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Mapping Research Trends of Project Based Learning for Students' Digital Literacy: A Bibliometric Analysis

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Abstract: The integration of technology with project-based learning (PjBL) has become a key approach to fostering 21st-century skills, particularly digital literacy. However, research exploring the relationship between PjBL and digital literacy remains fragmented and lacks comprehensive mapping. This study aims to analyze research trends and thematic evolution related to PjBL and students' digital literacy using a bibliometric approach. A total of 184 articles indexed in Scopus from 2015 to 2025 were analyzed using VOSviewer, including performance analysis, thematic mapping, and keyword co-occurrence. The results show a steady increase in publications, with a significant rise after 2020. The analysis identifies major research clusters focusing on digital literacy, immersive learning, instructional innovation, and interdisciplinary approaches. Furthermore, the findings suggest that PjBL is widely associated with enhancing student engagement, problem-solving skills, and broader 21st-century competencies. This study highlights emerging research directions, including the need for more robust pedagogical frameworks and increased cross-disciplinary collaboration. In conclusion, the integration of PjBL and digital literacy demonstrates strong potential to support more interactive and meaningful science learning aligned with digital era demands. Future research should focus on developing more adaptive and technology-integrated PjBL strategies.

Keywords: Bibliometic analysis; Digital literacy; Project-based learning; Science Mapping

Introduction

Ternty first century learning requires students to have competencies that are aligned with global demands. In the context of education, these global needs encourage the integration of digital technologies into learning activities to strengthen digital literacy and enhance scientific conceptual understanding (Asrizal et al., 2018; Chen & Zainudding, 2024; Oliveira et al., 2025). The needs of 21st-century competencies also emphasize critical thinking, creativity, communication, and collaboration as foundational elements of modern learning (P21, 2019; Thornhill-Miller et al., 2023). Previous studies have shown that the use of digital technologies can improve access to scientific information, strengthen student engagement, and create more meaningful learning environments (Getenet et al., 2024; Nkomo et al., 2021). In addition, the utilization of digital media in education supports conceptual representation through simulations, interactive models, and visualizations that enrich the learning experience (Khualid & Rohmah, 2025; Muliyadi et al., 2026; Wahidin et al., 2025). In this context, education in the 21st century demands the implementation of forward-thinking and flexible approaches that can nurture and sustain digital literacy as an essential competency for all students.

Educational transformation continues to advance alongside the increasing use of digital technologies in learning processes. One of the disciplines affected by this digital transformation is science, including physics education. Digital technologies enable more concrete representations of physical phenomena through simulations, virtual experiments, and interactive models

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that support students' construction of conceptual understanding (Herrera et al., 2024; Mufit et al., 2023; Munandar et al., 2024). Research indicates that the use of digital media in physics learning can enhance learning motivation, reduce misconceptions, and strengthen the mastery of scientific process skills (Adlim & Syukri, 2021; Susilawati et al., 2022). Moreover, access to digital devices allows students to engage in scientific exploration independently, flexibly, and in accordance with their individual learning styles (Akhmetzhanova et al., 2025; Scheel et al., 2022). Therefore, the implementation of digital transformation in physics education significantly elevates the overall quality of learning by creating learning environments that are innovative, grounded in authentic contexts, and designed to prioritize students' needs and participation.

Digital literacy has become an essential competency that students must master in contemporary learning. Research shows that students' digital literacy skills facilitate their ability to select, analyze, and interpret scientific information from various digital sources more effectively (Dašić et al., 2024). In addition, digital literacy supports students in developing higher-order thinking skills through activities such as exploration, simulation, and digital modeling (Warkentin et al., 2025). These developments align with the demands of modern learning, which require students to actively participate in technology-based scientific ecosystems. Therefore, digital literacy should be understood not just as a complementary skill set, but as a core component that substantially enhances the relevance, authenticity, and contextual alignment of physics learning experiences.

Students' digital literacy in Indonesia remains at a relatively low level. Various national reports indicate that students' abilities to access, comprehend, and evaluate digital information are still categorized as low to moderate (Afrina & Zulaikha, 2024; Jaruarti et al., 2024; Nurhasanah et al., 2025). This limited competence is reflected in students' difficulties in optimally utilizing digital learning resources, such as interpreting scientific data, assessing the credibility of information, and using learning-support applications (Karagul et al., 2021; Listiana et al., 2025). In physics learning, inadequate digital literacy affects students' ability to interpret simulations, dynamic graphs, and technology-based visual representations (Maries et al., 2017; Stefan et al., 2023). Moreover, disparities in digital infrastructure and teachers' pedagogical unpreparedness further reinforce the challenges in developing digital literacy in schools. Therefore, improving digital literacy is an urgent necessity to ensure that students can learn effectively in the context of 21st-century education.

Project-based learning (PjBL) has become one of the learning models aligned with the needs of the Merdeka Curriculum. The project-based learning model positions students at the center of the learning process through investigative activities and the completion of authentic projects that are relevant to real-life contexts (Chistyakov et al., 2023; Markula & Aksela, 2022; Zhang & Ma, 2023). In this process, learners are encouraged to utilize various digital tools and resources, ranging from information searching and data processing to the creative presentation of project products (Fitriani & Mustadi, 2021). The implementation of technology in project-based learning allows students to build digital literacy skills, including the capacity to locate, assess, and create information responsibly (Hinostroza et al., 2025; Mufaridah et al., 2025). In addition, project-based learning supports the strengthening of collaboration, communication, and problem-solving skills, which constitute core components of modern science learning (Afriani, 2025; Gabuardi, 2021; Rehman et al., 2024). Therefore, project-based learning functions as an instructional approach that not only deepens students' grasp of physics concepts but also strengthens digital literacy as an essential competency for learners in the digital age.

Project-Based Learning (PjBL) has strong potential for integrating digital literacy into the learning process. Within the project-based learning model, students are required to search for, evaluate, and process digital information as part of completing their projects, allowing digital literacy skills to develop authentically (Hikmawati et al., 2025). Learning experiences that emphasize technological exploration help students develop more comprehensive digital skills, ranging from information retrieval to the production of digital-based content (Rahayu & Khairi, 2025). Therefore, project-based learning is widely recognized as an effective pedagogical approach for developing the digital literacy competencies necessary to support learning processes in technologically driven educational settings.

Several studies have examined the implementation of project-based learning to improve students' digital literacy. However, most of these studies are empirical and context-specific, often focusing on particular subjects, educational levels, or local settings (Masnia et al., 2025). As a result, they do not provide a comprehensive understanding of how research on PjBL and digital literacy has evolved at a global level. In addition, there is still limited evidence regarding the overall research structure, including publication trends, collaboration networks, and the development of key research themes in this field. This limitation makes it difficult to systematically identify dominant research directions as well as underexplored areas that require further investigation.

Therefore, a more structured and comprehensive approach is needed to map the development of research

in this area. Bibliometric analysis offers a powerful method to examine research patterns, intellectual structures, and thematic relationships through quantitative and visual techniques. Unlike conventional literature reviews, this approach enables a macro-level analysis of research development, allowing for a clearer identification of trends, research gaps, and emerging topics.

The novelty of this study lies in its comprehensive bibliometric mapping of global research trends and thematic evolution of PjBL in relation to students' digital literacy over the past decade. This study not only analyzes publication trends but also integrates keyword co-occurrence, network visualization, and thematic evolution to reveal the underlying knowledge structure of the field. The importance of this study is grounded in the growing demand for technology-integrated learning and the development of 21st-century competencies. A clear understanding of research trends and gaps is essential for guiding future studies, improving instructional design, and supporting evidence-based educational policies. Therefore, this study provides a strategic foundation for advancing research and practice related to PjBL and digital literacy in contemporary education.

Method

The present research adopts a bibliometric analytical method. Bibliometric analysis is a quantitative approach aimed at describing, evaluating, and monitoring published research outputs. This method provides produces outcomes that exhibit greater objectivity and clarity, with minimized sources of bias that often arise in qualitative approaches (Zupic & Čater, 2015). Through systematic and quantitative procedures, bibliometric analysis enables an objective examination of the literature. This method allows for the identification of various patterns, including collaboration networks, keyword distributions, as well as the evolving patterns of scientific publications related to the investigated topic.

The dataset for this research was sourced from the Scopus database. Scopus was selected as the primary reference because of its extensive indexing of high-quality international scientific journals. The search procedure involved filtering publications issued between 2015 and 2025. Furthermore, a systematic screening process was implemented to guarantee that all included documents were aligned with the focus of the research focus and complied with the required standards of data quality.

The selection of keywords was undertaken meticulously to guarantee that the collected sources were genuinely pertinent to the study's topic. The keywords applied "Project-based Learning" and "Digital Literacy" were combined using the Boolean operator "AND" to precisely delimit the search results. This strategic formulation of keywords ensured that the identified publications appropriately captured the linkage between project-based learning approaches and digital literacy in technologically adaptive educational contexts. The search query was applied using the TITLE-ABS-KEY function in Scopus to ensure that the keywords appeared in the title, abstract, or keywords of the documents. The keywords "project-based learning" and "digital literacy" were combined using the Boolean operator "AND" to delimit the search results. The search was conducted using the TITLE-ABS-KEY function in Scopus to ensure the relevance of the retrieved documents.

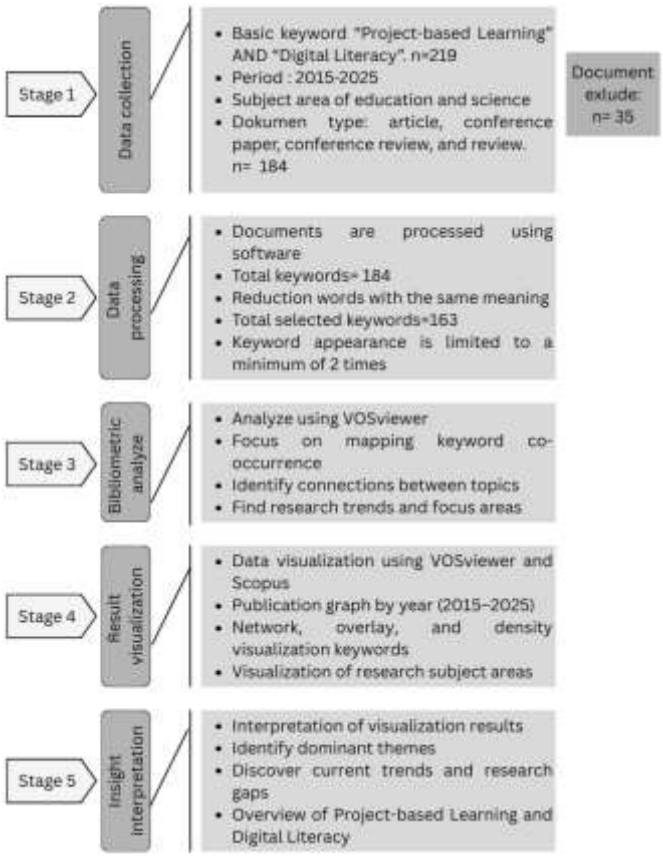

Figure 1. Stages of the workflow

This study implemented a structured sequence of steps to maintain transparency throughout the analysis procedure. The research was through five sequential stages, as adopted from Irawan et al. (2024). These stages included data collection from the Scopus database, article screening guided by inclusion criteria, data handling, bibliometric assessment, visualization of analytical outcomes, and interpretation of the results. Every phase was intentionally formulated to ensure that the resulting outputs were valid and in accordance with

the main focus of the research. This sequence ensured that only articles deemed relevant and scientifically appropriate were subjected to further analysis. A schematic representation of the research framework is additionally provided to offer a more transparent visual understanding of the methodological pathway.

This study utilizes various software to guarantee valid and reliable data visualization. Data processing, including keyword refinement, was carried out using Notepad and Microsoft Word, including a keyword refinement process procedure by consolidating terms that share similar meanings but differ in spelling variations. Furthermore, data visualization and interpretation were undertaken using the VOSviewer application, which was selected for its capability to generate interactive and easily comprehensible visual outputs. The visualizations produced generated through VOSviewer, which formed the foundation to analyze trends and patterns in the reviewed literature.

The data analysis involved processing the metadata obtained from Scopus. The processed dataset was subsequently imported into VOSviewer to analyze keyword occurrences and explore the connections among documents. The findings were visualized using network, overlay, and density visualization techniques to support the analysis of thematic clusters and prevailing research trends. A descriptive analysis was performed to explain the insights derived from these visual outputs. Various visualization results, including research developments and areas of study, were generated resulting from the analytical process conducted using Scopus data.

Result and Discussion

The third result of this analysis is associated with the overlay visualization interpretation. In this type of visualization, each node's color indicates the average year of publication during which the associated keyword was predominantly used. This approach provides a chronological summary of research trends and illustrates how the focus of study has shifted over time.

Figure 2 shows the increasing pattern of research publications addressing the integration of digital literacy and project-based learning in education during the 2015–2025 period. A significant increase in publication numbers is noticeable, especially post-2020, reflecting the increasing interest of the academic community toward the implementation of digital literacy and project-based learning among students. This trend aligns with the findings of Mota et al. (2024), who reported a notable surge in publications related to project-based learning since 2015, affirming that project-based learning has been widely recognized as a key strategy in modern educational innovation. These findings indicate that the adoption of project-based learning has become increasingly widespread in global education.

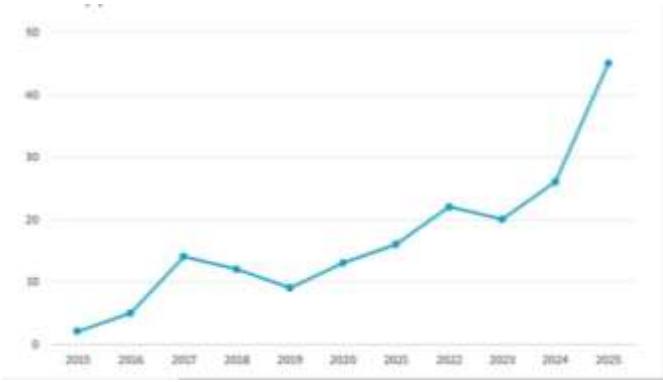

Figure 2. Distribution of publication growth 2015-2025

Reasearch by Fitri (2023) highlights showing that from 2015 onward, scholarly attention toward this topic has progressively intensified project-based learning, particularly within interactive and immersive learning environments. This suggests that project-based learning is not only gaining popularity but is also considered an effective model learning for promoting understanding and student engagement. Furthermore, Arifin et al. (2024) emphasize the importance of developing digital literacy as a core 21st-century competency and demonstrate that integrating innovative instructional models such as project-based learning can strengthen the attainment of modern educational goals. Overall, the increasing trend in related publications reflects a global effort to advance research on innovative learning models linked with digital literacy development, positioning project-based learning as an essential focal point in the field of educational research and underscoring the need for creative and adaptive instructional approaches aligned with 21st-century competencies.

The second finding of this study relates to the network visualization analysis. In this representation, each node represents a keyword, and the connecting lines illustrate the co-occurrence relationships among them. The color variations indicate clusters that organize closely associated subjects. This network visualization aids in recognizing the primary research themes as well as the emerging directions of development within this field.

According to the network visualization analysis shown in Figure 3, the findings indicate that "Project-based Learning" emerges as the most dominant keyword, evidenced by its highest frequency of occurrence and a total link strength of 309. This

dominance reflects the central position of project-based learning within scholarly discussions on the development of digital literacy across diverse learning contexts. Meanwhile, "digital literacy" appears as the second strongest node with a total link strength of 196, reinforcing its role as a strategic competence in 21st-century learning (Bartolome & Garaizar, 2022; Dai, 2024; Reddy et al., 2023). The strong connection between project-based learning and digital literacy is further highlighted by a high direct link value of 22, indicating that project-based approaches play a significant role in enhancing students' ability to use, analyze, and produce digital information critically (Bakermans & Ziino Plotke, 2018; Guo et al., 2020).

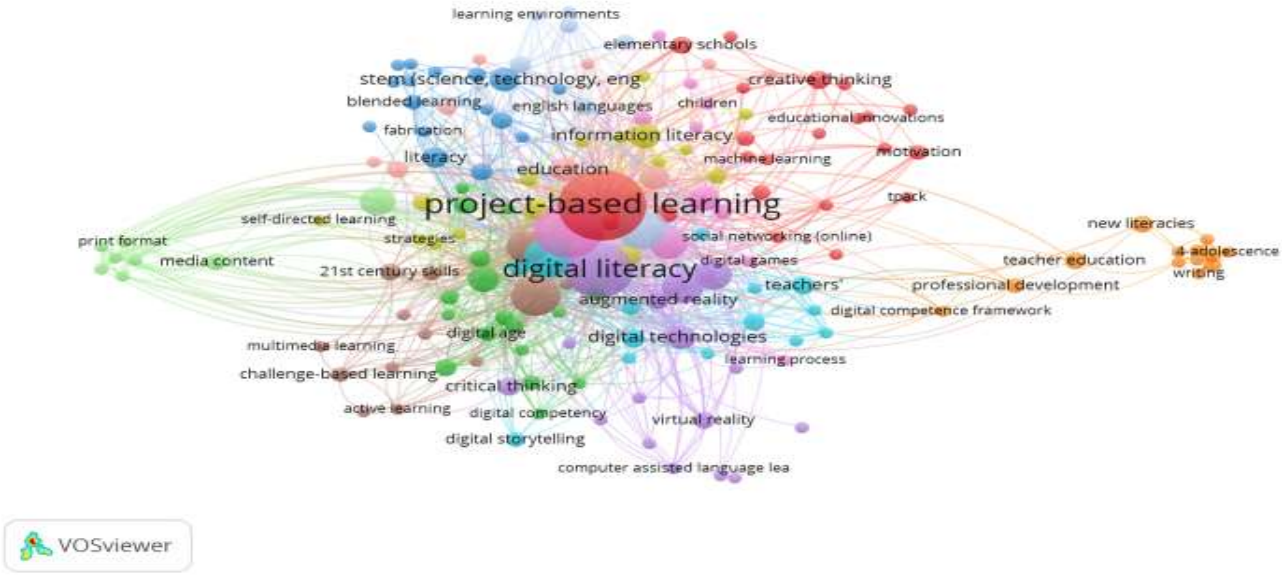

Figure 3. Network visualization

The structure of the resulting network reflects a broad and interconnected thematic relationship. Keywords such as "students," "e-learning," "teaching," "collaboration," and "curricula" appear with strong linkages, indicating that the enhancement of digital literacy is influenced not only by pedagogical strategies but also by curriculum design, learning ecosystems, and technological support in education (Asmayawati et al., 2024; Audrin & Audrin, 2022; Haleem et al., 2022). The presence of keywords such as "digital technology," "STEM," and "21st century skills" further suggests that the implementation of PjBL within the domain of digital literacy is frequently aligned with STEM contexts and essential 21st-century competencies, including creativity, problem-solving, and collaborative skills (Rehman et al., 2024; Warkentin et al., 2025).

The analysis also revealed the formation of 11 thematic clusters that illustrate the mapping of research foci in this field. The cluster containing terms such as creative thinking, educational innovation, and project-based learning indicates that pedagogical innovation serves as a fundamental basis for developing students' digital capabilities. Meanwhile, the cluster comprising digital skills, collaboration, and problem-based learning highlights the importance of active, problem-based learning in fostering digital competence (Chueh & Kao, 2024). Another cluster that includes digital literacy, digital technologies, and critical thinking reinforces the notion that digital literacy is viewed not only as a technical ability but also as a higher-order thinking skill required in modern digital learning environments (Ilomäki et al., 2023). In addition, the presence of clusters focusing on curricula, teaching, and 21st century skills demonstrates that instructional strategies and curriculum design are essential for the successful execution of project-based learning in the realm of digital literacy.

The strong interconnectedness between digital literacy, project-based learning, and other elements such as e-learning and learning systems illustrates that the use of digital technologies constitutes an integral component of project-based learning activities. This finding aligns with previous studies, which highlight that students' engagement in project-oriented tasks involving digital tools enhances their ability to evaluate, navigate, and independently produce digital information (Fami et al., 2023). Accordingly, the network analysis indicates that project-based learning functions as a relevant pedagogical framework for enhanced digital literacy, particularly when integrated with innovative instructional design, educational technologies, and collaborative learning approaches.

Overall, the pattern of interconnections among keywords in the network visualization indicates that

research on project-based learning and digital literacy is moving toward the development of learning models that integrate problem-solving, digital technology, and 21st-century skills as an inseparable unit. These findings provide a strong foundation for future studies to explore more adaptive, integrative, and responsive project-based instructional designs aligned with the demands of contemporary digital learning. In addition, future research directions are expected to strengthen the integration of digital technologies, competency-based curricula, and instructional strategies that support sustainable digital literacy development within modern educational contexts.

The third outcome of this study pertains to the overlay visualization analysis, which offers a temporal perspective on the evolution of research topics. In this type of visualization, the color assigned to each node corresponds to the average publication year in which the related keyword most frequently appeared. By incorporating this temporal dimension, the overlay map enables a clear chronological depiction of how research interests have progressed, thereby revealing shifts in thematic focus across the period of 2015–2025.

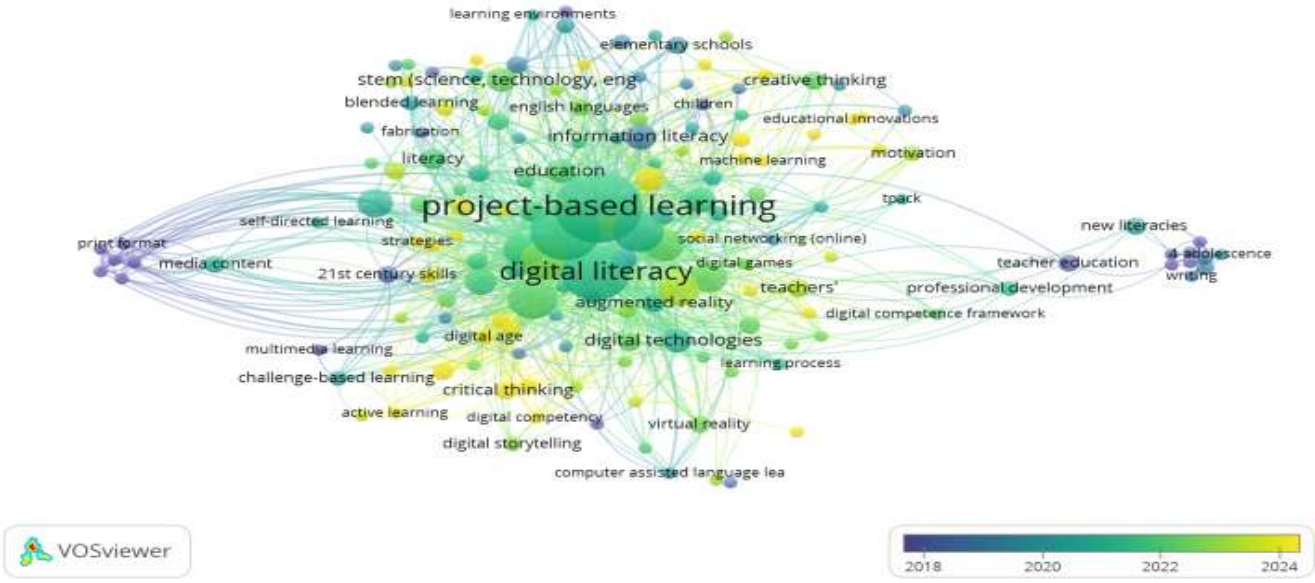

Figure 4. Overlay visualization

The overlay visualization analysis shown in Figure 4 depicts the chronological progression of research on digital literacy and project-based learning over the past decade. The dominance of blue tones during the early period (2015–2018) indicates that studies within this phase primarily emphasized pedagogical foundations and basic forms of literacy, as reflected in keywords such as "21st century skills" (2018.50), "information literacy" (2019), and "teacher education" (2018.25). These findings suggest that early research trends were oriented toward strengthening essential 21st-century competencies and enhancing educators' capacity to integrate innovative approaches into instructional practices (Haug & Mork, 2021; Martinez, 2022).

Entering the mid-period, represented by green tones (2019–2023), a noticeable shift emerges toward the integration of educational technology through the implementation of project-based learning and the strengthening of digital literacy. Keywords such as 'project-based learning' (2021.36), 'digital literacy' (2021.27), and 'e-learning' (2021.13) appear prominently within this phase, indicating that research increasingly positions project-based learning as an effective method for enhancing students' digital skills. This trend reflects the increasing agreement that digital literacy is a critical competency for managing the challenges of the digital era, particularly through learning activities that emphasize collaboration, problem solving, and the active use of technology (Deschênes, 2024; Frailon et al., 2018).

In the most recent phase, indicated by yellow coloration (2024–2025), the focus of research increasingly shifts toward strengthening higher-order thinking skills and advancing learning innovation. Keywords such as "critical thinking" (2024.60), "active learning" (2025), "educational innovation" (2025), and "problem solving" (2025) illustrate that contemporary studies are moving toward the utilization of project-based learning as a platform for developing complex cognitive abilities through exploratory, collaborative, and authentic learning activities. This trend reinforces the argument that PjBL is not merely a learning model, but also a strategic vehicle for fostering educational innovation

and enhancing the quality of technology-enhanced learning (Setiawan et al., 2025).

Overall, the temporal patterns revealed through the overlay visualization illustrate an evolution of research that initially focused on strengthening pedagogical foundations and basic literacies, then shifted toward the integration of digital technology through project-based learning, and in the most recent period transformed into studies emphasizing educational innovation, critical thinking skills, and active learning strategies. This development indicates that research on project-based learning and digital literacy is increasingly moving toward a holistic approach that positions technology, innovation, and 21st-century skills as key elements in modern instructional design. These findings provide opportunities for future research to further explore how the integration of project-based learning, digital technologies, and higher-order thinking skills can generate more adaptive and sustainable learning models within the context of future education.

The fourth result of this study relates to the density visualization analysis of the dataset, which provides deeper insight into the intensity and concentration of keyword usage within the collected documents. In this visualization, brighter or more saturated color regions signify keywords that occur with greater frequency and hold a more central or influential position within the research landscape. By interpreting these density patterns, researchers can more easily recognize the core keywords that represent the dominant focal points and foundational concepts within the examined domain.

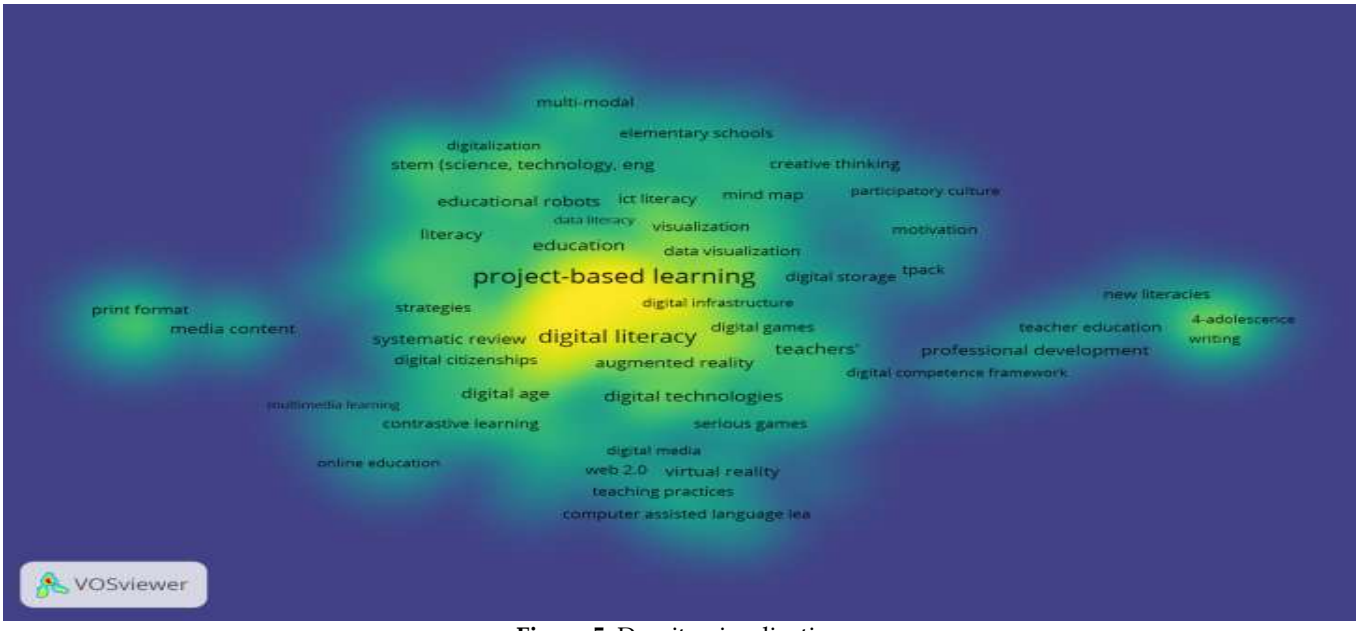

Figure 5. Density visualization

The outcomes of the density visualization analysis reveal the concentration level of keyword occurrences across the entire document set, thereby illustrating the central research focus within studies on digital literacy and project-based learning. The bright yellow areas in the density map indicate keywords with the highest intensity, namely digital literacy, students, and project-based learning. These three keywords appear with dominant frequency and occupy central positions in the research network, indicating that the implementation of digital literacy and project-based learning with an emphasis on student-centered learning constitutes the core theme most widely explored over the past decade. These findings reinforce the results of the earlier co-occurrence and overlay analyses, which similarly identified project-based learning and digital literacy as topics with strong link strength and a sustained developmental trend through 2025.

The green-shaded areas indicate keywords with medium density levels, such as digital technologies, information literacy, STEM, collaboration, and creative thinking. The positions of these keywords suggest that, although they are not examined as extensively as the core cluster, these areas still serve as significant supporting domains within studies on digital literacy and project-based learning. For instance, digital technologies and information literacy frequently appear in research evaluating 21st-century competencies, while STEM, collaboration, and creative thinking are closely associated with the skills fostered through the implementation of project-based learning across various learning contexts.

The blue areas in the density map indicate keywords with lower levels of occurrence, such as 21st century skills, TPACK, and teaching materials. This position suggests that although these topics remain relevant, the research attention given to them is not as substantial as that directed toward core themes such as project-based learning and digital literacy. Nevertheless, the presence of these keywords still reflects that studies related to 21st-century competencies, the TPACK framework, and instructional material development continue to be part of the broader research ecosystem supporting digital learning innovation.

Overall, this density pattern reinforces that research on project-based learning and digital literacy is dominated by themes oriented toward the integration of innovative pedagogy, the integration of digital technologies and the enhancement of students' skills. These results are consistent with earlier studies emphasizing the role of project-based learning and digital literacy in developing 21st-century competencies in an era of educational transformation (Lim et al., 2022; Oliveira et al., 2025).

The last result of this analysis relates to the subject area, which displays how various academic disciplines are reflected in the analyzed documents. Subject areas such as Mathematics, Science, Social Sciences, and Education illustrate the interdisciplinary nature of the research, highlighting how different fields contribute distinct perspectives and approaches. The colors or categories signify the main fields contributing to the publications, making it easier to identify dominant and emerging disciplines within the dataset. This visualization provides insight into the disciplinary distribution within the research area and helps to understand how various disciplines contribute to the topic of project-based learning and digital literacy in a more comprehensive and interconnected manner.

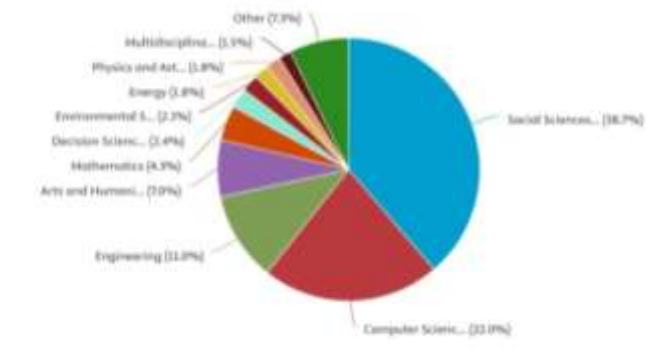

Figure 6. Subject area disribution

Based on the analysis of the subject-area visualization, research on project-based learning and digital literacy exhibits a broad disciplinary distribution, although it remains primarily concentrated within the domains of social sciences and education. Social Sciences emerges as the most dominant subject area, accounting for 38.7% of the publications, indicating that studies on project-based learning and digital literacy are predominantly developed within pedagogical, instructional, and socio-educational contexts. This dominance is consistent with previous literature, which emphasizes that project-based learning is a constructivist learning model that effectively supports 21st-century competencies, including digital literacy, collaboration, and problem-solving (Laar et al., 2020; Voogt & Roblin, 2012).

The field of Computer Science (22%) also occupies a substantial portion of the disciplinary distribution, indicating that the enhancement of students' digital literacy through project-based learning is frequently associated with the integration of technology, digital tools, and instructional media design. This reflects the role of developing digital tools as an essential foundation in modern project-based instruction (Baziuk & Rupšien, 2025; Oskarita & Nur, 2024). Meanwhile, Engineering (11%) also contributes to the discourse, particularly in studies that employ PjBL within the context of technical design, digital innovation, and engineering-oriented problem solving.

Subject areas such as Mathematics (4.3%), Decision Science (2.4%), and Environmental Sciences and Energy, each at around 2%, indicate that the PjBL approach and digital literacy have been used across disciplines in various educational contexts, albeit in smaller proportions. The emergence of disciplines such as Physics and Astronomy (1.8%) and the Multidisciplinary category (1.5%) confirms that PjBL has been widely adopted as an adaptive learning model that can be applied across various disciplines to improve students' digital skills.

Overall, the subject area patterns indicate that research on project-based learning and digital literacy is interdisciplinary in nature, yet remains firmly grounded within the domains of social sciences, education, and information technology. The dominance of the three major fields Social Sciences, Computer Science, and Engineering reinforces the notion that the integration of digital technology into project-based learning has become a central focus in preparing students to meet the demands of 21st-century education (OECD, 2024; Voogt & Roblin, 2012).

The distribution of subject areas also highlights an important opportunity for advancing research within the field of physics education, particularly because the contribution from the Physics and Astronomy subject area remains very low (1.8%). The low representation of research in this domain indicates that the implementation of digital literacy and project-based

learning has not yet been fully optimized to enhance students' competencies in physics learning, whether in conceptual understanding, inquiry skills, or scientific problem-solving. In fact, physics is a highly relevant domain for implementing technology-enhanced project-based learning, given its characteristics that demand the visualization of abstract phenomena, simulation, modeling, and experimental practice all of which can be strengthened through modern digital tools (Rozan et al., 2024).

The limited contribution of physics-related studies presents a strategic opportunity for future research, particularly in exploring how project-based learning can be designed as a platform for strengthening digital literacy through activities such as experiments, computational modeling, or simple engineering projects. The integration of technologies such as virtual laboratories, digital sensors, augmented reality, and interactive physics simulations offers new avenues to optimize the role of digital literacy in promoting students' conceptual understanding of physics as well as their 21st-century scientific skills (Ahmad et al., 2024; Monteiro & Martí, 2022; Raharja et al., 2025). Furthermore, the project-based learning model enables more meaningful learning experiences, as students engage in designing, constructing, and evaluating solutions relevant to real-world physics phenomena. Thus, the subject area visualization not only maps the disciplinary distribution but also highlights the need for more in-depth research in physics education grounded on digital literacy and project-based learning.

Conclusion

This bibliometric study reveals five major findings concerning the implementation of project-based learning and the enhancement of digital literacy skills in interactive learning environments. First, research on digital literacy and project-based learning has shown significant growth since 2015, reflecting increasing scholarly interest in immersive learning and educational technology. Second, thematic mapping reveals a strong relationship between project-based learning, digital literacy, and technology-based pedagogical innovation. Third, overlay visualization highlights recent research trends focusing on critical thinking, active learning, and educational innovation, indicating a shift toward more specific and advanced learning approaches. Fourth, limitations in direct classroom implementation identified in several studies suggest the need for further exploration, particularly in developing more robust and adaptive pedagogical frameworks. Fifth, subject-area analysis demonstrates dominant contributions from the social sciences, computer science, and engineering, while also indicating opportunities for further development in the field of physics. These findings underscore the importance of expanding research on project-based learning within the context of physics education and digital literacy to foster more meaningful and technology-integrated learning experiences. Future research is recommended to focus on empirical investigations of PjBL implementation, the integration of emerging digital technologies, and the development of interdisciplinary approaches that strengthen students' digital literacy skills in diverse educational contexts.

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Author Contributions

Conceptualization, F.E., A., F.M., and F.N.; methodology, F.E.; formal analysis, F.E.; investigation, F.E.; data curation, F.E.; writing—original draft preparation, F.E.; writing—review and editing, A., F.M., and F.N.; visualization, F.E.; supervision, A., F.M., and F.N. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

In the preparation of this paper, the authors encountered no conflicts. The research was carried out smoothly in accordance with established procedures and supported by official permissions. Its implementation did not disrupt the learning process in the classroom, as the research materials aligned with the curriculum applied in the school.

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