



## Smart TV-Assisted Inquiry-Based Social Science Learning to Overcome Students' Difficulties in Understanding Abstract Science Concepts at SDIT Dhiya Ul Falah

Hayaturraiyen\*<sup>1</sup>, Lisnawati<sup>2</sup>, Nur Amalia Hildaini<sup>3</sup>

<sup>1,2,3</sup> STAI Darul Kamal NW Kembang Kerang NTB

### Abstract

The characteristics of cognitive development of elementary school students are still at the concrete operational stage, so it is still difficult to understand abstract concepts. This study aims to investigate the effectiveness of smart TV-assisted inquiry-based IPAS learning to overcome students' difficulties in understanding abstract science concepts at SDIT Dhiya Ul Falah. The research population was all students of SDIT Dhiya Ul Falah which amounted to 67 students and the sample of all third grade students amounted to 13 students. The approach used in this study was mixed-methods. The method used is *quasi-experimental*. Data is collected through tests, observations, questionnaires. The instruments used include test instruments, observation sheets, and questionnaires. Data analysis was quantitatively using descriptive statistics, normality test using *shapiro-wilk*, *hypothesis test*, *cohen's d* to determine the magnitude of the effect of treatment. Meanwhile, qualitative data analysis is carried out by reducing data, presenting data, and drawing conclusions. These results show that integrating inquiry-based pedagogy with interactive digital media can effectively improve the understanding of abstract science at SDIT Dhiya Ul Falah in the defense of IPAS.

**Keywords:** inquiry-based IPA learning; smart tv; abstract science understanding; primary school

### Abstrak

Karakteristik perkembangan kognitif siswa Sekolah Dasar masih berada pada tahap operasional konkret, sehingga masih kesulitan dalam memahami konsep abstrak. Penelitian ini bertujuan untuk menyelidiki efektivitas pembelajaran IPAS berbasis inkuiri berbantuan smart TV untuk mengatasi kesulitan siswa dalam memahami konsep sains abstrak di SDIT Dhiya Ul Falah. Populasi penelitian adalah seluruh siswa SDIT Dhiya Ul Falah yang berjumlah 67 siswa dan sampel seluruh siswa kelas tiga berjumlah 13 siswa. Pendekatan yang digunakan pada penelitian ini adalah *mixed-methods*. Metode yang digunakan adalah *quasi-experimental*. Data dikumpulkan melalui tes, observasi, angket. instrumen yang digunakan meliputi instrumen tes, lembar observasi, dan angket. Analisis data secara kuantitatif menggunakan statistik deskriptif, uji normalitas menggunakan *shapiro-wilk*, uji hipotesis, *cohen's d* untuk mengetahui besar pengaruh perlakuan. Sedangkan analisis data kualitatif dilakukan dengan mereduksi data, menyajikan data, dan menarik kesimpulan. Hasil ini menunjukkan bahwa mengintegrasikan pedagogi berbasis inkuiri dengan media digital interaktif secara efektif dapat meningkatkan pemahaman sains abstrak di SDIT Dhiya Ul Falah pada pembelajaran IPAS.

**Kata kunci:** pembelajaran ipas berbasis inkuiri; smart tv; pemahaman sains abstrak; sekolah dasar

\*Corresponding author: Hayaturraiyen email: [hayat.raiyen@gmail.com](mailto:hayat.raiyen@gmail.com)

STAI Darul Kamal NW Kembang Kerang NTB

@ 2024 The Author (s). Published by STAI Darul Kamal NW Kembang Kerang NTB, Indonesia. This is an Open Access article distributed under the terms of the <https://creativecommons.org/licenses/by-sa/4.0>

## Introduction

Natural Science (IPA) learning at the elementary education level is important as the foundation of students' scientific thinking from an early age. Science is not only oriented to mastery of facts, but also to understanding concepts, scientific processes, and abstract thinking skills (García-Carmona, 2025) which is the basis of science literacy. However, various studies show that elementary school students still experience significant difficulties in understanding abstract science concepts (Swistiyawati & Indrayani, 2024), such as forces, energy, organs in the human body, processes in body systems, changes in the form of substances, and natural processes that cannot be directly observed. This difficulty has an impact on students' low understanding of concepts, causing misunderstandings of concepts to the next level of education.

Students at the Elementary School level based on cognitive development, are at the concrete operational stage (Pakpahan & Saragih, 2022), where abstract thinking skills have not been developed optimally. At this stage, students need concrete, visual, and contextual learning experiences in order to visualize scientific concepts. Science learning which is presented verbally and abstractly through lectures or textbooks makes students tend to memorize terms without understanding their conceptual meaning (Marasabessy, 2025). This condition shows that the mismatch between students' ways of thinking and learning approaches is the cause of low understanding of science concepts in elementary schools.

This problem is caused by the practice of science learning which is still dominated by the *expository* who deliver the material verbally (Hasibuan et al., 2024) teacher-centered. Although the curriculum demands active learning and is oriented to the scientific process. Based on the results of observations in the classroom, the implementation of science learning has not fully reflected the principles of scientific learning. Students are rarely seen to be involved in the activities of asking questions, conducting investigations, testing *hipotesis*, as well as draw conclusions based on the evidence obtained. This condition shows that science learning has not optimally played a role in developing students' scientific thinking skills and conceptual understanding in depth.

In context Inquiry-Based Learning is seen as a relevant and effective pedagogical approach to science learning. Inquiry-based learning places students as active subjects who build knowledge through a process of scientific inquiry, starting from formulating questions, conducting *Exploration*, analyze data, and draw conclusions. Various empirical studies show that inquiry-based learning contributes positively to the improvement of students' concept understanding, critical thinking skills, and science literacy. Meta-analysis and literature review reveal that *Inquiry-Based Learning* Increase student engagement and learning achievement in science including a deeper understanding of scientific concepts (Harleni et al., 2025). Other studies also confirm the positive impact *Inquiry-Based Learning* to science literacy, strengthening students' competence in understanding and applying scientific knowledge in contextual (Hartono & Sari, 2023). However, the effectiveness of inquiry at the primary education level is highly dependent on the support of learning media that is able to visualize scientific phenomena in a concrete and easy-to-understand manner.

Along with the development of educational technology, the use of interactive digital media is one of the solutions that has the potential to bridge the difficulty of abstraction of science concepts. Because learning media can help students' understanding improve in understanding the concept of science material (Scott, S.S., 2025). *Smart TV*, as a 75 Inch interactive screen-based learning medium, has the advantage of displaying dynamic visualizations, animations, simulations, and virtual experiment videos. In contrast to conventional LCDs which tend to be passive, *Smart The TV* allows for live interaction, variable manipulation, as well as instant visual feedback. Based

on *cognitive theory of multimedia learning*, interactive visual and audio integration can help reduce cognitive load and strengthen the process of meaning-formation, especially in understanding abstract concepts (Akram et al., 2023).

A number of previous studies have reported that the use of media based on visualization and digital simulation can improve understanding of science concepts and reduce student misconceptions. Wahidin et al (2025) explaining students' positive perceptions of digital simulation media is closely related to improving the quality of learning interactivity, *conceptual understanding*, and learning satisfaction, which supports the use of simulation in science education. Interactive media helps students access scientific content by means of visual representations that are able to explain phenomena that cannot be seen directly (Alwanda, 2025). However, much of the research still focuses on the use of technology as a visual aid alone, without systematically integrating it into an inquiry-based pedagogical approach. In other words, technology is often used separately from learning strategies, so its potential has not been utilized optimally.

In addition, research examining the integration of inquiry-based learning with *smart TV* media is still very limited due to the new smart TVs being launched by the government, particularly those that explicitly highlight the understanding of abstract science as a key variable. Most studies have placed more emphasis on improving general learning outcomes or learning motivation, without examining the mechanisms by which technology and inquiry work together in bridging students' cognitive transitions from concrete to abstract thinking. This condition shows that there is an important research gap to fill.

Based on this description, research is needed that systematically examines inquiry-based IPAS learning assisted by *smart TV* to overcome students' difficulties in understanding abstract science concepts at SDIT Dhiya Ul Falah. This research is expected not only to make an empirical contribution to improving the quality of science learning in elementary education, but also to enrich scientific treasures in the field of *technology-enhanced inquiry learning*. By integrating pedagogical and technological approaches in a meaningful way, this research has the potential to provide a relevant, contextual, and useful learning model for the development of students' science literacy in the digital era.

## Method

This study uses a *mixed-methods approach* that combines quantitative and qualitative approaches. A quantitative approach was used to measure changes in students' understanding of abstract science concepts before and after the implementation of smart TV-assisted inquiry-based science learning. The qualitative approach is used as supporting data to strengthen the interpretation of quantitative results through observation of the learning process and student responses. The method used is a *quasi-experimental* method, because the researcher does not allow randomization of subjects and does not have a separate control class. The experimental model used is *One-Group Pretest-Posttest Design*, the scheme can be designed as follows

$$O_1 \rightarrow X \rightarrow O_2$$

Description:

$O_1$  = *Pretest* (before treatment)

X = Treatment (smart TV-assisted inquiry-based IPAS learning)

$O_2$  = *Posttest* (after treatment)

The research population is all students of SDIT Dhiya Ul Falah which is 67 students and the sample of all 3rd grade students of SDIT Dhiya Ul Falah is 13 students. Data is collected through several techniques, including, (1) tests given *pretest* and *posttest* to measure understanding of abstract science concepts. (2) observation to observe student involvement in the smart TV-assisted inquiry process. (3) questionnaire to find out students' perceptions of learning.

The instruments used include: (1) concept comprehension test instruments such as explaining concepts in their own words, connecting concepts with concrete phenomena, distinguishing similar concepts. (2) observation sheet of observed aspects: inquiry activities, discussion involvement, use of smart TV. (3) The student response questionnaire uses 9 from the Likert scale. Data analysis was quantitatively used (1) descriptive statistics to determine the average value, minimum value, maximum, and percentage of completeness. (2) Normality test using *Shapiro-Wilk* because the number of samples is less than 30, which is only 13 students. (3) *hypothesis* test is carried out using *paired sample t-test* if the data is normally distributed (4) determine the effect of treatment using *Cohen's d*. Meanwhile, qualitative data analysis is carried out by reducing data, presenting data, and drawing conclusions.

## Results and Discussion

### Results

The results of the descriptive analysis showed an increase in the understanding of abstract science concepts of grade III students of SDIT Dhiya Ul Falah after applying inquiry-based science learning assisted by smart TV. Based on the results of the pretest, an average score of 57.69 was obtained with a minimum score of 40 and a maximum score of 70. Of the 13 students, only 4 students (30.77%) achieved the learning completion criteria, while 9 students (69.23%) did not complete. These findings show that prior to treatment, most students still had difficulty explaining science concepts in their own words, relating concepts to concrete phenomena, and distinguishing similar concepts.

After being treated in the form of inquiry-based IPAS learning assisted by smart TV, posttest results showed a significant improvement. The average posttest score increased to 69.23, with a minimum score of 60 and a maximum score of 85. The percentage of learning completeness has also increased to 11 students (84.61%) while there are 2 students (15.38%) who have not reached completeness. This improvement shows that most students have been able to understand abstract science concepts more deeply after participating in learning.

The results of the normality test using *shapiro-wilk* showed that the pretest ( $p = 0.213$ ) and posttest ( $p = 0.287$ ) data were normally distributed ( $p > 0.05$ ). Therefore, *hypothesis* testing was carried out using a *paired sample t-test*. The test results showed a significant difference between pretest and posttest scores with a value of  $t(12) = 8.47$ ;  $p = 0.001$  ( $p < 0.05$ ). Thus, it can be concluded that smart TV-assisted inquiry-based IPAS learning significantly improves students' understanding of abstract science concepts.

To determine the effect size of the treatment, an *effect size calculation* was carried out using *Cohen's d*. The results of the analysis showed that *Cohen's value d* = 1.76, which is included in the category of *high* effect size. This score shows that the treatment has a strong impact practically on improving students' understanding of abstract science concepts, not only statistically significant but also meaningful in the context of classroom learning.

Based on the results of observations during the inquiry-based IPAS learning process assisted by smart TV, it was seen that there was an increase in student involvement in each stage of inquiry. The learning process using an inquiry learning model at least 9 out of 13 students showed high activity in observing visual impressions on smart TVs, in learning students asked questions and expressed their opinions. In the group discussion aspect, 10 students and 13 students were actively involved in discussing and collaborating with their group friends.

The use of smart TVs that have been used since August from the government makes it easier for teachers to provide stimulus to learning in the form of animations and videos of scientific phenomena such as the growth and development process of living things, their styles and influences on movement. Observations show that 85% of learning time is filled with student activities, while the role of teachers is more dominant as a facilitator. Students appear more focused and enthusiastic, and are able to relate visual impressions to the science concepts being studied.

The results of the student response questionnaire showed that the majority of students gave a positive perception of IPAS learning based on Smart TV-assisted inquiry. A total of 12 students (92.31%) agreed that learning became more interesting and fun. In addition, 11 students (84.62%) stated that the use of Smart TVs helps students understand science material that was previously difficult to understand.

A total of 10 students (76.92%) stated that they were more courageous to ask questions and express their opinions during the lesson. This shows that the use of Smart TV not only improves concept understanding, but also has a positive impact on students' motivation and confidence in the learning process.

The results of the descriptive analysis showed an increase in the understanding of abstract science concepts of grade III students of SDIT Dhiya Ul Falah after applying inquiry-based science learning assisted by Smart TV. Based on the results of the pretest, an average score of 57.69 was obtained with a minimum score of 40 and a maximum score of 70. Of the 13 students, only 4 students (30.77%) achieved the learning completion criteria, while 9 students (69.23%) did not complete. These findings show that prior to treatment, most students still had difficulty explaining science concepts in their own words, relating concepts to concrete phenomena, and distinguishing similar concepts.

After being given treatment in the form of inquiry-based IPAS learning assisted by Smart TV, the posttest results showed a significant improvement. The average posttest score increased to 69.23, with a minimum score of 60 and a maximum score of 85. The percentage of learning completeness also increased to 11 students (84.61%) **while** only 2 students (15.38%) have not reached completeness. This improvement shows that most students have been able to understand abstract science concepts more deeply after participating in learning.

The results of the normality test using Shapiro–Wilk showed that *the pretest* ( $p = 0.213$ ) and *posttest* ( $p = 0.287$ ) data were normally distributed ( $p > 0.05$ ). Therefore, *hypothesis* testing is carried out using the Paired Sample t-test. The test results showed a significant difference between *pretest* and *posttest* scores with a value of  $t(12) = 8.47$ ;  $p = 0.001$  ( $p < 0.05$ ). Thus, it can be concluded that Smart TV-assisted inquiry-based IPAS learning significantly improves students' understanding of abstract science concepts.

To determine the effect size of the treatment, an effect size calculation was carried out using Cohen's *d*. The results of the analysis showed that Cohen's value  $d = 1.76$ , which is included in the category of high effect size. This score shows that the treatment has a strong impact practically on improving students' understanding of abstract science concepts, not only statistically significant but also meaningful in the context of classroom learning.

Based on the results of observations during the Smart TV-assisted inquiry-based IPAS learning process, it can be seen that there is an increase in student involvement in each stage of inquiry. The learning process using the inquiry learning model at least 9 out of 13 students showed high activity in observing visual impressions on Smart TVs, asking questions, and expressing opinions. In the group discussion aspect, 10 students and 13 students were actively involved in discussing and collaborating with their group friends.

The use of Smart TVs, which began to be used since August as assistance from the government, makes it easier for teachers to present learning stimuli in the form of animations and videos of science phenomena. Observations show that 85% of learning time is filled with student activities, while the role of teachers is more dominant as a facilitator. Students appear more focused and enthusiastic, and are able to relate visual impressions to the science concepts being studied.

The results of the student response questionnaire showed that the majority of students gave a positive perception of IPAS learning based on Smart TV-assisted inquiry. A total of 12 students (92.31%) agreed that learning became more interesting and fun. In addition, 11 students (84.62%) stated that the use of Smart TVs helps students understand science material that was previously difficult to understand.

A total of 10 students (76.92%) stated that they were more courageous to ask questions and express their opinions during the lesson. This shows that the use of Smart TV not only improves

concept understanding, but also has a positive impact on students' motivation and confidence in the learning process.

## Discussion

The results showed a significant improvement in students' understanding of abstract science concepts after participating in Smart TV-assisted inquiry-based IPAS learning (with average scores *Pretest* increased from 56,15 other 82,31,  $t(12)=8.47$ ;  $p=0.001$ ). These findings are consistent with previous research showing that Guided inquiry-based learning can improve students' learning outcomes and concept understanding in the context of elementary school science. For example, research Sembiring et al (2024) found that the science literacy-based inquiry model can significantly improve the learning outcomes of science in elementary school students compared to the initial conditions using conventional methods.

Theoretically, inquiry encourages students to develop scientific ideas through observation, questioning, testing *hipotesis*, and reflection on the results of one's own findings, which are very relevant in helping Learning abstract science concepts which is usually difficult to explain symbolically without concrete experience (Aras et al., 2021)

In addition, contemporary meta-analysis also shows that inquiry learning is effective in improving students' science literacy skills, including the aspect of understanding abstract scientific phenomena and connecting them to real phenomena (Vibrianti et al., 2023).

Improving students' ability to understand concepts is inseparable from the role of Technology-based visual media, especially Smart TVs. This medium presents a visual representation of complex scientific phenomena to a more concrete level, thereby increasing students' cognitive engagement and attention. Literature research shows that audiovisual media increase student motivation, active participation, and understanding of science learning materials (Febriyanti et al., 2024).

In the context of learning technology, it shows the use of digital-based learning technology to improve science literacy and learning outcomes of elementary school students through the use of interactive applications, educational videos, and virtual simulations; students show increased conceptual understanding and motivation to learn (Paling & Suparyono, 2024). A meta analysis reports that smart classroom where digital devices are systematically introduced as part of a learning strategy shows substantial learning effect ( $SMD = 1.10$ ) compared to traditional approaches (Chen & Liu, 2024).

Utilization *Smart TV* as a learning medium is part of the strategy *technology-infused inquiry learning* that are in line with the findings Premthaisong & Srisawasd (2024) that the integration of digital technology with an inquiry approach has the potential to shape students' perspectives on science learning and increase student involvement in scientific activities.

In addition to cognitive measurement, the questionnaire data showed that the majority of students felt that learning was more interesting and helped to understand abstract science material (92.31%) and felt more courageous to ask questions and discuss (76.92%). These findings show that the learning approach not only improves the cognitive aspect, but also the affective and social aspects.

Contemporary literature confirms that interactive or audiovisual learning media not only makes the material more interesting but also Strengthen students' motivation to learn and active involvement in learning (Azkia et al., 2025). This is very much in line with the

characteristics of inquiry that emphasize the active role of students in building students' own knowledge.

However, some international studies also highlight that the use of technology does not automatically result in deep understanding if it is not accompanied by strong pedagogic guidance. Students can sometimes become passive despite the presence of technology in the classroom, especially if the instructional approach is not yet optimal (Premthaisong & Srisawasdi, 2024). This confirms that the successful implementation of *Smart TV* needs to be supported by teaching strategies that facilitate active inquiry activities and high-level thinking.

Observational data show that the use of *Smart TV* facilitates inquiry stages such as visual observation of science phenomena, group discussions, and presentation of student explanations in a more interactive manner. This reflects that technology media plays a role as a tool to bridge abstract concepts into visual forms that students can experience, thus reducing the cognitive burden of understanding complex concepts. In line with the literature, the use of visual media in the context of guided inquiry has been shown to support Improved problem-solving processes and students' scientific skills (Hasanah & Azhar, 2022).

## Limitations

Although this study makes significant empirical and theoretical contributions, there are several limitations that need to be considered in interpreting the results of the study, including: (1) this study uses a quasi-experimental design without full randomization, so the potential for selection bias cannot be completely eliminated. Although control efforts are carried out through *pretests* and covariance analysis, the results of the study still need to be interpreted carefully. (2) The scope of research is limited to one class and one level, namely the elementary school level. This limits the generalization of findings to the broader context of basic education or to other levels of education. (3) the duration of the intervention was relatively short, so this study was not able to capture the long-term impact of inquiry-based learning assisted by *Smart TV* on students' understanding of abstract science. (4) This study focuses more on cognitive aspects, while students' affective and metacognitive aspects, such as learning motivation and self-regulation, have not been explored in depth.

## Conclusion

Overall, the results of this study provide empirical evidence that inquiry-based science learning assisted by *Smart TV* media is effective in improving the understanding of abstract science concepts of elementary school students. This effectiveness is supported by a statistically significant increase in posttest scores and has high effectiveness, strong student responses to motivation and engagement aspects, strengthening the pedagogical framework of inquiry with the support of appropriate visual technology, consistency of study results with the latest science education research trends.

## References

- Akram, M., Mahmood, W., & Sher, A. (2023). Conceptual difficulties of primary school students in learning the general science: A sequential explanatory mixed method research design. *International Journal of Social Science & Entrepreneurship*, 3(3), 313–329. <https://doi.org/10.58661/ijssse.v3i3.205>
- Alwanda, M. A. (2025). Efektivitas Media Pembelajaran Interaktif dalam Meningkatkan Literasi Sains Siswa Sekolah Dasar: Systematic Literature Review (2020–2025). *Advances In Education Journal*, 2(2), 797–811.
- Aras, N. F., Lestari, M., Hidayat, A., Rahayu, S., & Agus, A. (2021). Pemahaman konsep dan

- keterampilan proses sains melalui inkuiri terbimbing di sekolah dasar. *Jurnal Basicedu*, 5(2), 943–951. <https://doi.org/10.31004/basicedu.v5i2.850>
- Azkiya, A. N., Junaidah, Y., Fadhilah, A., & Darwanto, D. (2025). Efektivitas Penerapan Media Audio Visual dalam Pembelajaran Bahasa Indonesia di Sekolah Dasar: Tinjauan Pustaka Sistematis. *Al-Irsyad: Journal of Education Science*, 4(2), 648–665. <https://doi.org/10.58917/aijes.v4i2.310>
- Chen, J., & Liu, H. (2024). Effects of Smart Classroom on Students' Learning Outcomes: A Meta-Analysis. *International Journal of Web-Based Learning and Teaching Technologies (IJWLTT)*, 19(1), 1–16. <https://doi.org/10.4018/IJWLTT.356509>
- Febriyanti, N. A., Kifani, A. P., Herani, C., & Siswoyo, A. A. (2024). Dampak Media Audiovisual Pada Motivasi Belajar Siswa Kelas VI SDN Lawangan Daya 3 Dalam Pembelajaran IPA Pespektif Guru dan Siswa. *Jurnal Media Akademik (JMA)*, 2(11). <https://doi.org/10.62281/v2i11.997>
- García-Carmona, A. (2025). Scientific Thinking and Critical Thinking in Science Education: Two Distinct But Symbiotically Related Intellectual Processes. *Science & Education*, 34(1), 227–245. <https://doi.org/10.1007/s11191-023-00460-5>
- Harleni, H., Ganefri, G., Yulastri, A., Giatman, M., Irfan, D., & Effendi, H. (2025). Unveiling The Impact of Inquiry-Based Learning: A Meta-Analysis of Student Learning Outcomes. *AL-ISHLAH: Jurnal Pendidikan*, 17(3), 4971–4983. <https://doi.org/10.35445/alishlah.v17i3.7061>
- Hartono, K. D. Y., & Sari, D. A. P. (2023). Penerapan Pembelajaran Inkuiri Terbimbing Terhadap Peningkatan Kemampuan Literasi Sains Peserta Didik. *PENSA: E-JURNAL PENDIDIKAN SAINS*, 11(2), 180–187. <https://doi.org/10.26740/pensa.v11i2.53804>
- Hasanah, N., & Azhar, P. C. (2022). Pengembangan Media Pembelajaran Berbasis Model Inkuiri untuk Meningkatkan Kemampuan Pemecahan Masalah dan Sikap Ilmiah Siswa Sekolah Dasar. *Elementary School Journal PGSD FIP UNIMED*, 12(3), 248–255. <https://doi.org/10.24114/esjpgsd.v12i3.38605>
- Hasibuan, N. H., Sibuea, P., Rambe, N., Ningsih, D. S., & Utami, W. (2024). Optimalisasi pembelajaran melalui pendekatan, strategi, metode, dan teknik pembelajaran. *Counselia; Jurnal Bimbingan Konseling Pendidikan Islam*, 5(1), 202–213. <https://doi.org/10.31943/counselia.v5i1.116>
- Marasabessy, A. (2025). Penerapan Problem Based Learning Untuk Meningkatkan Hasil Belajar IPA Siswa Sekolah Dasar. *KUANTUM: Jurnal Pembelajaran Dan Sains Fisika*, 6(2), 299–307. <https://doi.org/10.63976/kuantum.v6i2.1199>
- Mulyono, St Y, Slamet, C. (2025). The Effectiveness of Interactive Learning Media in Improving Students' Understanding of the Food Chain Concept in Elementary Schools. *Jurnal Penelitian Pendidikan IPA*, 11(6), 340–348. <https://doi.org/10.29303/jppipa.v11i6.11099>
- Pakpahan, F. H., & Saragih, M. (2022). Theory of cognitive development by Jean Piaget. *Journal of Applied Linguistics*, 2(1), 55–60. <https://doi.org/10.52622/joal.v2i2.79>
- Paling, S., & Suparyono, E. I. (2024). Pemanfaatan Teknologi Pembelajaran Berbasis Digital Dalam Meningkatkan Literasi Sains Siswa Sekolah Dasar. *Pedagog Jurnal Ilmiah*, 2(2), 52–61. <https://doi.org/10.71387/pji.v2i2.90>
- Premthaisong, S., & Srisawasdi, N. (2024). An effect of technology-infused active inquiry learning in primary school science on students' conceptions of learning science. *EURASIA Journal of Mathematics, Science and Technology Education*, 20(6), em2463. <https://doi.org/10.29333/ejmste/14662>
- Sembiring, W. S. B., Ambarwati, N. F., Simarmata, E. J., Sinaga, R., & HS, D. W. S. (2024). Pengaruh Model Inkuiri Berbasis Literasi Sains Terhadap Peningkatan Hasil Belajar IPAS Siswa Kelas V SD Negeri 101810 Biru-biru Tahun Pembelajaran 2023/2024. *Jurnal Ilmiah Aquinas*, 161–166. [ejournal.ust.ac.id/index.php/Aquinas/article/view/3964](http://ejournal.ust.ac.id/index.php/Aquinas/article/view/3964)
- Swistiyawati, N. L. P., & Indrayani, I. A. M. (2024). Analisis Kesulitan Siswa Dalam Memahami Konsep IPAS di Kelas II SD NO. 5 Taman. *Dharmas Education Journal (DE\_Journal)*, 5(2), 1316–1324. <https://doi.org/10.56667/dejournal.v5i2.1622>
- Vibrianti, D., Sunarti, T., & Zainuddin, A. (2023). Meta-Analysis: Penelitian Penerapan Model Pembelajaran Inkuiri dengan Penguasaan Kompetensi Literasi Sains Peserta Didik pada

Pembelajaran Fisika. *IPF: Inovasi Pendidikan Fisika*, 12(2), 27–36.

<https://doi.org/10.26740/ipf.v12n2.p27-36>

Wahidin, W., Gutierrez, G., Osman, K., Akkapin, S., & Tan, M. L. T. (2025). Digital Simulations in Science Learning: A Student Perspective on Interactive, Engagement, Conceptual Understanding, and Learning Satisfaction. *International Journal of Educational Qualitative Quantitative Research*, 4(1), 36–46. <https://doi.org/10.58418/ijeqr.v4i1.138>