



Research Trends in the Development of Google Sites-Based Learning Media Integrated with PBL to Improve Generic Science Skills (2015-2024): A Systematic Review

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Received: December 14, 2024

Revised: March 21, 2026

Accepted: April 18, 2026

Published: March 31, 2026

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DOI: [10.56566/ijses.v3i1.274](https://doi.org/10.56566/ijses.v3i1.274)

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Abstract: This study aims to develop Google Sites-based learning media integrated with Problem-Based Learning (PBL) to improve general scientific skills in science subjects. The study adopted a design-based research approach, focusing on the design, implementation, and evaluation of educational media. The development process involved needs analysis, content creation, and iterative testing with feedback from educators and students. The media was designed to facilitate an interactive and collaborative learning experience, allowing students to engage with real-world problems and apply scientific concepts effectively. Pre- and post-intervention assessments were conducted to measure the impact on students' scientific skills. Results showed significant improvements in both areas, highlighting the effectiveness of using Google Sites as a versatile platform for PBL-oriented science education. The findings suggest that integrating digital tools in the learning environment can encourage higher-order thinking and improve students' overall engagement in science. Future research could explore scalability and adaptability across different educational contexts.

Keywords: Educational media development; General scientific skills; Google sites; Problem-based learning

Introduction

In the 21st century, education must adapt to rapid technological advances and the evolving demands of society (Muliyadi et al., 2023). Especially in science education, there is an urgent need to equip students not only with basic knowledge but also essential skills such as critical thinking and general scientific competence (Doyan et al., 2023). These skills are essential for students to navigate complex problems in the real world and make informed decisions (Agustina, 2022). This research focuses on developing Google Sites-based learning media that integrates PBL to improve students' general scientific skills (Parno et al., 2023). Google Sites offers a flexible platform for creating interactive and accessible learning environments that can meet a variety of learning needs (Muhammad et al., 2023). By utilizing these tools, educators can design engaging content that facilitates exploration and inquiry, allowing students to

actively participate in their learning process (Rasyid et al., 2024).

The purpose of this study was to evaluate the impact of the developed media on students' scientific and critical thinking skills at SMP Negeri 22 Mataram. Through this study, we aim to provide valuable insights into the effectiveness of technology-enhanced PBL in encouraging essential skills among junior high school students. The findings will also provide a framework for educators who wish to implement similar strategies in their classrooms, thus improving the quality of science education.

The ability to use technology in education is one of the essential skills that teachers must possess in the 21st century (Susilawati et al., 2023). This technology can be applied in creating interactive and interesting learning media, which in turn can increase students' motivation to learn (Munandar et al., 2024; Susilawati et al., 2025). One of the technologies that can be utilized is Google

How to Cite:

Susanti, D. (2026). Research Trends in the Development of Google Sites-Based Learning Media Integrated with PBL to Improve Generic Science Skills (2015-2024): A Systematic Review. *International Journal of Science Education and Science*, 3(1), xx-xx. <https://doi.org/10.56566/ijses.v3i1.274>

Sites, a free application that allows the creation of websites with various interesting features to support the learning process. This research aims to explore the utilization of Google Sites-based learning media in science education at the primary school level, specifically to assess its effectiveness in improving student motivation and understanding (Utami, 2023).

Method

The method in this study is an analytical descriptive method to understand and describe trends related to the development of learning media based on

google sites integrated with PBL to improve generic science skills. Data collection in this study through Google scholar using Publish or Perish and Dimension AI. The analysis in this study was conducted on 100 articles on Google scholar with a range of years 2015-2024.

Result and Discussion

The purpose of this study is to describe the research trends in the development of learning media based on google sites integrated with PBL to improve generic science skills carried out from 2015-2024.

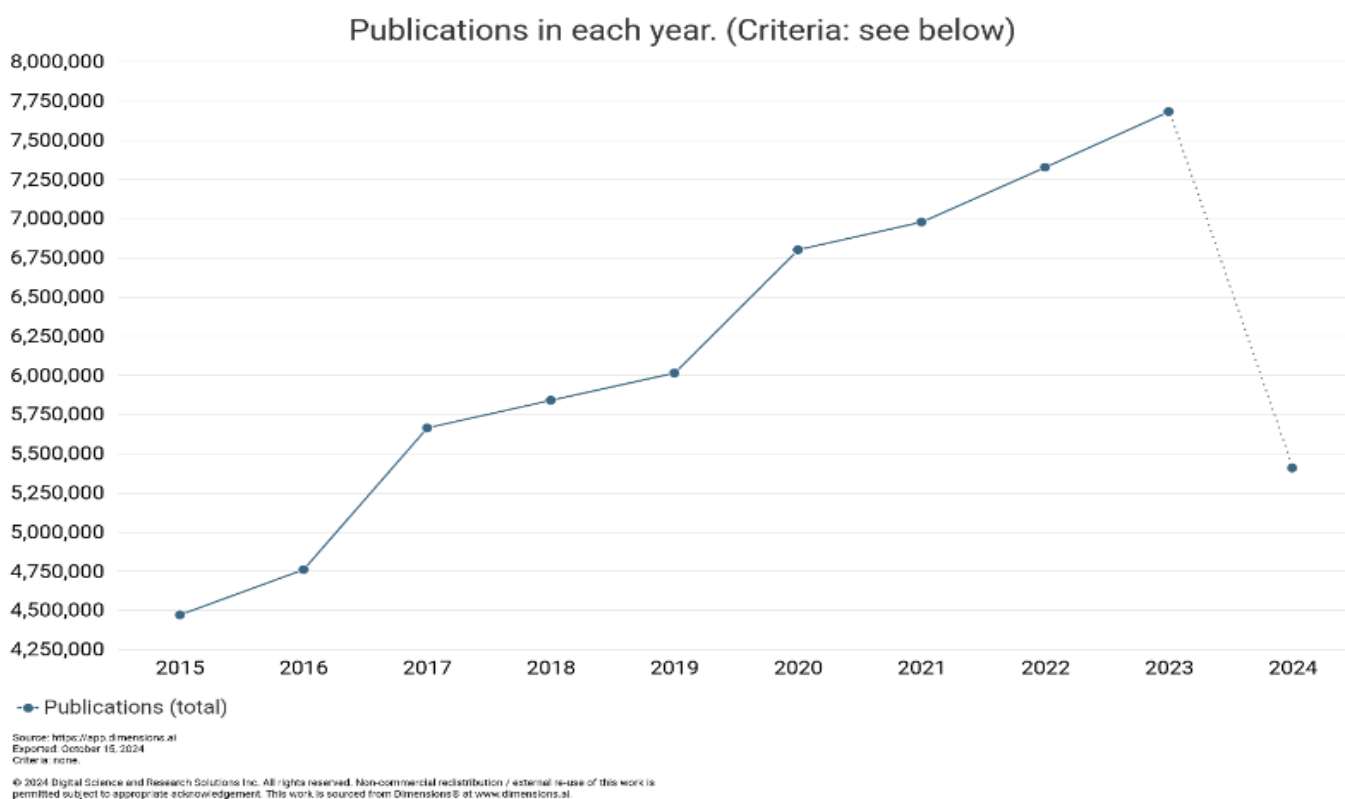


Figure 1. Research trend of developing learning media based on google sites integrated with PBL to improve generic science skills (2015-2024)

The figure is a line graph showing the number of scientific publications each year from 2015 to 2024. The vertical axis (y-axis) shows the number of publications in numbers, while the horizontal axis (x-axis) displays the years from 2015 to 2024.

In 2015-2016, the number of publications started from around 4,500,000 in 2015, then experienced a significant increase in 2016 with more than 5,500,000. In 2017-2018, the upward trend continued consistently from 2016 to 2017, reaching around 5,750,000 publications, and continued to increase until 2018 reaching around 6,250,000. In 2019-2021, the graph shows a sharper increase from 2018 to 2019, with the number of publications reaching more than 7,000,000.

This increase continues moderately until it peaks in 2021 with around 7,750,000 publications. Years 2022-2023, from 2021 to 2023, the number of publications remained stable at a high of around 7,750,000 to 8,000,000. Year 2024, in 2024, the graph shows a sharp decline in the number of publications to around 5,250,000. This decline is likely due to incomplete data for 2024, as the graph shows a dotted line indicating estimates or data that is not yet finalized. Overall, the global scientific publication trend shows consistent growth from 2015 to 2023, with the largest increase between 2018 and 2019. The decline that occurred in 2024 may still need to be analyzed further regarding the factors that affect the number of publications in that year.

Table 1. Trends in Learning Media Development Based on Google Sites Integrated PBL to Improve Generic Science Skills Based on Type of Research Publication

Publication type	Publications
Article	2,144,378
Chapter	733,632
Preprint	393,540
Proceeding	282,379
Edited book	160,365
Monograph	129,879

Based on table 1 Development of Learning Media Based on Google Sites Integrated PBL to Improve Generic Science Skills Based on the Type of Research Publication, it is known that the highest number of publications is in articles. Article on the development of learning media based on Google sites integrated PBL to improve generic science skills as many as 2,144,378 publications. While chapter 733,632, preprint 393, 540, Proceeding 282,379, edited book 160,365, and monograph 129, 879 publications.

Table 2. Top 10 Trend Titles of Google Sites-based Learning Media Development Integrated with PBL to Improve Generic Science Skills in 2015-2024

Name	Publications	Citations	Citations mean
arXiv	326,546	39,304	0.12
Lecture notes in computer science	101,431	1,414,085	13.94
SSRN Electronic Journal	32,271	156,764	4.86
Physical Review D	15,692	649,124	41.37
Physical Review B	15,137	561,894	37.12
bioRxiv	14,501	44,428	3.06
Journal of High Energy Physic	12,940	449,463	34.73
PLOS ONE	11,791	413,712	35.09
Proceedings of SPIE-the International Society for Optical Engineering	11,098	59,385	5.35
IEEE Access	10,580	259,814	24.56

Table 2 shows that the most publications related to the trend of developing learning media based on Google Sites integrated with PBL to improve generic science skills are arXiv journals. This journal published 326,548

publications, 39,304 citations and an average citation of 0.12. All editions in this journal are open and free to access and download for free by anyone.

Table 3. Top 10 Citations on the Trend of Developing Learning Media Based on Google Sites Integrated with PBL to Improve Generic Science Skills in 2015-2024

Cites	Years	Author	Title
94	2017	EN khabibah, M Masykuri	The effectiveness of module based on discovery learning to increase generic science skills
7	2022	NM Pujani, KGY Arsana, K suma	The effectiveness of introduction to astronomy teaching materials to improve problem solving and generic science skills
28	2017	R Nefianthi, A Ulimaz	Students science generic skills using Knos-KGS model ini biologi learning
6	2023	EFSA scientific committee (SC) S more	Guidance on protocol development for EFSA generic scientific assessments
7	2020	A Ramdani, SD Utami, I Efendi, IN Dewi	Local wisdom integrated biology learning program as an alternative to increase generic science skills
14	2019	N Harefa, RD Suyanti	Science generic skills of "chemistry"? prospective teachers : A study on collaborative learning using exe media
3	2018	PMJ Tuapattinaya	The correlation between generic science skill and biology learning results of public junior high schools in Ambon using scientific approach
10	2022	N El Gendy, CM Bertha, M. Abd El Shafy	Scientific and regulatory activities initiated by the US Food and Drug Administration to foster approvals of generic dry powder inhalers : quality perspective
28	2016	W Sunarmi, W Supartono	Preliminary Analysis of Assessment instrument design to reveal science generic skill and chemistry literacy
2043	2019	P Wessel, JF Luis, L Uidea, R Scharroo	The generic mapping tools version 6

Based on table 3 about the top 10 citations about the trend of developing learning media based on Google sites integrated PBL to improve generic science skills in

2015-2024, the most cited is about the generic mapping tools version 6 as many as 2043 citations in 2019.

Keywords like case study may frequently appear in more qualitative literature. On the other hand, terms such as data, field, and development are closer to the center, suggesting that they are more general and commonly used across various interdisciplinary studies.

This map provides a visual representation of how key terms in the scientific literature are interconnected. Researchers can use this information to understand research trends, emerging fields, or even identify gaps in the literature where certain keywords have not been widely discussed together.

Overall, the map illustrates the landscape of scientific research organized by the co-occurrence of keywords. This visualization helps identify closely related research clusters, trends in the field, and how specific topics are interconnected within the scientific literature.

Figure 3 illustrates keyword trends related to the development of Google Sites-based learning media

integrated with Problem-Based Learning (PBL) to enhance generic science skills. Yellow nodes represent terms that appear more frequently in recent publications (2021), while blue nodes indicate terms found in earlier publications (2017–2018). The gradient transition between blue and yellow reflects trends over time, with newer keywords (2020–2021) highlighted in green and yellow.

The largest nodes at the center of the map, such as study, science, model, and paper, indicate keywords that frequently co-occur in scientific literature. These nodes are connected to many other terms by lines, demonstrating their high frequency of occurrence. The connecting lines between nodes represent the co-occurrence of keywords within the same document. Thicker and more numerous lines around large nodes signify strong and frequent associations between these terms.

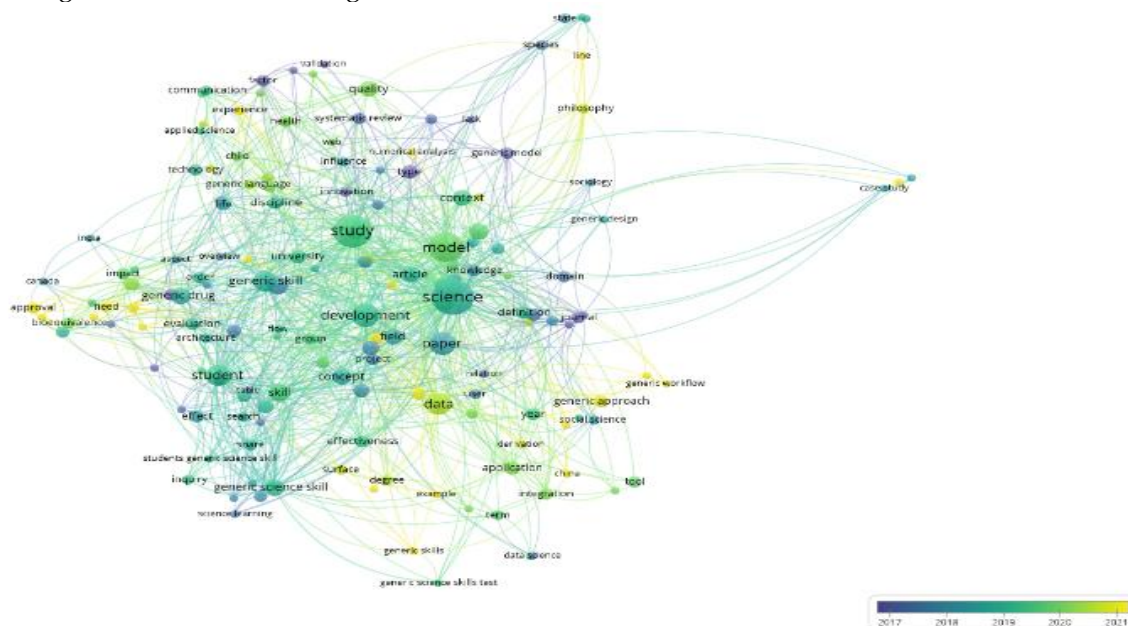


Figure 3. Overlay visualization of trends in developing google sites-based learning media integrated with PBL to enhance generic science skills

Trends Over Time: Keywords like case study, located on the right side of the map and highlighted in yellow, indicate their relevance in more recent publications. In the center and left portions of the map, terms such as generic skill, student, and generic drug, shown in light green to dark green, suggest these terms were frequently used during 2019–2020. Older terms, represented in blue, such as context, quality, and science, were prominent in earlier research, around 2017–2018.

The connecting lines also illustrate thematic relationships between keywords. For instance, the connection between development, generic skill, and paper highlights a strong association among these terms

in scientific literature. The thicker and more numerous the lines, the more frequently these keywords co-occur within the same documents. The timeline at the bottom of the map indicates that this visualization tracks keywords from 2017 to 2021, with colors ranging from dark blue to yellow to signify when a term was most frequently used.

Overall, the map provides a rich visualization of how research trends and relationships between topics have evolved over time across various scientific fields. It is a valuable tool for researchers to identify the most relevant terms today and to trace the evolution of older and emerging research topics.

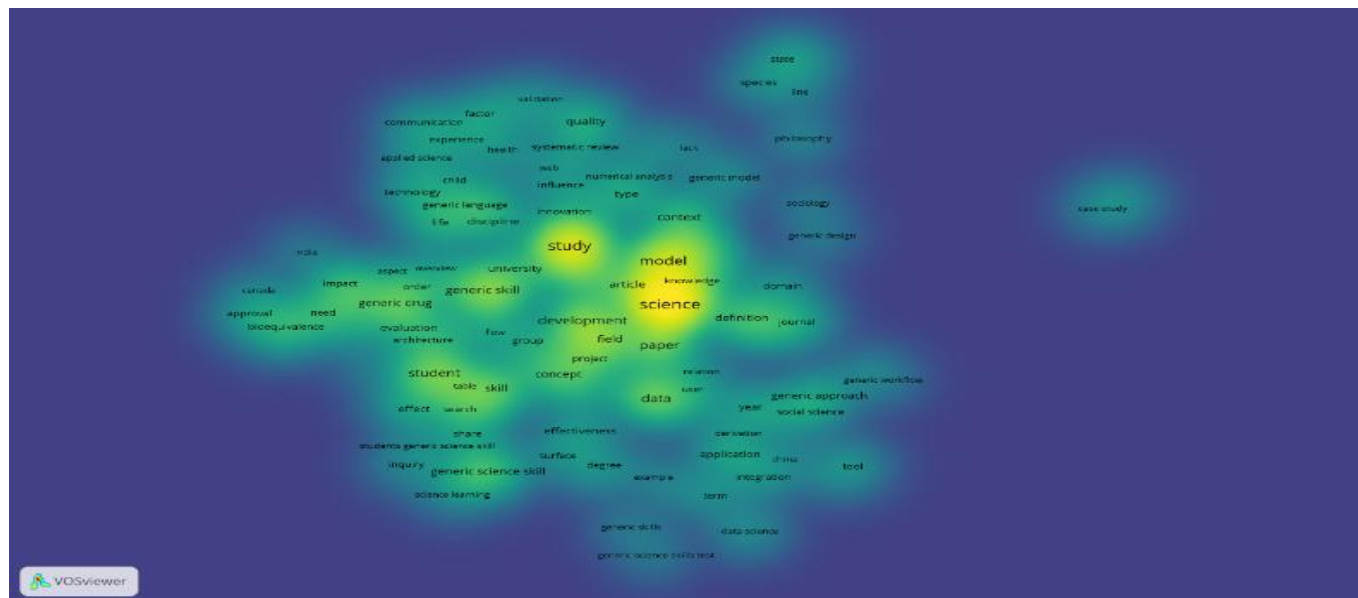


Figure 4. Density visualization of trends in developing google sites-based learning media integrated with PBL to enhance generic science skills

Figure 4 presents a density visualization generated using VOSviewer, showing the trends in the development of Google Sites-based learning media integrated with Problem-Based Learning (PBL) to enhance generic science skills. Topics that are more frequently studied are represented with brighter colors (yellow), while less common topics are shown in darker shades (green to blue).

Terms such as model, science, study, and paper, located at the center of the map and displayed in bright yellow, indicate these terms are the most frequently occurring and form the core focus of much scientific research. These terms are commonly used and represent central themes in the literature. Surrounding these key terms are others, such as development, field, generic skill, and data, which also appear frequently but not as prominently as the core terms, as indicated by their slightly darker green coloring.

Terms displayed in blue or light green represent less commonly occurring keywords in the scientific literature. For example, the keyword case study, while present on the map, is located farther to the right and is shaded darker, signifying lower density. In other areas of the map, terms such as bioequivalence, approval, and validation appear in light green regions, indicating moderate frequency, though not as high as the central terms.

The yellow areas on the map denote regions with a very high concentration of terms, signifying topics that are frequently discussed or appear in many research articles. Green areas indicate terms that are moderately frequent, while blue areas reflect regions with low keyword density, suggesting these terms are rarely found in the literature. This visualization provides insights into the trends and research focus within a

particular field or discipline. Bright yellow terms are central in scientific literature, while darker terms are less discussed or more specific to certain topics.

The heatmap serves as a visual representation of the distribution of keywords in scientific literature, highlighting both the most frequently occurring terms and those less frequently discussed. It aids researchers in identifying important keywords and emerging research trends across various fields, based on the density of their occurrence in scientific documents. Overall, this map helps understand research patterns and popular focal areas in academic work.

Conclusion

This study concludes that the development of Google Sites-based learning media integrated with Problem-Based Learning (PBL) enhances generic scientific skills, demonstrating its relevance in improving learning dynamics. The findings provide a new direction for the development of Google Sites-based learning media and the enhancement of students' generic scientific abilities.

Acknowledgments

Thank you to all parties who have helped in this research so that this article can be published

Author Contributions

All authors contributed to writing this article.

Funding

No external funding.

Conflicts of Interest

No conflict interest.

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