



## ANALYSIS OF CRITICAL THINKING SKILLS IN PROBLEM-BASED LEARNING AND INQUIRY LEARNING MODELS

Sam Phoen Worachak<sup>1</sup>, Phrapalad Somchai Damnoen<sup>2</sup>, Dong Anh Chi Hong<sup>3</sup>, Sabila Eka Septi<sup>4</sup>

<sup>1</sup> Faculty of Education, National University of Laos, Vientiane, Laos

<sup>2</sup> Faculty of Science, Mahachulalongkornrajavidyalaya University, Chang Wat Surin, Thailand

<sup>3</sup> Faculty of Fundamental Science, Ho Chi Minh City University of Transport, Ho Chi Minh, Vietnam

<sup>4</sup> Magister of Science Education, Pascasarjana, Universitas Jambi, Jambi, Indonesia

Corresponding author email: [sampw@gmail.com](mailto:sampw@gmail.com)

### Article Info

Received: 10 Oct 2023

Revised: 2 Nov 2023

Accepted: 23 Nov 2023

OnlineVersion: 28 Nov 2023

### Abstract :

This study is the first to conduct a literature review of the ability to think critically in problem-based learning and inquiry learning models in physics education. The method used is qualitative research with a literature review system. This research data collection technique uses secondary data, namely relevant research articles. The process of reviewing articles in this study focuses on problem-based learning and inquiry learning models that can improve students' critical thinking skills in physics concepts and phenomena. The instruments used in data collection included reviewing scientific articles from Google Scholar with the criteria for selected articles according to search keywords and articles published within the last ten years and analyzed using a synthesis matrix. From the literature study that has been carried out, the researcher found as many as 25 articles regarding problem-based learning and inquiry learning models that can improve students' critical thinking skills in physics education. With these learning models, students' low critical thinking skills in physics learning can be increased, and students understand physics learning better. The novelty of this study is that it provides a comprehensive and systematic overview of the existing literature on the effectiveness of problem-based learning and inquiry learning models in enhancing students' critical thinking skills in physics education. This study implies that it can inform teachers, curriculum developers, and policymakers on designing and implementing problem-based learning and inquiry learning models in physics education to foster students' critical thinking skills and learning outcomes.

Keywords: Critical Thinking, Inquiry Learning, Problem-Based Learning, Systematic Review

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## INTRODUCTION

Physics is a branch of science regarding natural science that emphasizes understanding concepts (Hajrin, 2019; McElreath, 2020; Astalini et al., 2022). In learning physics, understanding material concepts is needed so students can more easily understand learning physics. Developing the ability to understand concepts, principles, and laws of physics in learning activities must consider effective and efficient learning strategies and methods (Nasution, 2018; Romli & Riyadi, 2018; Rizaldi et al., 2021). Understanding physics concepts is the ability of students to know, define, and express the physics concepts they have learned without reducing their meaning (Hanna et al., 2017; Serway & Jewett, 2018; Simeon et al., 2020). One of the thinking skills needed in learning physics is critical thinking.

Critical thinking is a skill that must be taught to students through natural sciences or other disciplines to prepare them to be successful in life and opinion (Cahyono, 2017; Alsaleh, 2020; Saenab, 2020). The critical thinking skills of students in Indonesia are still relatively low based on the International Trends in International Mathematics and Science Study (TIMSS) students' necessary thinking skills show that Indonesian students are consistently ranked lower (Syafitri, 2021; Lutfianis, 2021; Umam & Susandi, 2022). Students need critical thinking skills to solve problems precisely and logically. The ability to think critically provides more precise directions in thinking and working and allows one to more accurately determine the relationship between something and another (Saputra, 2020). The teacher enhances the importance of students' critical thinking skills by using a learning model.

The learning model is a learning approach teachers use with stages in teaching according to learning objectives. Learning models can improve students' critical thinking skills (Amijaya et al., 2018; Paul & Elder, 2019; Teasdale & Aird, 2023). Learning models that can improve students' critical thinking skills include problem-based learning and inquiry learning models. The inquiry learning model improves critical thinking skills (Prayogi & Yuanita, 2018; Maryam et al., 2020; Prayogi & Verawati, 2020). The problem-based learning (PBL) model can increase conceptual understanding and critical thinking (Yuliyanti & Gunawan, 2019; Saiful et al., 2020; Uliyandari et al., 2021).

One of the learning models that is often used is the Problem-Based Learning model. Problem-Based Learning Model is learning obtained through a process toward understanding the resolution of a problem (Marsinah et al., 2019; Ediansyah et al., 2021; Darmaji et al., 2022). Problem-Based Learning is a learning model that uses issues that not only transfer knowledge from teacher to students but also take part in collaborative thinking between teachers and students, students and other students to get the essence of solving the problem being discussed (Suari, 2018; Ulger, 2018; Hoyi et al., 2021). The problem-based learning (PBL) learning model has the characteristics of learning starting with giving problems that have context with the real world, active group learning, formulating problems and identifying gaps in their knowledge, understanding and finding their material related to issues and solutions to problems (Aksela, 2019; Yuliyanti & Indra, 2019; Khairani et al., 2020).

The inquiry learning learning model is also often used to assist teachers in improving students' critical thinking skills. This is the opinion of Ahmatika (2017), Fuad et al. (2017), and Adnan et al. (2021) that one of the skills needed to improve students' critical thinking skills is the inquiry learning model. The Inquiry Learning learning model is a learning model that emphasizes students to find out and build their knowledge (Effendi & Krisma, 2021; Jufrida et al., 2021; Astalini et al., 2022). The Inquiry Learning learning model is a model developed so that students can find and use various sources of information and ideas so that their understanding of multiple problems, topics, or specific issues can increase (Setianingsih, 2016; Syahrial et al., 2019; Kurniawan et al. al, 2021). The inquiry learning model that directs students to solve problems with their abilities can make students think critically and be required to get answers to problems.

Similar research was also conducted by Sulaiman Aziza (2020) regarding a literature review of problem-based learning models for critical thinking skills. In addition, Kusumawati's research (2022) examines literature studies on critical thinking skills by applying the Problem-Based Learning model. In the relevant research inquiry learning model, there is research by Purwandari (2022), who examines the inquiry learning model for creative thinking in chemistry subjects, while research by Dhamayannti (2022) examines the effect of inquiry learning strategies on students' critical thinking abilities.

From some of these studies, it can be seen that no research examines the literature on students' critical thinking skills in problem-based learning and inquiry learning models. So, this study will focus on that theme. This research implies that it can provide knowledge to readers about how problem-based

learning and inquiry learning models can improve students' critical thinking skills so that this research can be used as a reference for subsequent research with the same subject matter.

Based on the above explanation, this research aims to describe critical thinking skills that can be used in problem-based and inquiry-learning models.

## RESEARCH METHOD

The method used in this study is a literature review system. The system literature review method is carried out for various purposes, including identifying, reviewing, evaluating, and interpreting all available research with interesting topic areas with specific relevant research questions (Barricelli et al., 2019; Razavian et al., 2019; Romiyati et al., 2023). The data collection technique used was a literature study. A literature study is a method used to collect data or sources related to the topic raised in a study (Habsy, 2017; Senathalia & Nurjanag, 2021; Parinata & Puspaningtyas, 2022).

This data collection technique uses secondary data, namely relevant research articles (Ayudha & Setyarsih, 2021; Ramadhanti & Simamora, 2023; Ramdhani, 2023). Reviewing articles in this study focuses on problem-based learning and inquiry learning models that can improve students' critical thinking skills. The instruments used in data collection included reviewing scientific articles sourced from Google Scholar with the criteria for selected articles according to search keywords and selected articles published within the last ten years. So, in this study, there were 25 articles, both national and international, which would later be reviewed by researchers who focused on the topics studied.

The analysis technique is carried out using a synthesis matrix. The synthesis matrix is a table/diagram that allows researchers to group and classify different arguments from several articles and combine different elements to get an impression/conclusion of the whole article in general (Murniati et al., 2018; Aldila & Mundarti, 2023). In this study, the researcher made a table consisting of the journal's name, author (year), title, and findings.

Data is selected through identification, screening, eligibility, and inclusion. The study discovery process followed PRISMA rules, as presented in Figure 1.

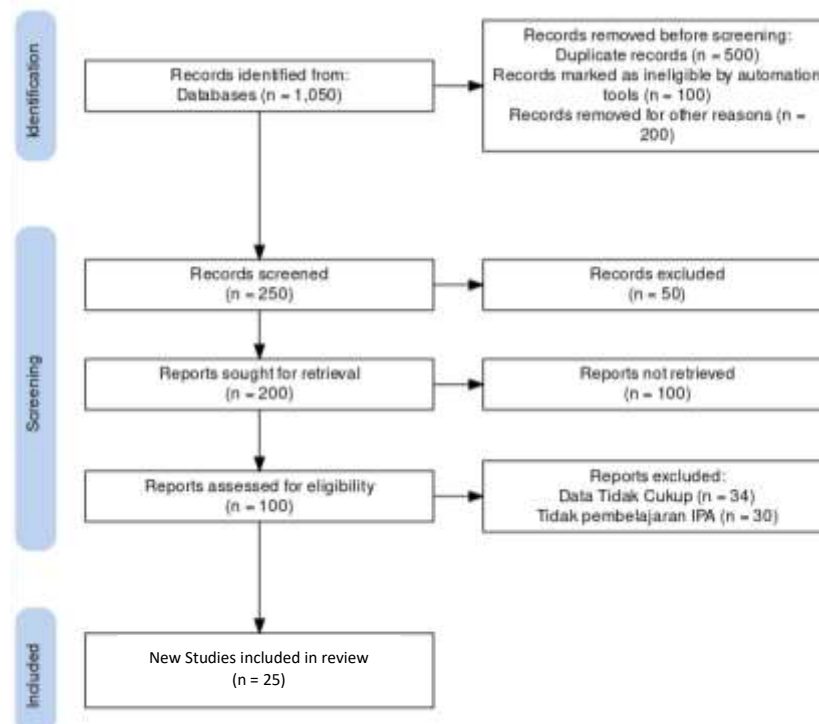


Figure 1. Literature Review Flowchart

**RESULTS AND DISCUSSION**

Article reviews are carried out by selected scientific articles based on topics, namely creative thinking, physics learning, and learning models. The number of articles reviewed in this study was 25 articles. The following are the articles reviewed in this study in Table 1.

Table 1. Results of Article Reviews

Name of Journal	Author (Year)	Title	Finding
JPFT (Jurnal Pendidikan Fisika Tadulako Online),	Priyadi, R., Mustajab, A., Tatsar, M. Z., & Kusairi, S. (2018)	<i>Analisis kemampuan berpikir kritis siswa SMA kelas X MIPA dalam pembelajaran fisika.</i> [Analysis of critical thinking abilities of class X MIPA high school students in physics learning.]	Students' critical thinking skills are still low because they can only complete physics calculations but not with the concepts.
Jurnal Education and Development,	Nasution, S. W. R. (2018)	<i>Penerapan model inkuiri terbimbing (guided inquiry) dalam meningkatkan kemampuan berpikir kritis pada pembelajaran fisika.</i> [Application of the guided inquiry model in improving critical thinking skills in physics learning.]	Students' critical thinking skills are better when using the guided inquiry model than when not using the model.
Lensa: Jurnal Kependidikan Fisika,	Islamiah, A. F., Rahayu, S., & Verawati, N. N. S. P. (2018).	<i>Efektivitas model pembelajaran problem based learning berbantuan lks terhadap kemampuan berpikir kritis fisika siswa SMAN 1 Lingsar Tahun Ajaran 2016/2017.</i> [The effectiveness of the problem-based learning model assisted by worksheets on the physics critical thinking abilities of students at SMAN 1 Lingsar in the 2016/2017 academic year.]	The LKS-assisted problem-based learning model is effective for students' critical thinking skills in physics.
Jurnal Pendidikan Fisika dan Teknologi,	Handriani, L. S., Harjono, A., & Doyan, A. (2015)	<i>Pengaruh model pembelajaran inkuiri terstruktur dengan pendekatan saintifik terhadap kemampuan berpikir kritis dan hasil belajar fisika siswa.</i> [The influence of a structured inquiry learning model with a scientific approach on students' critical thinking abilities and physics learning outcomes.]	The structured inquiry learning model with a scientific approach influences students' critical thinking skills.

Name of Journal	Author (Year)	Title	Finding
Jurnal Penelitian Pendidikan IPA,	Herliandry, L. D., & Harjono, A. (2019).	<i>Kemampuan berpikir kritis fisika peserta didik kelas X dengan model brain based learning.</i> [Physics critical thinking abilities of class X students using the brain-based learning model.]	There is an influence of the brain-based learning model on the physics critical thinking skills of class X students.
Jurnal Pendidikan Fisika dan Teknologi,	Munandar, H., Sutrio, S., & Taufik, M. (2018).	<i>Pengaruh model pembelajaran berbasis masalah berbantuan media animasi terhadap kemampuan berpikir kritis dan hasil belajar fisika siswa SMAN 5 Mataram tahun ajaran 2016/2017.</i> [The influence of the problem-based learning model assisted by animation media on the critical thinking skills and physics learning outcomes of students at SMAN 5 Mataram in the 2016/2017 academic year.]	Implementing PBLM with animation has an impact on students' critical thinking skills.
Quantum: Jurnal Inovasi Pendidikan Sains,	Sugiarti, M. I., & Dwikoranto, D. (2021).	<i>Peningkatan Kemampuan Berpikir Kritis Peserta Didik Melalui Blended Inquiry Learning Berbantuan Schoology Pada Pembelajaran Fisika: Literature Review.</i> [Improving Students' Critical Thinking Abilities Through Blended Inquiry Learning Assisted by Schoology in Physics Learning: Literature Review.]	With the help of Schoology, this blended inquiry learning model can improve students' creative thinking skills.
Berkala Fisika Indonesia,	Arini, W., & Juliadi, F. (2018).	<i>Analisis kemampuan berpikir kritis pada mata pelajaran fisika untuk pokok bahasan Vektor siswa kelas X SMA Negeri 4 Lubuklinggau, Sumatera Selatan.</i> [Analysis of critical thinking skills in physics subjects for the subject of Vector for class X SMA Negeri 4 Lubuklinggau, South Sumatra.]	Students' critical thinking skills are in the low category, with an achievement percentage of 35.91%.

Name of Journal	Author (Year)	Title	Finding
Jurnal Pendidikan Fisika dan Teknologi,	Yeritia, S., Wahyudi, W., & Rahayu, S. (2017).	<i>Pengaruh model pembelajaran inkuiri terbimbing terhadap penguasaan konsep dan kemampuan berpikir kritis fisika peserta didik kelas X SMAN 1 Kuripan tahun ajaran 2017/2018.</i> [The influence of the guided inquiry learning model on the mastery of physics concepts and critical thinking abilities of class X students at SMAN 1 Kuripan in the 2017/2018 academic year.]	Guided inquiry learning influences the mastery of concepts and critical thinking skills in physics.
PASCAL (Journal of Physics Science and Learning),	Husnah, M. (2017).	<i>Hubungan tingkat berpikir kritis terhadap hasil belajar fisika siswa dengan menerapkan model pembelajaran problem based learning.</i> [The relationship between the level of critical thinking and students' physics learning outcomes by applying the problem based learning model.]	The problem-based learning model can improve students' critical thinking.
Jurnal Pendidikan Fisika dan Teknologi,	Fatimah, N., Gunawan, G., & Wahyudi, W. (2016).	<i>Pembelajaran Berbasis Masalah Dengan Strategi Konflik Kognitif Terhadap Penguasaan Konsep Dan Kemampuan Berpikir Kritis Fisika Siswa Kelas XI SMKN 1 Lingsar Tahun Pelajaran 2015/2016.</i> [Problem-Based Learning Using Cognitive Conflict Strategy on Concept Mastery and Critical Thinking Ability in Physics for Class XI Students of SMKN 1 Lingsar in the 2015/2016 Academic Year.]	The problem-based learning model with cognitive conflict strategies influences students' mastery of physics concepts and critical thinking skills.
Jurnal Penelitian dan Pembelajaran Fisika Indonesia,	Aripin, W. A., Sahidu, H., & Makhrus, M. (2021).	<i>Efektivitas Perangkat Pembelajaran Fisika Berbasis Model Problem Based Learning untuk Meningkatkan Kemampuan Pemecahan Masalah dan Kemampuan Berpikir</i>	The problem-based learning model on harmonic vibration material effectively and efficiently improves students' problem-solving and critical thinking skills.

Name of Journal	Author (Year)	Title	Finding
		<i>Kritis Peserta Didik.</i> [Effectiveness of Physics Learning Tools Based on Problem Based Learning Models to Improve Students' Problem Solving and Critical Thinking Abilities.]	
Jurnal Kumparan Fisika,	Harjilah, N., Medriati, R., & Hamdani, D. (2019).	<i>Pengaruh Model Inkuiri Terbimbing Terhadap Keterampilan Berpikir Kritis Pada Mata Pelajaran Fisika.</i> [The Influence of the Guided Inquiry Model on Critical Thinking Skills in Physics Subjects.]	There is a significant influence of learning using the guided inquiry model on critical thinking skills in physics subjects, with a value of 3.2 and an effect of 94.2%.
Karst: JURNAL PENDIDIKAN FISIKA DAN TERAPANNYA,	Arifah, N., Kadir, F., & Nuroso, H. (2021).	<i>Hubungan antara model pembelajaran problem based learning dengan kemampuan berpikir kritis pada pembelajaran fisika siswa.</i> [The relationship between the problem-based learning model and critical thinking skills in students' physics learning.]	The problem-based learning (PBL) model greatly influences students' critical thinking skills in physics learning.
Jurnal Pendidikan Fisika dan Teknologi,	Agustina, K., Sahidu, H., & Gunada, I. W. (2020).	<i>Pengaruh model pembelajaran inkuiri terbimbing berbantuan media phet terhadap kemampuan pemecahan masalah dan berpikir kritis fisika peserta didik sma.</i> [The influence of the guided inquiry learning model assisted by Phet media on the problem solving and critical thinking abilities of high school students in physics.]	There is an effect of the treatment of the guided inquiry model assisted by PhET media on high school students' Physics problem-solving and critical thinking skills.
International Journal of Science and Mathematics Education,	Tiruneh, D. T., De Cock, M., Weldeslassie, A. G., Elen, J., & Janssen, R. (2017)	Measuring critical thinking in physics: Development and validation of a critical thinking test in electricity and magnetism.	The CTEM test can be used to measure students' abilities.
Journal of Physics: Conference Series	Zain, A. R. (2018)	Effectiveness of guided inquiry based on blended learning in physics instruction to improve	Guided inquiry in learning physics is efficacious in improving students' critical

Name of Journal	Author (Year)	Title	Finding
		critical thinking skills of the senior high school student.	thinking skills in optics material.
International Education Studies,	Maknun, J. (2020).	Implementation of Guided Inquiry Learning Model to Improve Understanding Physics Concepts and Critical Thinking Skills of Vocational High School Students.	The results showed that the average increase in understanding of physics concepts and critical thinking skills for the experimental class was 0.71 (high category) and 0.28 for the control class (low category).
Journal of Advanced Research in Dynamical and Control Systems (JARDCS),	Gunawan, G. (2019).	Increasing students' critical thinking skills in physics using a guided inquiry model combined with an advanced organizer.	The guided inquiry model is effective in increasing Critical thinking skills.
Journal of Physics: Conference Series	Nisa, E. K., Koestiari, T., Habibulloh, M., & Jatmiko, B. (2018)	Effectiveness of guided inquiry learning model to improve students' critical thinking skills at senior high school.	The guided inquiry learning model effectively improves students' critical thinking skills.
AIP Conference Proceedings	Miterianifa, Trisnayanti, Y., Khoiri, A., & Ayu, H. D. (2019).	Meta-analysis: The effect of problem-based learning on students' critical thinking skills.	The problem-based learning model has an impact of 1.2 with an effect of 83.45%
Jurnal Penelitian Pendidikan IPA	Neswary, S. B. A., & Prahani, B. K. (2022).	Profile of Students' Physics Critical Thinking Skills and Application of Problem-Based Learning Models Assisted by Digital Books in Physics Learning in High School	Students' critical thinking skills are low, so increasing them by applying the PBL model assisted by digital books is necessary.
Journal of Physics: Conference Series	Medriati, R., Hamdani, D., & Harjilah, N. (2021).	The difference in the guided inquiry model towards critical thinking skills in physics subject at SMAN 3 Kota Bengkulu.	There is a significant difference in learning using the guided inquiry model on critical thinking skills in physics students.
International Journal of Innovation, Creativity and Change	Maknuna, J. (2019).	The development of critical thinking skills in vocational high school students in Indonesia.	This Physics learning approach is capable of improving students' critical thinking skills.
Jurnal Pendidikan Sains Indonesia,	Saphira, H. V., & Prahani, B. K. (2022).	Profile of senior high school students' critical thinking skills and the need for of implementation PBL	To improve students' critical thinking skills, it is necessary to carry out learning innovations,



Name of Journal	Author (Year)	Title	Finding
		model assisted by augmented reality book.	especially in physics learning, by applying Problem-Based Learning with the help of Augmented Reality books.

Based on Table 1, it can be seen that students' critical thinking skills can be improved by using problem-based learning and inquiry learning models. Teachers can use learning models to develop strategies to enhance students' critical thinking skills.

Thinking critically is essential for students, especially in physics, because it helps students solve problems logically and rationally. Likewise, in everyday life, students will be trained to make decisions and solve problems (Sakahuni & Auliya, 2021; Usada et al., 2022; Sihombing & Sijabat, 2023). With critical thinking skills, students will analyze situations or problems based on facts to obtain conclusions. This aligns with (Agnafia, 2019; Destianti & Antoni, 2023; Susanti & Dani, 2023), who believe critical thinking is analyzing situations based on facts and evidence to obtain a conclusion. Based on the 25 articles reviewed, students' critical thinking skills are still relatively low. This makes the researchers from these articles research whether the learning model can improve or influence students' critical thinking skills.

Teachers can use learning models to make appropriate and efficient selection patterns to achieve learning objectives. Teaching models are teaching blueprints that are engineered in such a way as to achieve specific teaching goals (Khoerunnisa & Syifa, 2020; Herlena et al., 2021; Herlo et al., 2023). Problem-based learning and inquiry learning models are often used to improve students' critical thinking skills in physics. From the results of the reviews that have been carried out, the use of learning models also assists with learning media that are appropriate to learning materials, such as digital books, tests, phet simulations, and animations. The review results also show that the researchers examined the influence, relationship, and analysis of learning models on students' critical thinking skills.

The review results show that the problem-based learning model influences students' critical thinking skills. The problem-based learning model trains students to solve problems logically, hone the ability to gain knowledge, have scientific activity, and have the ability to assess themselves (Nurjannah, 2022; Rahadiyani, 2023; Hermawati, 2023). This learning model is suitable for improving the critical thinking skills of students who have almost the same abilities. If students have abilities that are too different from others, then this learning model will be more challenging to apply in the classroom. This is to Shoimin (2016), Pujaerto (2020), Rahmadhani, and Wirayudha (2023) that in a class that has a high level of student diversity, there will be difficulties in dividing tasks.

In the inquiry learning model, the researchers used several inquiry learning models, including guided inquiry, structured inquiry, and guided inquiry with blended learning. Using the inquiry learning model, this study increased students' critical thinking skills. The inquiry learning model places students at the center and the teacher as a guide in learning in the classroom. Learners complete tasks or problems independently with various scientific references and information in books or other learning media. This allows students to actively think critically in completing assignments or problems with the facts students find, make decisions, and conclude the results of their work.

Meilasari and Yelianti (2020) researched the literature review of problem-based learning models on students' critical thinking skills, while Purwandari et al. (2022) conducted a review of literature research on inquiry learning models of students' critical thinking skills. From this research there has been no research that examines the problem-based learning and inquiry learning models, so in this study, researchers examined using literature studies on these two models on students' critical thinking abilities.

This study has 25 articles that have been reviewed so that the results of the data obtained and presented are based on the facts. In addition, this study also examines two learning models that can improve students' critical thinking skills. This research implies that this research can provide knowledge to readers about effective learning models to improve students' critical thinking skills. It is hoped that for further research, more articles will be reviewed from various sources and that each of the most effective learning models will be compared to improve students' critical thinking skills.

The novelty of this study is that it provides a comprehensive and systematic overview of the existing literature on the effectiveness of problem-based learning and inquiry learning models in enhancing students' critical thinking skills in physics education. The study also identifies the gaps and challenges in the literature and suggests directions for future research. This study implies that it can inform teachers, curriculum developers, and policymakers on how to design and implement problem-based learning and inquiry learning models in physics education to foster students' critical thinking skills and learning outcomes.

## CONCLUSION

Based on a collection of articles about assessment portfolios in science learning, there are 26 journals from 2015 to 2023, according to Google Scholar. Grouping articles based on year of publication, it was found that most research on portfolio assessment was carried out in 2016 with a percentage of 30.77%. This means that portfolio assessment research was the most researched in 2016. Based on the many research findings and discussions carried out in this research, it can be said that much research has been conducted regarding the assessment of science learning portfolios. Based on objectives, Implementation/Influence/Effectiveness objectives are the most frequent research subjects (61.54%), while design objectives occupy second place. The most frequently used research design is a quasi-experimental design with a frequency of 42.31%. If we look at research utilization according to education level, senior high school is ranked third with a percentage of 57.69%. With a percentage of 50%, physics is the topic that uses the most portfolio assessment. Parents can track their children's educational progress through portfolio evaluations and learn about their strengths and weaknesses. Indirect verbal communication between parents and teachers is also visible.

## ACKNOWLEDGMENTS

The researcher would like to thank those who contributed and supported this research.

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