Volume 10 Number 1, April 2025, pp. 107~116
P-ISSN:2477-7935
E-ISSN: 2548-6225
DOI: 10.59052/edufisika.v10i1.43130

TEACHER PERCEPTION OF CITIZENSHIP IN SCIENCE LEARNING TOOLS IN UNIFORM STRAIGHT MOTION AND UNIFORMLY ACCELERATED STRAIGHT MOTION

Fhadira Insani Putri[1], Sri Purwaningsih [2], dan Asrial [3]
[1,2,3] Master of Science Education, University of Jambi, Jambi, Indonesia
Corresponding author email: fhadira17@gmail.com

Article Info
Recieved: 27 February 2025
Accepted: 14 April 2025
Publication: 19 April 2025

Abstract :
This research aims to analyze teacher perceptions of Citizenship in Science learning tools designed to develop critical thinking skills in physics, specifically for Regular Straight Motion and Regular Changing Straight Motion materials. Using a mixed-method approach with an explanatory sequential design, data was collected from 9 junior high school science teachers through both quantitative questionnaires and qualitative interviews. The research employed purposive sampling to ensure participants had direct experience teaching the relevant physics concepts. Quantitative data was analyzed descriptively while qualitative data was processed using the Miles and Huberman method. Results indicate that teachers perceive the learning tools very positively with an average rating of 90.06%, particularly appreciating the systematic design, content clarity, critical thinking facilitation, and 21st century learning integration. The novelty of this study lies in its explicit integration of Citizenship in Science approaches with critical thinking development in physics education, providing a framework that connects theoretical physics concepts with real-world applications and civic responsibility. This research contributes to understanding the potential implementation challenges and opportunities for innovative physics learning tools in classroom settings. The findings imply that physics education can be enhanced through tools that not only develop conceptual understanding but also foster critical thinking skills necessary for scientific citizenship, though further classroom implementation studies with larger samples are needed to validate effectiveness.

Keywords: Citizenship in Science, Critical Thinking Skills, Learning Tools

INTRODUCTION

Learning tools are one of the main elements in the educational process designed to assist teachers in delivering materials and guiding students to achieve learning objectives (Ahmal et al., 2020; Azni & Jailani, 2015; Fakhri, 2023). Good learning tools not only include systematic planning, but must also be able to facilitate the development of student skills according to the demands of the times (Harjono et al., 2019; Hartini, 2017; Nursari et al., 2021). In science learning, learning tools should ideally not only be oriented towards understanding concepts, but also encourage students to think critically and be able to relate material to real-life phenomena (Makhrus & Hadiprayitno, 2012; Novianti Taufik et al., 2023). Therefore, a learning approach based on active student involvement in science, such as Citizenship in Science, is becoming increasingly relevant to implement.

Citizenship in Science is an approach that emphasizes the importance of student participation in understanding science as part of social and environmental life. By using this concept, science learning not only focuses on transferring knowledge, but also builds students' awareness of science issues that impact society (Eleta et al., 2019; Mitchell et al., 2017; Queiruga-Dios et al., 2020). Through the application of Citizenship in Science, students are invited to think reflectively, identify science-based problems in everyday life, and contribute to finding solutions (Muaziyah et al., 2023; Roche et al., 2020; Vesterinen et al., 2016). This is in line with the needs of 21st century learning which prioritizes critical thinking skills as one of the main competencies that must be developed in science learning.

Critical thinking skills are one of the most important skills in science learning because they allow students to analyze information in more depth, evaluate data, and make decisions based on valid evidence (Indiana et al., 2024; Rosdianto et al., 2020; Sevtia et al., 2022). Critical thinking also helps students understand the relationship between theory and practice, so that students can apply science concepts in various real situations (Mulia & Murni, 2022; Nuai & Nurkamiden, 2022; Yolanda et al., 2024). Therefore, the integration of critical thinking into science learning tools can improve the quality of learning by fostering a scientific mindset and a sense of responsibility towards environmental and social problems.

Science learning at the junior high school level aims to provide a strong foundation for students in understanding scientific concepts that support the development of students' critical and analytical thinking skills (Aprina et al., 2024; Suryaningsih, 2018; Vebrianto & Istiqomah, 2021). In the process, science learning not only teaches theory, but also encourages students to conduct observations, experiments, and data analysis in order to find patterns and scientific principles behind various natural phenomena (Anggareni et al., 2013; Juhji, 2015; Sawitri et al., 2024). However, the effectiveness of science learning is highly dependent on how learning tools are designed and implemented by teachers in teaching and learning activities in the classroom (Rosdianto et al., 2022). Learning tools that are not optimally designed have the potential to reduce student participation and weaken the development of critical and analytical thinking skills which are the main objectives of science learning.

In the topics of Uniform Straight Motion and Uniformly Accelerated Straight Motion, students are not only required to understand the concepts and formulas theoretically, but also to relate them to real-life phenomena, such as the movement of vehicles or objects experiencing acceleration. These two topics are essential components of kinematics that can be utilized to foster critical thinking skills through graph analysis, interpretation of observational data, and the connection between mathematical models and real-world conditions. Therefore, the development of learning tools that integrate Uniform Straight Motion and Uniformly Accelerated Straight Motion materials with participatory and contextual approaches is crucial to support students' conceptual mastery and higher-order thinking skills.

This study is in line with the research conducted by Zagoto & Dakhi, (2018) which states that the availability of adequate learning devices will help teachers in implementing the learning process to achieve the expected learning goals and objectives. In addition, learning devices need to be designed in such a way as to encourage students to be actively involved in building their own knowledge and skills (Doyan et al., 2024; Fakhri, 2023; Rosdianto et al., 2018). Although various studies have discussed the importance of learning devices, there remains a significant research gap regarding how teachers perceive and evaluate Citizenship in Science learning tools specifically designed to enhance critical thinking skills in physics education. Previous research has primarily focused on general learning tools or devices without specifically addressing the integration of citizenship values in physics education through the context of Uniform Straight Motion and Uniformly Accelerated Straight Motion materials. Furthermore, while existing studies recognize the importance of critical thinking in science education, few have examined the practical aspects of implementing learning tools that explicitly target these skills within a citizenship-oriented framework.

This gap becomes even more apparent when considering the limited research on physics teachers' readiness to adopt innovative learning approaches that go beyond traditional content delivery to include societal relevance and application. According to Wahyuni et al., (2017) a person's perception is an active process that plays a role, not only the stimulus that affects it but also the individual as a whole with their experiences, motivations and attitudes that are relevant in responding to the stimulus. In addition, perception is a process of making judgments or building impressions about various things in a person's sensory field (Istiani et al., 2017; Yudha et al., 2023). Based on the description above, it is necessary to carry out a readability test to describe teacher perceptions of learning tools for train student developed critical thinking skills.

This research aims to analyze science teachers' perceptions regarding Citizenship in Science learning tools that are specifically designed to enhance students' critical thinking skills in Uniform Straight Motion and Uniformly Accelerated Straight Motion material. The study seeks to determine the acceptability, usability, and potential effectiveness of these learning tools from teachers' perspectives before their implementation in classroom settings. By examining teachers' perceptions across multiple dimensions including appearance, content, usefulness, and relevance to 21st century learning needs, this research provides valuable insights for developing more effective physics learning tools that integrate citizenship concepts while promoting critical thinking abilities.

RESEARCH METHOD

Research Design

This study uses a mixed method with an explanatory model, with variables in the form of teacher perceptions of learning devices on Uniform Straight Motion and Uniformly Accelerated Straight Motion materials. The mixed method explanatory model is a combination of quantitative and qualitative research methods carried out sequentially (Subedi, 2016). In the first stage, quantitative data collection is carried out which is then continued with the second stage, namely qualitative data collection. In quantitative research, the samples used are analyzed systematically and the results are presented in numerical form.

Research Subject

The subjects of the study consisted of 9 science teachers of grade VII junior high schools who taught Uniform Straight Motion and Uniformly Accelerated Straight Motion materials. The selection of subjects was carried out purposively to ensure that respondents had a direct relationship with the research topic.

Instruments and Data Collection Technique

Quantitative data collection was carried out using a questionnaire. Strengthening and complementing quantitative data can be done with qualitative data. This qualitative data was obtained from the results of interview analysis. The sampling technique in this study used the purposive sampling technique. Purposive sampling is a sampling technique from data sources with certain considerations (Rosdianto et al., 2017; Tanti et al., 2021). Considerations in sampling are grade VII science teachers who teach Uniform Straight Motion and Uniformly Accelerated Straight Motion materials.

Table 1. Teacher Perception Questionnaire Grid

Assessment Aspects	Statement Number
Appearance	1,2,3,4,5
Content or material	6,7,8,9,10,11
Usefulness	12.13
Relevance	14.15

(Adaptation: Suastrawan, 2021)

The following is a Teacher Interview Sheet consisting of 4 aspects, namely appearance, content/material, usefulness and relevance.

Table 2. Teacher Interview Sheet Grid

Assessment Aspects	Statement
Appearance	Overall view of learning devices
Content or material	Ease and clarity of content
Usefulness	Supports critical thinking skills
Relevance	Learning tools support 21st century learning

(Adaptation: Suastrawan, 2021)

The questionnaire data on teacher perceptions of learning devices were collected using a Likert scale. The level of teacher perception of learning devices was used to determine the category of teacher perception, namely: very good, good, not good, and very not good.

Table 3. Interpretation of Likert Scale

No.	Criteria	Score
1	Very good	4
2	Good	3
3	Not good	2
4	Very not good	1

(Siahaan et al., 2019)

Data Analysis Technique

the interval data can be analyzed by calculating the percentage of answers based on scoring each answer from the respondent using the following formula:

$$Score\ percentage = \frac{total\ score}{maximum\ score} \times 100\%$$

The percentage of perceptions obtained is then interpreted into criteria based on table 4

Table 4. Teacher Perception Result Criteria

No.	Percentage	Category
1	0%-25%	Very not good
2	26%-50%	Not good
3	51%-75%	Good
4	76%-100%	Very good

(Fortuna et al., 2022)

Qualitative data were analyzed using Miles and Hubarman analysis. Sugiyono, (2015) revealed that analysis activities in Miles & Huberman data include reducing data, presenting data, and drawing research conclusions. Reducing data is an activity to summarize into several important focuses. Data presentation is an activity to present data in the form of tables, graphs, and so on so that the data will be organized and easy to understand.

Research Procedure

The last activity is drawing conclusions and verification. The following are the procedures in this research

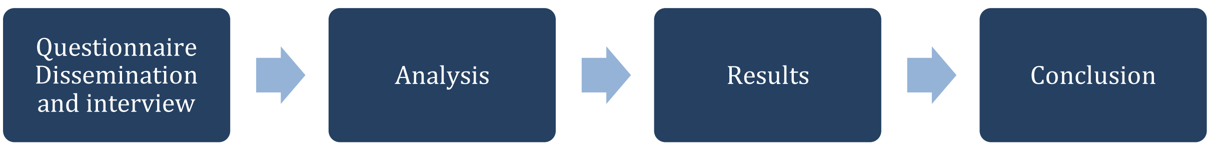

Figure 1. Research Procedure

RESULTS AND DISCUSSION

The collection of teacher perception data was carried out by distributing a questionnaire consisting of 15 questions consisting of aspects of appearance, content or material, usefulness, and relevance filled out by 9 science teachers. The level of teacher perception of learning devices on Uniform Straight Motion and Uniformly Accelerated Straight Motion materials can be seen in Table 5.

Table 5. Results of the teacher perception questionnaire on learning tools

Aspect	Total Score	Maximum Score	Percentage	Category
Appearance	161	180	89.44 %	Very good
Content or material	195	216	90.27 %	Very good
Usefulness	66	72	91.66 %	Very good
Relevance	64	72	88.88 %	Very good
Average	121.5	135	90.06 %	Very good

Based on the table of results of teacher perceptions of learning tools, the average percentage of data obtained from the teacher perception questionnaire of learning tools is 90.06% out of 100% with the very good category, so according to the teacher, this learning device can be an alternative in helping to train students' critical thinking skills in science learning, especially on Uniform Straight Motion and Uniformly Accelerated Straight Motion materials. The following is a summary of the results of interviews with 9 science teachers regarding the development of learning devices.

Table 6. Summary of the results of interviews with 9 teachers regarding learning devices

Aspect	Answer
Overall view of learning devices	Most teachers stated that the appearance of the learning device was quite attractive and systematic. Seven out of nine teachers stated that the design was quite neat and easy to understand, especially in the presentation of materials and instructions. However, one teacher suggested that the use of colors and visualizations be more varied to increase student appeal.
Ease and clarity of content	Eight teachers considered the content of the material to be clear and easy to understand, both by teachers and students. The structure of the concept delivery was considered systematic and not confusing.
Usefulness	Nine teachers agreed that the learning tool was good enough to encourage students to think critically. This can be seen from the presence of trigger questions, analysis tasks, and discussions that require students to explore concepts more deeply.
Relevance	Most teachers stated that the learning devices already accommodated aspects of 21st century learning, especially in terms of collaboration and problem solving. Eight teachers highlighted the existence of discussion-based activities and group work that strengthen communication skills and include technology-based group activities, such as the use of interactive visual simulations using Phet Simulation, to be more in line with current learning needs.

The results of interviews with nine teachers regarding learning devices on the overall display statement of learning devices, most teachers stated that the display of learning devices was quite attractive and systematic. This shows that the design of the device has met good aesthetic and readability standards in supporting the learning process. However, one teacher provided input so that the use of colors and visualization was more varied to increase student appeal. Previous research has shown that attractive visual design can increase student engagement in learning (Mayer, 2014). Therefore, increasing graphic elements and colors in devices can be one strategy to increase learning effectiveness.

Ease and clarity of material content, eight teachers considered the material content to be clear and easy to understand by both teachers and students. The systematic concept delivery structure is considered to support better understanding of the material. Language adjustment is very important in learning tools to make it simpler and in accordance with the level of student understanding. This is in line with the constructivist learning theory which emphasizes that the language used in the material must be in accordance with the level of cognitive development of students to make it easier to understand (Vygotsky & Cole, 1978). The usefulness of the device in supporting critical thinking, all teachers agree that this learning device has a good contribution in encouraging students to think critically. The existence of trigger questions, analysis tasks, and discussions are the main factors that support the development of students' critical thinking skills. This is in accordance with the results of Ennis's research, (2011), which emphasizes that learning that involves analysis and discussion can significantly improve critical thinking skills. Therefore, this learning device can be considered effective in encouraging students' ability to explore concepts more deeply.

Relevance to 21st century learning, most teachers stated that the learning devices have accommodated aspects of 21st century learning, especially in terms of collaboration and problem solving. Eight teachers highlighted that discussion activities and group work in the devices have supported the strengthening of communication and cooperation skills. In addition, teachers also appreciated the use of interactive simulation-based technology, such as Phet Simulation, which is considered capable of improving conceptual understanding through a more concrete visual approach. This is in accordance with the technology-based learning approach recommended by Mishra & Koehler, (2006) in the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes the importance of integrating technology in learning to improve teaching effectiveness.

The results of the study indicate that the Citizenship in Science learning device based on critical thinking skills on Uniform Straight Motion and Uniformly Accelerated Straight Motion materials obtained a perception with an average percentage is 90.06% which is categorized as very good. The findings of this study explicitly indicate that the Citizenship in Science learning tools based on critical thinking skills are highly relevant in supporting physics education, particularly on the topics of Uniform Straight Motion and Uniformly Accelerated Straight Motion at the junior high school level. In the context of physics, these topics are often taught in a mathematical and procedural manner. However, through the developed learning tools, teachers are able to present a more contextual and meaningful approach, in which students not only understand the formulas and motion graphs but also relate them to real-life phenomena such as road safety, transportation efficiency, and environmental issues.

The main contribution of these tools to 21st-century science learning lies in their integration of the four core components of 21st-century learning, namely: (1) critical thinking and problem-solving, (2) communication, (3) collaboration, and (4) creativity. In this study, teachers assessed that the presence of trigger questions, analysis tasks, group discussions, and the use of technological simulations such as PhET Simulation served as effective means to foster students' critical thinking abilities and collaborative skills. This is crucial because physics education is not solely aimed at producing students who master concepts, but also at shaping scientific citizens who are capable of making science-based decisions in social life. Furthermore, the Citizenship in Science approach used in the study aligns with the transformative learning paradigm, which positions students as agents of change. When students are trained to analyze motion-related problems within social contexts (e.g., traffic accidents caused by vehicle acceleration), they are not only learning physics, but also understanding how physics knowledge can be applied to create a safer, more sustainable, and equitable society. This reflects the concrete contribution of physics education to character development and 21st-century skill building.

The novelty of this study lies in its focus on examining teachers' perceptions of Citizenship in Science learning tools that are specifically designed to develop students' critical thinking skills. So far, the Citizenship in Science approach has rarely been explicitly integrated into the design of learning tools at the school level, especially those that emphasize strengthening critical thinking competencies as part of the formation of reflective and responsible scientific citizens. By exploring teachers' perceptions, this study provides new contributions in understanding the readiness, challenges, and potential for implementing this innovative learning tool in the classroom, while enriching the literature on the integration of citizenship values in contextual science learning that is oriented towards 21st century skills.

The implication of this finding is that the Citizenship in Science learning device can be a model for the development of other devices that are more innovative and in accordance with current educational needs. By strengthening the visualization aspect, simplifying language, and utilizing technology more optimally, this device has the potential to improve the quality of science learning in schools and help students develop better critical thinking skills in facing the challenges of the digital era. Although this learning tool has received a good response, there are some limitations, namely that this study only involved nine teachers as respondents, so the generalization of the findings to a wider population still needs to be studied further. Therefore, further research with a wider scope and direct implementation trials in the classroom can provide a more comprehensive picture of the effectiveness of this tool in improving the quality of learning.

CONCLUSION

Based on the results of the study, it shows that the Citizenship in Science learning device based on critical thinking skills on Uniform Straight Motion and Uniformly Accelerated Straight Motion materials received very good perceptions from teachers, with an average percentage is 90.06%. The findings of this study provide practical implications that the *Citizenship in Science* learning tools based on critical thinking skills can serve as an innovative alternative in science education, particularly for the topics of Uniform Straight Motion and Uniformly Accelerated Straight Motion. Teachers can utilize these tools to enhance the learning process, which not only focuses on conceptual understanding but also promotes higher-order thinking skills and students' social awareness of science-related issues in everyday life. These tools can also be adapted for other science topics that require the reinforcement of critical thinking skills and the integration of citizenship values into science learning. However, the implementation of these tools has so far been limited to teachers' perceptions, without direct trials in classroom settings. Therefore, further research is necessary in the form of practical implementation in the classroom to determine the extent to which these tools effectively. Such follow-up research is also essential to identify possible technical and pedagogical challenges that may arise when the tools are applied in actual teaching practices.

ACKNOWLEDGMENTS

The author would like to express his deepest gratitude to all parties who have provided support and assistance in the preparation of this article. Hopefully this article can provide benefits.

REFERENCES

Ahmal, A., Supentri, S., Pernantah, P. S., & Hardian, M. (2020). Peningkatan kompetensi pedagogik guru melalui pelatihan perangkat pembelajaran abad-21 berbasis merdeka belajar di Kabupaten Pelalawan Riau. *Unri Conference Series: Community Engagement*, *2*, 432–439. https://doi.org/10.31258/unricsce.2.432-439

Anggareni, N. W., Ristiati, N. P., & Widiyanti, N. L. P. M. (2013). Implementasi Strategi Pembelajaran Inkuiri Terhadap Kemampuan Berpikir Kritis Dan Pemahaman Konsep IPA Siswa SMP. *E-Journal Program Pascasarjana Universitas Pendidikan Ganesha*, *3*(1), 1–11. https://ejournal-pasca.undiksha.ac.id/index.php/jurnal_ipa/article/view/752/538

Aprina, E. A., Fatmawati, E., & Suhardi, A. (2024). Penerapan Model Problem Based Learning Untuk Mengembangkan Keterampilan Berpikir Kritis Pada Muatan IPA Sekolah Dasar. *Didaktika: Jurnal Kependidikan*, *13*(1), 981–990. https://doi.org/https://doi.org/10.58230/27454312.496

Azni, T. N., & Jailani, J. (2015). Pengembangan perangkat pembelajaran trigonometri berbasis strategi pembelajaran inkuiri melalui model pembelajaran kooperatif tipe STAD. *Jurnal Riset Pendidikan Matematika*, *2*(2), 284–295. https://doi.org/10.21831/jrpm.v2i2.7347

Doyan, A., Ayub, S., & Harjono, A. (2024). Effectiveness of Thermodynamics Textbooks Assisted by Heyzine Flipbook to Improve Students ' Generic Science , Critical Thinking and Conceptual Understanding. *Jurnal Penelitian Pendidikan IPA*, *10*(10), 7839–7844. https://doi.org/10.29303/jppipa.v10i10.9091

Eleta, I., Clavell, G. G., Righi, V., & Balestrini, M. (2019). The promise of participation and decision-making power in citizen science. *Citizen Science: Theory and Practice*, *4*(1). https://doi.org/10.5334/cstp.171

Ennis, R. (2011). Critical thinking: Reflection and perspective Part II. *Inquiry: Critical Thinking Across the Disciplines*, *26*(3), 5–19.

Fakhri, A. (2023). Kurikulum Merdeka dan Pengembangan Perangkat Pembelajaran : Menjawab Tantangan Sosial dalam Meningkatkan Keterampilan Abad 21. *C.E.S (Confrence Of Elementary Studies)*, *1*(1), 32–40.

Fortuna, T. D., Risdianto, E., & Hamdani, D. (2022). Persepsi Guru Dan Siswa Terhadap Keterbacaan E-Modul Alat-Alat Optik Berbantuan Mind Mapping Untuk Melatihkan Keterampilan Berpikir Kreatif Siswa SMA Kota Bengkulu. *Amplitudo: Jurnal Ilmu Pembelajaran Fisika*, *2*(1), 19–24. https://ejournal.unib.ac.id/jipf/article/download/25368/11277

Harjono, A., Makhrus, M., Savalas, L. R. T., & Rasmi, D. A. C. (2019). Pelatihan Pengembangan Perangkat Pembelajaran Ipa Untuk Mendukung Kesiapan Guru Sebagai Role Model Keterampilan Abad 21. *Jurnal Pendidikan Dan Pengabdian Masyarakat*, *2*(3), 343–347. https://doi.org/10.29303/jppm.v2i3.1345

Hartini, A. (2017). Pengembangan Perangkat Pembelajaran Model Project Based Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Sekolah Dasar. *ELSE (Elementary School Education Journal): Jurnal Pendidikan Dan Pembelajaran Sekolah Dasar*, *1*(2a), 6–16. https://journal.um-surabaya.ac.id/pgsd/article/view/1038

Indiana, S., Amaliyah, N., & Hartini, T. A. (2024). Hubungan Antara Kemampuan Berpikir Kritis dan Kemampuan Berpikir Kreatif dengan Penguasaan Konsep Dasar IPA pada siswa kelas V di SDN Gugus 2 Kecamatan Cipayung Kota Depok. *Pedagogi : Jurnal Penelitian Pendidikan*, *11*(1), 86–104. https://doi.org/https://doi.org/10.25134/pedagogi.v11i1.8507

Istiani, H., Hasyim, A., & Yanzi, H. (2017). Persepsi Guru Tentang Kendala Pelaksanaan Beban Kerja Guru Pada Beberapa Mata Pelajaran. *Jurnal Kultur Demokrasi (JKD)*, *5*(3), 1–15.

Juhji. (2015). Pendekatan Saintifik dalam Pembelajaran IPA di Madrasah Ibtidaiyah Abstrak Pendahuluan. *Primary Volume*, *7*(01), 44–57. https://doi.org/https://doi.org/10.32678/primary.v7i1.2976

Makhrus, M., & Hadiprayitno, G. (2012). Penerapan Perangkat Pembelajaran Fisika Berorientasi Pembelajaran IPA Terpadu Tipe Connected. *Jurnal Pendidikan Dan Pembelajaran (JPP)*, *19*(2), 237–242.

Mayer, R. E. (2014). Multimedia Instruction. *Handbook of Research on Educational Communications and Technology: Fourth Edition*, 385–399. https://doi.org/10.1007/978-1-4614-3185-5

Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record: The Voice of Scholarship in Education*, *108*(6), 1017–1054. https://doi.org/10.1177/016146810610800610

Mitchell, N., Triska, M., Liberatore, A., Ashcroft, L., Weatherill, R., & Longnecker, N. (2017). Benefits and challenges of incorporating citizen science into university education. *PLoS ONE*, *12*(11), 1–15. https://doi.org/10.1371/journal.pone.0186285

Muaziyah, S. E. S., Hidayat, T., Sriyati, S., & Lutianasari, L. (2023). Implementation of the Merdeka Curriculum Using Citizen Science Project Weather-it to Improve Critical Thinking Skills of Junior High School Students. *Jurnal Penelitian Pendidikan IPA*, *9*(3), 1470–1479. https://doi.org/10.29303/jppipa.v9i3.2277

Mulia, S., & Murni, S. (2022). Implikasi Pembelajaran Praktikum Ilmu Pengetahuan Alam Dalam Kemajuan Kognitif Siswa. *Science Education Research (Search) Journal*, 1–11. http://e-jurnal.iainsorong.ac.id/index.php/jaser/article/view/1232

Novianti Taufik, A., Kristina, H., Fajri Gibran, B., Sabililah, A., Septiani, S., Asfi Warraihanah, D., Nurmalia, L., Syofiarni, S., & Tati Risalah, O. (2023). Pengembangan E-Book Kontekstual Berorientasi Kearifan Lokal Banten untuk Siswa SMP. *Jurnal Pendidikan Mipa*, *13*(4), 1095–

1104. https://doi.org/10.37630/jpm.v13i4.1251

Nuai, A., & Nurkamiden, S. (2022). Urgensi Kegiatan Praktikum Dalam Pembelajaran Ilmu Pengetahuan Alam di Sekolah Menengah Pertama. *Science Education Research (Search)Journal*, 48–63. https://e-jurnal.iainsorong.ac.id/index.php/jaser/article/view/1240

Nursari, E. V., Setiawati, I., & Lismaya, L. (2021). Analisis Perangkat Pembelajaran Berbasis Higher Order Thinking Skill (HOTS) di Masa Pandemi Covid-19. *ALVEOLI: Jurnal Pendidikan Biologi*, *2*(2), 78–97. https://doi.org/10.35719/alveoli.v2i2.52

Queiruga-Dios, M. Á., López-Iñesta, E., Diez-Ojeda, M., Sáiz-Manzanares, M. C., & Dorrío, J. B. V. (2020). Citizen science for scientific literacy and the attainment of sustainable development goals in formal education. *Sustainability (Switzerland)*, *12*(10). https://doi.org/10.3390/su12104283

Roche, J., Bell, L., Galvão, C., Golumbic, Y. N., Kloetzer, L., Knoben, N., Laakso, M., Lorke, J., Mannion, G., Massetti, L., Mauchline, A., Pata, K., Ruck, A., Taraba, P., & Winter, S. (2020). Citizen Science, Education, and Learning: Challenges and Opportunities. *Frontiers in Sociology*, *5*(December), 1–10. https://doi.org/10.3389/fsoc.2020.613814

Rosdianto, H., Dafian, Y., & Muliyani, R. (2022). The Response of High School Students In Singkawang City Towards Physics Learning During Covid-19 Pandemic. *JIPF (Jurnal Ilmu Pendidikan Fisika)*, *7*(2), 210. https://doi.org/10.26737/jipf.v7i2.3455

Rosdianto, H., Murdani, E., & Hendra. (2017). the Implementation of Poe (Predict Observe Explain) Model To Improve Student'S Concept Understanding on Newton'S Law. *Jurnal Pendidikan Fisika*, *6*(1), 55–57. https://doi.org/10.22611/jpf.v6i1.6899

Rosdianto, H., Sulistri, E., Rosmaiyadi, Mariyam, Husna, N., Citroresmi Prihatingtyas, N., Wahyuni, R., Nurhayati, & Utami, C. (2018). Correlation between Science Process Skills and the Comprehension of Physics Concept with Critical Thinking Skills on Newton's Laws. *Borneo International Conference On Education And Social Thinking*, *1*(December), 42–47. https://doi.org/10.5220/0009016100420047

Rosdianto, H., Syahandri, U. H., & Mahapoonyanont, N. (2020). Students' Cognitive Learning Outcomes In Simple Machine Subjects Through REACT Learning Model. *JIPF (Jurnal Ilmu Pendidikan Fisika)*, *5*(3), 123. https://doi.org/10.26737/jipf.v5i3.1712

Sawitri, A. D., Priyanti, P. W., Wanah, N., & Prayogo, M. S. (2024). Membangun Generasi Peduli Lingkungan : Analisis Literatur Pembelajaran Sains di Tingkat SD / MI. *INKUIRI: Jurnal Pendidikan IPA*, *13*(1), 106–113. https://doi.org/10.20961/inkuiri.v13i1.80296

Sevtia, A. F., Taufik, M., & Doyan, A. (2022). Pengembangan Media Pembelajaran Fisika Berbasis Google Sites untuk Meningkatkan Kemampuan Penguasaan Konsep dan Berpikir Kritis Peserta Didik SMA. *Jurnal Ilmiah Profesi Pendidikan*, *7*(3), 1167–1173. https://doi.org/10.29303/jipp.v7i3.743

Siahaan, A. D., Medriati, R., & Risdianto, E. (2019). Pengembangan Penuntun Praktikum Fisik Dasar II Menggunakan Teknologi Augmented Reality Pada Materi. *Jurnal Kumparan Fisika*, *2*(2), 91–98. https://doi.org/https://doi.org/10.33369/jkf.2.2.91-98

Subedi, D. (2016). Explanatory Sequential Mixed Method Design as the Third Research Community of Knowledge Claim. *American Journal of Educational Research, Vol. 4, 2016, Pages 570-577*, *4*(7), 570–577. https://doi.org/10.12691/education-4-7-10

Sugiyono. (2015). Metode Penelitian Kunatitatif Kualitatif dan R&D. *Alfabeta, Bandung*.

Suryaningsih, Y. (2018). Pembelajaran berbasis praktikum sebagai sarana siswa untuk berlatih menerapkan keterampilan proses sains dalam materi biologi. *BIO EDUCATIO : (The Journal of Science and Biology Education)*, *2*(2), 49–57. https://doi.org/10.24014/konfigurasi.v1i2.4537

Tanti, T., Kurniawan, D. A., Sukarni, W., Erika, E., & Hoyi, R. (2021). Description of Student Responses Toward the Implementation of Problem-Based Learning Model in Physics Learning.

JIPF (Jurnal Ilmu Pendidikan Fisika), *6*(1), 30. https://doi.org/10.26737/jipf.v6i1.1787

Vebrianto, R., & Istiqomah, D. (2021). Pengembangan Buku Saku Berbasis Literasi Sains untuk Meningkatkan Kemampuan Berfikir Kritis Siswa dalam Pembelajaran IPA di Madrasah. *Anterior Jurnal*, *20*(3), 97–101. https://doi.org/10.33084/anterior.v20i3.2057

Vesterinen, V. M., Tolppanen, S., & Aksela, M. (2016). Toward citizenship science education: what students do to make the world a better place? *International Journal of Science Education*, *38*(1), 30–50. https://doi.org/10.1080/09500693.2015.1125035

Vygotsky, L. S., & Cole, M. (1978). *Mind in society: Development of higher psychological processes*. Harvard university press.

Wahyuni, S., Marwan, & Susanna. (2017). Persepsi Siswa terhadap Penggunaan Media Pembelajaran Fisika di SMA Negeri se-kota Banda Aceh. *Jurnal Ilmiah Mahasiswa (JIM) Pendidikan Fisika*, *2*(1), 135–140.

Yolanda, A., Sihotang, M., Alfin Zebua, J., Hutasoit, M., & Lupitasari Sinaga, Y. (2024). Strategi Pembelajaran Kontekstual untuk Meningkatkan Pemahaman Konsep Siswa Sekolah Dasar. *Pragmatik : Jurnal Rumpun Ilmu Bahasa Dan Pendidikan*, *2*(3), 301–308. https://doi.org/10.61132/pragmatik.v2i3.941

Yudha, S., Nurfajriani, & Silaban, R. (2023). Persepsi Peserta Didik Terhadap Penggunaan Multimedia Interaktif Berbasis Android Pada Materi Kimia Semester Ganjil Kelas X SMA. *Chemistry in Education*, *12*(2), 106–111. https://doi.org/https://doi.org/10.15294/chemined.v12i2.66474

Zagoto, M. M., & Dakhi, O. (2018). Pengembangan Perangkat Pembelajaran Matematika Peminatan Berbasis Pendekatan Saintifik Untuk Siswa Kelas Xi Sekolah Menengah Atas. *Jurnal Review Pendidikan Dan Pengajaran*, *1*(1), 157–170. https://doi.org/10.31004/jrpp.v1i1.884