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A Review: Improving Scientific Attitudes through Physics Learning Media with PjBL Model

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Abstract: Physics learning media developed using the Project-Based Learning (PjBL) model plays a crucial role in shaping students' scientific attitudes. This research aims to identify and analyze research trends of physics learning media based on PjBL model to improve scientific attitude. This research method is descriptive and analytical. The data used in this research was obtained from documents indexed by Google Scholar from 2015-2024 using Publish or Perish and Dimension.ai. Research procedures use PRISMA guidelines. The data identified and analyzed are the type of publication, publication source, and the title of research trend that is widely cited. The data analysis method uses bibliometric analysis assisted by VOS viewer software. The results of the analysis show that research trend indexed by Google Scholar from 2015 to 2024 has experienced a fluctuating increase. Where the research trend is with an increase in the number of publications every year, namely from 2015 to 2023. However, in 2024 the research trend on the physics learning media based on PjBL model to improve scientific attitude has decreased. There are many documents in the form of articles, proceedings, book chapters, edited, preprint and monograph books that discuss research about the trend. Key words that are often used in research of scientific attitude are critical thinking, scientific literacy, scientific approach, creativity, etc.

Keywords: Learning Media; Physics; Project based learning; Scientific attitude

Introduction

Physics learning media developed using the Project-Based Learning (PjBL) model plays a crucial role in shaping students' scientific attitudes. Scientific attitudes, such as curiosity, objectivity, openness to evidence, perseverance, and responsibility, are among the primary goals of science education, aligned with the 21st-century curriculum (Kain et al., 2024). The PjBL model emphasizes learning through real-life projects relevant to everyday life. By actively involving students in the design, implementation, and evaluation of projects, they not only gain conceptual understanding but also internalize scientific values. For example, when students are asked to design a demonstration apparatus for Newton's laws using simple materials, they learn to observe, formulate hypotheses, test them, and reflect on the results, directly fostering scientific attitudes (Parra-Zeltzer et al., 2025). PjBL-based learning media can foster students' emotional and social engagement. Through group work on projects, students are trained to respect the opinions of others, collaborate, and be open to criticism. Research shows that the implementation of Project-Based Learning (PjBL) supported by interactive media can enhance students' curiosity, discipline, and communication skills in physics learning (Al-Kamzari & Alias, 2025). Furthermore, learning media integrated

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with digital technology—such as simulations, experimental videos, and collaborative platforms—enable students to access broader information and independently test truths. This strengthens their objective and critical thinking in dealing with scientific phenomena. Research shows that the use of project-based media in science learning is effective in fostering a sense of scientific responsibility because students are required to produce tangible, accountable products. Project-Based Physics learning media is not only a means of conveying concepts but also a vehicle for developing essential scientific attitudes. Students are no longer merely recipients of information but also active actors in building scientific knowledge and character through meaningful learning experiences.

Human resources are the main indicator of successful education. Good education will produce superior and competitive human resources. Basically, education is a conscious human effort to develop the potential of students by encouraging and facilitating students in the learning process. Learning is a process of behavioral change related to cognitive, affective and skills to become better (Santosa et al., 2021). The paradigm shift in the learning process requires teachers to be able to design creative and innovative learning by utilizing technology that is in line with the Industrial Revolution 4.0 Era. Learning activities are designed in such a way that they can facilitate students to construct their own knowledge and apply it, practice skills, and expand the knowledge they have acquired during learning (Izzati et al., 2019). The industrial revolution 4.0 is in line with the demands of the 21st century and the government must prepare a strategy to face the era of globalization and respond to the demands of the 21st century (Stehle & Peters-Burton, 2019); (Van Laar et al., 2020); (Larson & Miller, 2011); (González-Pérez & Ramírez-Montoya, 2022). This strategy is expected to produce individuals who are competent in technology and science so that they can advance the nation (Dewi Muliani & Citra Wibawa, 2019); (Mynbayeva et al., 2015). It is known that the demands of the 21st century are the main things that must be considered, especially in the field of education to face future challenges (Geisinger, 2016); (Kaufman, 2013). So in other words the skills required in the 21st century must be mastered (DiCerbo, 2014); (Fry & Seely, 2011); (Griffin, 2017); (Jang, 2016); (Lambert & Gong, 2010); (Sibille et al., 2010).

Education that is able to prepare students to be able to face technological advances is education with student-centered learning. Student-centered learning aims to build their cognitive structure through data, theories, or facts observed by students, especially in science learning. One of the objectives of the subject matter includes: as a means of fostering students' scientific attitudes; appreciating individual and group work; and developing reasoning skills in inductive and deductive analysis with scientific concepts and principles. Based on the objectives of science learning, the implementation process must be a means of training students to have a high scientific attitude. Scientific attitudes are included in the educational character that students must have, and the implementation of learning is expected to be able to train students' scientific attitudes. Scientific attitudes describe open-mindedness, curiosity, and an optimistic approach to failure as scientific training values (Amaliyah et al., 2024). One part of science is modern physics. Modern physics is one of the important courses in physics because it underlies several other advanced courses, including quantum physics, solid state physics, statistical physics and nuclear physics. In general, the concept of modern physics includes the special theory of relativity, quantum theory for electromagnetic radiation and matter, hydrogen-like atoms, multielectron atoms, nuclear physics, and atomic systems. Another factor is the still rare use of learning media in the Modern Physics course that can provide a better understanding of abstract materials. In science learning, there is one aspect that students must pay attention to, namely scientific attitudes. Scientific attitude requires mastery of processes that include science process skills, namely the ability to carry out an action concept, theory, principle, law in the form of facts or evidence, which includes the skills of observing, making hypotheses, making questions, predicting, designing experiments, using tools and materials, grouping, interpreting, applying concepts, and communicating. Students must have these abilities to be able to have a scientific attitude and work scientifically. Science learning must be taught comprehensively consisting of facts, concepts, principles, laws, and theories. This can be achieved by training students' scientific skills and attitudes (Fitriansyah et al., 2021).

One of the efforts to improve students' scientific attitude is by developing interactive web-based media using a model that can facilitate the improvement of scientific attitude of students. The learning model used is Project Based Learning (PjBL). Project-Based Learning (PjBL) is a form of learning that focuses on students. Students are actively involved in the learning process. Students' thinking skills in dealing with problems will be trained through PjBL. Students work together with others and reflect on what they have learned. In addition, students can be active in the search and decision-making process by improving their practical thinking skills (Hayati et al., 2023). The use of learning models is very good when combined with the use of learning media.This is closely related to the use of information and communication technology which is increasingly developing rapidly as an effort to digitize

education in the implementation of the independent curriculum. Information and Communication Technology (ICT)-based learning in the world of education cannot be separated from the needs of 21st century learning, especially in science learning (Makhrus et al., 2025). One alternative that can be done is that learning media is integrated with technology, such as interactive web-based media. Through interactive website-based learning media, lecturers can monitor the learning process and development of students. This will help the learning evaluation process in Modern Physics courses (Mahulae et al., 2023). Therefore, this research wants to know the research trend of the development of modern physics learning media based on interactive web using the PjBL model to improve scientific attitude.

Method

This research method is descriptive and analytical, which aims to understand and describe research trends in the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude. The data used in this study was obtained from information sources indexed by Google Scholar using analytical tools such as Publish or Perish and Dimension.ai. To carry out a search on Google Scholar, keywords related to research trends on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude. In this research, an analysis was carried out on 1,000 documents that had been indexed by Google Scholar between 2015 and 2024.

The Google Scholar database was chosen as a place to search for documents because Google Scholar applies consistent standards in selecting documents to be included in its index, and Google Scholar displays more documents than the top databases. Others, especially research in the field of education (Hallinger & Chatpinyakoop, 2019). To filter data that has been collected via Publish or Perish, researchers used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Result and Discussion

This research aims to describe research trends on modern physics learning media based on interactive web using the PjBL model to improve scientific attitude conducted from 2015 to 2024. Research documents on research trends are taken from documents from 2015 to 2024. Figure 1 is presented below regarding research trends on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude. Figure 1 shows that the trend in research on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude experiencing increases and decreases. Where the research trend with an increase in the number of publications from 2015 to 2024 has increased. Where the research trend is with an increase in the number of publications every year, namely from 2015 to 2023. However, in 2024 the research trend has decreased. The increasing trend in research on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude caused by 21st century education has focused on improving scientific attitude. In 2015 there were 56 publications related to the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude, then this will continue to increase to 931 publications in 2023. This increasing research trend provides a deeper understanding the problem which is low of scientific attitude in science learning and ways to solve that problem. Research is able to improve scientific attitude through various methods, one of them is Project Based Learning model. Below are also table 1 presented research of modern physics learning media based on interactive web using the PjBL model to improve scientific attitude based on the type of publication.

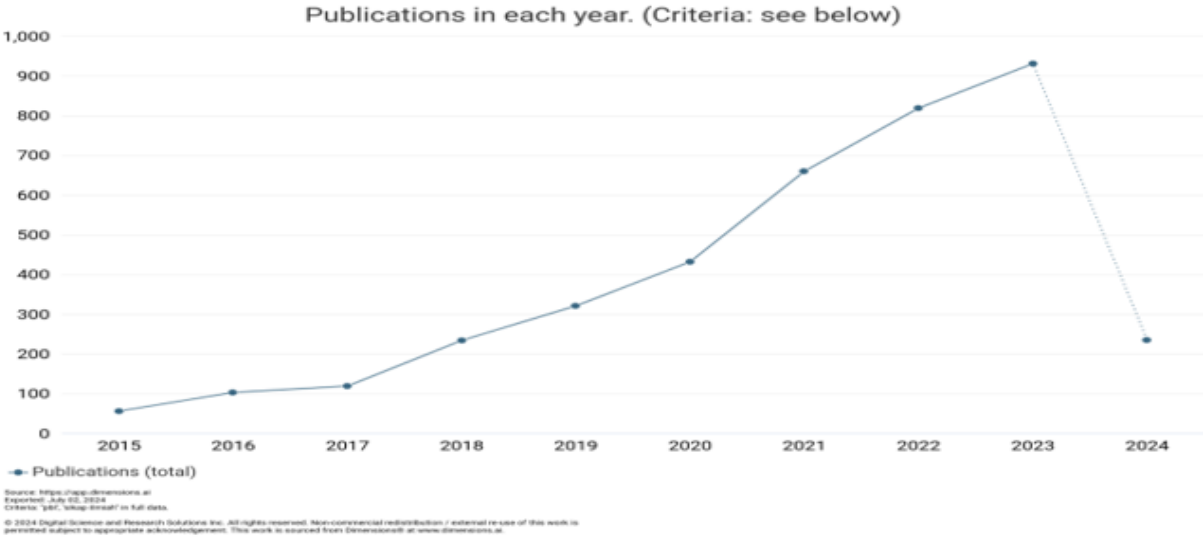

Figure 1. Research trends in physics learning media based on PjBL model to improve scientific attitude

Table 1. Trends in physics learning media based on PjBL model to improve scientific attitude Research Based on Publication Types

Publication Type	Publications
Article	3.85
Edited Book	67
Proceeding	38
Chapter	7
Preprint	1
Monograph	1

Based on Table 1, it is known that research modern physics learning media based on interactive web using the PjBL model to improve scientific attitude from 2015 to 2024 contained in 6 types of publications. In the form of articles there were 3.85 documents, chapters as many as 7 documents, proceedings as many as 38 documents, edited books as many as 67 documents, preprint and monographs only 1 document each. Research trends in article form is the type of publication that contains the most research about modern physics learning media based on interactive web using the PjBL model to improve scientific attitude compared to other types of publications (Prahani et al., 2022); (Guo et al., 2020). Meanwhile, the type of publication contains the least amount of research results modern physics learning media based on interactive web using the PjBL model to improve scientific attitude is preprint and monograph. Research conducted by (Oltarzhevskyi, 2019); (Anderson, 2025), states that an article is a complete factual essay of a certain length created for publication in online or print media (via newspapers, magazines or bulletins) and aims to convey ideas and facts that can convince and educate. These articles are usually published in scientific journals both in print and online (Suseno & Fauziah, 2020).

Below are also Table 2 presented top ten (10) sources title trends in research on modern physics learning media based on interactive web using the PjBL model to improve scientific attitude which are often cited by other researchers related to this matter. Table 2 shows that the most widely published source of research trends on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude is the Jurnal Basicedu, namely 114 publications with 904 citations and an average citation of 7.93. Basicedu Journal is a journal which is managed by the Study Programe of Elementary Teacher Education in the Faculty of Education Universitas Pahlawan Tuanku Tambusai. Basicedu Journal publishes the result of literature studies as well as research result in the scope of education in general and basic education in particular. The study cover education and learning in basic education, guidance and counselling in basic education, the studies of five areas of elementary school namely mathematics, Indonesian language, science, social studies, and civics and additional fields such as English in basic education includes the study of local content studied in the scope of basic education. Below are also table 3 presented top ten (10) article title trends in research on modern physics learning media based on interactive web using the PjBL model to improve scientific attitude which are often cited by other researchers related to this matter.

Table 2. Top 10 Sources Title Trend of physics learning media based on PjBL model to improve scientific attitude Research in 2015-2024

Name	Publications	Citations	Citations Mean
Jurnal Basicedu	114	904	7.93

Jurnal Penelitian Pendidikan IPA	85	165	1.94
Edukatif Jurnal Ilmu Pendidikan	64	374	5.84
Advances in Social Science, Education and Humanities Research	61	60	0.98
Jurnal Ilmiah Profesi Pendidikan	54	30	0.56
AKSIOMA Jurnal Program Studi Pendidikan Matematika	38	77	2.03
Jurnal Pendidikan Teori Penelitian dan Pengembangan	37	70	1.89
Jurnal Cendekia Jurnal Pendidikan Matematika	37	172	4.65
Jurnal Ilmiah Pendidikan dan Pembelajaran	36	64	1.78
Journal of Education Action Research	35	60	1.71

Table 3 shows that research on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude that is widely cited by other researchers is about "PBLPOE: A Learning Model to Enhance Students' Critical Thinking Skills and Scientific Attitudes" which is 29.00 (Novalia et al., 2025). Then the research entitled "The Critical Thinking Skills and Scientific Attitudes of Pre-Service Chemistry Teachers Through the Implementation of Problem-Based Learning Model" was cited 19.00 times per year. Research by (Hikmawati et al., 2021) entitled "The Effect of Problem-Based Learning Integrated Local Wisdom on Student Hots and Scientific Attitude" is also widely cited by other researchers, namely 8.33 per year. (Sakliressy et al., 2021), in their research entitled "Students Scientific Attitude in Learning Physics Using Problem Based Learning Model with Experimental and Project Methods" was cited 8.33 per year. This research data is comparable to data on the increasing trend of research on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude model to improve scientific attitude in science learning from 2015 to 2024. This means that in that year, research related to it was continuously cited by other researchers. In the articles researched and written by these researchers, there are many terms related to modern physics learning media based on interactive web using the PjBL model to improve scientific attitude. Below are presented ten (10) popular keywords related to modern physics learning media based on interactive web using the PjBL model to improve scientific attitude.

Table 3. Top 10 Citations on Trend of physics learning media based on PjBL model to improve scientific attitude Research in 2015-2024

Cites/year	Year	Author	Title
29.00	2020	Fitriani, Apriza; Zubaidah, Siti; Susilo, Herawati; Al Muhdhar, Mimien Henie Irawati	PBLPOE: A Learning Model to Enhance Students' Critical Thinking Skills and Scientific Attitudes
19.00	2022	Dwi Wahyudiati	The Critical Thinking Skills and Scientific Attitudes of Pre-Service Chemistry Teachers Through the Implementation of Problem-Based Learning Model
8.33	2021	H Hikmawati, I W Suastra, K Suma, A. A. I A. R Sudiatmika, R Rohani	The Effect of Problem-Based Learning Integrated Local Wisdom on Student Hots and Scientific Attitude
8.33	2021	M T Sakliressy, W Sunarno, F Nurosyid	Students Scientific Attitude in Learning Physics Using Problem Based Learning Model with Experimental and Project Methods
5.20	2019	Mustika Wati	The Effectiveness of Problem-Based Learning in Improving Students Scientific Literacy Skills and Scientific Attitudes
5.00	2019	I W Suastra and N P Ristiati	Developing Critical Thinking, Scientific Attitude, and Self-efficacy in Students through Project Based Learning and Authentic Assessment in Science Teaching at Junior High School
1.67	2021	A Dirmanto, E Cahyono,T Sulistyaningsih	The Effectiveness of Problem Based Learning on Acid-Base Materials to Improve Scientific Attitude and Creativity of SMA N 1 Comal Students
1.00	2019	A N Arini, H Hartono, K Khumaedi	Analysis of Problem Solving Skilsl and Students Scientific Attitudes through the Implementation of Problem Based Learning Module
1.00	2022	L Pujiarto	Problem-Based Physical Learning with Experimental and Demonstration Methods: Analysis with Scientific Attitude and Student Creativity
0.67	2021	Indah Wulandari, Muhammad Syukri, Murniati	Enhancing Senior High School Students' Scientific Attitude Through Problem Based Learning

Table 4 shows that the keywords that often appear related to research on the the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude are critical thinking 9 times

with a level of 1.19. This indicates that scientific attitude are often researched together with critical thinking abilities (García-Carmona, 2025); (Irwanto, 2022); (Rudolph, 2024).

Table 4. Keywords on Trend physics learning media based on PjBL model to improve scientific attitude Research in 2015-2024

Terms	Occurrences	Relevance
Scientific literacy	8	3.20
Scientific approach	10	1.29
Creativity	10	1.23
Critical thinking	9	1.19
Biology	12	1.18
Curriculum	13	1.02
Elementary school	12	0.91
Science process skill	25	0.74
Physics	37	0.70
Inquiry	32	0.56

Table 4 also shows that scientific literacy is also a keyword that appears frequently in research trends on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude, namely 8 times with a relevance of 3.20. Scientific attitude are often researched together with scientific literacy (Ernawati et al., 2022); (Guerrero & Sjöström, 2025); (Reddy, 2021).

Below are the visualization is accomplished by generating a landscape map, which offers a visual representation of subjects related to scientific studies. The outcomes of bibliometric mapping for the co-word network in articles related to the topic modern physics learning media based on interactive web using the PjBL model to improve scientific attitude are illustrated in Figure 2. Figure 2 shows the results of bibliometric keyword mapping on research trends on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude. In Figure 2 there are 65 keyword items that are often used in research on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude from 2015 to 2024. Figure 2 also contains 6 clusters, where the first cluster is colored red and consists of 17 keyword items, namely creativity, critical thinking, curiosity, project, scientific literacy, etc. The second cluster in green consists of 16 keyword items, namely inquiry, effectiveness, physics, achievment, etc. The third cluster in blue consists of 15 keyword items, namely biology, curriculum, development, implementation, etc. The fourth yellow cluster consists of 12 keyword items, namely ability, learning model, student, teacher, etc. The fifth purple cluster consists of 4 keyword items, namely activity, experiment, observation and science process skill. And the last cluster consists only 1 keyword item, namely analysis.

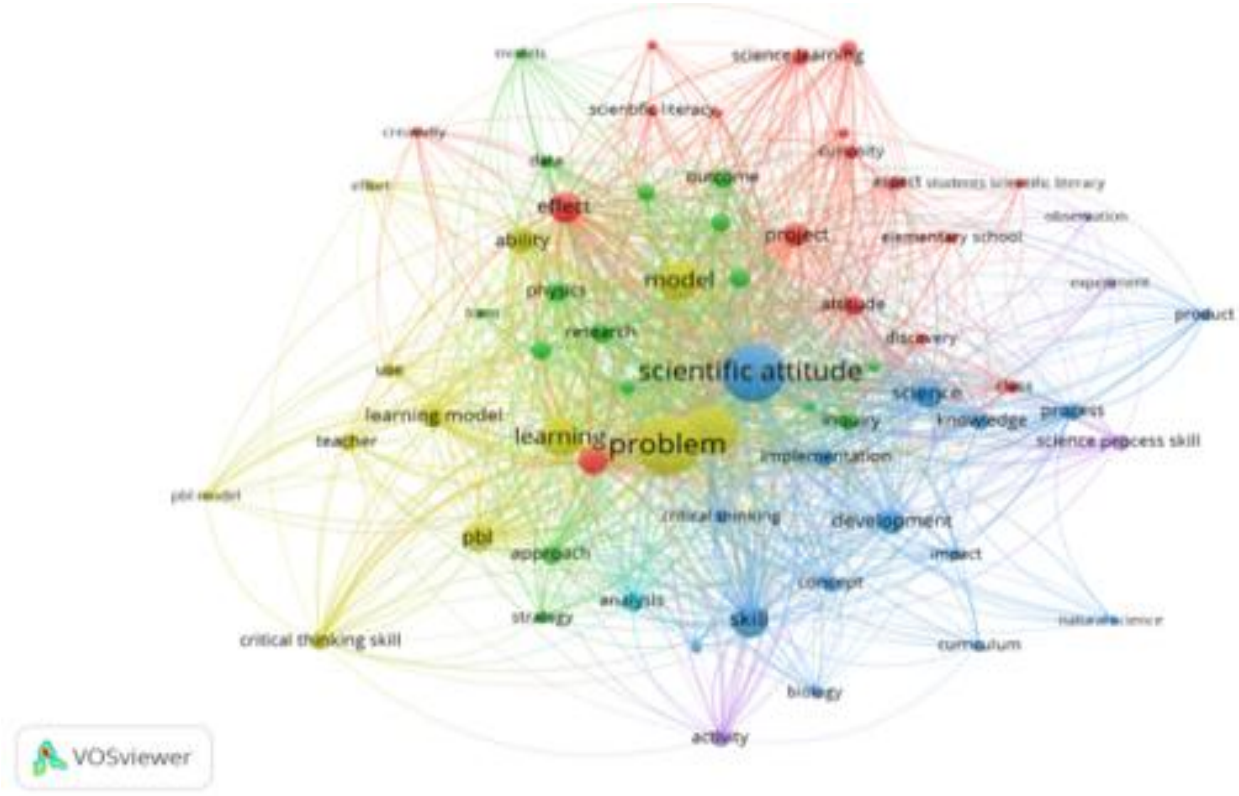

Figure 2. Network visualization on trend physics learning media based on PjBL model to improve scientific attitude research

Figure 2 above also shows that network visualization shows the network between the terms being visualized. Keywords classified into six clusters are arranged in a color chart showing the divisions that are connected to each other. The results of this analysis can be used to determine keyword research trends in the last year. This analysis shows several keywords that are often used in research on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude. The more keywords that appear, the wider the visualization displayed. Below are also presented keywords regarding the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude based on overlay visualization. Figure 3 shows the trend of keywords related to research on modern physics learning media based on interactive web using the PjBL model to improve scientific attitude in Google Scholar indexed journals from 2015 to 2024. Trends in the themes of writing articles related to the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude from the oldest to the newest year are marked with purple, blue themes, turquoise, dark green, light green and yellow. In the picture above you can see that the experiment, creativity, implementation, scientific approach, etc. This shows that these keywords were widely used by researchers in 2020. In 2021, the keywords that frequently appeared were critical thinking, scientific literacy, inquiry, PBL, etc.

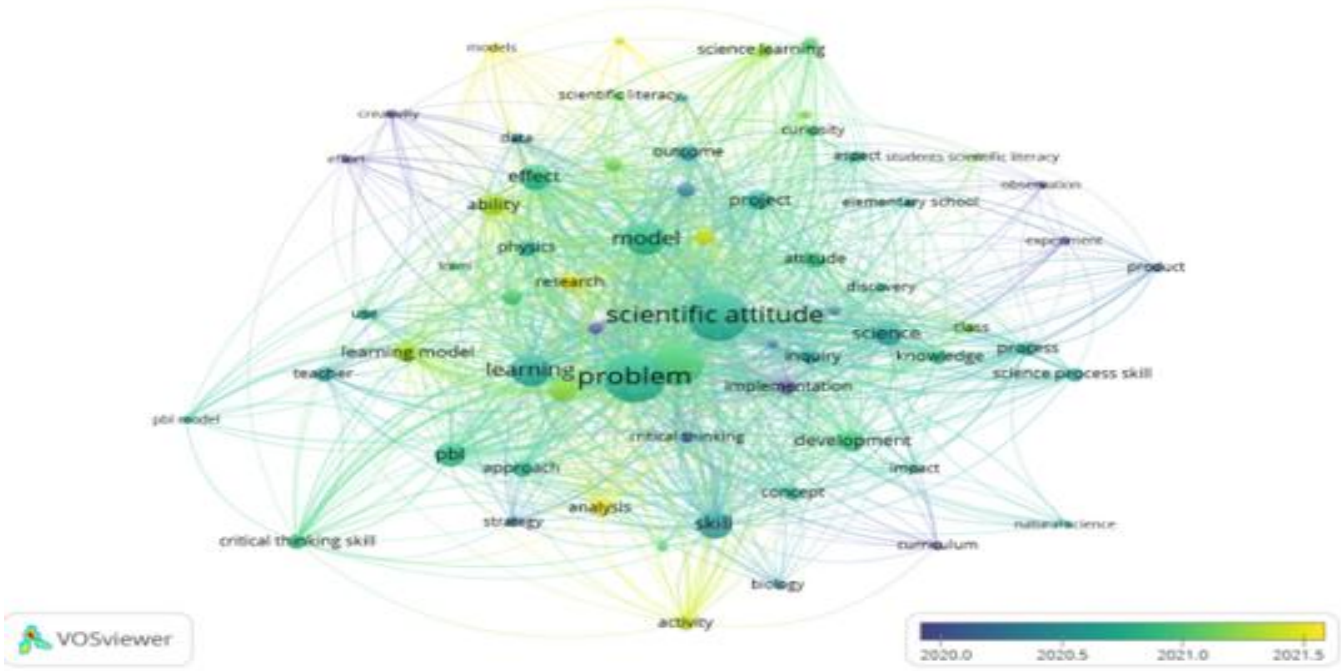

Figure 3. Overlay visualization on trend physics learning media based on PjBL model to improve scientific attitude research

Research on modern physics learning media based on interactive web using the PjBL model to improve scientific attitude is one area of research that has developed rapidly in recent years. The following also presents keywords for modern physics learning media based on interactive web using the PjBL model to improve scientific attitude research based on density visualization. Figure 4 shows density visualization. The density of research themes is shown in bright yellow. The brighter the colors of a theme, the more research is done. The fainter the color means the theme is rarely researched (Liao et al., 2018). Faintly colored themes such as scientitfc approach, physics, scientific literacy are dimly colored keywords. This shows that these keywords can be used as a reference for further research. (Doyan et al., 2023) and (Bahtiar et al., 2023) stated that yellow indicates keywords that are currently and frequently used in research.

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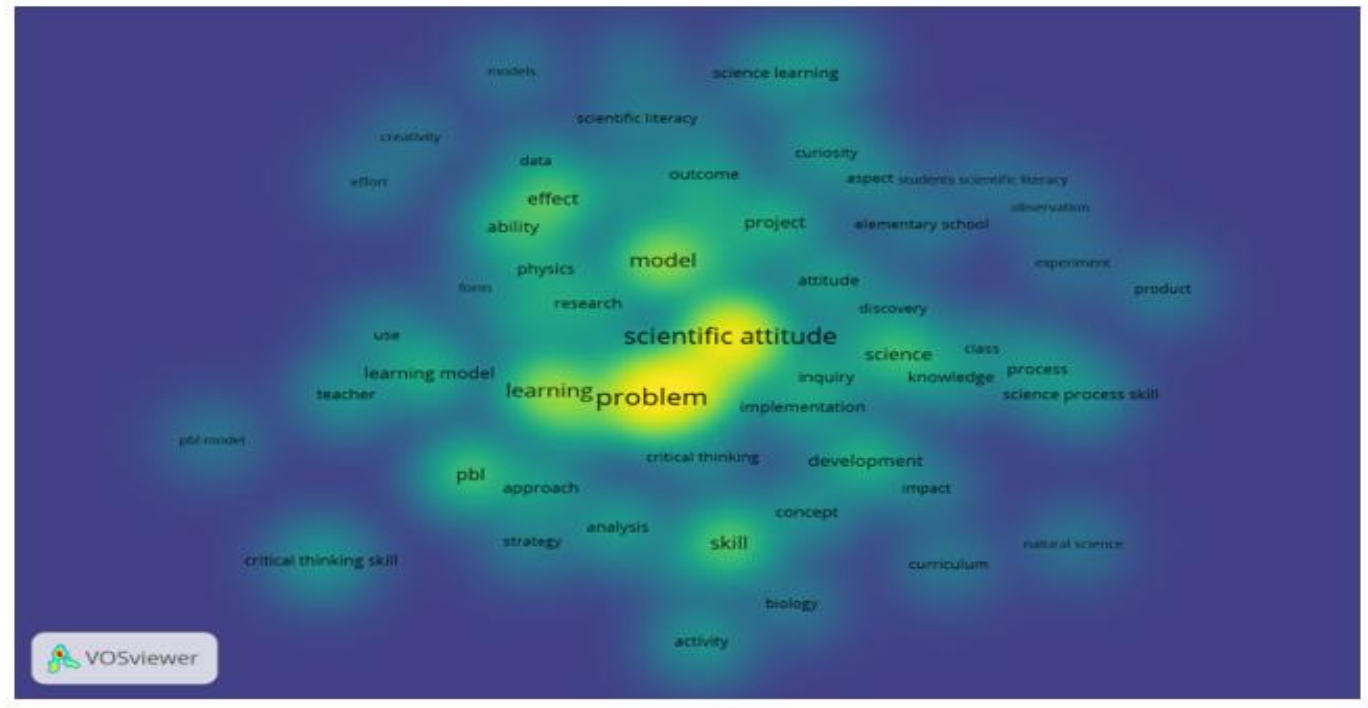

Figure 4. Density visualization on trend physics learning media based on PjBL model to improve scientific attitude research

Overall, research on modern physics learning media based on interactive web using the PjBL model to improve scientific attitude is important because it makes significant contributions to the 21st century education and PjBL model is a learning model that is able to facilitate scientific attitude (Napitupulu et al., 2024); (Aziza & Wulandari, 2020); (Qahfi et al., 2024). Scientific attitude are very important so that students are able to process information to solve problems both in learning and in real life (Muhamad Dah et al., 2024); (Suryawati & Osman, 2017). The research trend in modern physics learning media based on interactive web using the PjBL model to improve scientific attitude is expected to continue to develop in the next few years. This can be done by developing new combination of PjBL model with technology or other things like web interactive to facilitate students' scientific attitude, especially in modern physics (Rizaldi & Ziadatul Fatimah, 2023); (Septyan & Kuswanto, 2025); (Pujianto et al., 2024).

Conclusion

The research trend on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude indexed by Google Scholar from 2015 to 2024 has experienced a fluctuating increase. Where the research trend is with an increase in the number of publications every year, namely from 2015 to 2023. However, in 2024 the research trend on the modern physics learning media based on interactive web using the PjBL model to improve scientific attitude has decreased. There are many documents in the form of articles, proceedings, book chapters, edited, preprint and monograph books that discuss research about modern physics learning media based on interactive web using the PjBL model to improve scientific attitude. Key words that are often used in research of scientific attitude are critical thinking, scientific literacy, scientific approach, creativity, etc.

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Author Contributions
Conceptualization, A. D and S; methodology, A. H., S. A.; formal analysis, M. I.; investigation, N. R. A.; resources, A. D.; writing—preparation of original draft, S.; writing—reviewing and editing, A. H.; visualization, S. A; supervision, M. I.; project administration, N. R. A; obtaining funding, A. D. All authors have read and approved the published version of the manuscript

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