JURNAL BASICEDU

Volume 9 Nomor 6 Tahun 2025 Halaman 1954 - 1963

Research & Learning in Elementary Education

https://jbasic.org/index.php/basicedu

Student Activities in Science Learning through Guided Inquiry with PhET Simulations

Farhan Iqbal Pratama[1]✉, Warkonah[2], Tri Hesti Hidayati[3], Fahrur Rozi[4], Ellianawati[5]

Pendidikan Dasar, Universitas Negeri Semarang, Indonesia[1,2,3,4,5]

E-mail: fipratama77@students.unnes.ac.id

Abstrak

Penelitian ini dilatarbelakangi oleh rendahnya aktivitas peserta didik dalam pembelajaran sains yang didominasi metode ceramah dan bersifat buku teks. Penelitian ini bertujuan untuk mengetahui peningkatan aktivitas peserta didik melalui penerapan model *guided inquiry learning* berbasis PhET Simulations. Metode penelitian menggunakan deskriptif kuantitatif dengan pendekatan eksperimen. Desain penelitian menggunakan *one grup pretest-posttest*. Sampel penelitian berjumlah 20 peserta didik kelas V SD Negeri 2 Bulurejo. Teknik pengambilan data melalui lembar observasi aktivitas peserta didik dan dokumentasi. Data dianalisis menggunakan statistik deskriptif. Hasil penelitian menunjukkan adanya peningkatan aktivitas peserta didik dari pembelajaran 1 dan 2 setelah dilakukan pembelajaran sains melalui model *guided inquiry learning* berbasis PhET Simulations. Aktivitas peserta didik pada pembelajaran 1 yang terkategori "Aktif" mampu meningkat menjadi "Sangat Aktif" pada pembelajaran 2. Pemanfaatan media PhET Simulations berhasil membuat peserta didik sangat aktif dalam pembelajaran sains yang diterapkan pada sintaks "Data Collection". Integrasi model *guided inquiry* berbasis PhET Simulations memberikan kontribusi nyata dalam meningkatkan aktivitas ilmiah peserta didik di setiap sintaks pembelajaran dan mampu memusatkan peserta didik sebagai pembelajar. Penelitian ini menunjukkan suatu kebaruan dengan integrasi model *guided inquiry learning* dan PhET Simulations terhadap peningkatan aktivitas peserta didik di setiap sintaks yang belum banyak diteliti.

Kata Kunci: sains, guided inquiry, PhET, aktivitas pembelajaran

Abstract

This study is motivated by the low level of student participation in science lessons, which are often dominated by lectures and textbook-based learning. The purpose of this study was to ascertain whether using the PhET Simulation-based guided inquiry learning approach increased student engagement in science classes. This study employed an experimental, quantitative descriptive methodology. A one-group pretest-posttest design was employed in the study. Twenty fifth-graders from SD Negeri 2 Bulurejo comprised the research sample. Documentation and student activity observation sheets were used as data collection methods. Descriptive statistics were employed to analyse the data. The results showed an increase in student activity from learning 1 and 2 after science learning was conducted through the guided inquiry learning model based on PhET Simulations. The level of student activity in the first lesson, categorised as 'active', increased to 'very active' in the second lesson. The use of PhET simulations successfully made the students very active in science learning, as applied in the 'Data Collection' syntax. Integrating the guided inquiry model based on PhET Simulations has a tangible impact on increasing students' scientific activity at every learning stage. It enables students to take centre stage as learners. This study demonstrates a novel approach to improving student involvement in each syntax, an approach that has not been extensively studied.

Keywords: *science, guided inquiry, PhET, learning activity*

✉ Corresponding author :

Email : fipratama77@students.unnes.ac.id

DOI : https://doi.org/10.31004/basicedu.v9i6.10956

ISSN 2580-3735 (Media Cetak)

ISSN 2580-1147 (Media Online)

DOI: https://doi.org/10.31004/basicedu.v9i6.10956

INTRODUCTION

Education is a vital substance, a central pillar of civilisation and national progress. Through education, quality human resources with character and competitiveness can be developed, enabling them to contribute to society and improve their status (Adisaputro & Rosidi, 2020). In the face of the Fourth Industrial Revolution and the global challenges of the 21st Century, science education in primary school becomes crucial as a strategic means of nurturing the 4C competencies of critical thinking, creativity, collaboration, and communication from an early age. Three main foundations must be considered when implementing science education in this era: an in-depth understanding of the nature of science; adapting materials and methods to children's developmental stages using Jean Piaget's theory and constructivism; and applying scientific learning integrated with the science of inquiry and constructivism (Sofiyah et al., 2024).

The Merdeka Curriculum places Science and Social Studies (IPAS) at the forefront of a progressive response to the need for holistic, integrated learning (Fitriyah et al., 2024). The aim is to develop inquiry skills, self-understanding, and an understanding of one's environment, fostering knowledge and concepts through concrete, contextual learning experiences (Hasanah et al., 2023; Siswoyo et al., 2024). The philosophy of IPAS promotes learner-centred, curiosity-driven learning and the development of higher-order thinking skills, as well as the strengthening of the Profile of the Pancasila Learner. The implementation of the Merdeka Learning Curriculum positions the Science and Social Studies (IPAS) subject as a strategic means of building a foundation for scientific thinking and social awareness at the primary school level (Anggraena et al., 2021).

In theory and philosophy, IPAS demands the implementation of scientific learning, inquiry, and prioritisation of science skills (Sofiyah et al., 2024). However, the researcher identified a significant discrepancy between curriculum requirements and field practices. Observation at SD Negeri 2 Bulurejo revealed that the IPAS learning process was still largely dominated by traditional, teacher-centred approaches (Margolang et al., 2025). The lecture method, combined with homework based on textbooks, results in low student engagement, minimal discussion, and infrequent investigative activities. Abstract topics such as electricity are complex to teach using the IPAS concept in practice. A lack of adequate interactive media hinders students' active involvement in the discovery process. This directly prevents achieving the essential IPAS goal of fostering individuals who are critical, creative, and skilled in scientific processes.

In response to low levels of learning activity, the researcher believes that a structured pedagogical intervention supported by relevant media is required: the implementation of the Guided Inquiry Learning model. This model aligns with the spirit of IPAS, as it encourages learners to seek knowledge independently (Utomo & Siwi, 2025). In model-guided inquiry learning, the teacher acts as a facilitator, providing learners with a clear framework for progressing through the stages of an investigation. These stages include formulating a problem, creating a hypothesis, collecting data, and drawing conclusions (Azzahra et al., 2024). This model inherently requires participants to be highly active at every stage, developing their critical thinking and problem-solving skills, as well as their ability to construct knowledge independently.(Chu et al., 2021; Pramana et al., 2024).

To help students understand abstract concepts, guided inquiry learning is combined with PhET simulations, an interactive media platform. Created by the University of Colorado Boulder, PhET offers a secure, virtual laboratory for conducting experiments, manipulating variables, and observing results in real time. (Noverma et al., 2024). However, without adequate media support, it will be challenging to apply the guided inquiry learning model to abstract IPAS concepts or phenomena that are difficult to teach in the classroom, such as electricity. The use of media in learning can help convey lessons more easily and attract students' attention (Ramadhani et al., 2024). Therefore, PhET media make it possible to visualise abstract concepts and turn them into concrete, investigable phenomena.

Combining the guided inquiry learning model with PhET Simulations as a virtual investigative environment has the potential to transform passive classes into dynamic, student-centred ones. Previous studies

DOI: https://doi.org/10.31004/basicedu.v9i6.10956

have shown that using the guided inquiry model alongside PhET simulations in the experimental group leads to a greater increase in activity than in the non-experimental group (Sirait et al., 2025). Other researchers have also demonstrated that the guided inquiry learning model integrated into PhET can support academic achievement by encouraging active student participation in the learning process, thereby improving outcomes, interest, and motivation (AR & Efendi, 2024; Mayliana et al., 2022). Although it has been proven that it increases students' active participation in learning, the research has not provided comprehensive information on the extent to which it increases students' learning activities as measured by the learning process.

In light of this urgency, the researcher deemed it necessary to conduct in-depth research into the implementation of the Guided Inquiry Learning model using PhET simulations to improve learning activities for primary school students in IPAS lessons. This study will analyse the impact of guided inquiry learning based on PhET simulations on primary school students' learning activities. Therefore, this study is highly significant, as it provides empirical evidence of the guided inquiry learning model's effectiveness as a concrete solution to low levels of learning activity among primary school students. Furthermore, implementation is considered practical and relevant, and in line with the demands of inquiry-based learning in the Merdeka Curriculum.

METHOD

This study employed a descriptive research design with a quantitative approach. According to (Paramita et al., 2021), quantitative descriptive research is conducted to address a problem and to gather extensive information about a phenomenon using quantitative procedures. This research aimed to describe the change in student activity before and after the implementation of the guided inquiry learning model integrated with PhET Simulations. The research design was a one-group pretest-posttest design, in which data were collected at both the pretest and posttest using an observation sheet with a Likert scale.

$$O_1 \; X \; O_2$$

Description:

O_1 : Measurement (observation of activity) before treatment.

X : Treatment (implementation of the guided inquiry learning model integration PhET).

O_2 : Measurement (activity observation) after treatment.

(Sugiyono, 2022).

This study was conducted at SD Negeri 2 Bulurejo in the Gadingrejo district of Pringsewu, Lampung, during the second semester of the 2024/25 academic year. The subjects of the study were the 20 students in Class VA. Class VA was chosen as the main subject because, according to the researcher's initial observations, this class was facing the challenge of low activity levels in IPAS lessons. Furthermore, the one-group approach was chosen because the researcher wanted to conduct an in-depth analysis of changes in group activity after the intervention.

Data collection was conducted through direct observation at two main stages of the treatment. The research procedure comprises three stages: (1) the initial stage, in which the researcher conducts an initial measurement (O_1) of the learners' activities; This data was obtained from observation sheets on activity, completed by two observers during the initial IPAS session, before the implementation of the guided inquiry learning model and PhET. The second stage was the treatment stage (X), during which the treatment was administered during two meetings. During each meeting, students were taught using the guided inquiry learning model with a structured syllabus (orientation, formulating problems, formulating hypotheses, collecting data/experimenting using PhET simulations, analysing data, and concluding). The teacher acted as a facilitator, guiding the investigation. The final stage (O_2) involved the researcher conducting a final measurement using the same activity observation sheet during the final IPAS lesson. The primary data collection instrument is the Activity Observation Sheet for Students, which uses a 1–4 Likert scale. This scale is designed to evaluate

DOI: https://doi.org/10.31004/basicedu.v9i6.10956

students' engagement and activity at each stage of the guided inquiry learning process. In addition to observations, supplementary data were collected in the form of photos of activities and field notes.

Descriptive statistical techniques are used to analyse the quantitative data collected. Descriptive statistics were used to analyze the data by describing the collected data (Sugiyono, 2022). Data were collected using a 15-statement observation sheet, which was scored on a Likert scale from 1 to 4.

Table 1. Likert Scale Categories on the Observation Sheet

Category	Scale
Very Active	4
Active	3
Moderately Active	2
Less Active	1

The students' average activity level is converted to a percentage range using the following table.

Table 2. Percentage Distribution of Student Activity

Percentage (%)	Category
< 43,74	Less Active
43,75 – 62,49	Moderately Active
62,50 – 81,24	Active
> 81,25	Very Active

The categorisation results were then presented to illustrate the increase in learning activity among participants from the pre-test to the post-test stage following the implementation of the guided inquiry learning model based on PhET simulations.

RESULT AND DISCUSSION

Result

The observed activity data refers to student activity in each syntax of the guided inquiry learning model integrated with PhET Simulations media. Based on the experiment that was conducted, namely teaching IPAS material on electricity in grade 5 at SD Negeri 2 Bulurejo, the following data were obtained.

Table 3. Comparison of data from the first and second lessons

No.	Student Name	Average Learning 1 (%)	Category	Average Learning 2 (%)	Kategory
1	AAP	76.67	Active	85.00	Very Active
2	AAP	73.33	Active	86.67	Very Active
3	AFM	68.33	Active	88.33	Very Active
4	ALAP	71.67	Active	88.33	Very Active
5	AFA	78.33	Active	85.00	Very Active
6	AH	68.33	Active	85.00	Very Active
7	AAD	75.00	Active	86.67	Very Active
8	ATS	78.33	Active	85.00	Very Active
9	AAK	80.00	Active	90.00	Very Active
10	AU	78.33	Active	85.00	Very Active
11	ALU	73.33	Active	86.67	Very Active
12	AAR	80.00	Active	93.33	Very Active
13	BR	73.33	Active	88.33	Very Active
14	BAQ	80.00	Active	86.67	Very Active
15	CFA	68.33	Active	85.00	Very Active
16	CO	78.33	Active	93.33	Very Active
17	DAH	73.33	Active	85.00	Very Active
18	DS	61.67	Moderately Active	80.00	Active
19	FR	66.67	Active	85.00	Very Active

No.	Student Name	Average Learning 1 (%)	Category	Average Learning 2 (%)	Kategory
20	FAR	73.33	Active	78.33	Active
Average		**73.83**	**Active**	**86.33**	**Very Active**

Source: Researcher data analysis for 2025.

As shown in Table 3, the observation data indicate a significant increase in learner activity following the implementation of the guided inquiry learning model with PhET simulations. Before the intervention, the average level of class participation was 73.83%, placing it in the 'Active' category. After the intervention, however, the average for Learning 2 increased sharply to 86.33%, putting the overall class activity in the 'Very Active' (>81.25%) category. This increase is supported by individual shifts: 19 out of 20 students achieved the 'Very Active' category, while the remaining student improved from 'Moderately Active' to 'Active'. These results suggest that guided inquiry and PhET interventions effectively promote consistent student participation and engagement.

Furthermore, data on student activity during guided inquiry learning using the PhET Simulations media were analysed to obtain an average review percentage for each syntax of the guided inquiry learning model. These calculation results were observed from each student's observation sheet. The following table shows student activity in the syntax model used.

Table 4. Student activities in each syntax of the integrated guided inquiry learning model using PhET Simulations

Guided Inquiry Learning Syntax	Learning Activity 1	Category	Learning Activity 2	Category
Orientation	72.92	Active	82.92	Very Active
Presenting the Problem	50.00	Moderately Active	71.25	Active
Hypotheses Submission	71.88	Active	78.13	Active
Data Collection	81.25	Very Active	89.58	Very Active
Testing Hypotheses	81.25	Very Active	93.75	Very Active
Communicating Conclusion	71.67	Active	89.58	Very Active
Average	**71.50**	**Active**	**84.20**	**Very Active**

Source: Researcher data analysis for 2025.

As shown in Table 4, the observation data for each component of the guided inquiry learning model indicate that implementing this intervention significantly enhances student engagement, raising the overall average from 71.50% (Active) at the initial meeting to 84.20% (Very Active) at the final meeting. The most significant increases were seen in the 'Communicating Conclusion' (from 71.67% to 89.58%), 'Testing Hypotheses' (from 81.25% to 93.75%), and 'Presenting the Problem' (from 50.00% to 71.25%) syntacts. The drastic increase in the 'Presenting the Problem' syntax, which was initially in the 'Moderately Active' category, shows that the structured guidance of the guided inquiry model successfully encouraged students to become more confident and proactive in formulating or accepting research problems. Meanwhile, the Data Collection and Testing Hypotheses syntacts were already in the 'Very Active' category from the outset, a status that was further reinforced at the second meeting. This confirms that using PhET Simulations effectively stimulates practical exploration and investigation.

DOI: https://doi.org/10.31004/basicedu.v9i6.10956

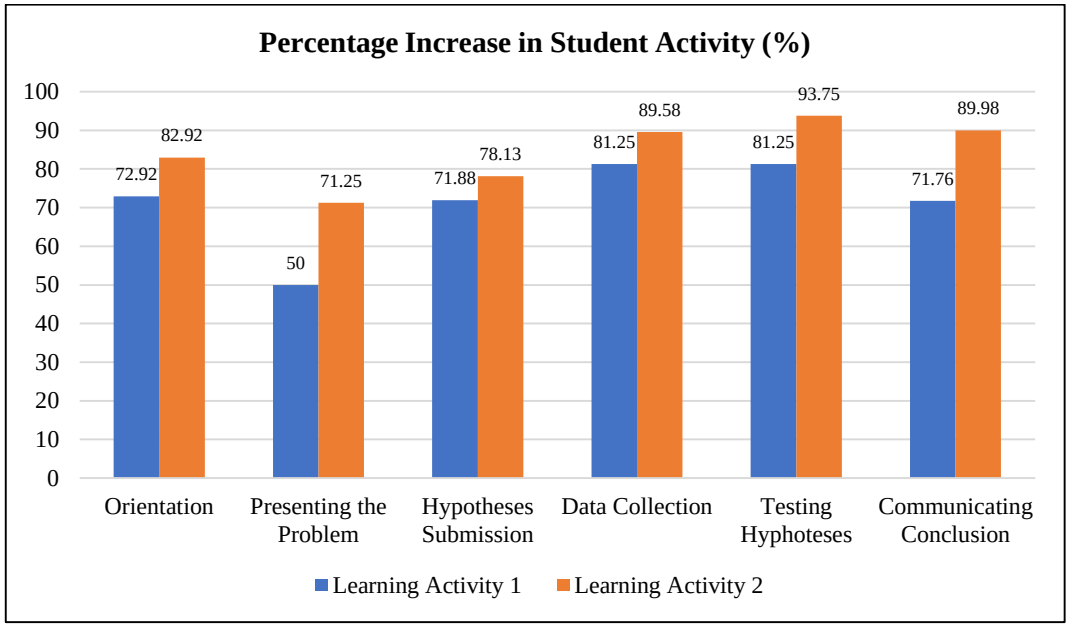

Figure 1. Bar chart showing the percentage increase in student activity

Based on Figure 1, it was found that student activity in each syntax of the PhET Simulations-based guided inquiry learning model that had been implemented in the first and second lessons increased. This significant increase was driven by the use of simulations in the electricity learning activities. Students were more enthusiastic and motivated in solving problems presented by educators using PhET media. Although the "Hypotheses Submission" syntax experienced the lowest increase, which was 6.25% compared to other syntaxes, this indicates that the guided inquiry learning model applied to science learning (IPAS) in the fifth-grade elementary school was able to increase student activity.

Discussion

The main issue underlying this study is the low level of student activity in science learning (IPAS) at SD Negeri 2 Bulurejo. This condition arises because lecture methods and textbooks dominate the learning process, trapping students as passive recipients of information and resulting in observable behaviors, namely a lack of participation in discussions, minimal initiative to ask questions, and minimal investigative activities. This situation directly hinders the achievement of IPAS objectives, namely to develop individuals who are critical, creative, and possess scientific process skills (Hasanah et al., 2023; Siswoyo et al., 2024). As a progressive response, the proposed solution is the application of a guided inquiry learning model integrated with PhET Simulations media. This solution is urgent because guided inquiry learning is philosophically in line with the spirit of the Merdeka Curriculum and the demands of human resource development (Adisaputro & Rosidi, 2020), where the inquiry model can place students as active subjects in the search for knowledge (Utomo & Siwi, 2025), while PhET Simulations provide a virtual laboratory that can visualize abstract concepts in a concrete and investigative manner (Noverma et al., 2024), acting as a key bridge to transform passive classes into dynamic ones.

The implications of applying the PhET Simulations-based guided inquiry learning model on learning show substantial changes in behavior and increased activity. This change is marked by a shift in the average class activity category from "Active" in Learning 1 to "Very Active" in Learning 2. Specifically, student enthusiasm increased rapidly because the PhET media successfully made them very active as they interacted and manipulated variables in the "Data Collection" and "Testing Hypotheses" syntax. Significant changes were also observed in the "Presenting the Problem" and "Communicating Conclusions" syntaxes, with student behaviour shifting from passive to more confident problem formulation and presentation in Learning 2. The

DOI: https://doi.org/10.31004/basicedu.v9i6.10956

increase in activity across all of these syntaxes demonstrates that the scaffolding provided by teachers, combined with the engaging, investigative environment of PhET, effectively overcomes initial barriers and encourages structured, active participation throughout the scientific process.

The significant increase in activity reflects the philosophical alignment between the guided inquiry learning model and constructivist theory, which views learners as active builders of knowledge rather than passive recipients (Trisnani, 2024). In the context of IPAS, the guided inquiry learning model positions learners as subjects who must construct their own understanding through exploration and discovery, in line with the demands of the Merdeka Learning Curriculum (Agustini et al., 2024). This allows students to understand learning materials through concrete experience, enabling them to retain information for a long time.

The presence of PhET Simulations also helped increase the use of the activity as a learning medium. The significant increase in participants' enthusiasm, particularly in the "Data Collection" and "Testing Hypotheses" sections, is due to PhET's ability to demonstrate how electricity can be conducted. The interactive visualisation provided enables students to conceptualise abstract understanding as concrete (Ilham et al., 2024). This study reinforces similar findings by (Sirait et al., 2025) and (Rosyani et al., 2025), who emphasise that PhET's ability to manipulate variables in real time provides an investigative experience that would be impossible in a conventional classroom, transforming abstract concepts (e.g. electrical circuits) into tangible objects that can be investigated. However, this study has a significant novelty: the detailed analysis of students' behaviour and increased activity at each step of the guided inquiry learning model.

By breaking down the results of observations at each stage of the scientific process, from Orientation to Communicating Conclusions, this study provides structured empirical evidence of how the combination of models and media influences the behaviour of learners at each stage of the scientific process, providing teachers with a clear roadmap for optimising the use of PhET at specific inquiry stages. Guided inquiry learning has been shown to stimulate curiosity and promote active learning among students (Maryani et al., 2023; Sumianti, 2023). Thus, PhET acts as an effective cognitive bridge in overcoming visualisation barriers in science education.

An in-depth analysis of each guided inquiry syntax reveals a structured shift in behaviour. Significant changes are evident in the "Presenting the Problem" and "Communicating Conclusions" syntactic structures, where learners transition from passive to confident. The highest increase in the "Data Collection" and "Testing Hypotheses" syntaxes proves that the combination of model and media is highly effective at the core stage of science process skills. The inquiry framework provides structure, while PhET provides investigative tools. This demonstrates that an inquiry environment supported by interactive simulations optimally facilitates science process skills such as observing, measuring, and interpreting data (Novika, 2025).

Although showing an overall success, the challenges were identified in syntax 'Hypotheses Submission', which marks the lowest increase. This result indicates that, despite the investigative environment being established, the ability to formulate hypotheses independently remains a cognitive barrier requiring higher-order thinking skills (HOTs). The low increase can be linked to the residual effects of previous learning processes dominated by lectures, which do not train critical and rational thinking skills, but rather focus on memorisation rather than discovery (Nazifa et al., 2025; Putra, 2021). At this stage, more critical thinking questions are needed to provide support and guidance (scaffolding). These questions aim to help bridge the gap in students' thinking, encouraging them to progress from mere observation to formulating clear and testable hypotheses (Saharani et al., 2024). These findings serve as a reminder to teachers that PhET is helpful in data collection, but does not necessarily address difficulties in the initial conceptualisation stage, such as formulating hypotheses. Therefore, scaffolding steps that facilitate critical thinking before moving on to the PhET exploration stage should be the focus of the next methodological improvement.

Overall, these findings reinforce the empirical evidence on the effectiveness of the guided inquiry learning model based on PhET Simulations in transforming passive classes into highly active ones, while highlighting the need for further pedagogical interventions to develop higher-order critical thinking skills in hypothesis

formulation. Although the study demonstrated success, the researchers encountered challenges during implementation, particularly in the initial cognitive-abstract stage of inquiry. Although activity levels increased overall, the 'Hypotheses Submission' syntax experienced the lowest increase, indicating that students still struggle to formulate hypotheses independently, a behaviour that requires high-level critical thinking skills.

The limitations of this study include the use of a descriptive, quantitative design with a one-group pretest-posttest experimental design. This design is effective in describing changes in behaviour. Still, the absence of a control group makes it difficult to isolate the influence of the guided inquiry learning model based on PhET Simulations from external factors, such as student maturity, which may also contribute to increased activity. Therefore, future researchers are advised to use a pretest-posttest control group design to strengthen causal inference and validate the effectiveness of this model.

CONCLUSION

Based on the research findings, it can be concluded that implementing the Guided Inquiry Learning Model alongside PhET Simulations has significantly and effectively increased student learning activity in IPAS learning at SD Negeri 2 Bulurejo. This is evident in the surge in average class activity, which rose from 73.83% ("Active") to 86.33% ("Very Active"). This demonstrates that combining guided inquiry models, which provide an investigative framework, with PhET simulations, which facilitate visual exploration, is an effective solution to the dominance of conventional learning methods. This success has important practical implications, providing empirical evidence of a teaching model that aligns with the Merdeka Curriculum's requirements for developing science process skills. This is particularly significant given that PhET media has been proven to engage students effectively in practical activities such as 'Data Collection' and 'Testing Hypotheses'. Therefore, this model is recommended for implementation in other classes that struggle to visualise abstract concepts and increase active student participation.

REFERENCES

Adisaputro, S. E., & Rosidi, I. 2020. Pengembangan Sumber Daya Manusia di Era Milenial Membentuk Manusia Bermartabat. *J-KIS: Jurnal Komunikasi Islam, 01*(01), 1–27.

Agustini, Rahmawati, S., Annisha, D., Tobondo, Y. A., Gradini, E., Effendi, Parera, H. R., Ota, M. K., Muslim, R., Zainal, Jarudin, Almubarokah, N. H., Obina, W. M., Separ, F. M., Parera, A., Latifah, Nasar, A., Adhima, F., Suryadinata, N., & Alfansuri, D. U. 2024. *Inquiry-Based Learning dalam Kurikulum Merdeka*. PT. Mifandi Mandiri Digital.

Anggraena, Y., Felicia, N., Ginanto, D. E., Pratiwi, I., Utama, B., Alhapip, L., & Widiaswati, D. 2021. *Kurikulum untuk pemulihan pembelajaran* (1st (ed.)). Pusat Kurikulum dan Pembelajaran Badan Standar, Kurikulum, dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi.

AR, E., & Efendi. 2024. Penerapan model pembelajaran inkuiri berbantuan PhET Simulation untuk meningkatkan hasil dan motivasi belajar siswa kelas V MIN I Langsa. *Gravitasi: Jurnal Pendidikan Fisika dan Sains, 7*(02), 1–10.

Azzahra, N., Yogica, R., & Fitri, R. 2024. Menggali Potensi Model Inkuiri Terbimbing dalam Membentuk Kemampuan Berpikir Kritis Peserta Didik pada Pembelajaran Biologi. *Papanda Journal of Mathematics and Sciences Research (PJMSR), 3*(2), 81–89.

Chu, S. K. W., Reynolds, R. B., Tavares, N. J., Notari, M., & Lee, C. W. Y. 2021. *21st Century Skills Development Through Inquiry-Based Learning*. Springer International Publishing. https://doi.org/10.1007/978-981-10-2481-8

Fitriyah, S. N., Suciptaningsih, O. A., & Mashfufah, A. 2024. Pengembangan Bahan Ajar IPAS Berbasis Kearifan Lokal Berbantuan Aplikasi Pengembangan Bahan Ajar IPAS Berbasis Kearifan Lokal Berbantuan Aplikasi Heyzine pada Muatan Cerita Tentang Daerahku. *JIIP (Jurnal Ilmiah Ilmu*

Pendidikan), *7*(6), 5230–5236. https://doi.org/10.54371/jiip.v7i6.4447

Hasanah, A., Amelia, C. R., Salsabila, H., Agustin, R. D., Setyawati, R. C., Elifas, L., & Marini, A. 2023. Pengintegrasian Kurikulum Merdeka dalam pembelajaran IPAS: Upaya Memaksimalkan Pemahaman Siswa tentang Budaya Lokal. *Jurnal Pendidikan Dasar dan Sosial Humaniora*, *3*(1), 33–44.

Ilham, M., Husniati, A., & Muzaini, M. 2024. Implikasi Model Problem Based Learning Berbantuan Media PheT Simulations Terhadap Aktivitas dan Hasil Belajar Matematika Siswa. *Jurnal Riset HOTS Pendidikan Matematika*, *4*(4), 1502–1518. https://doi.org/10.51574/kognitif.v4i4.2041

Margolang, R. U. U., Saragih, M. P., Huwaida, A., & Syahrial. 2025. Identifikasi Permasalahan Metode Pembelajaran IPAS pada Siswa Kelas IV SDN 060866. *Edukasi Elita: Jurnal Inovasi Pendidikan*, *2*(2), 161–172. https://doi.org/10.62383/edukasi.v2i2.1413

Maryani, U. S., Halidjah, S., & Pranata, R. 2023. Peningkatan sikap Ilmiah Siswa melalui Model Inkuiri Terbimbing Pada Materi FPB dan KPK kelas IV di Sekolah Dasar Negeri 34 Pontianak Selatan. *AS-SABIQUN: Jurnal Pendidikan Islam Anak Usia Dini*, *5*(2), 475–491. https://doi.org/10.36088/assabiqun.v5i2.3005

Mayliana, T. W., Subekti, H., & Sabtiawan, W. B. 2022. Peningkatan Keterampilan Proses Sains Dan Minat Belajar melalui Pembelajaran Inkuiri Terbimbing Berbasis PhET. *Pensa E-Jurnal: Pendidikan Sains*, *10*(3), 339–344. https://doi.org/10.26740/pensa.v10i3.45394

Nazifa, S., Ramdani, A., Mertha, I. G., & Sukarso, A. A. 2025. Pengaruh Penerapan Model Pembelajaran Inkuiri Terbimbing (Guided Inquiry) Dipadukan dengan Strategi Pembelajaran Mind Mapping terhadap Hasil Belajar Biologi Siswa di SMAN 1 Gerung. *Journal of Classroom Action Research*, *7*(2), 775–782. https://doi.org/10.29303/jcar.v7i2.11231

Noverma, N., Perawati, P., & Susanti, T. 2024. Pemanfaatan PhET Interactive Simulation sebagai sumber belajar ilmu pengetahuan alam di sekolah menengah pertama. *JPGI (Jurnal Penelitian Guru Indonesia)*, *9*(4), 40–44.

Novika, R. 2025. Augmented Reality sebagai Inovasi Lembar Kerja Peserta Didik Berbasis Inkuiri untuk Meningkatkan Keterampilan Proses Sains. *UPGRADE: Jurnal Pendidikan Teknologi Informasi*, *2*(2), 41–50. https://doi.org/10.30812/upgrade.v2i2.4765

Paramita, R. W. D., Rizal, N., & Sulistyan, R. B. 2021. *Metode Penelitian Kuantitatif: Buku ajar Perkuliahan Metodologi Penelitian bagi Mahasiswa Akuntansi & Manajemen* (3rd ed.). Widya Gama Press.

Pramana, P. M. A., Suarni, N. K., & Margunayasa, I. G. 2024. Relevansi Teori Belajar Konstruktivisme dengan Model Inkuiri Terbimbing terhadap Hasil Belajar Siswa. *Ideguru : Jurnal Karya Ilmiah Guru*, *9*(2), 487–493. https://doi.org/10.51169/ideguru.v9i2.875

Putra, M. 2021. Pengaruh Metode Pembelajaran Inkuiri Terbimbing dan Pemecahan Masalah terhadap Kemampuan Berpikir Kritis. *Jambura Economic Education Journal*, *3*(2), 72–84. https://doi.org/10.37479/jeej.v3i2.10391

Ramadhani, A., Wardani, S. F., & Samsiar. 2024. Pemanfaatan Gadget sebagai Teknologi Digital sebagai Strategi dalam Meningkatkan Potensi Berbahasa Anak Usia Dini. *JOTE: Journal On Teacher Education*, *5*(3), 38–46.

Rosyani, W. A., Nuraeni, F., & Fajrussalam, H. 2025. Pengaruh Model Inkuiri Terbimbing Berbantuan PheT Simulations terhadap Pemahaman Konsep IPA Peserta Didik SD. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *10*(3), 303–313. https://doi.org/10.23969/jp.v10i3.27769

Saharani, A., Fakhruddin, & Apriani, E. 2024. Penerapan Model Pembelajaran Inquiri terhadap Kemampuan Berfikir Kritis dan Keatif Siswa dalam Pembelajaran Pendidikan Agama Islam di SMAN 01 Rejang Lebong. *Sibernetik: Jurnal Pendidikan dan Pembelajaran*, *2*(1), 71–78. https://doi.org/10.59632/sjpp.v2i1

Sirait, S. H., Irwansyah, Sinulingga, K. N. B., & Putri, J. I. 2025. Pengaruh Pembelajaran Berdiferensiasi

Berbasis Model Inkuiri dengan Media PheT pada Hasil Belajar IPA dan Aktivitas Siswa Sekolah Dasar. *Jurnal Pendidikan MIPA, 15*(1), 51–59. https://doi.org/10.37630/jpm.v15i1.2359

Siswoyo, A. A., Wijaya, B. R., & Efendi, S. F. 2024. Electronic student Worksheets Based on Project-Based Learning Integrated with Local Wisdom in Social Science Subjects as A Form of Implementation of Creative Pedagogy Learning In Elementary School. *Al-Bidayah: Jurnal Pendidikan Dasar Islam*, *16*(2), 369–400. https://doi.org/10.14421/al-bidayah.v16i2.10201

Sofiyah, K., Lestari, R. F., Nazifah, S., & Limbong, N. 2024. Landasan Psikologis dalam Pembelajaran IPA di Madrasah Ibtidaiyah. *Strategy: Jurnal Inovasi Strategi dan Model Pembelajaran*, *4*(1), 19–27.

Sugiyono. 2022. *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. CV. Alfabeta.

Sumianti, W. S. 2023. Eksplorasi implementasi Model Inkuiri Terbimbing dalam Pembelajaran IPA untuk Meningkatkan Kemampuan Berpikir Kritis dan Rasa Ingin Tahu Siswa Sekolah Dasar di SD Negeri 2 Wadaga. *Misool: Jurnal Pendidikan Dasar*, *5*(1), 33–47. https://doi.org/10.47945/misool.v5i1.1904

Trisnani, E. E. 2024. Strategi Pembelajaran Inkuiri terhadap Hasil Belajar IPS Siswa Madrasah Ibtidaiyyah (MI). *Jurnal Studi Pendidikan Dasar*, *2*(1), 60–80.

Utomo, K. Y., & Siwi, D. A. 2025. Implementasi Model Pembelajaran Guided Inquiry pada Mata Pelajaran IPAS siswa kelas V Sekolah Dasar Negeri 02 Lempong Kecamatan Jenawi Kabupaten Karanganyar Tahun Ajaran 2024/2025. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *10*(03), 132–142.