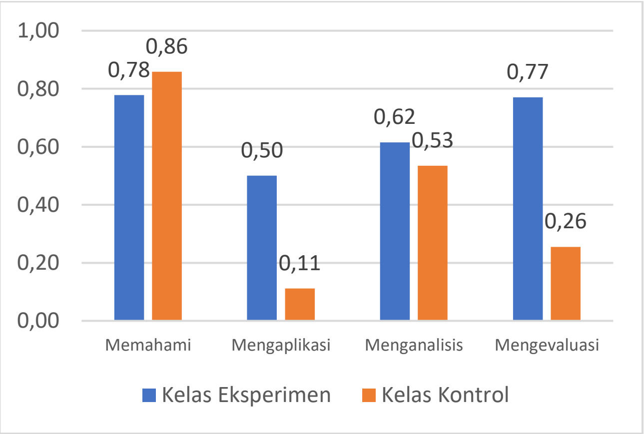

Figure 1. Average N-Gain Diagram for Each Aspect of Cognitive Ability

Based on the diagram in Figure 1, the average N-Gain scores in the experimental class for cognitive aspects C2 and C5 showed a significant increase, falling into the "high" category according to Hake (1998), compared to aspects C3 and C4, which showed an increase in the "moderate" category. Meanwhile, the control class obtained varying average N-Gain scores; for the cognitive aspect C2, there was a highly significant increase falling into the "high" category according to Hake (1998), compared to aspect C4, which showed an increase in the "moderate" category, and aspects C3 and C5, which fell into the "low" category.

The increase in N-Gain for each aspect yielded different values. In the experimental class, the "understanding" aspect achieved an N-Gain score of 0.78, which falls into the high category. The "application" and "analysis" aspects fell into the moderate category, with average N-Gain scores of 0.50 and 0.62, respectively. Meanwhile, the "evaluation" aspect achieved a score of 0.77, which falls into the high category. Meanwhile, in the control class, the "understanding" aspect achieved an N-Gain score of 0.86, which falls into the high category; the "analysis" aspect achieved a score of 0.53, which falls into the moderate category; while the "application" and "evaluation" aspects fell into the low category with average N-Gain scores of 0.11 and 0.26, respectively. Nevertheless, the average N-Gain score for all cognitive aspects fell into the moderate category, at 0.67 for the experimental class and 0.57 for the control class. Therefore, it can be concluded that all cognitive aspects improved following the implementation of the guided inquiry model using a deep learning approach.

Next, the research data were analyzed using hypothesis testing to determine differences in the improvement of cognitive abilities between the experimental and control classes after implementing the guided inquiry learning model on the topic of heat. Before conducting hypothesis testing, the research data had to meet the prerequisites of normality and homogeneity. The results of the normality test for the experimental class are shown in Table 3.

Tabel 3. Normality Test Results

Group	Test	Shapiro-Wilk (Sig.)	Notes
Control	*Pretest*	0,193	Normally Distributed
	Posttest	0,002	Not Normally Distributed
Experiment	*Pretest*	0,607	Normally Distributed
	Posttest	0,001	Not Normally Distributed

Based on Table 3, the significance value (Sig.) of the Shapiro-Wilk normality test for the control class's pretest results was 0.193, which was deemed to be normally distributed because the value was greater than 0.05; meanwhile, the significance value for the posttest results was 0.002, which was deemed not to be normally distributed because the value was less than 0.05. Meanwhile, in the experimental class, the significance value for the pretest results was 0.607, indicating a normal distribution, and the posttest results yielded a value of less than 0.001, meaning these posttest results were deemed not normally distributed. Based on the posttest results obtained for both classes, which were determined to be non-normally distributed, it can be concluded that the data do not meet the assumption of normality. Therefore, the subsequent hypothesis testing was conducted using a non-parametric test—specifically, the Mann-Whitney U test—to determine whether there is a significant difference between the experimental and control classes (two independent/unrelated samples) as a substitute for the Independent Samples T -test to compare the final results of the two classes.

Next, a homogeneity of variance test was conducted to determine whether the data from the experimental and control groups had homogeneous variances. This analysis used Levene's test. Data processing for this homogeneity of variance test was performed using IBM SPSS Statistics on the pretest and posttest data regarding cognitive ability in the experimental and control groups, as presented in Table 4.

Table 4. Results of the Homogeneity Test for Cognitive Ability

Variabel	*Levene Statistic*	Sig.	Note
Cognitive Learning Outcomes	0,001	0,975	Homogen

Based on Table 4, the Levene's statistic for the mean was 0.01, with a p-value of 0.975. Given that the p-value is far greater than 0.05, it can be concluded that the variance in the cognitive ability data of students in the experimental and control classes is equal, or homogeneous. This homogeneity of variance reinforces the validity of the conclusion that the observed improvement is not solely due to differences in initial ability but is also attributable to the intervention of the learning activities themselves. Therefore, the guided inquiry model with a deep learning approach can have a positive and equitable impact on students' cognitive abilities.

Based on the results of the prerequisite tests—namely, the normality and homogeneity tests—it was found that the posttest data on students' cognitive abilities were not normally distributed. Therefore, the subsequent analysis will use a nonparametric statistical test, specifically the Mann-Whitney U test. The hypotheses tested are: = there is no significant difference in cognitive ability between the experimental and control classes, and = there is a significant difference in cognitive ability between the experimental and control classes. Data analysis for the Mann-Whitney U test was conducted using IBM SPSS Statistics on the pretest and Posttest data for cognitive ability in the experimental and control classes, as presented in Table 5.

Table 5. Results of the Mann-Whitney U Test of Students' Cognitive Abilities

Kelas	Mean Rank	Mann-Whitney U	Z	Asymp. Sig. (2-tailed)
Control	27,55	353,500	-2,178	0,029
Experiment	37,45			

Based on Table 5, the test results show that the mean rank in the experimental class was 37.45, which was significantly higher than the mean rank in the control class of 27.55. Furthermore, the Asym.Sig. (2-tailed) value obtained was 0.029. This means that the significance value is smaller than the specified significance level; therefore, the null hypothesis of the statistical test is rejected and the alternative hypothesis is accepted. This indicates that there is a significant difference in the improvement of students' cognitive abilities between the experimental and control classes. Therefore, it can be concluded that the implementation of the guided inquiry learning model with a deep learning approach in the experimental class resulted in superior cognitive abilities among students compared to the implementation of the guided inquiry model in the control class.

Conclusion

Based on the results obtained during the research process, it can be concluded that students' cognitive abilities regarding heat-related material improved in both the experimental and control classes after the guided inquiry learning model was implemented. However, the experimental class showed a greater improvement in cognitive abilities compared to the control class because the experimental class integrated a deep learning approach into the guided inquiry learning model. This is evidenced by the N-Gain score in the experimental class of 0.67, compared to 0.57 in the control class. These results are supported by the Mann-Whitney U test, which showed an Asymp. Sig. (2-tailed) value of 0.029, indicating a significant difference in cognitive abilities between the experimental and control classes. Therefore, the guided inquiry learning model using a deep learning approach can serve as an alternative solution to enhance students' cognitive abilities. These findings align with research conducted by Pakpahana & Suyanti (2025), which states that integrating the guided inquiry model with a deep learning approach can enhance students' higher-order thinking skills (HOTS).

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References

Albani, A. F. (2025). Relevansi Kurikulum Deep Learning dalam Konteks Pendidikan Indonesia. Jurnal Sosialita, 20(1), 115–121.

Alhebaishi, S., Stone, R., & Ameen, M. (2025). Emotional Engagement and Teaching Innovations for Deep Learning and Retention in Education: A Literature Review. International Journal of Advanced Computer Science and Applications, 16(3), 35–45. https://doi.org/10.14569/IJACSA.2025.0160304

Almira, A., Rachmawati, A., Jelita, I. N., & Nurlaili, Y. (2023). Evaluasi Penerapan Model Pembelajaran Inkuiri Terbimbing dalam Pembelajaran Kimia: suatu Tinjauan Sistematis Literatur. arXiv preprint arXiv:2312.10090.

Alwanda, R. I., Alviasyah, E. N., Lailatul, S. F., & Jariyah, I. A. (2024). Urgensi keterampilan abad 21 pada pembelajaran IPA di SMP dalam menyongsong era society 5.0. Science Education and Development Journal, 2(2), 44–50.

An, B., & Gao, L. (2023). Retracted: Construction of an Inquiry-Based Teaching Model for Ideological and Political Education in Colleges and Universities from the Perspective of Deep Learning. Mobile Information Systems, 2022. https://doi.org/10.1155/2022/9286979

Anderson, L. W., & Krathwohl, D. R. (2010). Kerangka Landasan untuk Pembelajaran, Pengajaran dan Asesmen; Revisi Taksonomi Pendidikan Bloom (Terjemahan Agung Prihantoro (ed.)). Pustaka Pelajar.

Astiti, K. A., & Yusuf, Y. H. M. (2018). Pengaruh penggunaan bahan ajar berbasis kontekstual terhadap peningkatan pemahaman konsep fisika siswa materi suhu dan kalor. Jurnal Fisika: Fisika Sains Dan Aplikasinya, 3(2), 185–192.

Atmojo, I. R. W., Muzzazinah, M., Ekawati, E. Y., Triastuti, R., Isnantyo, F. D., Sukarno, S., & Ramadian, R. K. (2025). Pelatihan Implementasi Pendekatan Pembelajaran Deep Learning untuk Meningkatkan Kompetensi Pedagogik Guru SD di Kota Surakarta. Jurnal Pengabdian UNDIKMA, 6(1), 123. https://doi.org/10.33394/jpu.v6i1.14507

Cristiana, D. I., Anjarini, T., & Purwoko, R. Y. (2021). Pengembangan modul pembelajaran IPA berbasis kontekstual materi suhu dan kalor di sekolah dasar. SITTAH: Journal of Primary Education, 2(2), 145–160.

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. American journal of Physics, 66(1), 64–74. https://doi.org/10.1119/1.18809

Hasanah, U., Prastiwi, R., Arya, L., & Yulian, D. (2025). International Journal of Educational Implementation of Deep Learning Approach in Indonesian Education. International Journal of Educational Technology and Society, 2(2), 0–4. https://doi.org/10.61132/ijets.v2i2.358

Indraganti, M. (2017). Enquiry-based learning workshop for deep learning in Middle Eastern classrooms – an action research approach. Educational Action Research, 0792(October), 1–23. https://doi.org/10.1080/09650792.2017.1379423

Mardhiyah, R. H., Aldriani, S. N. F., Chitta, F., & Zulfikar, M. R. (2021). Pentingnya Keterampilan Belajar di Abad 21 sebagai Tuntutan dalam Pengembangan Sumber Daya Manusia. Lectura: Jurnal Pendidikan, 12(1), 29–40.

Pakpahana, F., & Suyanti, R. D. (2025). The Effect of Guided Inquiry Model with Deep LearningApproach on Student ' s HOTS in Elements , Compounds , and Mixtures at Junior High School. Jurnal Pendidikan Sains, 13(3), 210–217. https://doi.org/10.17977/jps.v13i32025p210

Permendikdasmen. (2025). Peraturan Menteri Pendidikan Dasar dan Menengah Republik Indonesia Nomor 13 Tahun 2025.

Qoiriah, V. F., & Febrianto, A. R. (2025). Investigating the Implementation of Student-Centered Learning in an EFL Class at an Indonesian Private School. EDUJ : English Education Journal, 3(1), 38–50.

Sanjaya, W. (2016). Strategi Pembelajaran Berorientasi Standar Proses Pendidikan. Kencana Prenadamedia Group.

Sinaga, S. J., Situmorang, C. P. Y., Manurung, R. L., Angelica, E., & Tambunan, J. T. (2025). Penguatan Kompetensi 4c Untuk Mewujudkan Keberhasilan Afektif, Kognitif, dan Psikomotorik Siswa SMA Negeri 1 Galang. SAMBARA: Jurnal Pengabdian Kepada Masyarakat, 3(3), 483–495. https://doi.org/10.58540/sambarapkm.v3i3.929