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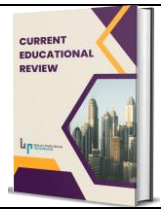

Research Trends in Project-Based Science Modules to Enhance Scientific Literacy, Environmental Literacy, and Entrepreneurial Motivation

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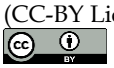

Abstract: This research aims to identify and analyze research related to module development in increasing scientific literacy, entrepreneurial motivation and environmental literacy. This research uses descriptive and analytical methods. Data was obtained from documents indexed by Google Scholar in the period 2015-2024, using the Publish or Perish and Dimension.ai tools. Research procedures refer to PRISMA guidelines. The data studied includes types of publications, publication sources, as well as widely cited research titles regarding the development of science modules in increasing scientific literacy, entrepreneurial motivation, and environmental literacy. Data analysis was carried out using bibliometric methods with the help of VOS Viewer software. The results of research regarding the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy indexed in Google Scholar from 2015 to 2024 were mostly carried out separately and few were carried out by combining the three additional variables. The graphic results show an increase, but when seen in quantity the amount is still small. Many documents in the form of articles, proceedings, book chapters, preprints, and edited books discuss research on project-based learning models to improve problem solving skills in science learning. Key words that are often used in this research include Environmental literacy, Environmental knowledge, Students motivation, Project work, and Environmental education.

Keywords: Entrepreneurship Motivation; Environmental Literacy; Projects; Science Modules; Science Literacy.

Introduction

Scientific literacy, environmental literacy and entrepreneurial motivation are three aspects that support the formation of individuals who are ready to face global challenges in the 21st century. The role of education is very vital in increasing students' awareness and knowledge of the environment and entrepreneurial skills based on natural science (Siregar & Nasution, 2020). Various environmental challenges that arise due to human activities require in-depth understanding so that the younger generation can play a role in maintaining ecosystem balance (Suryanda et al., 2020). Thus, it is important for the world of education to present a learning model that not only equips students with knowledge, but also with awareness and applicable skills in protecting the environment (Nopia et al., 2022).

In the context of science education, scientific literacy refers to students' ability to understand scientific concepts, think critically, and apply scientific knowledge in everyday life (Agung et al., 2022). Environmental literacy includes students' understanding of environmental concepts and issues as well as the ability to take action that supports environmental sustainability (Sari et al., 2021). Entrepreneurial motivation, on the other hand, is an encouragement that fosters students'

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interest in developing environmentally friendly and sustainable business skills (Yudha et al., 2020). These three variables have the potential to complement each other and become a basis for students in dealing with increasingly complex environmental issues.

However, a problem that is often encountered in science education is the lack of teaching materials that are able to link scientific literacy, environmental literacy and entrepreneurial motivation in an integrated manner (Rachmatica et al., 2021). Existing learning modules often do not support students' active involvement and are less relevant to environmental issues around them, resulting in low student awareness and participation in protecting the environment (Handoko et al., 2021). This research offers a new approach by developing a project-based science module that integrates these three aspects to increase students' motivation and awareness of environmental issues.

In line with this, science learning plays an important role for students in the process of knowing and explaining natural phenomena around them and being able to utilize them in their daily lives (Kurniawan et al., 2023; Nurlia, 2023). This role is related to the focus of science learning which emphasizes understanding concepts regarding scientific facts and process aspects through scientific methods (Kholipah, 2020). In addition, the science material taught is generally integrated with real life, resulting in broader relevance and context for students' lives (Meliniasari et al., 2023; Hurriyah et al., 2023). By developing modules that link science, the environment and entrepreneurship, it is hoped that students will not only learn theory but also be able to apply it in real contexts, strengthening their understanding of the importance of science in everyday life.

This research aims to develop a project-based science module that can increase students' scientific literacy, entrepreneurial motivation and environmental literacy. This module is expected to be not only valid and practical, but also effective in motivating students to study science while developing environmentally responsible entrepreneurship skills (Anita et al., 2020). The urgency of this research lies in the need for innovative learning resources that are able to prepare students to face environmental issues critically and appliedly, while building sustainable entrepreneurial motivation (Aji et al., 2022).

Method

This study employed a descriptive-analytical method designed to explore and map out research developments related to the development of project-based science modules aimed at improving scientific literacy, entrepreneurial motivation, and environmental literacy. The research was conducted using a Systematic Literature Review (SLR) approach following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure transparency, replicability, and methodological rigor throughout the review process.

The data analyzed in this study were obtained from scholarly documents indexed by Google Scholar, chosen for its broad coverage of educational research and consistent indexing standards. A total of 1,000 documents published between 2015 and 2024 were screened and retrieved. The selection process was facilitated by the Publish or Perish software, which extracted bibliographic metadata, and Dimensions.ai, which was used to assess citation impact and research relevance.

The search strategy was carried out in two stages to optimize the inclusion of relevant studies. In the first stage, the main keyword "project-based science module development" was combined with one of the additional variables (scientific literacy, entrepreneurial motivation, or environmental literacy) entered alternately into the search field. In the second stage, the search was refined by combining the main variable with all three additional variables simultaneously, thereby ensuring the identification of integrative studies that reflect multi-dimensional outcomes.

The search and screening process involved manual refinement to exclude duplicate articles, inaccessible full texts, and non-research-based publications. The filtered literature was then further analyzed descriptively to identify patterns, research gaps, and emerging trends related to the integration of project-based learning with science education and real-world competencies. Data visualization and mapping techniques were employed where appropriate to illustrate keyword distributions and thematic concentrations.

This method allowed the researchers to comprehensively identify the progression, focus, and potential directions of studies concerning project-based science modules, with particular attention to their impact on students' scientific understanding, environmental awareness, and entrepreneurial mindset development.

Result and Discussion

This research aims to summarize research regarding the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy. The articles used in this research start from 2015 to 2024. Search results are divided based on 2 steps which have different results. The first step, research document data was collected

separately based on 3 variables consisting of scientific literacy, entrepreneurial motivation, and environmental literacy. Next, in the second step research document data was collected by combining these 3 variables. Then, each result from the two steps is analyzed to determine the differences in the results. The basic keywords included in the two steps of collecting research documents are "project-based science module development", then continued with the keywords from the first and second steps. Keywords used when collecting documents are in Indonesian.

Figure 1 shows the results of data collection using the first step which separates the 3 research variables. The first step is to obtain results from the number of publications in each year which are different for each variable. The graph experienced an increase for the scientific literacy variable in 2019 and was followed by the environmental literacy variable from 2021. However, these 2 variables experienced a drastic decline in 2023. Then, the entrepreneurial motivation variable experienced the lowest increase in the graph compared to the other 2 variables. This is related to educational efforts to improve aspects of literacy in Indonesia which are still low based on the 2018 PISA scores (OECD, 2019). In 2019, there were 8 publications related to the development of project-based science modules to increase scientific literacy. This figure continues to increase until it reaches 70 publications in 2023. Furthermore, in 2021 there will be an initial increase of 10 publications on the development of project-based science modules to increase environmental literacy. The increase in research graphs for scientific literacy and environmental literacy occurred because they discussed the same concept regarding literacy. In addition, this provides deeper insight into the low literacy aspect in science learning as well as proposed solutions to overcome it, including through the use of project-based learning models. However, the entrepreneurial motivation variable appears to be still lacking, so this shows the need for increased research regarding the development of media or learning models related to entrepreneurship. Figure 1 below displays research data on project-based learning models to increase scientific literacy, entrepreneurial motivation, and environmental literacy separately.

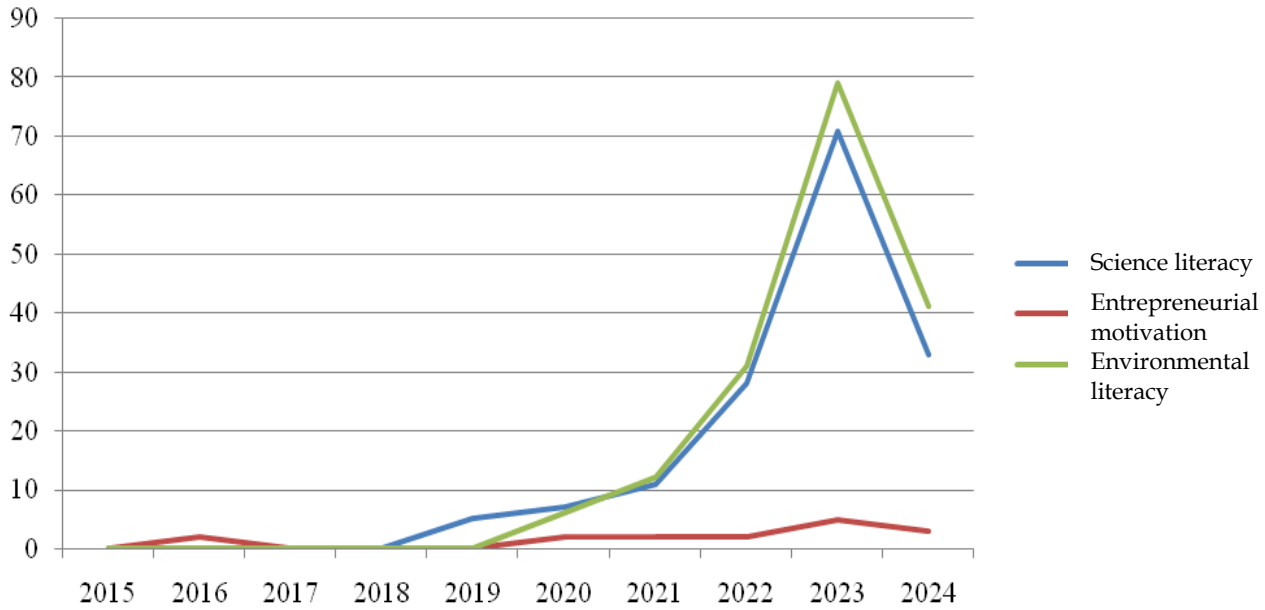

Figure 1. Research on the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy (first step)

Figure 1 shows that research is related to the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy. The research graphic results were obtained from the second research document collection step. The documents obtained from research from 2015 to 2024 have increased. The results obtained were not as big as when the research variables were collected using the first step. This research increased in number of publications from 2021 and fell again in 2022. However, this trend rose again significantly in 2023.

This increase in research is due to the independent curriculum approach which is more student-centered, differentiated and project-based learning (Putri & Muhtarom, 2024). Apart from that, the project-based learning model is related to the independent curriculum approach which is student-centered, so that students are required to be creative and critical. The independent

curriculum encourages educators to develop learning modules related to scientific literacy, such as developing E modules to improve scientific literacy and numeracy (Nyamik & Wahyuningtyas, 2022). In 2021, there were 4 publications on the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy, and the number decreased to 1 publication in 2022. However, in 2023 this research experienced an increase again reaching 5 publications. This shows that the development of modules that combine the variables of scientific literacy, entrepreneurial motivation, environmental literacy has not been carried out much and needs to be improved. Table 1 shows a research graph regarding the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy.

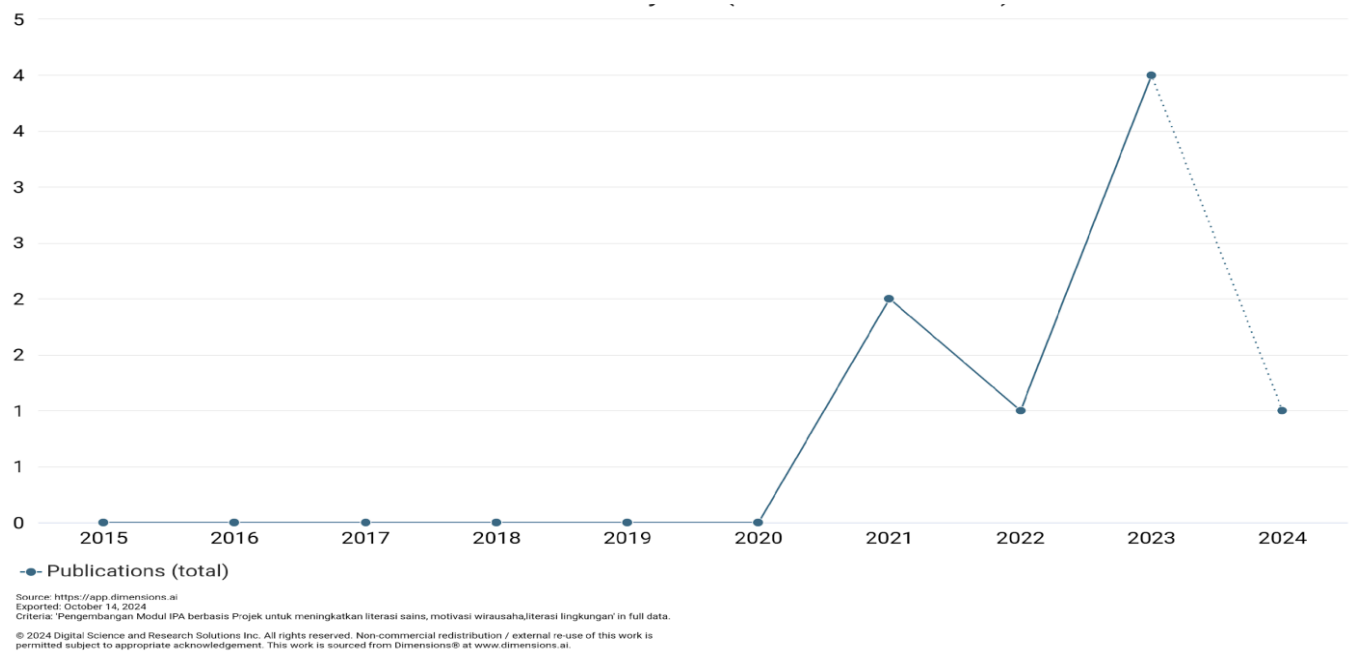

Figure 2. research on the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy (second step).

Based on Table 1, it is known that research regarding the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy from 2015 to 2024 uses the first step consisting of 5 types of publications. The highest number of publications was found in the scientific literacy variable at 742, with the highest number of publications in the article type at 742 publications and the lowest in the chapter and monograph types with the same number of publications, namely 3. After the scientific literacy variable, the highest number of publications was environmental literacy at 637 publications, the type of publication in this variable is articles totaling 581 and the lowest in chapter type is 1 publication.

Furthermore, the variable that has the lowest number of publications is entrepreneurial motivation, with 24 articles and 16 edited books. Research regarding the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy in the form of articles. The article type is the type of publication that contains the most research results compared to other types of publications. Meanwhile, the type of publication regarding the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy is chapter.

Table 1. Project-Based Science Module to Improve Scientific Literacy, Entrepreneurial Motivation, and Environmental Literacy (first step)

Publication Type	Publication		
	Science literacy	Entrepreneurial motivation	Environmental literacy
Article	680	24	581
Chapter	3	-	1
Edited Book	49	16	47
Monograph	3	-	4
Proceeding	7	-	4
Amount	742	40	637

Table 2 shows that the number of types of publications regarding the development of project-based science modules to increase scientific literacy and entrepreneurial motivation from 2015 to 2024 is less than

using the first step. The type of publication in this research consisted of edited books totaling 15 publications and the lowest was the article type. The search results for the type of publication were 15 articles and 6 edited book publications. The results of the publication search carried out using the second step can be seen in Table 2.

Table 2. Project-Based Science Module to Improve Scientific Literacy, Entrepreneurial Motivation, and Environmental Literacy (second step)

Publication Type	Publication
Edited Book	15
Article	6

Based on the search results, the top 5 sources for titles regarding the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy are displayed. The results of the research analysis are divided into 4 tables based on two (2) search steps. The results of the first search step can be seen in Tables 3 to 5, while in the second step the research results are displayed in Table 6.

Table 3 shows the research source regarding the development of project-based science modules to increase scientific literacy which is most widely published is the Journal of Advances in Social Science, Education and Humanities Research, namely 43 publications with 53 citations and an average of 1.23 citations. The Advances in Social Science, Education and Humanities Research journal contains scientific articles that publish scientific works in the fields of social sciences, education and humanities. The first edition was published in 2014. All editions in this journal are open access, that is, articles published in it are immediately and forever free to read, download, copy & distribute. Table 3 displays the top five (5) article titles regarding the development of IPA modules project-based to increase scientific literacy which is often cited by other researchers in this regard.

Table 3. Top 5 Sources of Project-Based Science Module Development Titles to Improve Science Literacy in 2015-2024

Name	Publications	Citation	Citations Mean
Advances in Social Science, Education and Humanities Research	43	53	1.23
Journal of Science Education Research	31	53	1.71
Basicedu Journal	21	153	7.29
EDUCATIVE JOURNAL OF EDUCATIONAL SCIENCE	17	32	1.88
Journal of Education Technology	17	106	6.24

Table 4 presents the search results for the top 5 sources for the title project-based science module development to increase entrepreneurial motivation. The journal that publishes the most scientific work regarding the development of science modules related to entrepreneurial motivation is Advances in Social Science, Education and Humanities Research. The number of publications from this journal is 12 with 19 citations, and has an average-average citations 1.58. There are fewer publications regarding the development of science modules with entrepreneurial motivation variables in this journal compared to scientific literacy variables. Apart from that, the entrepreneurial motivation variable has different journal names compared to the scientific literacy variable, such as journals Advances in Economics, Business and Management Research with 2 publications with 0 citations. The following is table 4 which presents the top 5 titles for developing project-based science modules to increase entrepreneurial motivation.

Table 4. Top 5 Sources of Project-Based Science Module Development Titles to Increase Entrepreneurial Motivation in 2015 – 2024

Name	Publications	Citation	Citations Mean
Advances in Social Science, Education and Humanities Research	12	19	1.58
Advances in Economics, Business and Management Research	2	0	0
Basicedu Journal	2	9	4.50
SOCIO DIDACTICS Social Science Education Journal	1	0	0
Jurnal VARIDIKA	1	91	91.00

Table 5 displays search results regarding the development of project-based science modules to increase environmental literacy. The search results showed that the largest number of publications were journals Advances in Social Science, Education and Humanities Research. The number of publications in this journal is 39 publications with 52 citations and has an average citation of 1.33. The results of the publication of the environmental literacy variable in this journal are greater than the entrepreneurial motivation variable and

smaller than scientific literacy. The name of the journal displayed in the environmental literacy variable is different from the scientific literacy and entrepreneurial motivation variables, such as the journal Basicedu with a total of 24 publications, 356 citations and an average citation of 14. 83. Search results for top 5 sources of titles regarding the development of Project-based science modules for increasing environmental literacy can be seen in Table 5.

Table 5. Top 5 Sources of Project-Based Science Module Development Titles to Improve Environmental Literacy in 2015 – 2024.

Name	Publications	Citation	Citations Mean
Advances in Social Science, Education and Humanities Research	39	52	1.33
Basicedu Journal	24	356	14.83
Journal of Science Education Research	19	32	1.68
EDUCATIVE JOURNAL OF EDUCATIONAL SCIENCE	17	32	1.88
Educational Professional Scientific Journal	10	127	12.70

Table 6 presents search results regarding the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy. The number of additional variables listed in table 6 is 3 variables or combining all the additional variables. The research results showed that the highest number of publications were in journals Advances in Social Science, Education and Humanities Research, with a total of 11 publications and 18 citations, and has an average-The average citation is 1.64. The results of this research are fewer than the results of research where the variables are separated. Top 5 sources for project-based science module development titles to increase scientific literacy, entrepreneurial motivation and environmental literacy can be seen in Table 6.

Table 6. Top 5 Sources of Project-Based Science Module Development Titles to Improve Scientific Literacy, Entrepreneurial Motivation, and Environmental Literacy in 2015-2024.

Name	Publications	Citation	Citations Mean
Advances in Social Science, Education and Humanities Research	11	18	1.64
Advances in Economics, Business and Management Research	2	0	-
Journal of Science Education Research	1	0	-
Journal of Innovative Science Education	1	3	3.00
BIODIC	1	0	-

The search results obtained several research titles that were most cited by other researchers regarding the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy. The results of this search are differentiated based on 2 search steps. The first search step is displayed in tables 7 to 9, while the search results data with the second step is displayed in table 10.

Based on the search results, quite relevant data was found regarding the development of project-based science modules to increase scientific literacy from 2015 to 2024. However, research specifically focuses on developing science modules to improve three additional variables in this research, namely scientific literacy, motivation entrepreneurship, and environmental literacy, are still very limited. This shows that there have not been many studies on science modules with a focus on these three variables. One of the reasons is the complexity of integrating these three variables into one learning module. Apart from that, selecting the right material for the module is also a challenge in its development. As a result, there are still few modules designed to effectively increase scientific literacy, entrepreneurial motivation, and environmental literacy simultaneously.

Table 7 displays the top five frequently cited quotes regarding the development of project-based science modules to increase scientific literacy. One of the most widely referenced studies is a study entitled "Analysis of Factors Causing Students' Low Scientific Literacy Ability," which has an average of 123.75 citations per year (Fuadi et al., 2020). This research is an important reference in understanding the factors that influence low scientific literacy. Furthermore, research entitled "Application of STEM Integrated Project Based Learning to Increase Students' Scientific Literacy in View of Gender" is also widely referenced, with an average of 75.63 citations per year (Afriana et al., 2016). This study shows the importance of STEM approaches in increasing scientific literacy, especially taking into account gender differences. Apart from that, research entitled "Students' Scientific Literacy in Science Learning in Indonesia" has also become a popular reference, with an average of 68.60 citations each year (Naruto, 2019). These three studies show the importance of developing project-

based modules that are integrated with modern learning approaches to increase students' scientific literacy.

Table 7. Top 5 Quotes for Developing Project-Based Science Modules to Improve Science Literacy in 2015 2024.

Citations/year	Year	Author	Title
123.75	2020	H Fuadi, AZ Robbia, J Jamaluddin	Analysis of factors causing low scientific literacy abilities of students
75.63	2016	J Afriana, A Permanasari, A Fitriani	Implementation of STEM integrated project based learning to increase students' scientific literacy in terms of gender
68.6	2019	YF Narut, K Supardi	Students' scientific literacy in science learning in Indonesia
33.33	2021	FA Febrianti	Development of a Professional Flip PDF Based Digital Book to Improve Students' Scientific Literacy Abilities
33.00	2020	R Muzijah, M Wati, S Mahtari	Development of e-modules using the Exe-Learning application to train scientific literacy

Table 8 presents five search results regarding the development of project-based science modules to increase entrepreneurial motivation. This search focuses on the second additional variable, namely entrepreneurial motivation, and is carried out with the first search step. The research with the highest number of citations is the article entitled "21st Century Skills: Skills Taught Through Learning," which has an average of 192,00 citations per year (Zubaidah, 2016). This research shows the importance of 21st century skills in the context of project-based learning. Furthermore, the book entitled "Research on ADDIE and R2D2 Model Development: Theory & Practice" is in second place with an average of 85.75 citations per year (Rayanto, 2020). This study is widely referred to because it developed innovative learning models, namely ADDIE and R2D2. The third most frequently referenced research is the article entitled "Project Based Learning Model for Social Skills and Creative Thinking," with an average of 24.75 citations per year (Kusadi et al., 2020). These three studies provide significant contributions in linking entrepreneurial motivation with the development of project-based modules.

Table 8. Top 5 Quotes on Development of Project-Based Science Modules to Increase Entrepreneurial Motivation in 2015 2024

Citations/year	Year	Author	Title
192.00	2016	S Zubaidah	21st century skills: Skills taught through learning
85.75	2020	YH Rayanto	Addie and R2d2 Model Development Research: Theory & Practice
24.75	2020	NMR Kusadi, IP Sriartha, IW Kertih	Project based learning model for social skills and creative thinking
18.60	2019	A Rahmawati	Analysis of high school students' collaboration skills in used cooking oil recycling project-based learning
15.75	2020	AG Wicaksono	Implementation of science learning based on a STEM approach in welcoming the era of industrial revolution 4.0

Table 9 displays five search results regarding research on developing project-based science modules to increase environmental literacy which are most frequently referred to by other researchers. This search focuses on environmental literacy variables and is carried out using the first search step. The research with the highest number of citations is the article entitled "Forming Environmentally Caring Character in Elementary School Students through Science Learning," with an average of 33.17 citations per year (Santika et al., 2022). This article is widely referred to because it emphasizes the importance of forming an environmentally caring character in students from an early age. Furthermore, the article entitled "Project-Based Interactive E-Modules on Student Learning Outcomes" is in second place with an average of 41.00 citations per year. This article highlights the influence of project-based interactive modules on improving student learning outcomes. In third position, the article entitled "Environmental Literacy in the 2013 Curriculum and Science Learning in Elementary Schools" has an average of 33.17 citations per year (Kusumaningrum, 2018). This research discusses the importance of environmental literacy in implementing the 2013 Curriculum. These three articles provide significant contributions to environmental literacy and the development of project-based science modules.

Table 9. Top 10 Quotes on Development of Project-Based Science Modules to Improve Environmental Literacy in 2015-2024.

Citations/year	Year	Author	Title
78.50	2022	IGN Santika, IW Suastra	Forming environmentally caring character in elementary school students through science learning
41.00	2020	MSA Dewi, NAP Lestari	Project-based interactive e-module on student learning outcomes
33.17	2018	D Kusumaningrum	Environmental literacy in the 2013 curriculum and science learning in elementary schools
15.83	2018	L Lutfi, I Ismail, AA Azis	The influence of stem-integrated project based learning on scientific literacy, creativity and student learning outcomes
15.83	2018	L Lutfi, I Ismail, AA Azis	The influence of stem-integrated project based learning on scientific literacy, creativity and student learning outcomes

Table 10 displays five search results related to the development of project-based science modules that focus on increasing scientific literacy, entrepreneurial motivation, and environmental literacy which are most frequently cited by other research. This search uses the second step by combining the main variable and three additional variables that are appropriate to this research. The search results showed that the research most frequently referred to was the article entitled "Portrait of an Independent Curriculum, a Form of Independent Learning in Elementary Schools" with an average of 499.00 citations per year (Rahmadayanti et al., 2022). This article discusses the implementation of the independent curriculum in elementary schools as part of the Merdeka Belajar policy relating to project-based learning. The second research with the highest number of citations is the article written by Rayanto (2020), entitled "Research on ADDIE and R2D2 Model Development: Theory & Practice," which received an average of 85.75 citations per year. This article offers an innovative ADDIE and R2D2 based learning development model, and is more related to concepts in module development. The third position is occupied by the article entitled "Study of Project Based Blended Learning as a Post-Pandemic Learning Model and Form of Implementation of the Independent Curriculum," with a total of 85.75 citations per year. This article has been widely cited because it discusses the project-based blended learning approach in implementing the independent curriculum, especially after the pandemic. These three articles provide an important overview in the literature regarding the development of project-based science modules, especially in increasing scientific literacy, entrepreneurial motivation, and environmental literacy.

Table 10. Top 5 Quotes on Project-Based Science Module Development to Improve Scientific Literacy, Entrepreneurial Motivation, and Environmental Literacy in 2015 2024

Citations/year	Year	Author	Title
499.00	2022	D Rahmadayanti, A Hartoyo	Portrait of the independent curriculum, the existence of independent learning in primary school
85.75	2020	YH Rayanto	Addie and R2d2 Model Development Research: Theory & Practice
48.50	2022	MR Fahlevi	Study of project based blended learning as a post-pandemic learning model and a form of implementing the independent curriculum
57.00	2023	MN Rusmiati, R Ashifa	Analysis of the Problems of Implementing the Independent Curriculum in Elementary Schools
48.50	2022	MR Fahlevi	Study of project based blended learning as a post-pandemic learning model and a form of implementing the independent curriculum
32.75	2020	D Nugraha, D Octavianah	21st century literacy discourse in Indonesia

Table 11 presents search results regarding keywords that frequently appear in research on developing project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy. The keyword that appeared most frequently was "Environmental literacy," recorded 6 times with a relevance level of 3.28. The development of science modules is also often integrated with a group project approach to develop various 21st century skills, one of which is collaboration and problem solving (Kurniatunnisa & Wowor, 2023). Apart from that, table 11 shows that "Environmental education" often appears as a keyword in science module development research with results found when searched 6 times with a relevance of 1.98. There are still not many articles discussing the development of science modules in relation to increasing scientific literacy, motivation and entrepreneurship

Table 11. Keywords for the Development of Project-Based Science Modules to Increase Scientific Literacy, Entrepreneurial Motivation, and Environmental Literacy in 2015-2024

Term	Incident	Relevance
Environmental literacy	6	3.28
Environmental knowledge	3	2.74
Students motivation	3	2.52
Project work	3	2.12
Environmental education	6	1.98

The visualization displayed is a landscape map that provides a visual representation of topics related to scientific research. The visualization results using the second search step are because this visualization image focuses more on finding novelty and relationships between the main variable and the three additional variables in this research. The keywords used in this visualization image are English because the results are neater than using Indonesian. The results of bibliometric mapping for the keyword network in the article which focuses on developing project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy are presented in Figure 12.

Figure 2 Presents a mapping of keywords related to the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy. Keywords frequently used in research on this theme from the period 2015 to 2024 consist of 46 items. The image also shows five clusters, the first cluster is student which consists of 13 keywords, such as thinking ability, case, effect, entrepreneur, entrepreneurship, evaluation and others. The second cluster is the word science which consists of 11 keywords, including environmental education, environmental knowledge, environmental literacy and others. The third cluster is the word motivation which consists of 9 keywords, including application, course, development, digital literacy, and so on. The fourth cluster has as its center the word project which is connected to 7 keywords, such as business, environment, future, outcome, STEM, and others. Finally, the fifth cluster has a basic branching of learning and consists of 6 keywords, such as case study, citizen science, interest, project, and others.

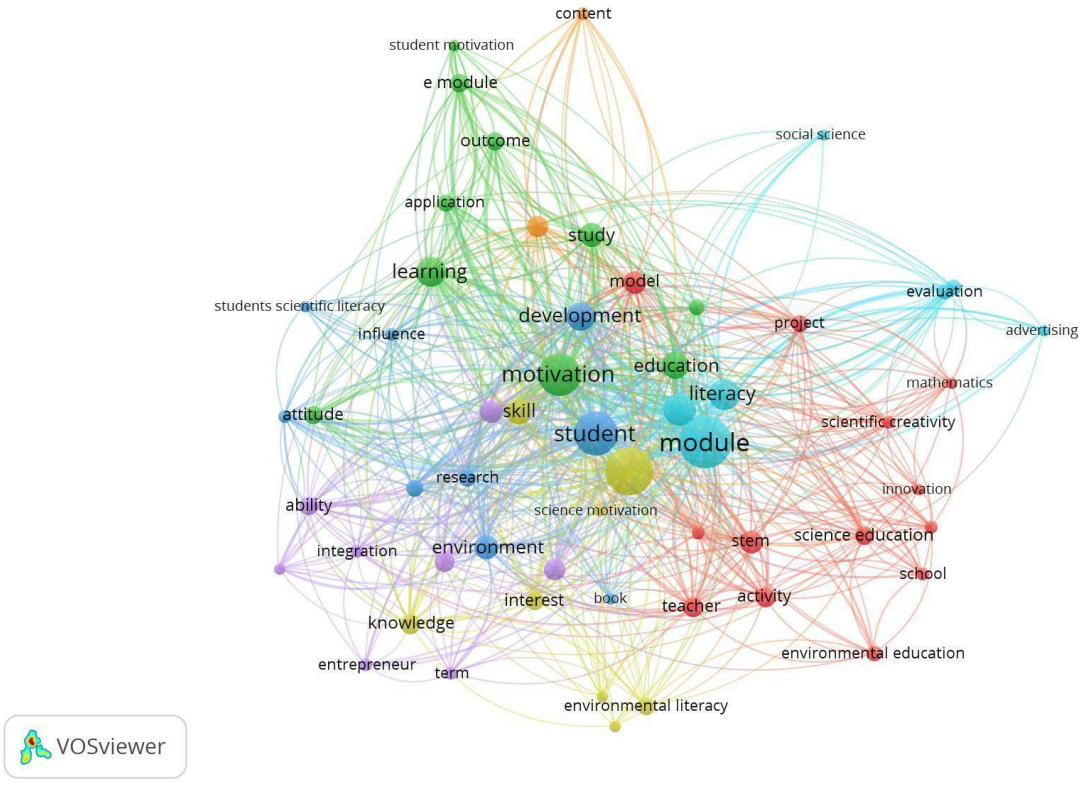

Figure 3. Network visualization in the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy

Figure 2 also displays a network visualization that shows the relationships between the visualized terms. Keywords divided into six clusters are displayed in a colored graph showing the relationship between these

clusters. The results of this analysis can be used to see keyword research trends in recent years. This analysis reveals several keywords that are often used in research regarding project-based learning models to improve problem solving skills in science learning. The more keywords that appear, the wider the visualization displayed.

Apart from that, keywords related to project-based learning models to improve problem solving skills in science learning based on overlay visualization are also presented. Figure 3 shows the trend of keywords related to research on project-based learning models to improve problem-solving skills in science learning in journals indexed by Google Scholar from 2015 to 2024. Trends in article writing themes related to project-based learning models to improve problem-solving skills in science learning it is marked by the colors purple, blue, turquoise, dark green, light green and yellow, from the earliest to the newest. In this figure, it can be seen that in 2020, creative thinking skills, case studies, and technology are keywords that are widely used by researchers. Meanwhile, in 2021, keywords that frequently appear include critical thinking, local wisdom, PjBL, computational thinking, STEM, and others.

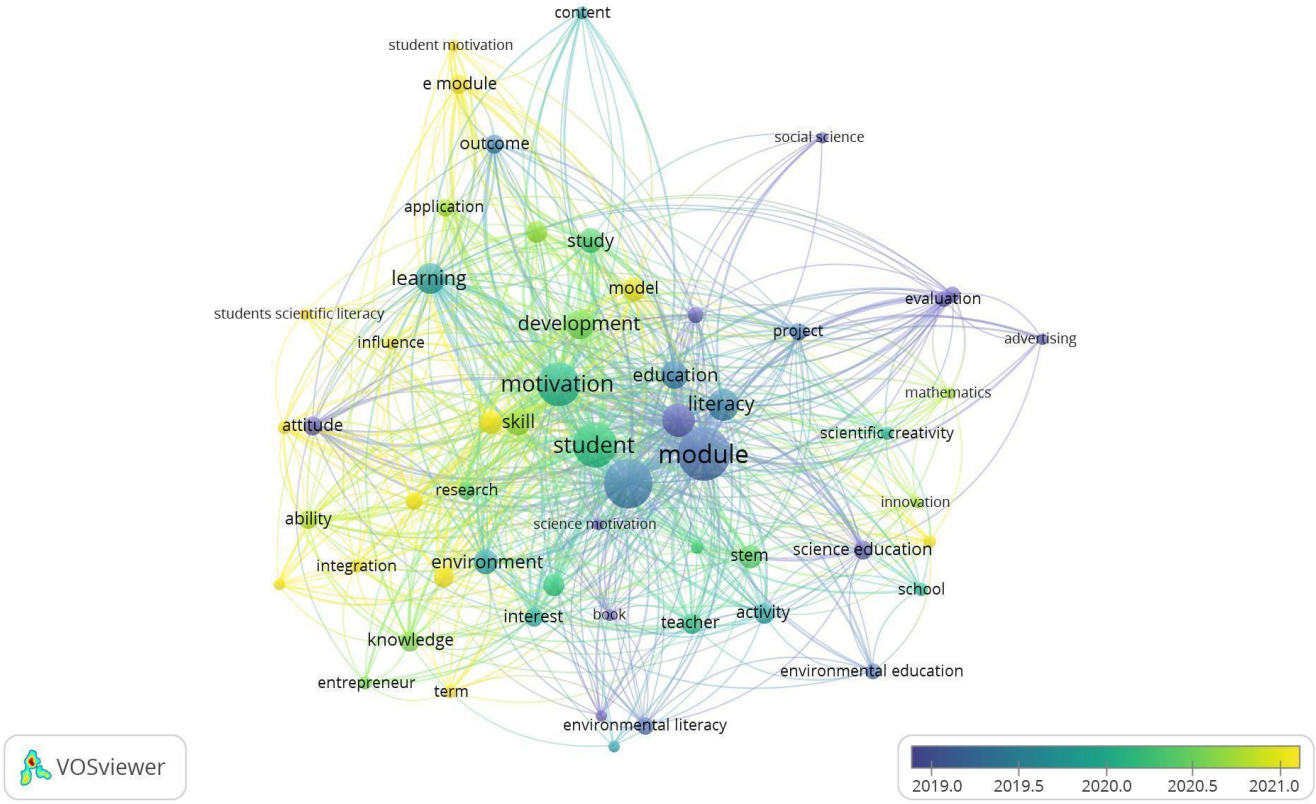

Figure 4. Overlay visualization of project-based science module development to increase scientific literacy, entrepreneurial motivation and environmental literacy

Research discussing the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy has experienced development in recent years when viewed using the second tracking step. However, the quantity in the development of this research is still relatively small if seen in table 2. In addition, there is a visualization of the density of keywords related to this research model to show the relationship between the main topics. Figure 5 visualizes the most frequently researched topics using bright yellow color meanings. The brighter the colors of a theme, the more research has been conducted in that area (Doyan et al., 2024). In contrast, themes with darker colors, such as module, science, project, and others, indicate that these topics are less frequently explored, so they can be interesting areas for further research (Liao et al., 2018). Furthermore, findings from research in 2021 found several themes in bright yellow, such as e module, effect, digital literacy, student motivation, and so on, used as keywords that are currently widely used in research.

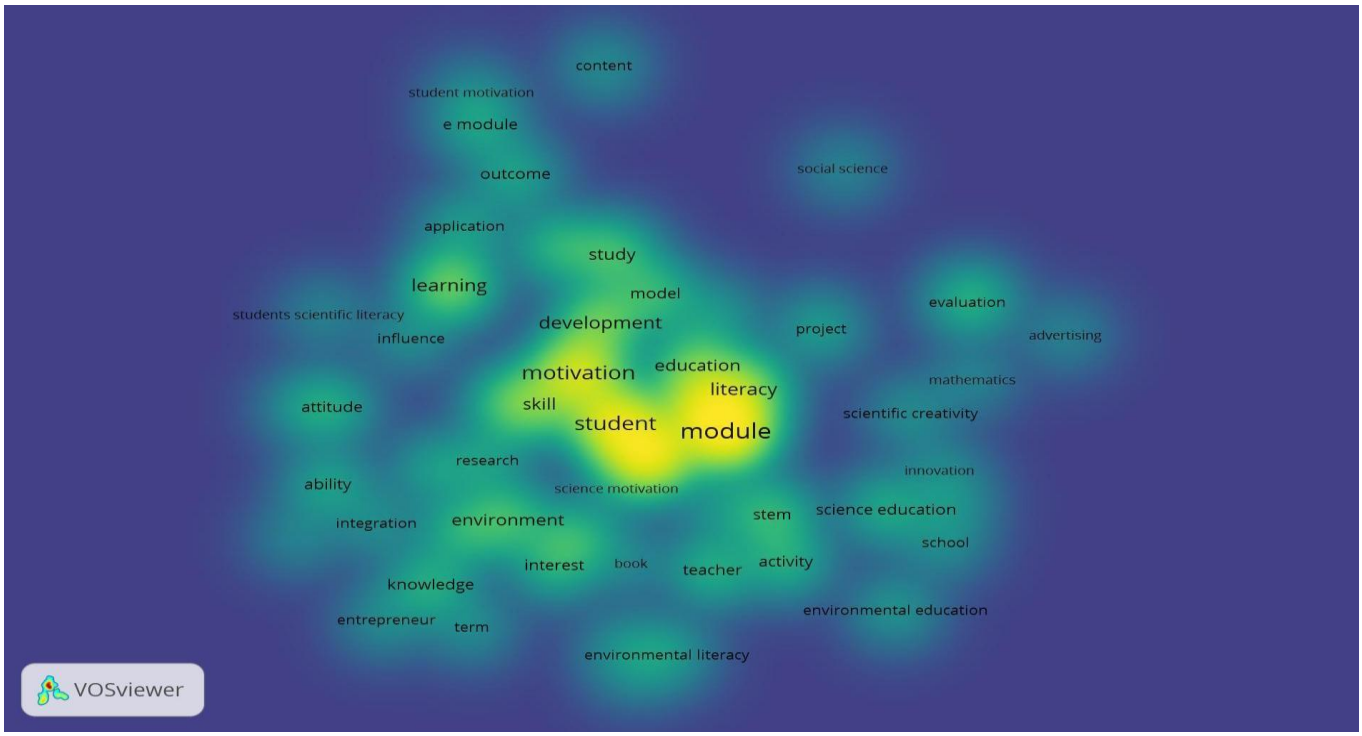

Figure 5. Overlay visualization on the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy

Overall, research regarding the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy is important to support 21st century education. The PjBL model is a learning model that can facilitate students to increase scientific literacy, entrepreneurial motivation and environmental literacy (Ermawati et al., 2024; Abidin et al., 2023: Irsani et al., 2024). Students' academic improvement can be measured through their literacy level, especially regarding scientific and environmental literacy related to global issues (Wulandari & Hani, 2023). Apart from that, development that supports the entrepreneurial motivation aspect of students is expected to enable students to create job opportunities and be able to provide for themselves financially (Hayati, 2022; Sugiat & Rusdian, 2023). Research that discusses the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy still needs to be developed. This can be done by developing new combinations of new models such as PBL with technology or other approaches such as biopreneurship to facilitate students to increase digital and financial literacy.

Conclusion

Research on the trend of project-based learning models to improve problem solving skills in science learning in the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy is very interesting to carry out in applying science concepts in students' lives. The results of research regarding the development of project-based science modules to increase scientific literacy, entrepreneurial motivation and environmental literacy indexed in Google Scholar from 2015 to 2024 were mostly carried out separately and few were carried out by combining the three additional variables. The graphic results show an increase, but when seen in quantity the amount is still small. Many documents in the form of articles, proceedings, book chapters, preprints, and edited books discuss research on project-based learning models to improve problem solving skills in science learning. Key words that are often used in this research include Environmental literacy, Environmental knowledge, Students motivation, Project work, and Environmental education.

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