JPPIPA 10(7) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Electronic Based Practicum Guide Using Inquiry Models to Improve Science Process Skills and Student Learning Outcomes

Utari Prisma Dewi[1], Syafriani[2*]

[1] Master of Physics Education, Faculty of Mathematics and Natural Science, Universitas Negeri Padang, Padang, Indonesia.
[2] Department of Physics, Faculty of Mathematics and Natural Science, Universitas Negeri Padang, Padang, Indonesia.

Received: May 17, 2024
Revised: June 20, 2024
Accepted: July 25, 2024
Published: July 31, 2024

Corresponding Author:
Syafriani
syafri@fmipa.unp.ac.id

DOI: 10.29303/jppipa.v10i7.7677

Abstract: Low science process skills also result in low learning outcomes. So the solution is to develop an electronic-based practicum guide using an inquiry model on measurement material. This research aims to develop an electronic-based practicum guide using an inquiry model on measurement material to improve science process skills and student learning outcomes. The development model is the ADDIE model. The research instruments used were expert and practitioner validation questionnaires, student response assessment questionnaires and pretest-posttest results. Data was analyzed quantitatively descriptively. The results of the N-gain test are 16 students who got a score of (g) ≥ 0.7, 14 students who got a score of (g) ≥ 0.3, and 14 students who got a score of (g) <0.3 as many as 0 people. Based on the results of this research, it can be concluded that electronic-based practicum guides using inquiry models in measurement material can improve science process skills and student learning outcomes.

Keywords: Inquiry; Learning outcomes; Measurement; Practical guide; SPS

Introduction

Improving the quality of education in Indonesia is always carried out through improving education following the changes and developments in life that are currently occurring in the 21st century. In today's learning, we are required to train "new" skills that are relevant to this change, namely 21st Century skills (Fatmaryanti et al., 2024). However, as time goes by and advances in technology, education is required to make new innovations in order to create a generation or human resources with superior character (Saputri et al., 2022). One of these improvements is by improving the curriculum from the 2013 Curriculum to the Independent Curriculum. The implementation of the Independent Curriculum influences learning materials in schools (Hasmawati et al., 2023; Maulia et al., 2024). The Independent Curriculum gives educators the freedom to create quality learning that suits students' needs and learning environment (Fadillah et al., 2023). In accordance with the demands of the independent curriculum currently in use, science process skills must be developed in learning, especially in science lessons (Triani et al., 2023).

One of the science lessons is physics. Physics is a scientific discipline that investigates both natural phenomena and phenomena related to human existence, and teaches students to reason rationally and mathematically (Suprapto et al., 2021; Wirayuda et al., 2022). Difficulties in learning physics are caused by various different things simultaneously inherent in the presentation of a physics lesson (Ady, 2022; Kuswanto, 2017). Physics learning focuses on concepts that require a high level of understanding. Physics learning can develop students' inductive and deductive analytical thinking skills in solving problems related to natural events and can develop knowledge, skills and attitudes (A. R. Putri et al., 2018; Sulistiyono, 2022; Yolviansyah et al., 2022). An important and useful skill for students to have in learning science is science process skills.

Science process skills equip students in studying physics, which will also be useful in everyday life.

How to Cite:
Dewi, U. P., & Syafriani. (2024). Electronic Based Practicum Guide Using Inquiry Models to Improve Science Process Skills and Student Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *10*(7), 3799–3804. https://doi.org/10.29303/jppipa.v10i7.7677

Science process skills are basic competencies in the learning process by prioritizing the ability to acquire knowledge and communicate what has been obtained (Fitriani et al., 2021). Science process skills are needed by students to face a world dominated by science and technology (Jaya et al., 2022; Yalçınkaya-Önder et al., 2022). So science process skills are very important for students in science education as shown by the existence of a relationship between science process skills and student academic achievement (Senisum et al., 2022; Sideri et al., 2021).

Even though science process skills are important for students, facts in the field show that students' science process skills are still in the unsatisfactory category. This can be seen from the science abilities of Indonesian students based on the 2015 TIMSS survey which is more towards the low level with a percentage of 54% (Hadi et al., 2019). The results of research conducted by Sampe et al. (2022), show that students' science process skills are still very low because learning still uses conventional models and practical activities or activities that support students' science process skills are still rarely implemented.

Talking about the ability of the science process in schools cannot be separated from learning outcomes. The science process skills obtained through practicum activities are very useful because in practicum the skills developed are not only psychomotor skills but also cognitive and affective skills. Putri et al. (2024) the implementation of the teaching method from the teacher is apparently not enough to significantly improve outcomes of learning from students in physics according to the data on the end-of-semester assessment results which are still very far from expected. Science process skills are very important to help students understand science concepts better and obtain optimal learning outcomes (Dewi, 2019; Lestari et al., 2023; Maizaliani et al., 2024).

Insufficient science process skills will have an impact on student learning outcomes, in accordance with research conducted by Rafiah et al. (2018), namely that the teaching and learning process is only centered on the teacher, as a result students are not trained to develop science process skills and this will result in low student learning outcomes. To support practicum activities, a practicum guide is needed. This is in accordance with research by Trisnawati (2011) which states that practical instructions are needed to guide practical activities so that they can run smoothly.

Practical guidance should also be able to guide students to develop creativity and scientific attitudes in conducting experiments. One approach that can be used is to use an inquiry model. Based on how to develop students' science process skills, it is necessary to have a learning model that can support the emergence and improvement of students' science process skills, one of which is the inquiry learning model (Hasan, 2024; Meisaroh et al., 2024). Inquiry is a series of learning activities that maximally involve all students' abilities to search and investigate systematically, critically, logically, analytically, so that students can formulate their own discoveries with full confidence.

Therefore, inquiry education aims to increase the level of thinking and critical thinking skills. The guided inquiry learning models itself is a learning model that is student centered or in other words centered on students, this model puts students in a situation where they are required to experiment independently in order to see for themselves the phenomena that occur (Wulaningsih et al., 2011). According to Siahaan et al. (2020) the guided inquiry learning approach can improve science process skills because in the learning stages it will provide more opportunities for students to seek and find their own facts with direct experience which results in a more optimal learning process. In addition, presenting material that involves multiple representations in guided inquiry syntax helps students understand concepts (Nurani et al., 2024). The application of this model is very meaningful in efforts to improve the quality of learning (Juniati et al., 2017). Inquiry can be a form of education in gaining insight (Salam, 2019). Apart from that, learning also requires learning media. Learning media is one of the solutions to improve the quality of learning and student interest in learning materials (Aristaria et al., 2024; Lumbantoruan et al., 2022).

The practicum guides used so far are still print-based, making students bored and not interested in carrying out practicums. Khotimah et al. (2023) said that there are still many students who lack skills in asking questions, students also seem bored and busy themselves, which affects student learning outcomes. This Is because the physics learning process that is taking place is not carried out in accordance with its essence (Nisah et al., 2024). And the guides currently used are only used to measure science process skills or only to measure learning outcomes.

The newest thing in this research is developing a practical guide to improve both science process skills and student learning outcomes and to respond to developments in the era where students are required to be technologically literate, so the guide developed is electronic-based. So the aim of this research is to develop an electronic-based practicum guide using an inquiry model in measurement material to improve science process skills and student learning outcomes.

Method

This type of research is research and development of the Lee and Owens model with the ADDIE approach. The development model used in this research is the (Lee et al. (2004) model with the ADDIE approach which consists of 5 stages, namely analysis, design, development, implementation and evaluation. The stages of development of ADDIE by Lee and Owens are shown in Figure 1.

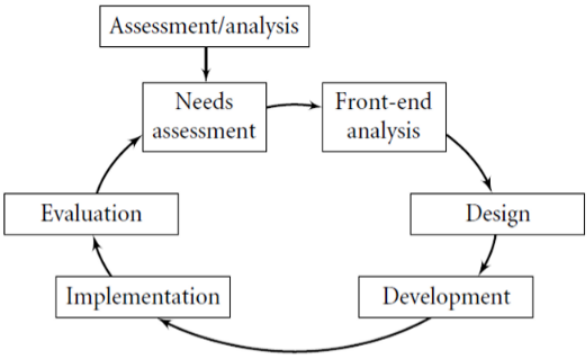

Figure 1. The Lee and Owens concept

The research instruments in this study were expert validation sheet questionnaires, practitioner sheets, student response assessment questionnaires and pretest-posttest results. The research design used was pre-experimental with one group pretest-posttest. The pre-experimental design with one group pretest-posttest is as follows. The collected pretest and posttest data were then used to find the N-gain value. The formula for finding the N-gain value is as follows:

$$N - Gain = \frac{Posttest - Pretest}{Ideal\ Value - Pretest} \quad (1)$$

The N-gain value is then converted into statement form. The criteria for stating the N-gain value can be seen in Table 1 below:

Table 1. Score Criteria

N-Gain Value	Effectiveness
(g) ≥ 0.7	Tall
0.7 > (g) ≥ 0.3	Currently
(g) <0.3	Low

Result and Discussion

The electronic-based practicum guide uses an inquiry model on measurement material to improve science process skills and student learning outcomes developed using the Lee and Owens model with the ADDIE (analysis, design, development, implementation and evaluation) approach. At the needs analysis and assessment stage there are two stages, namely Need Assessment or needs assessment carried out to determine the gap between actual and ideal conditions and Front-End Analysis carried out to collect techniques that can be used as a solution to the existing gap.

Next is the design stage, where the researcher designs the product being developed, namely an electronic-based practicum guide using an inquiry model on measurement material to improve science process skills and student learning outcomes.

The Effectiveness of Electronic-Based Practicum Guides in Improving Science Process Skills

The following are the overall results or recapitulation of the results of observations of students' science process skills before and after carrying out learning using the practicum guide. This diagram shows the average percentage value of students' science process skills.

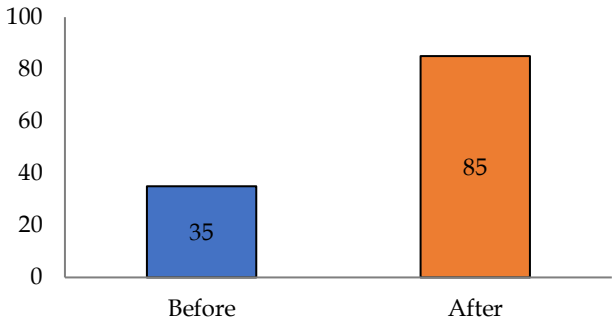

Figure 2. SPS percentage value based on observation sheet

Based on Figure 2, the results obtained from observations of students' science process skills in learning before using the practicum guide were 35% in the very poor category, while students' science process skills in learning using the practicum guide were in the good category. Therefore, it can be concluded that there is an increase in students' science process skills after carrying out learning using the practical guide developed by researchers. In line with the results of research conducted by Fauzi (2017) stated that science practicum guidebooks are able to improve students' science process skills. Likewise, in research conducted by Fajarianingtyas et al. (2020), it was concluded that inquiry-based practicum guides were proven to be effective in improving students' science process skills.

Effectiveness of Electronic-Based Practicum Guides in Improving Cognitive Learning Outcomes

Data on pretest and posttest results were obtained from tests before using the practicum guide and after using the practicum guide. The presentation of pretest-posttest data and N-Gain values from field trial results can be seen in Table 2.

Table 2. Pretest and Posttest Results of Cognitive Learning Outcomes

Student Code	Pretest Value	Posttest Value	N-Gain	Effectiveness Level
A1	30	75	0.64	Currently
A2	40	90	0.83	Tall
A3	30	75	0.64	Currently
A4	45	75	0.54	Currently
A5	50	80	0.6	Currently
A6	35	80	0.69	Currently
A7	35	75	0.61	Currently
A8	35	80	0.69	Currently
A9	50	95	0.9	Tall
A10	35	75	0.61	Currently
A11	30	80	0.71	Tall
A12	45	95	0.90	Tall
A13	35	90	0.84	Tall
A14	35	75	0.61	Currently
A15	35	75	0.61	Currently
A16	35	75	0.61	Currently
A17	30	80	0.71	Tall
A18	45	95	0.90	Tall
A19	30	90	0.85	Tall
A20	25	75	0.66	Currently
A21	35	95	0.92	Tall
A22	40	85	0.75	Tall
A23	25	80	0.73	Tall
A24	45	75	0.54	Currently
A25	40	90	0.83	Tall
A26	50	85	0.7	Tall
A27	30	85	0.78	Tall
A28	40	75	0.58	Currently
A29	45	90	0.81	Tall
A30	35	90	0.84	Tall

Table 2 shows that there is a change in scores from before and after using the practicum guide which is shown in the pretest and posttest scores. Next, the values obtained are analyzed to find the N-gain value. There were 16 students who got a score of (g) ≥ 0.7, 14 students who got a score of (g) ≥ 0.3, and 0 students who got a score of (g) < 0.3. In line with research conducted by Pangestika et al. (2018), it shows that the practicum guide developed can improve students' practical skills and cognitive learning outcomes. Likewise, in research carried out by Fajarianingtyas et al. (2020), it was concluded that there was an increase in learning outcomes as shown by an N-gain of 0.74 with high criteria when using the inquiry-based practical instructions that had been developed. Likewise, the results of research conducted by Rafiah et al. (2018) state that through guided inquiry learning, science process skills and student learning outcomes can be improved.

Conclusion

The results of observations of students' science process skills in learning before using the practicum guide were 35% which was in the very poor category, while students' science process skills in learning after using the practicum guide were 82% in the good category. Therefore, it can be seen that there is an increase in students' science process skills after carrying out learning using the practicum guide developed by researchers. The practical guide that has been developed has been proven to improve students' cognitive learning outcomes. The results of the N-gain test carried out were 16 students who got a score of (g) ≥ 0.7, 14 students who got a score of (g) ≥ 0.3, and 14 students who got a score of (g) <0.3 as many as 0 people. Based on the results of this research, it can be concluded that electronic-based practicum guides using inquiry models in measurement material can improve science process skills and student learning outcomes.

Acknowledgments

The author would like to thank profusely for the award that has been given to the author, in which this article has been analyzed and referenced. The author is very honored and excited to know that this work has been accepted and recognized by a respectable journal such as JPPIPA.

Author Contributions

Author contributions include Utari Prisma Dewi: collecting data, analyzing data, writing original draft, and so on; Syafriani: person in charge of research.

Funding

This research was independently funded by researchers.

Conflicts of Interest

The authors declare no conflict of interest

References

Ady, W. N. (2022). Analisis Kesulitan Belajar Siswa SMA terhadap Mata Pelajaran Fisika pada Materi Gerak Lurus Beraturan. *Jurnal Pendidikan Dan Ilmu Fisika*, *2*(1), 104. https://doi.org/10.52434/jpif.v2i1.1599

Aristaria, A., Wilujeng, I., & Herawati, N. I. (2024). Development of Physics Interactive Learning Media based on Problem Based Learning assisted by SAC Application to Improve Student Problem Solving Ability. *Jurnal Penelitian Pendidikan IPA*, *10*(4), 1731–1738. https://doi.org/10.29303/jppipa.v10i4.6082

Dewi, T. M. (2019). Pengembangan Buku Penuntun Praktikum IPA SD Berbasis Keterampilan Proses Sains Pada Mata Kuliah Praktikum IPA SD Untuk Mahasiswa Pendidikan Guru Sekolah Dasar (PGSD). *SIMBIOSA*, *8*(1). https://doi.org/10.33373/sim-bio.v8i1.1803

Fadillah, E. S., Siregar, R. A. D., & Siregar, E. J. (2023). Analisis Aktivitas Belajar Siswa dengan Pemanfaatan Lingkungan Sekolah Sebagai Sumber

Belajar Mata Pelajaran Biologi di Kelas X SMA Negeri 1 Angkola Timur. *Jurnal Edugenesis*, *6*(2), 29–32. Retrieved from https://journal.spada.ipts.ac.id/index.php/BIOESA/article/view/1622

Fajarianingtyas, D. A., & Hidayat, J. N. (2020). Pengembangan Petunjuk Praktikum Berorientasi Pemecahan Masalah sebagai Sarana Berlatih Keterampilan Proses dan Hasil Belajar Mahasiswa IPA Universitas Wiraraja. *Jurnal Pendidikan Sains Indonesia*, *8*(2), 152–163. https://doi.org/10.24815/jpsi.v8i2.15515

Fatmaryanti, S. D., Kurniawan, E. S., Hakim, Y. Al, Sarwanto, & Ulfah, D. L. (2024). Enhancing 21st Century Skills for Prospective Physics Teachers through Arduino-Based Multiple Representations in Learning Heat and Temperature. *Jurnal Penelitian Pendidikan IPA*, *10*(4), 1779–1786. https://doi.org/10.29303/jppipa.v10i4.5315

Fauzi, M. . I. A. (2017). *Pengembangan Panduan Praktikum untuk Meningkatkan Keterampilan Proses Sains SIswa SD/Mi Kelas V* [Universitas Islam Negeri Sunan Kalijaga]. Retrieved from https://digilib.uin-suka.ac.id/id/eprint/27705/

Fitriani, R., Maryani, S., Chen, D., Aldila, F. T., Br.Ginting, A. A., Sehab, N. H., & Wulandari, M. (2021). Mendeskripsikan Keterampilan Proses Sains Siswa melalui Kegiatan Praktikum Viskositas di SMAN 1 Muaro Jambi. *PENDIPA Journal of Science Education*, *5*(2), 173–179. https://doi.org/10.33369/pendipa.5.2.173-179

Hadi, S., & Novaliyosi. (2019). TIMSS Indonesia (Trends In International Mathematics And Science Study. In *Prosiding Seminar Nasional & Call For Papers*. Retrieved from https://jurnal.unsil.ac.id/index.php/sncp/article/view/1096.

Hasan, A. M. (2024). The Use of Inquiry Learning Model on Plant Growth and Development Material to Improve Students' Science Process Skills. *Jurnal Penelitian Pendidikan IPA*, *10*(3), 982–990. https://doi.org/10.29303/jppipa.v10i3.4874

Hasmawati, Ali, M. S., & Arsyad, M. (2023). Influence of the Guided Inquiry Learning Model and Scientific Attitude in Physics on Students' Science Process Skills. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 11484–11496. https://doi.org/10.29303/jppipa.v9i12.4729

Jaya, T. D., Tukan, M. B., & Komisia, F. (2022). Penerapan Pendekatan Inkuiri Terbimbing Untuk Melatih Keterampilan Proses Sains Siswa Materi Larutan Penyangga. *Educativo: Jurnal Pendidikan*, *1*(2), 359–366. https://doi.org/10.56248/educativo.v1i2.44

Juniati, N. W., & Widiana, I. W. (2017). Penerapan Model Pembelajaran Inkuiri untuk Meningkatkan Hasil BELAJAR IPA. *Journal of Education Action Research*, *1*(2), 122. https://doi.org/10.23887/jear.v1i2.12045

Khotimah, K., & Supratiyoko, K. (2023). Peningkatan Keterampilan Proses Sains Siswa Melalui Model Pembelajaran Problem Based Learning. *LAMBDA : Jurnal Ilmiah Pendidikan MIPA Dan Aplikasinya*, *3*(1), 13–21. https://doi.org/10.58218/lambda.v3i1.533

Kuswanto. (2017). *Deskripsi keterampilan proses sain melalui praktikum fisika dasar untuk mahasiswa pendidikan fisika tahun ajaran 2016/2017 di universitas jambi*. Retrieved from https://repository.unja.ac.id/id/eprint/1773

Lee, W. W., & Owens, D. L. (2004). *Multimedia-based instructional design: computer-based training, web-based training, distance broadcast training, performance-based solutions*. John Wiley & Sons.

Lestari, A. K., Fitriani, A., & Kusnadi. (2023). Application of STEM-Integrated Guided Inquiry Model to Improve Science Process Skills of Junior High School Learners on Human Respiratory System Material. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 11078–11084. https://doi.org/10.29303/jppipa.v9i12.5845

Lumbantoruan, A., Muhaimin, M., & Purwaningsih, S. (2022). Pengembangan E-Modul Berbasis Pemecahan Masalah Untuk Sekolah Menengah Atas Sebagai Upaya Dalam Melatih Keterampilan Proses Sains. *SPEKTRA: Jurnal Kajian Pendidikan Sains*, *8*(2), 99–111. https://doi.org/10.32699/spektra.v8i2.253

Maizaliani, C. R., Muhibbuddin, M., Syukri, M., Saminan, S., Nurmaliah, C., Evendi, E., & Herliana, F. (2024). Utilizing Visual Teaching Materials to Assist Students in Science Subjects Improves Science Process Skills. *Jurnal Penelitian Pendidikan IPA*, *10*(4), 2162–2169. https://doi.org/10.29303/jppipa.v10i4.6815

Maulia, E., Hakim, R., Bentri, A., & Darmansyah, D. (2024). Development of an E-Module Based on a Guided Inquiry Learning Model in Natural Science Subjects in Elementary Schools. *Jurnal Penelitian Pendidikan IPA*, *10*(4), 1551–1555. https://doi.org/10.29303/jppipa.v10i4.6997

Meisaroh, S., & Suparno. (2024). Development of Android-Based Interactive Mobile Learning with Guided Inquiry Models to Improve Higher Order Thinking Skills on Light Wave Material. *Jurnal Penelitian Pendidikan IPA*, *10*(2), 522–529. https://doi.org/10.29303/jppipa.v10i2.4869

Nisah, K., Saminan, Syukri, M., Elisa, & Markisni. (2024). Optimizing of Physics Learning through PjBL-STEM Model to Improve Critical Thinking Skills and Students Responsibility Attitudes. *Jurnal Penelitian Pendidikan IPA*, *10*(4), 1770–1778.

https://doi.org/10.29303/jppipa.v10i4.6795

Nurani, I., & Suyanta. (2024). Development of Multiple Representation-based Electronic Teaching Materials Using Guided Inquiry on Acid-Base Topic. *Jurnal Penelitian Pendidikan IPA*, *10*(4), 1674–1683. https://doi.org/10.29303/jppipa.v10i4.5118

Pangestika, D. S., & Prasetyo, Z. K. (2018). Practical Guide Based on Learning Cycle 5E to Enhance Students' Cognitive Learning Outcomes. *Biosaintifika: Journal of Biology & Biology Education*, *10*(3), 491–499. https://doi.org/10.15294/biosaintifika.v10i3.14884

Putri, A. R., Maison, M., & Darmaji, D. (2018). Kerjasama dan Kekompakan Siswa dalam Pembelajaran Fisika di Kelas XI MIPA SMA Negeri 3 Kota Jambi. *EduFisika*, *3*(02), 32–40. https://doi.org/10.22437/edufisika.v3i02.5552

Putri, V. N., Sundari, P. D., Hufri, H., & Sari, S. Y. (2024). Physics Teaching Materials Based on The Creative Problem-Solving Model with Concept Maps: The Effect on Students' Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *10*(4), 1907–1915. https://doi.org/10.29303/jppipa.v10i4.5805

Rafiah, R., Arifuddin, M., & Mahardika, A. I. (2018). Meningkatkan Keterampilan Proses Sains dan Hasil Belajar IPA Melalui Model Pembelajaran Inkuiri Terbimbing. *Jurnal Ilmiah Pendidikan Fisika*, *2*(3), 186. https://doi.org/10.20527/jipf.v2i3.1023

Salam, R. (2019). Model Pembelajaran Inkuiri Dalam Pembelajaran IPS. *Harmony*, *2*(1), 7–12. https://doi.org/10.15294/harmony.v2i1.19965

Sampe, M., Riwu Ga, P., & Benu, H. (2022). Pengaruh Model Project Based Learning Terhadap Keterampilan Proses Sains pada Pembelajaran IPA Materi Sistem Peredaran Darah Manusia di Kelas V SD Gmit Manumuti. *Journal of Character and Elementary Education*, *1*(1), 73–81. https://doi.org/10.35508/jocee.v1i1.9979

Saputri, A. G., & Trihantoyo, S. (2022). Penerapan Model Pembelajaran Problem Solving Dalam Perspektif Merdeka Belajar Di Masa Pandemi Covid-19. *Jurnal Inspirasi Manajemen Pendidikan*, *10*(02), 352–363. Retrieved from https://ejournal.unesa.ac.id/index.php/inspirasi-manajemen-pendidikan/article/view/47242

Senisum, M., Susilo, H., Suwono, H., & Ibrohim. (2022). GIReSiMCo: A Learning Model to Scaffold Students' Science Process Skills and Biology Cognitive Learning Outcomes. *Education Sciences*, *12*(4), 228. https://doi.org/10.3390/educsci12040228

Siahaan, K. W. A., Lumbangaol, S. T. P., Marbun, J., Nainggolan, A. D., Ritonga, J. M., & Barus, D. P. (2020). Pengaruh Model Pembelajaran Inkuiri Terbimbing dengan Multi Representasi terhadap Keterampilan Proses Sains dan Penguasaan Konsep IPA. *Jurnal Basicedu*, *5*(1), 195–205. https://doi.org/10.31004/basicedu.v5i1.614

Sideri, A., & Skoumios, M. (2021). Science Process Skills in the Greek Primary School Science Textbooks. *Science Education International*, *32*(3), 231–236. https://doi.org/10.33828/sei.v32.i3.6

Sulistiyono, S. (2022). Pengembangan Modul Pembelajaran Fisika Berbasis Scientific Investigation untuk Meningkatkan Kemandirian Belajar dan Penguasaan Materi Siswa SMA. *JagoMIPA: Jurnal Pendidikan Matematika Dan IPA*, *2*(1), 33–41. https://doi.org/10.53299/jagomipa.v2i1.157

Suprapto, N., Ibisono, H. S., & Mubarok, H. (2021). The use of physics pocketbook based on augmented reality on planetary motion to improve students' learning achievement. *Journal of Technology and Science Education*, *11*(2), 526. https://doi.org/10.3926/jotse.1167

Triani, E., Darmaji, & Astalini. (2023). Identifikasi Keterampilan Proses Sains dan Kemampuan Berargumentasi. *Jurnal Pendidikan Dan Pembelajaran IPA Indonesia*, *13*(1), 9–16. https://doi.org/10.23887/jppii.v13i1.56996

Wirayuda, R. P., Wandai, R., & Ginting, A. A. B. (2022). Hubungan Sikap Siswa Terhadap Hasil Pembelajaran Fisika SMA N 1 Kota Sungai Penuh. *Integrated Science Education Journal*, *3*(1), 24–27. https://doi.org/10.37251/isej.v3i1.172

Wulaningsih, S., Prayitno, B. A., & Probosari, R. M. (2011). Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Keterampilan Proses Sains Ditinjau Dari Kemampuan Akademik Siswa Science Process Skills Viewed From Student'S Academic. *Circulation Research*, *108*(9), 1037–1037. https://doi.org/10.1161/RES.0b013e31821e0b53

Yalçınkaya-Önder, E., Zorluoğlu, S. L., Timur, B., Timur, S., Güvenç, E., Özergun, I., & Özdemir, M. (2022). Investigation of Science Textbooks in terms of Science Process Skills. *International Journal of Contemporary Educational Research*, *9*(2), 432–449. https://doi.org/10.33200/ijcer.1031338

Yolviansyah, F., Maison, M., & Kurniawan, D. A. (2022). Identifikasi Miskonsepsi Peserta Didik Pada Pembelajaran Fisika di SMA N 8 Kota Jambi. *Edumaspul: Jurnal Pendidikan*, *6*(1), 541–545. https://doi.org/10.33487/edumaspul.v6i1.3164