Science Learning Based on the Guided Inquiry Model: An Effort to Improve the Science Concept Understanding of Students

Armi larasati[1], Lud Waluyo[1], Beti Istanti Suwandayani[1*]

[1] Master Pedagogy Study Program, Universitas Muhammadiyah Malang, Malang, Indonesia

Abstract: This study aims to analyse the effect of the guided inquiry learning model on the understanding of science concepts among seventh-grade students regarding motion and force material according to the Merdeka Curriculum. The research used a quasi-experimental method with a non-equivalent control group pretest-posttest design. The sample consisted of 56 seventh-grade students from SMPN 2 Narmada, selected using cluster random sampling technique, with class VII A serving as the control group and VII B as the experimental group. The research results show that the average post-test score of the experimental class (70.54) is higher than that of the control class (51.43), and there is a significant difference based on the independent t-test ($p < 0.05$) using the IBM SPSS 23 application. The improvement in students' conceptual understanding is indicated by an N-Gain value of 0.5078, which falls into the moderate category. This confirms that the guided inquiry learning model has a positive effect on students' understanding of science concepts.

Keywords: Conceptual Understanding, Guided Inquiry Learning Model, Motion and Force

Introduction

Education is about shaping quality human beings with noble character who are able to adapt to the times (Suraji & Sastrodiharjo, 2021). In the 21st century, education graduates are expected to have a broad perspective and the ability to keep up with the rapidly developing science and technology (Hakim & Darojat, 2023; Budiyono & Haerullah, 2024). This development demands a learning process that involves active interaction between students, teachers, and various learning resources. An active and supportive learning environment will help students form attitudes, expand their knowledge, and develop skills (Izzatika et al., 2023).

Science subjects play an important role in helping students understand various natural and life phenomena. IPA encompasses three main aspects: as a product in the form of a collection of scientific knowledge, as a process that emphasizes scientific methods of working through observation and investigation, and as an attitude that fosters motivation and curiosity in learning (Sakdiah et al., 2018; Ozkan & Dökme, 2024). Therefore, learning strategies that actively involve students in constructing knowledge are essential for deepening their understanding of science concepts. This research aims to examine the impact of implementing learning models as a form of innovation in science education.

Low student learning outcomes are often related to a weak understanding of the concepts. Conceptual understanding is an important foundation that students must master for meaningful learning to take place (Reswara et al., 2024). Concepts not only serve as theory but also help students explain and predict various scientific phenomena (Pahru et al., 2023). However, science learning that is still dominated by conventional and teacher-centered models, and overemphasizes calculation aspects, often makes learning less contextual

and unrelated to students' real-life experiences (Dewi & Wulandari, 2021).

Based on the results of observations and analysis of learning outcomes at SMPN 2 Narmada, students' understanding of science concepts is still considered low. This condition highlights the need for learning innovation through the application of appropriate strategies and models so that science is not seen as a difficult subject. Additionally, the learning model implemented must align with the Merdeka Curriculum, which emphasizes student activity in the learning process. One learning model considered relevant to these characteristics is the guided inquiry learning model.

The guided inquiry learning model allows students to conduct structured experiments, collect data, and draw conclusions based on their own observations (Ngilmaya et al., 2021; Sutarningsih, 2022). In this model, the teacher acts as a facilitator who guides the exploration process to keep students focused, active, and responsible for their learning activities (Mustika et al., 2021; Roslina, 2023). The application of the guided inquiry model has proven effective in improving science process skills, problem-solving abilities, and scientific communication through direct concept discovery activities (Faizin et al., 2024; Novitasari & Budijastuti, 2020).

This research aims to determine the effect of implementing the guided inquiry learning model on science subjects at the junior high school level, specifically on the motion and force material, referring to the Merdeka Curriculum. By implementing this model, students not only receive concepts theoretically but also actively participate in the experimental process using scientific steps. This constructivist and contextual learning approach encourages students to explore knowledge independently (Angraini et al., 2024; Arega & Hunde, 2025).

Numerous studies have demonstrated the effectiveness of the guided inquiry learning model in enhancing science process skills and conceptual understanding. However, research specifically integrating this model with the demands of the merdeka curiculum on *motion and force* material at the junior high school level is still limited. Therefore, the novelty of this research lies in the empirical testing of the guided inquiry learning model adapted to the principles of the Merdeka curiculum to improve students' understanding of science concepts, specifically at SMPN 2 Narmada. This research is expected to provide a solution to conventional learning that lacks student engagement by adopting a more contextual and real-world experience-based learning approach (Ajeng Ayuningtias & Rukmana, 2023).

In conclusion, this research makes a significant contribution by connecting scientific research findings with educational practice through the implementation of the guided inquiry learning model. This model provides solutions to various pedagogical constraints faced by students when learning science. It is hoped that this model will produce meaningful learning and align with the development of 21st-century skills.

Method

The type of research used is a Quasi-Experimental Design. A quasi-experiment is an experimental method that involves treatment implementation, impact measurement, and the use of experimental units, but does not employ randomization in determining comparison groups. Therefore, conclusions about changes are drawn from differences in treatment outcomes (Abraham & Supriyati, 2022). The specific design used in this study is the Non-Equivalent Control Group Design. In this design, samples are given a pretest before the treatment so that the influence of the treatment can be more accurately identified by comparing conditions before and after the intervention. The quasi-experimental method, specifically a Non-Equivalent Control Group Design, was used to measure the impact of the guided inquiry model. The study involved 56 seventh-grade students from SMPN 2 Narmada, selected through cluster random sampling. Two classes, VII A (control group) and VII B (experimental group), were compared, with each group receiving different instructional models.

Table 1. Research Design

Class	Pre-test	Treatment	Post-test
Experimental	O_1	X_1	O_3
Control	O_2	X_2	O_4

(Abraham & Supriyati, 2022)

Explanation:

O_1, O_2: before observation, pretest

X_1, X_2 : experiment, control

O_3, O_4 : after observation, posttest

This research was conducted at SMPN 2 Narmada, Narmada District, West Lombok Regency, West Nusa Tenggara (NTB). The study population consisted of all seventh-grade students at SMPN 2 Narmada in the 2024/2025 academic year. The total number of seventh-grade students was 71, divided into three classes. A sample is defined as a smaller part of the population, representing the whole (Mulyani R. Sri, 2021). The sampling technique used in this study was cluster random sampling, which is a method where everyone has an equal opportunity to be selected as a research

subject. As a result, Classes VII A and VII B, totaling 56 students, were chosen as the research sample.

The research instrument was a concept-understanding test in the form of written essay questions. To measure students' conceptual understanding, the test items were developed based on the indicators of conceptual understanding to be assessed, namely: interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining (Rohmah et al., 2020). The five essay questions used were tested for validity and reliability using SPSS (Statistical Product and Service Solution) version 23 to ensure that the items covered all aspects of conceptual understanding intended to be measured. The product–moment correlation values ranged from 0.663 to 0.812, greater than the table value of 0.334 (for N = 35), indicating that the items were valid. Reliability testing was also conducted to ensure accuracy and consistency of the test instrument. A test can be considered reliable if it demonstrates high reliability (Ardiansyah Jailani & Risnita, 2023). Based on the results, the Cronbach's Alpha (α) value of the essay test was 0.797, higher than 0.334, indicating that all pretest and posttest data from the five essay questions were reliable.

This study aimed to systematically evaluate the implementation of the guided inquiry learning model. The instruments were designed to assess the improvement of students' conceptual understanding before and after the treatment. The learning outcome data was first analyzed to meet the requirements for hypothesis testing, including normality and homogeneity tests. Normality was tested using either the Kolmogorov–Smirnov or Shapiro–Wilk test; in this study, Shapiro–Wilk was used because the sample size was less than 30. The tests were conducted using SPSS version 23 with a significance level (α) = 0.05. Based on the decision criteria, the null hypothesis of normality was not rejected if Sig > 0.05. Homogeneity testing was conducted on the students' initial data (pretest) using a variance test (Mulyani R. Sri, 2021). Finally, hypothesis testing was carried out using an independent t-test in

IBM SPSS 23. This test was applied to compare the mean scores of two groups, namely the data before and after the treatment.

In addition, the N-Gain score was used as an indicator to measure the extent of improvement in students' conceptual understanding after the treatment. All statistical analyses were conducted using IBM SPSS 23. The classification of N-Gain scores is presented as Table 2.

Table 2. N-Gain Criteria

Interval	Category
g > 0.7	High
0.3 ≤ g ≤ 0.7	Moderate
g < 0.3	Low

If the N-Gain value is greater than 0.7, the improvement in conceptual understanding falls into the *high* category; if the value is between 0.3 and 0.7, it is classified as *moderate*; and if it is less than 0.3, it is classified as *low*. With this systematic research design and procedure, the study is expected to produce valid and reliable data, thereby providing credible evidence regarding the effectiveness of the guided inquiry learning model in improving students' conceptual understanding.

Results and Discussion

This study employed a quasi-experimental design using a Non-Equivalent Control Group Design to compare students' conceptual understanding. The initial step involved constructing pretest and post test items based on the learning objectives to measure students' understanding of the topic *motion and force*. These items had already undergone validity and reliability testing. Prior to hypothesis testing, a normality test was conducted to ensure that the collected data were normally distributed. In this study, the normality test was performed using SPSS version 23, with the decision rule that data are normally distributed if Sig > 0.05.

Table 3. Results of Normality Test

	Class	Kolmogorov-Smirnov[a]			Shairo-Wilk		
		Statistic	Df	Sig	Statistic	Df	Sig
Concept	Experimental Pretest	.120	28	.200*	.978	28	.788
Understanding	Experimental Posttest	.148	28	.120	.959	28	.327
	Control Pretest	.127	28	.200*	.937	28	.090
	Control Posttest	.153	28	.090	.955	28	0.270

Based on the table, it can be seen that for the experimental class pretest, the significance value of the Shapiro–Wilk test was 0.788, and for the experimental class posttest it was 0.327, according to the SPSS output. For the control class, the pretest value was 0.090 and the

posttest value was 0.270. Since all Sig values were greater than 0.05, the assumption of normality was fulfilled. In other words, the distribution of pretest and posttest scores in both the experimental and control

classes can be considered normal. Thus, the study could proceed with parametric analysis (Usmadi, 2020).

Furthermore, one of the requirements for parametric statistical analysis is the homogeneity test, which determines whether the variances between

sample groups are equal. In SPSS, Levene's test is used to test homogeneity. The null hypothesis of Levene's test states that the variances across groups are equal, and the data are considered homogeneous if the calculated p-value is greater than 0.05

Table 4. Results of Homogeneity Test

		Levene Statistic	df1	df2	Sig.
Concept	Based on Mean	2.920	1	54	.093
Understanding	Based on Median	2.695	1	54	.106
	Based on Median and with adjusted df	2.697	1	52.796	.108
	Based on trimmed mean	2.954	1	54	.091

Table 5. N-Gain

	N	Minimum	Maximum	Mean	Std. Deviation
N-Gain	28	.00	.80	.5078	.19483
Valid N (listwise)	28				

Based on Table 2 and the N-Gain classification criteria, the average N-Gain score of 0.5078 with N = 28 indicates a *moderate* category.

From Table 6, the highest score in the experimental class was 90, compared to 80 in the control class, while the lowest score in the experimental class was 60 and only 10 in the control class. The average score of the

experimental class was 70.54, whereas the control class obtained an average of 51.43.

Table 6. Posttest Results of Conceptual Understanding in the Experimental and Control Classes

Class	N	Highest score	Lowest score	Average
Experimental	28	90	60	70.54
Control	28	80	10	51.43

Table 7. Independent Sample Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Concept Understanding	Equal variances assumed	2.920	0.093	4.423	54	.000	19.107	4.320	10.446	27.769
	Equal variances not assumed			4.423	52.746	.000	19.107	4.320	10.441	27.773

The research results indicate that the significance value p (0.000 < 0.05) signifies a significant influence of the guided inquiry learning model on the understanding of science concepts among seventh-grade students at SMPN 2 Narmada. The average concept understanding score increased from 41.96 on the pretest to 72.68 on the posttest. This increase indicates that learning with the guided inquiry model is able to significantly improve students' conceptual understanding, which is in line with the findings of Latukau (2022) who reported an improvement in conceptual understanding through inquiry-based learning.

The guided inquiry learning model places students at the center of learning, where the learning process emphasizes direct experience through investigation and

experimentation, rather than mere memorization. This approach aligns with constructivist theory, which states that knowledge is actively constructed by learners through real-world experiences, with the teacher acting as a facilitator guiding the learning process through directed questions (Lestari et al., 2024; Liu et al., 2022).

The application of the guided inquiry model to *motion and force material* encourages students to actively connect concepts with everyday life problems. Through scientific steps such as problem formulation, hypothesis development, experiment execution, and data analysis, students can clarify concepts that were previously less understood, such as the difference between distance and displacement. This process not only enhances conceptual understanding but also trains critical thinking and problem-solving skills, which are essential

for 21st-century learning (Sinuraya et al., 2024; Faizin et al., 2024).

The results of the posttest value comparison show that the experimental class using the guided inquiry model obtained an average score of 70.54, which is higher than the control class using conventional learning with an average score of 51.43. This difference confirms that the guided inquiry model is more effective in improving science concept understanding compared to conventional learning. This finding is consistent with previous research stating that guided inquiry learning helps students become more skilled in observation and more understanding of science principles, thus increasing students' conceptual understanding (Sitorus Pane et al., 2023; Wangdi et al., 2020).

The guided inquiry learning model also increases student engagement and motivation, as highlighted by Muksin & Ali (2025) and Nuriatus Sholikhah et al. (2025). This process helps students better understand concepts in the topic of *motion and force*. By conducting experiments, students realize that motion and force are not merely abstract theoretical concepts, but rather science topics closely connected to real-life situations. This is consistent with Sukarelawan et al. (2024), who emphasized that guided inquiry makes science learning more meaningful, engaging, and directly related to students' daily experiences. is consistent with Sukarelawan et al. (2024), who emphasized that guided inquiry makes science learning more meaningful, engaging, and directly related to students' daily experiences.

The N-Gain test results show an average value of 0.5078, which falls into the *moderate* category. This indicates a fairly effective improvement in concept understanding through the application of the guided inquiry model. This finding is supported by the results of the Independent T-Test, which showed a significant difference between the experimental and control groups ($p < 0.05$). Thus, statistically and pedagogically, the guided inquiry model has been proven to have a positive impact on students' conceptual understanding.

In the context of the Merdeka Curriculum, the results of this research provide practical contributions by demonstrating that the guided inquiry learning model aligns with the principles of learning that emphasize student activity, meaningful learning, and the strengthening of critical thinking skills. This model can be a relevant alternative science learning strategy to help students understand science concepts more deeply through contextual and real-world problem-based learning experiences. In conclusion, the application of the guided inquiry learning model has been proven to be more effective than conventional learning in improving students' understanding of science concepts. These findings support constructivist theory, which emphasizes the importance of direct learning experiences and active student involvement in knowledge construction (Faizin et al., 2024), and reinforce the relevance of using the guided inquiry model in implementing the Merdeka Curriculum.

Conclusion

Based on the research findings, it can be concluded that the guided inquiry learning model has a significant effect on students' science conceptual understanding of science. This is supported by the hypothesis testing of pretest (before treatment) and posttest (after treatment) results, which showed a significance value of 0.000 < 0.05, meaning that H_0 was rejected and H_a was accepted. The average pretest score was 41.96, while the average posttest score increased to 72.8, indicating substantial improvement in students' conceptual understanding of science. These findings suggest that guided inquiry learning fosters instruction that is relevant to scientific and technological advancement, preparing students for competition in the 21st century. The researcher recommends that educators adopt the guided inquiry learning model to enhance students' science conceptual understanding. However, this model requires careful preparation to ensure effective implementation.

Conflict of Interest
The authors declare no conflict of interest.

Refferences

Abraham, I., & Supriyati, Y. (2022). Desain Kuasi Eksperimen Dalam Pendidikan: Literatur Review. *Jurnal Ilmiah Mandala Education (JIME)*, *8*(3), 2442–9511. https://doi.org/10.36312/jime.v8i3.3800/http

Ajeng Ayuningtias, R., & Rukmana, D. (2023). The Influence Of The Inquiry Learning Model On The Learning Outcomes Of Natural Sciences Class Four

Elementary School. *Jurnal Cakrawala Pendas*, *9*(4), 580–591. https://doi.org/10.31949/jcp.v9i4.5381

Angraini, L. M., Kania, N., & Gürbüz, F. (2024). Students' Proficiency in Computational Thinking Through Constructivist Learning Theory. *International Journal of Mathematics and Mathematics Education*, 45–59. https://doi.org/10.56855/ijmme.v2i1.963

Ardiansyah Jailani, M. S., & Risnita. (2023). *Teknik Pengumpulan Data Dan Instrumen Penelitian Ilmiah*. http://ejournal.yayasanpendidikandzurriyatulquran.id/index.php/ihsan

Arega, N. T., & Hunde, T. S. (2025). Constructivist instructional approaches: A systematic review of evaluation-based evidence for effectiveness. *Review of Education*, *13*(1). https://doi.org/10.1002/rev3.70040

Asni, A., Wildan, W., & Hadisaputra, S. (2020). Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Hasil Belajar Kimia Siswa Materi Pokok Hidrokarbon. *Chemistry Education Practice*, *3*(1), 17. https://doi.org/10.29303/cep.v3i1.1450

Budiyono, S., & Haerullah, H. (2024). Dampak Teknologi Terhadap Pembelajaran Di Abad 21. *Tsaqofah*, *4*(3), 1790–1800. https://doi.org/10.58578/tsaqofah.v4i3.3005

Dereje, E. W. (2023). The effect of inquiry based technology integration on conceptual and procedural geometry knowledge of preservice mathematics teachers. *Journal of Pedagogical Sociology and Psychology*. https://doi.org/10.33902/JPSP.202321592

DeRosa, D., Franzblau, C., Phillips, C., & Romney, C. (2020). CityLab at Boston University – Thirty Years of Innovation and Partnerships. *The Journal of STEM Outreach*, *3*(2). https://doi.org/10.15695/jstem/v3i2.02

Dewi, E. P., & Wulandari, F. (2021). Identification of Misconceptions in Science Learning During the Covid-19 Pandemic Using the CRI (Certainty of Response Index) Method for Primary school Students. *Jurnal Penelitian Pendidikan IPA*, *7*(SpecialIssue), 145–150. https://doi.org/10.29303/jppipa.v7iSpecialIssue.876

Faizin, A., Susantini, E., & Raharjo, R. (2024). Application of A Guided Inquiry Learning Model to Improve Students' Scientific Literacy Skills. *IJORER : International Journal of Recent Educational Research*, *5*(2), 490–503. https://doi.org/10.46245/ijorer.v5i2.573

Jundu, R., Tuwa, H., & Seliman, R. (2020). *Hasil Belajar IPA Siswa SD di Daerah Tertinggal dengan Penerapan Model Pembelajaran Inkuiri Terbimbing The Influence to Science Learning Results for Elementary School Students in Underdeveloped Regions with The Implementation of Guided Inquiry Model*.

Latukau, M. (2022). Pembelajaran IPA Dengan Model Inkuiri Terbimbing Untuk Meningkatkan Pemahaman Konsep dan Keterampilan Proses Sains Siswa SD. *Jurnal Ilmiah Wahana Pendidikan*, *Desember*, *2022*(23), 351–362. https://doi.org/10.5281/zenodo.7397601

Lestari, S., Azmi Manurung, A., Tinggi Ilmu Tarbiyah Al-Hikmah Tebing Tinggi, S., Dasar Negeri, S., Tinggi, T., & Dasar Negeri Alur Sali Aceh tamiang, S. (2024). *Teori Belajar Konstruktivisme dan Implikasi dalam Pembelajaran IPA SD*. http://Jiip.stkipyapisdompu.ac.id

Liu, A. L., Hajian, S., Jain, M., Fukuda, M., Obaid, T., Nesbit, J. C., & Winne, P. H. (2022). A microanalysis of learner questions and tutor guidance in simulation-assisted inquiry learning. *Journal of Computer Assisted Learning*, *38*(3), 638–650. https://doi.org/10.1111/jcal.12637

Margunayasa, I. G., Dantes, N., Marhaeni, A. A. I. N., & Suastra, I. W. (2019). The effect of guided inquiry learning and cognitive style on science learning achievement. *International Journal of Instruction*, *12*(1), 737–750. https://doi.org/10.29333/iji.2019.12147a

Muksin, M., & Ali, N. (2025). Implementasi Model Pembelajaran Inkuiri Terbimbing Untuk Meningkatkan Minat Belajar Peserta Didik Pokok Bahasan Hukum Newton Tentang Gerak Pada Kelas X SMK Negeri 6 Tidore Kepulauan. *KUANTUM: Jurnal Pembelajaran Dan Sains Fisika*, *6*(1), 92–97. https://doi.org/10.63976/kuantum.v6i1.878

Ngilmaya, A. N. K., Irawan, E., & Ifariyah, F. (2021). Efektivitas Model Inkuiri Terbimbing dalam Meningkatkan Kemampuan Menarik Kesimpulan Peserta Didik. *Jurnal Tadris IPA Indonesia*, *1*(2), 199–209. https://doi.org/10.21154/jtii.v1i2.190

Novitasari, F. D., & Budijastuti, W. (2020). Validitas Lembar Kegiatan Peserta Didik (LKPD) Berbasis Inkuiri Terbimbing pada Materi Perubahan Lingkungan untuk Melatihkan Keterampilan Proses Peserta Didik Kelas X SMA. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, *10*(1), 113–125. https://doi.org/10.26740/bioedu.v10n1.p113-125

Nuriatus Sholikhah, Fatimah Zahro, & Dwi Haryanta. (2025). Penerapan Pembelajaran Guided Inquiry untuk Meningkatkan Keaktifan dan Hasil Belajar Siswa SMK Kelas X ATPH. *Pragmatik : Jurnal Rumpun Ilmu Bahasa Dan Pendidikan*, *3*(2), 187–199. https://doi.org/10.61132/pragmatik.v3i2.1606

Ozkan, Y. Ö., & Dökme, İ. (2024). Syrian Migrant Students' Attitudes Toward Science: <scp>A</Scp> Comparative Analysis With Their

<scp>Turkish</Scp> Peers, Phase I. *School Science and Mathematics*, *124*(4), 232–248. https://doi.org/10.1111/ssm.12639

Reswara, T. R., Parno, Nugraheni, D., Suwasono, P., Jannah, R., & Khamis, N. (2024). Analysis of student scientific literacy skills on energy and simple machines topics. *Journal of Physics: Conference Series*, *2900*(1), 012022. https://doi.org/10.1088/1742-6596/2900/1/012022

Rohmah, R. N., Utomo, D. P., & Zukhrufurrohmah, Z. (2020). The Effectiveness of Implementation Warmer Apperception to Construct the Conceptual Understanding on the Learning Material of Vector. *Mathematics Education Journal*, *3*(2), 159. https://doi.org/10.22219/mej.v3i2.11073

Sinuraya, J., Motlan, M., & Mihardi, S. (2024). The Level Affected of Investigation-Based Group Inquiry Model on Student Cognitive Learning Outcomes. *Proceedings of the 5th International Conference on Innovation in Education, Science, and Culture, ICIESC 2023, 24 October 2023, Medan, Indonesia*. https://doi.org/10.4108/eai.24-10-2023.2342059

Sitorus Pane, R., Derlina, D., & Siregar, A. (2023). Increasing Student's Concept Understanding and Science Process Skills Through Inquiry Training Models. *Proceedings of the 8th Annual International Seminar on Transformative Education and Educational Leadership, AISTEEL 2023, 19 September 2023, Medan, North Sumatera Province, Indonesia*. https://doi.org/10.4108/eai.19-9-2023.2341888

Sukarelawan, Moh. I., Indratno, T. K., Widodo, W., Dwijananti, P., Hikmah, F. N., & Abdullah, N. S. Y. (2024). What do my students need? Deep analysis of student's individual cognitive ability using person diagnostic map. *Momentum: Physics Education Journal*, *8*(2), 217–229. https://doi.org/10.21067/mpej.v8i2.9900

Suraji, R., & Sastrodiharjo, I. (2021). Peran spiritualitas dalam pendidikan karakter peserta didik. *JPPI (Jurnal Penelitian Pendidikan Indonesia)*, *7*(4), 570. https://doi.org/10.29210/020211246

Sutarningsih, N. L. (2022). Model Pembelajaran Inquiry untuk Meningkatkan Prestasi Belajar IPA Siswa Kelas V SD. *Journal of Education Action Research*, *6*(1), 116. https://doi.org/10.23887/jear.v6i1.44929

Usmadi, U. (2020). Pengujian persyaratan analisis (Uji homogenitas dan uji normalitas). *Inovasi Pendidikan*, *7*(01).

Wangdi, D., Precharattana, M., & Kanthang, P. (2020). A Guided Inquiry laboratory to enhance students' understanding of the Law of Mechanical Energy Conservation. *International Journal of Innovation in Science and Mathematics Education*, *28*(1). https://doi.org/10.30722/IJISME.28.01.003