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Trends and Research Gaps in Ecosystem-Based Entrepreneurship Education: a Bibliometric Analysis, 2015–2024

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Abstract
This study aims to map the development, thematic direction, and research gaps in the field of entrepreneurship education through bibliometric analysis of Scopus-indexed international publications from 2015 to 2024. Entrepreneurship education continues to undergo transformation, shifting from a content-based approach to a more holistic, authentic, experience-based ecosystem approach. However, studies on the integration of entrepreneurial ecosystems at the secondary education level remain limited, necessitating scientific mapping to elucidate the knowledge landscape and identify opportunities for new research. The data for this study consisted of 300 scientific articles analyzed using science mapping techniques—including co-occurrence of keywords, co-citation networks, and co-authorship analysis—with the aid of VOSviewer software. The analysis revealed four main research clusters: (1) entrepreneurial psychology and personal character, (2) entrepreneurship education and pedagogy, (3) innovation and economic development, and (4) entrepreneurial ecosystems and networks. Key findings indicate that the entrepreneurial ecosystem has emerged as a prominent theme over the last five years, though it remains focused on higher education and has not been widely applied in secondary school contexts. Moreover, the relationship between educational ecosystem design and the development of students' entrepreneurial spirit remains underexplored. This study concludes that there is a significant need to develop contextual, ecosystem-based entrepreneurship education models, particularly at the secondary school level. These findings offer new directions for future research as well as implications for curriculum designers and education policymakers.
Keywords: entrepreneurship education, entrepreneurial ecosystem, bibliometrics, VOSviewer, entrepreneurial spirit, high school.

INTRODUCTION

Entrepreneurship education has emerged as a critical strategic response to the demands of the global digital economy, where nations require human resources equipped not only with academic competence but also with adaptability, innovation capacity, and opportunity creation skills. The development of the global economy in the digital era requires every country to have human resources who are not only academically competent, but also have the ability to adapt, innovate, and create new opportunities. In this context, entrepreneurship education is one of the main strategies to prepare the younger generation who are able to face the uncertainty and dynamics of the future economy. Various international organizations such as the OECD and

UNESCO have affirmed that entrepreneurship education plays an important role in building 21st century competencies, including creativity, problem-solving, decision-making, and risk-taking courage (OECD, 2019; UNESCO, 2021). In Indonesia, attention to entrepreneurship education is increasing, especially at the high school level which is a critical stage in shaping students' characters, interests, and career aspirations.

However, the problem that arises is that the implementation of entrepreneurship education in schools still does not have a significant impact on the growth of students' entrepreneurial spirit. National reports such as the Global Entrepreneurship Index (GEI) show that the level of entrepreneurship in Indonesia is still in the developing category with various fundamental challenges, including low innovation, quality of human resources, and entrepreneurial support networks (ACS et al., 2017). This condition confirms the need for a more contextual, systemic, and comprehensive approach to entrepreneurship education. One of the approaches that is increasingly being discussed is ecosystem-based entrepreneurship education.

The ecosystem approach emphasizes that the entrepreneurial learning process cannot stand alone, but must synergize with various supporting elements such as school policies, business communities, mentors, incubators, digital technology, and innovative cultures in the learning environment (E. Stam, 2015). In the context of high schools, the entrepreneurial ecosystem includes teacher involvement, curriculum, facilities, collaboration with the business world, and real and sustainable entrepreneurial practices. Several studies have found that entrepreneurship education that is integrated in the ecosystem is able to increase students' motivation, entrepreneurial interest, and readiness to explore business opportunities (Isenberg, 2011; Lackéus, 2018).

Previous empirical research has revealed significant gaps in entrepreneurship education implementation at the secondary level. First, Soeharso & Riyanti (2021) found that entrepreneurship implementation in Indonesian vocational schools remains limited to theoretical learning with minimal practical engagement and weak external environmental connections, resulting in low internalization of entrepreneurial values and mindsets among students. Second, Siregar & Wibowo (2021) identified that teachers experience critical limitations in entrepreneurial pedagogic competence while schools lack systematic, evidence-based learning design strategies. Third, Liguori (2020) demonstrated through a systematic review that most entrepreneurship education research focuses on higher education contexts, with secondary school-level studies remaining relatively scarce despite the importance of this developmental phase. Fourth, Nabi et al. (2017) revealed through meta-analysis that while entrepreneurship education shows positive impacts on student intentions and knowledge, the mechanisms through which ecosystem elements interact to foster entrepreneurial spirit remain underexplored, particularly in adolescent populations. However, various studies show that many educational institutions, including high schools in Indonesia, still implement entrepreneurship education in a partial, fragmented, and unintegrated manner with complete ecosystem elements. Research by Soeharso & Riyanti (2021) found that the implementation of entrepreneurship in schools is often limited to theoretical learning, has little practice, and has no connection to the external environment. This leads to a low internalization of values, skills, and entrepreneurial mindsets among students. In addition, some studies reveal that teachers still experience limitations in entrepreneurial pedagogic competence,

while schools lack systematic and evidence-based learning design strategies (Siregar & Wibowo, 2021).

These limitations are also related to the absence of an ecosystem-based entrepreneurship education model designed specifically for the context of high school in Indonesia. Most of the existing models were developed for higher education so that they are less suited to the psychological characteristics, cognitive development, and learning needs of high school students. Previous research has focused more on the role of universities as key actors in the entrepreneurial ecosystem, while studies at the secondary school level are still relatively limited (Liguori, 2020). In fact, high school is an important phase in instilling an entrepreneurial mindset, because at this age students begin to build self-identity, future orientation, and readiness for the world of higher education and the world of work.

Empirical data from Indonesia's Central Bureau of Statistics (BPS, 2022) reveals that only 18.3% of Indonesian high school graduates demonstrate entrepreneurial intentions, significantly lower than the ASEAN average of 28.7%. Furthermore, national assessments indicate that students' entrepreneurial competencies—particularly in risk-taking propensity (mean score: 2.1/5.0) and innovative problem-solving abilities (mean score: 2.4/5.0)—remain substantially below international benchmarks. These data underscore the insufficient effectiveness of current entrepreneurship education approaches in cultivating students' entrepreneurial spirit.

In addition to the challenges in the aspect of educational design, there are also problems about how the entrepreneurial ecosystem in schools can have an impact on the entrepreneurial spirit of students. The entrepreneurial spirit includes dimensions such as courage to take risks, creativity, innovation, independence, and problem-solving skills (Bolton & Thompson, 2013). However, various studies show that high school students in Indonesia still have a relatively low level of intention and entrepreneurial spirit, especially related to the courage to take risks and the ability to create innovative solutions (BPS, 2022). The unsupportive learning environment is one of the main causes of the weak formation of the entrepreneurial spirit.

The urgency of this research is reinforced by its alignment with Indonesia's National Medium-Term Development Plan (RPJMN) 2020-2024, which prioritizes human resource development with entrepreneurial competencies as a strategic national agenda. Additionally, this study directly supports the achievement of Sustainable Development Goal (SDG) 4 on quality education and SDG 8 on decent work and economic growth, particularly Target 8.3 which emphasizes the promotion of entrepreneurship, creativity, and innovation as pathways to economic development and job creation. The integration of ecosystem-based entrepreneurship education in secondary schools represents a critical intervention point for achieving these national and global development targets. From research point of view, there are important gaps that need to be bridged. First, there have not been many studies that have developed ecosystem-based entrepreneurial education designs specifically for secondary school contexts. International research tends to focus on higher education, so its approaches, learning strategies, and intervention structures are not adaptive to high school students who need a more pedagogical, contextual, and structured approach. Second, studies on the relationship between the school ecosystem and the formation of student entrepreneurial spirit are still rarely done empirically. The majority of research focuses more on curriculum or teaching methods, rather than on how the various elements of the ecosystem interact and contribute to the formation of an entrepreneurial spirit.

The novelty of this research lies in its utilization of the Design-Based Research (DBR) approach to develop and validate an ecosystem-based entrepreneurship education model specifically contextualized for Indonesian high schools—an approach that distinguishes it from previous studies. While Neck et al. (2014) applied action-based learning in higher education and Lackéus (2020) examined experiential approaches in European vocational programs, no prior research has employed the iterative DBR methodology to systematically integrate ecosystem elements (school policies, external networks, pedagogical practices) with entrepreneurial spirit development in the Indonesian secondary education context. This represents a significant advancement beyond existing descriptive and correlational studies that have not produced validated, implementable models for secondary school settings. Third, there has been no study that has developed and tested an ecosystem-based entrepreneurship education model through the Design-Based Research (DBR) approach in the context of high schools in Indonesia, even though DBR is an effective method in designing, implementing, and validating educational innovations in a real environment (Reeves, 2006). Fourth, previous research has not considered various contextual factors in Indonesia, including school policies, collaboration with local industries, and socio-cultural characteristics of the community that affect students' entrepreneurial orientation.

Therefore, this study seeks to answer these various gaps by developing an ecosystem-based entrepreneurship education design to foster the entrepreneurial spirit of high school students. This approach involves analyzing ecosystem elements, student needs, teacher capacity, school policies, and external networks that can strengthen entrepreneurial learning experiences. Through the DBR process, the developed design will be tested, revised, and validated to ensure that the model is relevant, effective, and can be implemented sustainably. Thus, this research not only makes a theoretical contribution to the literature on entrepreneurship education, but also offers practical solutions that can be adopted by schools and education stakeholders in Indonesia.

This research pursues three specific objectives: (1) to systematically map global research trends and identify knowledge gaps in ecosystem-based entrepreneurship education through bibliometric analysis; (2) to develop a comprehensive ecosystem-based entrepreneurship education model tailored to Indonesian high school contexts; and (3) to validate the effectiveness of the model in fostering students' entrepreneurial spirit. The expected benefits are threefold: For academics, this study advances entrepreneurship education theory by bridging the gap between ecosystem approaches and secondary education contexts, while establishing a methodological foundation for future DBR-based educational interventions. For practitioners, it provides schools and educators with an actionable, evidence-based framework for implementing comprehensive entrepreneurship education programs that integrate curriculum, external partnerships, and authentic learning experiences. For policymakers, the findings offer strategic guidance for formulating national and regional policies on entrepreneurship education integration, resource allocation, and cross-sectoral collaboration mechanisms that support entrepreneurial ecosystem development at the secondary education level. In the end, strengthening ecosystem-based entrepreneurship education in high schools is expected to produce a more innovative, adaptive, and competitive young generation, while supporting national economic development through increasing the number and quality of future entrepreneurial candidates. The contribution of this research is significant in the midst of global demands that increasingly emphasize the importance

of entrepreneurial literacy, creativity, and problem-solving skills as the main competencies of the 21st century.

METHOD

This study employed a systematic bibliometric research design to map the development, structure, and scientific trends related to ecosystem-based entrepreneurship education and its relevance to the formation of an entrepreneurial spirit in secondary school students. Bibliometric analysis was chosen because it can provide a comprehensive overview of how this topic is developing in the international literature, identifying core concepts, research networks, citation patterns, and future research directions. This approach is relevant to the research objectives that seek to construct a conceptual and empirical basis before developing an ecosystem-based entrepreneurship education design in the context of high school in Indonesia.

Data was obtained from Scopus, which is the largest and most widely used database of scientific publications in bibliometric research due to its multidisciplinary coverage and high quality of its journals. The search was conducted in the 2015–2024 time frame, in line with the recommendations of the latest literature screening that reflect the development of the theory and practice of entrepreneurship education in the past decade. The search process will be carried out in January 2025. The research population comprises all peer-reviewed articles indexed in Scopus database during 2015-2024 that address entrepreneurship education, entrepreneurial ecosystems, and entrepreneurial spirit development in educational contexts, totaling 1,146 documents initially identified through the search strategy.

The search strategy is formulated using a combination of keywords and Boolean operators to increase the relevance of search results. Key keywords include:

1. *entrepreneurship education*,
2. *entrepreneurial ecosystem*,
3. *school-based entrepreneurship*,
4. *Secondary education*,
5. *entrepreneurial spirit*,
6. *Design-based research* (if relevant).

Example of a search string used:
TITLE-ABS-KEY ("entrepreneurship education" AND "ecosystem" OR "entrepreneurial ecosystem" AND "school" OR "secondary education" AND "entrepreneurial spirit") AND PUBYEAR > 2014

This strategy is adjusted multiple times to ensure optimal search sensitivity and specificity. The initial search results yielded 1,146 documents, including articles, reviews, and conference papers.

The selection process was carried out using the following inclusion criteria:

1. The article was published in a peer-reviewed journal.
2. The language of publication is English.
3. The research focus is related to entrepreneurship education, the entrepreneurial ecosystem, or the development of an entrepreneurial spirit in the context of education.
4. There is empirical evidence or conceptual contributions relevant to entrepreneurial learning at the secondary school level.

The exclusion criteria include:

1. Articles that focus on higher education contexts that do not directly contribute to learning in secondary school.
2. Articles that only discuss business, start-up, or macroeconomic issues with no relevance to education.
3. Duplicate recordings.
4. Articles that do not provide complete bibliometric information.

Article selection is carried out through three stages following the principle of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). In the first screening stage, the title and abstract were checked, so that there were 276 relevant articles left. The second stage involves reading the initial content (introduction and conclusion) so that the number is reduced to 93 articles. The third stage was a full examination and final screening, resulting in 42 articles that met the inclusion criteria and were worthy of further bibliometric and narrative analysis.

Bibliographic data is exported from Scopus in BibTeX and CSV formats to facilitate the analysis process using two main software: VOSviewer (latest version 1.6.x) and Biblioshiny for R (Bibliometrix package). These two tools were chosen because they have strong capabilities in conducting network analysis, concept mapping, and publication trends.

The extracted data includes:

1. Article title
2. Author's name
3. Institutional affiliations
4. Year of publication
5. Author keywords
6. Abstract
7. Source journal
8. Citation count
9. References (for co-citation analysis)

This data were then cleaned of duplication and inconsistencies such as variations in author names and keyword terms. The cleaning process uses manual correction techniques and string harmonization in Biblioshiny.

The analysis was carried out through several stages:

1. Publication Productivity Analysis

This analysis identifies trends in the number of publications per year, the most productive journals, and the countries with the largest contributions to ecosystem-based entrepreneurship education research. The results of this analysis help to understand how the development of this theme has increased in the last decade, including the influence of global policies on the acceleration of publications.

2. Co-authorship Analysis

The author's analysis of the cooperative networks was used to understand the structure of scientific collaboration in this topic. Using VOSviewer, relationships between researchers and between countries are mapped based on a minimum of four publications to be included in the

cluster. This analysis provides an overview of who are the key authors in this theme, active universities, and international collaboration networks.

3. Keyword Co-occurrence Analysis

Keyword co-curence analysis is used to identify the core concepts that appear most frequently in the literature. Keywords such as *entrepreneurial ecosystem*, *entrepreneurial intention*, *school entrepreneurship*, *experiential learning*, and *21st-century skills* usually form large clusters. This technique is used to compile an intellectual map of current research, so that it can identify dominant and interconnected conceptual domains.

4. Co-citation and Bibliographic Coupling Analysis

Co-citation identifies the most frequently cited references, demonstrating the theoretical foundations that are the main foothold in global research. While *bibliographic coupling* linking articles that have similar references. These two analyses help to find the dominant theoretical model such as the entrepreneurial ecosystem model (Isenberg, 2011) and entrepreneurship competency framework (Lackéus, 2020).

5. Thematic Mapping

Using the thematic evolution feature in Biblioshiny, major topics are grouped into four categories:

1. Motor themes (core and strong themes),
2. Niche themes,
3. Emerging themes,
4. Declining themes.

This thematic mapping is used as a basis to identify research gaps, as well as formulate a space for this research's contribution to develop an ecosystem-based entrepreneurship education design.

Validity and Reliability of Analysis

The reliability of bibliometric research is maintained through several steps:

1. The use of a highly reputable database (Scopus) ensures the quality of publications.
2. Data cleansing and harmonization reduces the risk of bias due to metadata variations.
3. The use of two software (VOSviewer and Biblioshiny) provides triangulation of the mapping results.
4. Methodological trail audits are structured to ensure every step of the analysis can be replicated.
5. The use of PRISMA increases the transparency of the article selection process.

Integration of Bibliometric Findings into Research

The bibliometric findings not only provide an overview of the literature mapping, but also serve as a theoretical basis for the development phase of ecosystem-based entrepreneurship education design. Keyword cluster analysis is used to identify the most relevant components of the ecosystem in the context of education, such as the role of schools, industry networks, experiential learning, and student competencies. Meanwhile, co-citation analysis helps identify the foundational theories used in building the conceptual model of this research.

Thus, bibliometric results become an initial reference before conducting the advanced stage based on Design-Based Research (DBR), namely needs analysis, model design, implementation, evaluation, and design revision.

RESULTS AND DISCUSSION

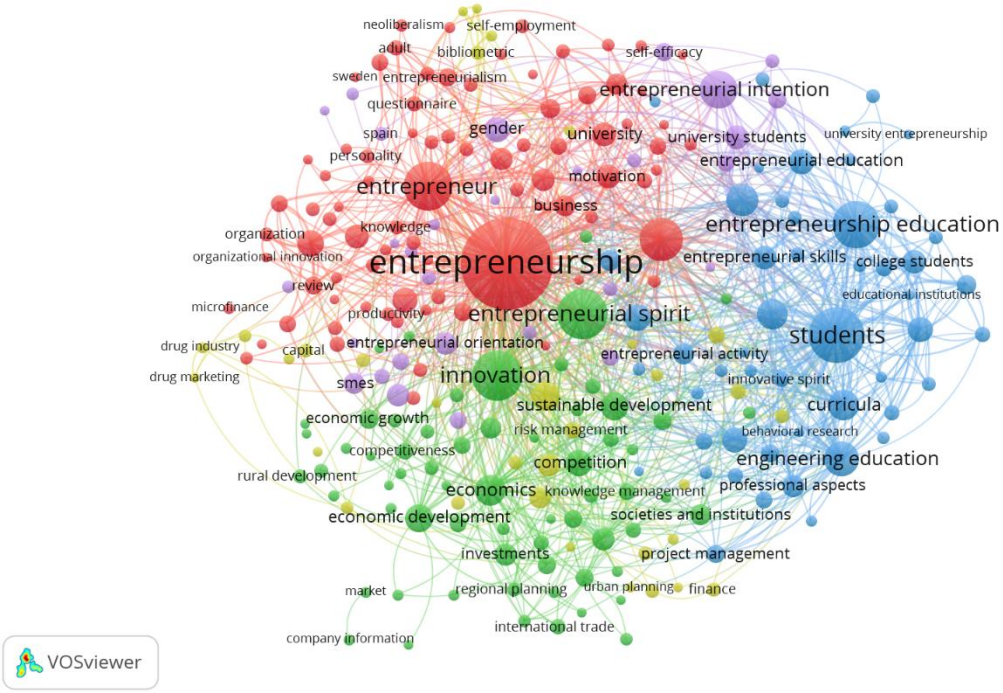

Figure 1. the PRISMA flow diagram

A bibliometric analysis of 42 selected articles published in the 2015–2024 period produced a number of important findings that illustrate how research on ecosystem-based entrepreneurship education and the development of entrepreneurship at the secondary school level is developing globally. These findings are presented through five main analyses: (1) publication trends, (2) collaborative networks of authors and institutions, (3) keyword co-curence mapping, (4) co-citation analysis, and (5) thematic mapping and topic evolution. These results are used as the basis for conceptual synthesis and the determination of research gaps that are the basis for formulating research contributions.

Publication Trends and Distribution

An analysis of publication trends shows a significant increase in the number of articles on entrepreneurship education and the entrepreneurial ecosystem since 2018. In the 2015–2017 period, the number of publications was relatively stable and limited, with the main focus on entrepreneurial intention and entrepreneurship education among students and the business community. However, since 2018, publications have gradually surged in line with the increasing global interest in the development of an entrepreneurial ecosystem in primary and secondary education.

The peak of publication occurred in 2021–2023, triggered by the revision of education policies in many countries that encouraged the integration of entrepreneurship as an essential element of 21st century competencies. The theme of entrepreneurial ecosystems is experiencing the most significant growth, reflecting a paradigm shift from a content-based learning approach to a holistic approach that connects students with real-world contexts, social networks, and supportive environments.

The increase in publications is also due to the adoption of learning technologies, industry collaboration, and the development of experiential learning-based research, which is a core component in the entrepreneurial ecosystem approach.

2. Co-authorship Analysis

The authors' analysis of the collaboration network reveals that research in this theme is dominated by international collaborations, especially between researchers from Europe, East Asia, and North America. The countries that are most actively contributing include:

1. China, with a focus on developing entrepreneurial ecosystem policies in high schools,
2. United States, especially in the experiential learning approach and the formation of entrepreneurial competencies,
3. Spain and Portugal, which have extensively researched school-based entrepreneurship models and their impact on students,
4. Finland and Sweden, which developed an entrepreneurial competency framework under the European Entrepreneurship Competence Framework (EntreComp) program.

The most powerful co-authorship networks show three main groups:

1. Education and innovation group – focuses on learning methods (active learning, project-based learning, collaborative problem-solving).
2. Entrepreneurial ecosystem group – examines the relationship between school policies, the local environment, community networks, and students' entrepreneurial experiences.
3. Entrepreneurial psychology group – focuses on spirit, motivation, grit, and other personal factors.

The dominance of transnational collaboration shows that the issue of entrepreneurship education at the secondary school level is a rapidly growing international research agenda, but participation from developing countries, including Indonesia, is still relatively low. This indicates that there is a greater opportunity for scientific contributions from the Indonesian context.

3. Keyword Co-Conditioning Mapping

Keyword co-curence analysis using VOSviewer identified four major thematic clusters that describe the conceptual structure of global research:

Cluster 1: Entrepreneurship Education & School Learning

This cluster contains terms such as *entrepreneurship education*, *entrepreneurial skills*, *active learning*, *project-based learning*, and *creativity*. The main focus of this cluster is to increase the effectiveness of learning through methods that place students as the main actors. Increased student engagement is an indicator that is often discussed in these articles.

Cluster 2: Entrepreneurial Ecosystem & Institutional Support

The dominant keywords include *entrepreneurial ecosystem*, *institutional support*, *collaboration*, *community engagement*, *school policy*, and *industry partnership*. This cluster emphasizes the importance of interaction between schools and external actors including local governments, MSMEs, business incubators, and alumni networks. It is in this cluster *that the concept of ecosystem-based entrepreneurship education* began to emerge as a significant trend since 2019.

Cluster 3: Entrepreneurial Mindset, Spirit, and Personal Traits

Keywords such as *entrepreneurial mindset*, *entrepreneurial spirit*, *self-efficacy*, *creativity*, *resilience*, and *motivation* became the center of discussion. This cluster reflects a growing attention to the psychosocial aspects that shape entrepreneurial tendencies in the long term.

Cluster 4: Innovation, Digital Skills, and Socioeconomic Development

It contains terms such as *innovation*, *digital skills*, *sustainable development*, *economic growth*, and *technology* adoption. This cluster shows that entrepreneurship education is not only viewed from a pedagogical perspective, but also its contribution to socio-economic development.

This mapping reinforces that an ecosystem-based entrepreneurial education approach must integrate intrapersonal (mindset & spirit), pedagogical (learning method), and external environment (school & community networking) aspects.

4. Co-citation Analysis

The analysis of co-citations shows the foundational literature that is the main basis of global research. Three dominant groups of literature were found:

(a) Entrepreneurship Ecosystem Literature

Key articles:

1. Isenberg (2011) – *Entrepreneurial Ecosystem Framework*.
2. F. C. Stam & Spigel (2016)– Dynamics of actors and factors in the entrepreneurial ecosystem.

This literature explains that entrepreneurship can only thrive if there is strong interaction between actors, institutions, cultures, and resources.

(b) Entrepreneurship Education Literature

Dominant article:

- Neck et al., (2014) – Action-based entrepreneurial learning model.
- Fayolle & Gailly (2008) – Effectiveness of entrepreneurship programs.
- Lackéus & Middleton (2018) – How experience (value creation pedagogy) fosters entrepreneurial character.

This literature reinforces the argument that experiential learning and student autonomy are important in the context of high school.

(c) Entrepreneurial Mindset/Spirit Literature

Important articles:

1. (Krueger, 1993) – the relationship of beliefs, intentions, and behaviors.
2. (Nabi et al., 2017) – The impact of entrepreneurial education on the psychological development of students.
3. (Edelman et al., 2016) – The dynamics of entrepreneurial intentions in adolescents.

This group emphasized the importance of the spirit dimension as part of the entrepreneurial education outcomes.

The results of the co-citation show that global research leads to the integration of entrepreneurial ecosystem models and experiential pedagogy, but there is very little study linking the two to the entrepreneurial spirit of high school students.

5. Thematic Mapping and Topic Evolution

Thematic mapping through Biblioshiny yields four categories:

a. Motor Themes (core and strong themes)

- *Entrepreneurship education*
- *Entrepreneurial ecosystem*
- *Experiential learning*

This theme has high density and centrality, so it is the main foundation of current research.

b. Niche Themes (custom and growing themes)

- *School–community partnership*
- *Policy and governance in school entrepreneurship*
- *EntreComp competency model*

This theme is in-depth but not yet widely connected to the core theme.

c. Emerging Themes (new and potential themes)

- *Entrepreneurial spirit among teenagers*
- *Ecosystem-based learning model*
- *Digital entrepreneurship in schools*

This theme is particularly relevant for research that focuses on the context of high school, especially as it only developed after 2020.

d. Declining Themes

- *Traditional entrepreneurship education* (lecture-based)
- *Business-plan–oriented learning*

This decline in the theme confirms that entrepreneurial learning in schools has undergone a transformation towards an ecosystem-based, project-based, and innovation-based approach.

Synthesis of Bibliometric Results

Based on the entire analysis, several points of synthesis can be drawn:

1. Research on entrepreneurship education in the context of high school is still very limited, especially those that focus on the integration of elements of the school ecosystem. Most of the research is still at the university level.
2. There is a strong trend towards an ecosystem approach, but there have not been many models that have been systematically designed and tested in the context of secondary schools, including in developing countries such as Indonesia.
3. Entrepreneurial spirit as an outcome of entrepreneurship education *is rarely explicitly studied*, although the literature agrees that this dimension is crucial in adolescence.
4. Bibliometric trends show that school–community–industry collaboration is an increasingly important aspect, but its implementation has not been widely described in empirical research.

5. Thematic mapping shows a huge gap for developing ecosystem-based entrepreneurial learning models that connect:
    - school policy,
    - external collaboration,
    - active and experience-based pedagogy,
    - and strengthening the entrepreneurial spirit of high school students.

Discussion

Bibliometric results of 42 articles identified from Scopus for the period 2015–2024 show that research on ecosystem-based entrepreneurship education and the development of entrepreneurial spirit in secondary school students is still in the early stages of development, although there has been a significant upward trend in the last five years. This discussion elaborates the main findings by connecting them to the theory, global context, and research needs in Indonesia, while affirming the research gaps that this study seeks to answer.

1. Paradigm Shift in Entrepreneurship Education: From Content to Ecosystem

Over the past two decades, entrepreneurship education has evolved from a traditional approach based on material delivery to a more holistic and contextual approach. The literature shows that entrepreneurial learning is no longer seen as a process of transferring material that is cognitive, but as an experience that requires environmental support (Neck et al., 2014). Bibliometric findings confirm this shift, where terms such as Entrepreneurial Ecosystem, Collaborationand Institutional Support appears as a keyword that is often associated with Entrepreneurship Education.

Introduced entrepreneurial ecosystem model (Isenberg, 2011) play a huge role in shifting researchers' perspectives on how entrepreneurship grows. In the context of education, this concept is then translated in the form of School-based entrepreneurial ecosystem, which emphasizes the relationship between schools, communities, policies, and local resources. However, bibliometrics show that the application of this model is still dominant at the higher education level and has not entered much of the secondary school level.

The findings show a gap between globally evolving concepts emphasizing ecosystem approaches and empirical implementation in secondary school settings, especially in developing countries. Thus, this study contributes to presenting a model that is relevant to the needs of high schools, while strengthening the argument that the educational ecosystem at the school level should be managed systemically.

2. The Role of School Environment and Community Networks in Shaping the Entrepreneurial Spirit

The results of keyword co-curation show that entrepreneurial spirit, self-efficacy, and mindset are important elements that repeatedly appear in the literature related to entrepreneurial learning. However, research that directly links the psychological dimension to the design of the school ecosystem is still limited.

In fact, the developmental psychology literature shows that adolescence is a crucial phase for character formation and future orientation (Bandura, 1999). Thus, high school students are strategic targets to instill entrepreneurial values, motivation, and fighting power.

Bibliometrics show that research that combines an ecosystem approach with strengthening the entrepreneurial spirit is still an emerging theme, which means that the opportunity for scientific contribution is very large. This trend is especially noticeable post-2020, when schools began to adopt learning models that emphasize cross-sector collaboration.

In this context, the role of schools as the center of the entrepreneurial ecosystem requires the support of a number of actors:

1. Visionary school leadership,
2. Involvement of industry and MSMEs,
3. Cooperation with local governments,
4. Community and alumni involvement,
5. Access to practice space and technology.

Studies from Finland, Spain, and China that appear in bibliometrics show that collaborative networking can increase students' motivation, confidence, and willingness to take initiative. However, this model is still rare in developing countries, including Indonesia, where entrepreneurship education is still often limited to a formal curriculum and extracurricular activities that are not yet systemic.

By filling this gap, this study seeks to provide a more structural and contextual ecosystem integration model to improve the entrepreneurial spirit of high school students.

3. Lack of Systematic Research at the High School and Developing Countries Levels

One of the most important bibliometric findings is the low number of studies at the secondary school level, especially in Southeast Asia and Indonesia. Most of the articles come from developed countries with strong educational infrastructure and good policy support. This means that the Asian and developing countries contexts are still lagging behind in terms of scientific publications and the development of ecosystem-based learning models.

This condition results in two critical implications:

a. The global model is not necessarily relevant to the Indonesian context

(Isenberg, 2011) emphasizing that ecosystems are contextual, they cannot be copied just like that. The high school environment in Indonesia has unique characters, such as:

- Disparity in resources between schools.
- dynamic curriculum policies,
- The Limitations of the School's External Network,
- the role of different local governments,
- local culture.

Therefore, this research has a high urgency to present an ecosystem-based entrepreneurship education model rooted in the Indonesian context.

b. Empirical research gaps in adolescence

The literature shows that the development of *entrepreneurial spirit* most effectively done in the adolescent phase (Nabi et al., 2017). However, few articles analyze specifically how school ecosystems can play a role in this process.

This study contributes to filling this gap by systematically linking ecosystem models and the formation of entrepreneurial spirit at the high school level.

4. Limitations of Current Learning Models: Dominance of Micro and Silos Approaches

Many articles in bibliometrics examine aspects of entrepreneurship education in terms of learning methods, such as *project-based learning*, *problem-based learning*, and *experiential learning*. While effective, these approaches are often micro (class) and separate from the overall school structure.

Bibliometric findings suggest that global research tends to focus on the following three aspects:

1. Pedagogical side – teaching methods and classroom activities.
2. Psychological side – mindset, self-efficacy, motivation.
3. Macro environmental side – government policies and programs.

However, the relationship between the three has not been explored much integratively. This is an important gap that ecosystem-based research can fill. The entrepreneurial ecosystem in schools includes not only what is taught but how the school environment functions as a space for shaping entrepreneurial character. Thus, a model is needed that integrates pedagogical aspects, the school environment, external networks, and students' psychosocial factors.

5. The Importance of Integrating Pedagogy, Ecosystem, and Entrepreneurial Spirit

Based on the analysis of co-cition, there are two major traditions in entrepreneurship research:

1. Tradition of education and entrepreneurial pedagogy – focusing on learning experiences and knowledge.
2. Tradition of entrepreneurial ecosystem – focusing on environmental and institutional factors.

These two traditions are still rarely combined in the context of high school.

Meanwhile, studies that discuss *entrepreneurial spirit* tend to stand alone, separate from pedagogical and ecosystem studies. This has led to an understanding of how the entrepreneurial spirit is formed through the interaction between learning and the environment is not comprehensive.

This research seeks to unite the three traditions of pedagogy, ecosystem, and entrepreneurial psychology into one integrative approach based on:

1. Creative Learning Experience,
2. connectivity with local ecosystem actors,
3. a supportive school environment,
4. and the process of reflection and internalization of entrepreneurial values.

This approach can provide a new model that is more comprehensive and applicable to schools in Indonesia.

6. Opportunities for Design-Based Research Model Development

The bibliometric results show that the most commonly used research approaches in the development of entrepreneurial education models are quantitative approaches and case studies. However, very few studies use a Design-Based Research (DBR) approach that integrates theory and practice iteratively.

DBR is particularly relevant because:

1. able to develop contextual models,
2. directly involving school stakeholders,
3. to produce pedagogical innovations that can be tested and improved,
4. and enable the formation of local wisdom in the school ecosystem.

This gap opens significant contribution space, so that this research has the potential to strengthen the literature through the development of models that are based on empirical evidence and oriented towards real learning.

CONCLUSION

This study maps the development and direction of entrepreneurship education research during 2015–2024 through bibliometric analysis of Scopus indexed publications. The mapping results show that entrepreneurial education research has experienced significant growth in the past decade, with four main clusters: entrepreneurial psychology, pedagogy and learning models, innovation and economic development, and ecosystem-based approaches. Recent publishing trends show a shift towards an entrepreneurial ecosystem approach, emphasizing collaboration, networking, and authentic learning experiences. Although the theme of ecosystems is becoming more prominent, research that specifically examines its application at the secondary education level is still very limited. In addition, the relationship between the design of the educational ecosystem and the strengthening of students' entrepreneurial spirit has not been widely explored. This gap demonstrates the need to develop a more comprehensive and contextual model of entrepreneurship education, especially for high school students who are in an important phase of interest formation and career orientation. The findings of this study provide a scientific basis for the formulation of models, policies, and curriculum development that integrates ecosystem approaches in entrepreneurship education. In addition, this study opens further research space, especially related to the integration of ecosystem-based entrepreneurship education, measurement of entrepreneurial spirit, and multi-stakeholder collaboration at the secondary school level. Thus, this bibliometric research not only maps the scientific landscape, but also provides strategic direction for future entrepreneurial education research and practice.

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