

Bibliometric Analysis of the Academic-Industry Gap in Vocational Education: Dual Professional Capacity and Competency Standards

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Abstract

The gap between vocational graduate competencies and industry remains a strategic challenge requiring strong academia-industry synergy. This study aims to map publication trends, collaboration networks, and thematic evolution of literature on academic-industry integration in vocational education. Using a bibliometric approach, the sample comprises 219,327 publications retrieved from the Dimensions AI database. Network analysis via VOSviewer visualized keyword co-occurrence, author collaboration, institutional affiliations, and geographic distribution to trace thematic shifts over time. Results reveal accelerated post-2020 research productivity, dominance of quantitative-structural approaches, and fragmented author collaborations into three main clusters, with the United States and China as global research epicentres. These findings imply that developing vocational lecturers' dual professional capacity requires consistent policy frameworks, emerging technology integration, and strengthened cross-community collaboration. Consequently, this research provides a strategic roadmap for formulating lecturer training policies and curriculum synchronization based on national competency standards, directly offering actionable solutions to bridge the academic-industry gap in Indonesian vocational education.

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Introduction

The transformation of the global vocational education landscape essentially demands closer alignment between the academic ecosystem and the dynamics of rapidly evolving industrial needs, because the mismatch between graduate competencies and industrial needs, limited industrial involvement in curriculum development, is an obstacle in the development of vocational education [1]. The integration of information and communication technologies is the backbone of these efforts, although their adoption in the vocational education sector still faces significant structural and cultural barriers [2]. Established dual education systems in developed countries offer a continuum model of integration from parallel

learning to full curricular synchronisation to ensure that graduates master theoretical knowledge as well as practical skills that are tested in real-world work environments [3].

The success of a similar model in Switzerland proves that combining human capital development with effective screening and signalling mechanisms can accelerate students transition to an increasingly competitive job market [4]. In the midst of accelerating industrial digitalisation, the strategy of modernising training regulations and increasing the attractiveness of vocational programs is a strategic imperative to maintain the relevance of the curriculum and ensure the competitiveness of the national workforce [5]. Active collaboration between researchers, academics, and industry practitioners has demonstrated a pattern of partnerships that are able to bridge the dichotomy between research findings and urgent field operational needs [6]. Collaborative interventions through change workshops and workplace-school partnerships help strengthen personal competencies and facilitate contextual learning oriented towards real-world problem-solving [7]. As such, the emergence of micro credentials provides a flexible and digitally verified pathway for educators and students to obtain competency certifications that are directly recognised by the modern industrial sector. This global phenomenon confirms that the gap between vocational education and industry demands cannot be overcome through conventional approaches alone, but rather requires an adaptive, scalable, and sustainable framework in the long term.

Dual professional capacity development for vocational lecturers faces multidimensional complexities that demand deep integration between academic pedagogy and dynamically changing industry technical expertise. Interdisciplinary approaches such as STEAM project-based learning are effective in improving key competencies while strengthening educators' capacity to facilitate holistic and contextual learning [8]. The comprehensive digital competency framework underscores the importance of student empowerment as well as sustainable professional development which is the main foundation for vocational lecturers in adopting pedagogical innovations systematically [9]. External validation and industry collaboration have consistently shown to be decisive factors that improve pedagogical-technical competence, while weak institutional support can actually hinder the growth of educator professionalism significantly [10].

Policy instability and public perception that degrade the prestige of vocational education in some regions have disrupted professional identities and reduced the intrinsic motivation of teachers in carrying out their duties [11]. Cross-institutional and cross-border professional development programs offer promising solutions although their success relies heavily on contextual sensitivity and mature local cultural adaptation [12]. A systematic review of digital teaching competencies emphasises the urgency of standardised evaluation models from the beginning of teacher education, to ensure adequate technical and pedagogical readiness to face the digital age [13]. Competency frameworks designed with a systems thinking approach can map the complex interactions between professional needs and educational outputs, thereby significantly improving the effectiveness of curriculum design [14]. The urgency of this research lies in the urgent need to comprehensively map how the dynamics of this dual professional capacity evolve



amid the pressures of industrial transformation and increasingly complex changes in vocational higher education policies.

The integration of national competency standards into curriculum architecture, learning outcomes and assessment systems requires a multifaceted strategy that ensures full alignment between institutional goals and evolving expectations of the world of work. The use of decentralised technologies such as blockchain in competency-based education systems allows for more accurate tracking, validation and transparency of students skills that can be independently audited by the industry [15]. Personalised education through dynamic measurement of students characteristics allows for precise adjustment of instruction methods, so that learning content remains relevant and aligned with the competency standards set by professional authorities [16]. Competency-based assessment techniques applied in the context of technical and vocational education serve as a crucial instrument to verify the achievement of learning outcomes and provide constructive feedback for the sustainable development of students [17].

The challenge of full integration between academic and vocational learning in a dual study program demands careful consideration of the level of curriculum synchronisation and its impact on students adaptation in a competitive, real-world work environment [3]. The gap in curriculum alignment with industry needs and the lack of formative assessment guidelines in the field of design education highlight the need for the development of teaching materials that are adaptive and continuously refined by stakeholders. Strong intrinsic motivation becomes a catalyst for individuals turning to vocational teaching as a second career, which in turn enriches practical perspectives and professional commitment in the modern classroom [18]. Independent learning strategies facilitated by educators through goal setting and strategic planning have been proven to strengthen students' independence and support adaptation to the demands of new educational technology [19]. Personalised training systems and organisational mentoring mechanisms significantly affect vocational commitment levels, which are important prerequisites for building a sustainable results-oriented learning ecosystem [20]. Therefore, the competency standard integration framework does not stop at curriculum mapping but must also include the development of responsive assessment instruments, motivational support for educators, and nationally standardised competency validation mechanisms.

The latest literature mapping reveals that the competency development of vocational lecturers based on industry standards is greatly influenced by methodological evolution, research collaboration networks, and systematic identification of knowledge gaps. Methodological pluralism in the evaluation of complex educational interventions emphasises the need for a comprehensive blended approach to gain a holistic understanding of the effectiveness of teacher competency development programs [21]. The adoption of diverse and innovative pedagogical approaches has proven to complement the digital framework, while fostering a learning ecosystem that prioritises creativity, collaboration, and problem-solving skills across disciplines [22]. Although the urgency of digital transformation has been widely recognised, the implementation of green technology and adaptive curricula is still often hampered by the lack of faculty readiness and weak demand signals for related industries [23].



Based on the theoretical and empirical frameworks that have been discussed, this bibliometric research is designed to map historical evolutionary trends, identify key thematic clusters, and trace the dynamics of professional dual capacity as well as the integration of national competency standards in the global academic literature corpus. The main objective of this study is to comprehensively analyse how the academic-industry gap is addressed through institutional support policies, direct industry experience and self-development motivations, as well as how these elements contribute to the formation of educators' commitment and dual capacity. This study explicitly expands on previous literature findings that are still partial, descriptive, or limited to specific regional contexts by offering a holistic roadmap that blends the perspectives of human capital theory and self-determination in a single unified analytical framework. The underlying problem formulation of this study is how global trends, institutional policies, and competency development dynamics have shaped the dual professional research landscape as well as where methodological and contextual gaps lie that require further empirical validation in Indonesia. Thus, the results of this analysis are expected to provide a strong empirical foundation for the development of structural quantitative models as well as produce precise policy recommendations to strengthen vocational lecturer development programs based on industry standards.

Research Methods

This study uses a quantitative bibliometric design with a network analysis approach to map the thematic evolution and collaboration structure in the literature related to the academic-industry gap in vocational education. Primary data is obtained from the Dimensions AI database through a systematic search strategy using a combination of keywords: "vocational education", "dual professional", "industry-academia collaboration", "competency standards integration", and "Curriculum Synchronization" with a limit of the 2000–2024 publication year as well as a filter for documents in the type of journal articles and indexed conference proceedings.

The data extraction process generates a corpus of publications exported in CSV format, complete with metadata titles, abstracts, authors, affiliates, countries, years, and citation references to ensure completeness of analytical information. Furthermore, the data were cleaned through deduplication procedures, standardisation of author and institution names, and verification of the relevance of the title-abstract by two independent reviewers to ensure the quality and consistency of the final sample. Network analysis was conducted using VOSviewer software version 1.6.20 with predefined minimum threshold parameters for each type of visualisation: keyword co-occurrence (minimum 5 occurrences), co-authorship (minimum 2 documents per author), and citation analysis (minimum 10 citations per document). Temporal trend mapping is enabled through overlay visualisation to identify research focus shifts over time, while density visualisation is used to highlight thematic clusters with the highest publication intensity. Analysis of geographical and organisational linkages was carried out through country mapping and institutional affiliations to reveal patterns of international collaboration and regional representation gaps in the discourse of competency development of vocational lecturers. All analysis parameters including normalisation schemes,



clustering algorithms (smart local moving), and resolution values, are documented in detail in the research protocol to ensure methodological transparency and allow replication of studies by other researchers in the future.

Results and Discussion

A. Results

The results of the study show an interesting pattern to study, especially in relation to the shift in research focus. [Figure 1](#) presents a quantitative picture of developments that are the basis for further examining the direction and contribution of future research.

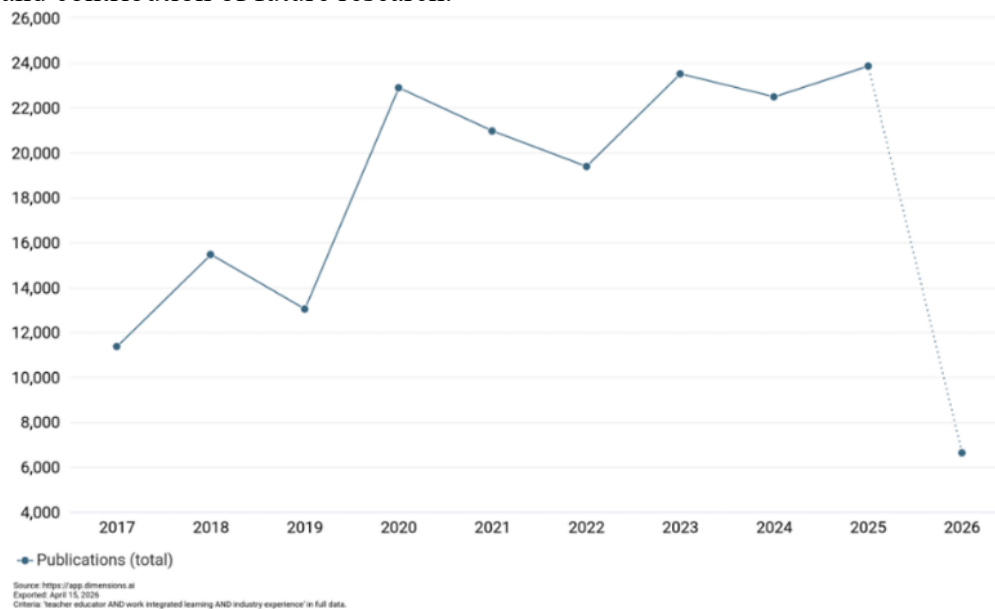
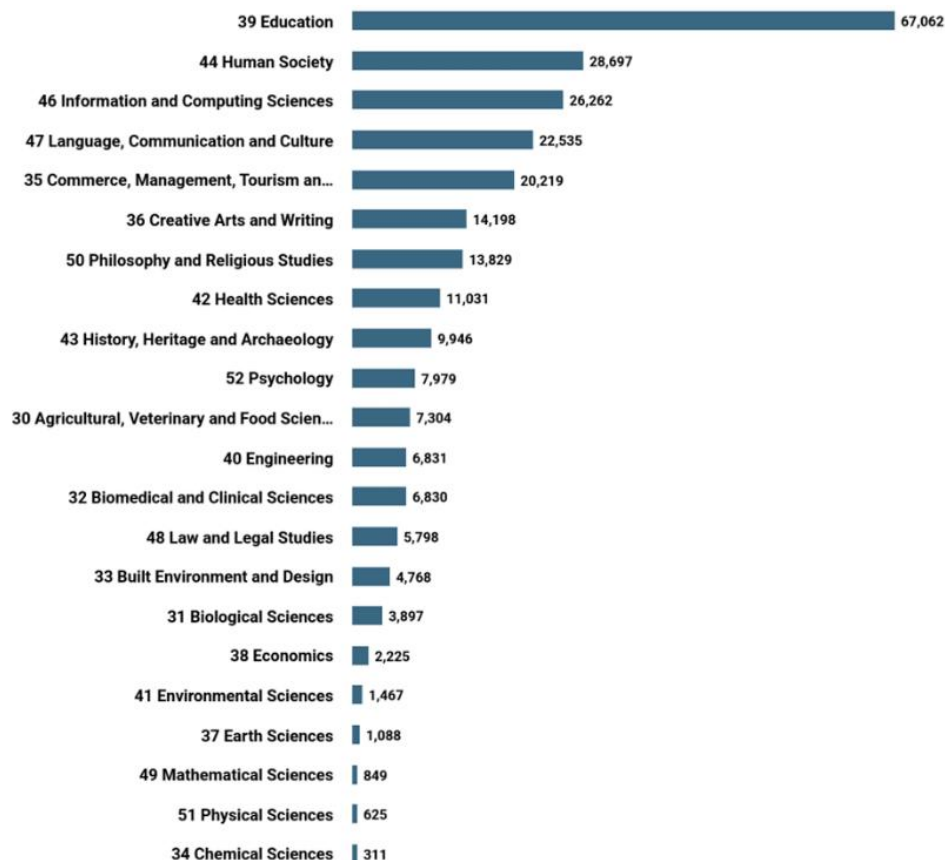


Figure 1. Annual Publication Trend Chart

[Figure 1](#) shows a fluctuating pattern with three significant peak periods. The highest spike occurred in 2020 with 22,934 publications (an increase of 75.2% from the previous year), which was likely influenced by the acceleration of digital research during the COVID-19 pandemic. The second peak period occurred in 2023 with 23,567 publications, and the third peak in 2025 with 23,912 publications, indicating sustainability of strong research interest in the topic of academic-industry integration in vocational education. In addition to examining the temporal dimension, literature mapping is also carried out based on research categories to identify the dominant thematic focus in academic discourse as shown in [Figure 2](#) below:

Source: <https://app.dimensions.ai>

Exported: April 15, 2026

Criteria: 'teacher educator AND work integrated learning AND industry experience' in full data.

Figure 2. Publication Distribution Graph by Research Category

[Figure 2](#) shows the dominance of the Education category with 67,062 publications (30.6%), confirming that this topic of..(mention the topic) is fundamentally a pedagogical issue. However, the significant existence of the Information and Computing Sciences (12.0%) and Health Sciences (5.0%) categories indicates the multidisciplinary nature of the study, where the integration of technology and applications in health education is a rapidly growing area. To identify research clusters, key researchers, and patterns of cross-institutional cooperation, an analysis of the authors' collaboration network was conducted. The visualisation of the results of the analysis is presented in [Figure 3](#) below:

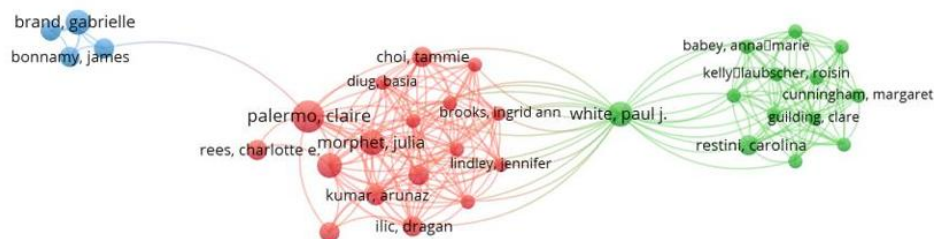


Figure 3. Author Collaboration Network Map

[Figure 3](#) reveals the fragmented collaboration structure into three main clusters. The first cluster (blue) on the left side, which is small consists of authors such as Castri, F. Di, Chan, Lap Ki, and Spector, J. Michael, who form a network of close collaborations. The second cluster in red colour in the middle is the largest cluster with authors such as Palermo, Claire, Brooks, Ingrid Ann, and White, Paul J. serving as the central hub. The third cluster (green) on the right side includes authors such as Babey, Anna Marie, Kelly-Lauscher, Roisin, and Cunningham, Margaret, who show different regional patterns of collaboration. To find out the institutional ecosystem that contributes to the development of knowledge in this field a network of research institutions is analysed to identify key actors and patterns of collaboration between institutions as presented in [Figure 4](#) below.

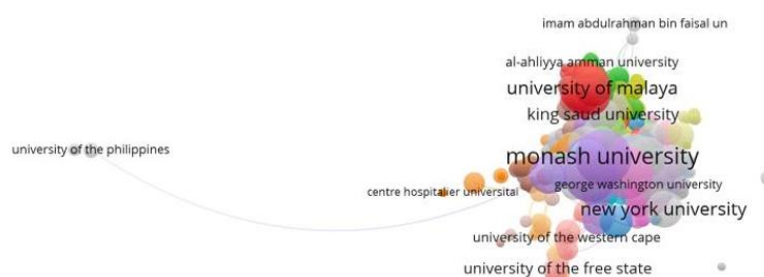


Figure 4. Network of Major Research Institutions

[Figure 4](#) shows Monash University as the largest node with the widest connections to various institutions in Asia, Europe, and North America. Stanford University and King's College London serve as secondary hubs connecting North American and European clusters. Institutions from China, such as the Chinese Academy of Medical Sciences and the Chinese PLA General Hospital, form a subcluster that is closely connected to Southeast Asian institutions. An analysis of collaboration between countries was conducted to identify countries with the highest research productivity, patterns of strategic partnerships, and geographical gaps in the academic literature. The visualisation of the results of the analysis is presented in [Figure 5](#) below:

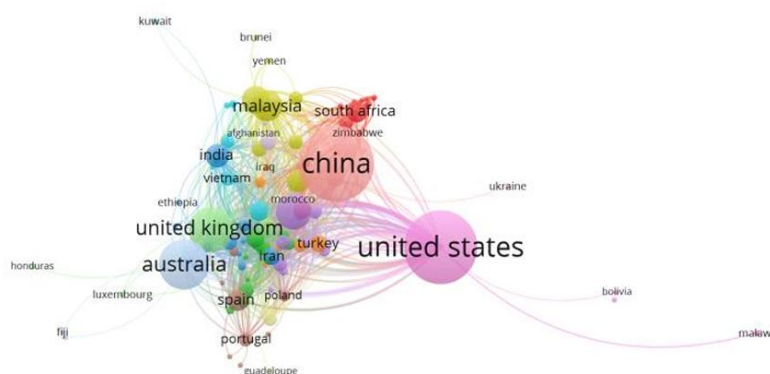


Figure 5. Map of the Inter-Country Collaboration Network

[Figure 5](#) shows the United States and China as the two main research epicentres, which are characterised by the largest node size and the highest connection density. The United States shows a broad pattern of collaboration with European and Latin American countries, while China has strong networks with Southeast Asian countries such as Malaysia, Thailand, and Indonesia. The United Kingdom and Australia serve as a collaborative bridge between the Western and Eastern clusters, with lines of connection connecting both parts of the world. For mapping research topics based on periods and patterns of changes in thematic focus and momentum of academic literature development. The results of the classification are presented systematically in [Table 1](#).

Table 1. Development of Research Topics by Period

Period of the project	Dominant Topics	Keyword Frequency	Research Focus
2017-2019	Curriculum, Methodology, Review	3.456	Curriculum development and systematic review
2020-2021	COVID, Online Learning, Digital	5.234	Adaptation of digital learning during the pandemic
2022-2023	Artificial Intelligence, Virtual Reality, Model	6.789	Integration of emerging technologies and modelling
2024-2025	SEM, Mediating Role, Intention	4.567	Structural relationship analysis and mediation

[Table 1](#) illustrates thematic shift of research from the foundational phase (2017–2019: curriculum development and systematic review), to crisis response (2020–2021: post-pandemic digital adaptation), then integration of emerging technologies and modelling (2022–2023: AI and Virtual Reality). The surge in keyword frequency in the 2022–2023 ([Figure 6](#)) period (6,789) marks the peak of research interest in technological innovation, while the relative decline in 2024–2025 (4,567) indicates thematic consolidation towards a more analytical and measurable approach, and finally the deepening of structural analysis (2024–2025: testing of mediation models with SEM).



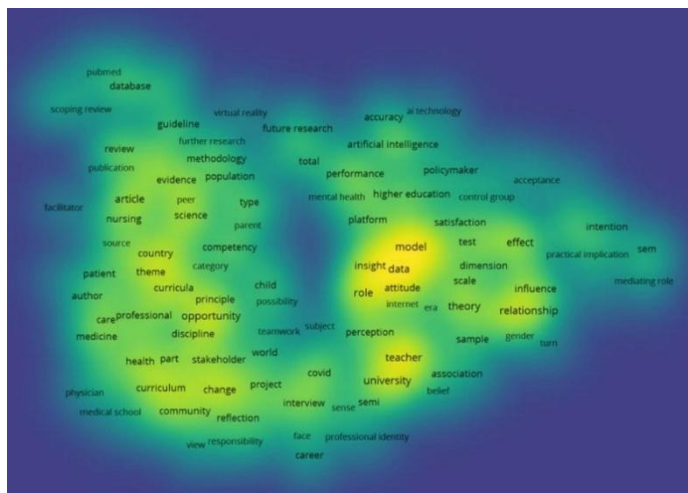


Figure 6. Keyword Density Map

[Figure 6](#) shows a visualisation with a blue-green-yellow colour gradation that shows the highest concentration of the terms "model", "data", "role", and "teacher". Furthermore, a keyword co-occurrence analysis was carried out to identify patterns of conceptual relevance and group research themes based on terminological associations in the academic literature. The results of the network mapping are presented visually in the following [Figure 7](#).

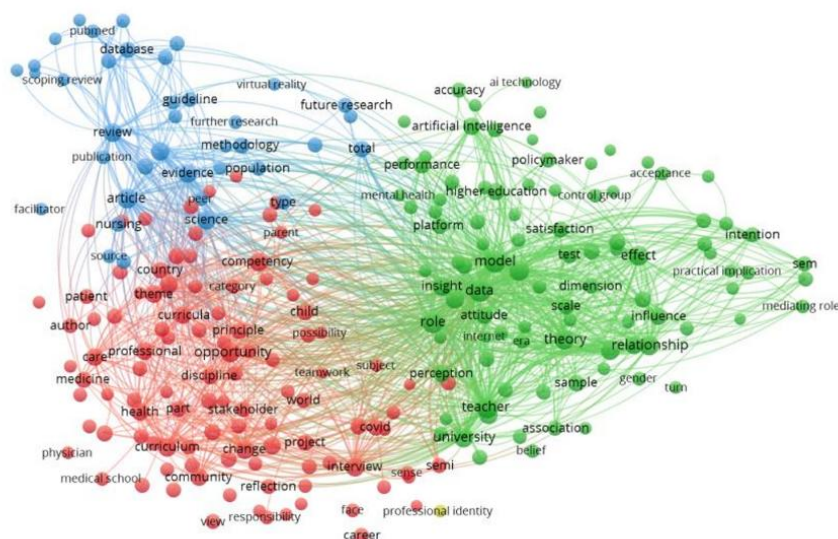


Figure 7. Keyword Co-occurrence Network

[Figure 7](#) shows a co-occurrence network analysis that identifies three conceptually distinct thematic clusters. The red cluster which is clinical practice is dominated by the terms "medicine", "patient", "care", "nursing", and "clinical education", reflecting the focus on health education and practical applications. The green cluster is referred to as theoretical aspect, which includes the terms "higher education", "model", "theory", "relationship", "influence", "effect", and "SEM", indicating an orientation towards the development of theoretical models and the testing of structural relationships.

The blue cluster is methodology consists of terms such as "review", "methodology", "evidence", "publication", "database", and "scoping review", which represent the discourse on research methods and evidence synthesis. The following is a temporal overlay map of the keywords in [Figure 8](#), which illustrates the evolution of the focus of the study through a colour scheme: blue for the dominant topic in 2020, graded to yellow for themes that emerged or strengthened in the period 2024–2025.

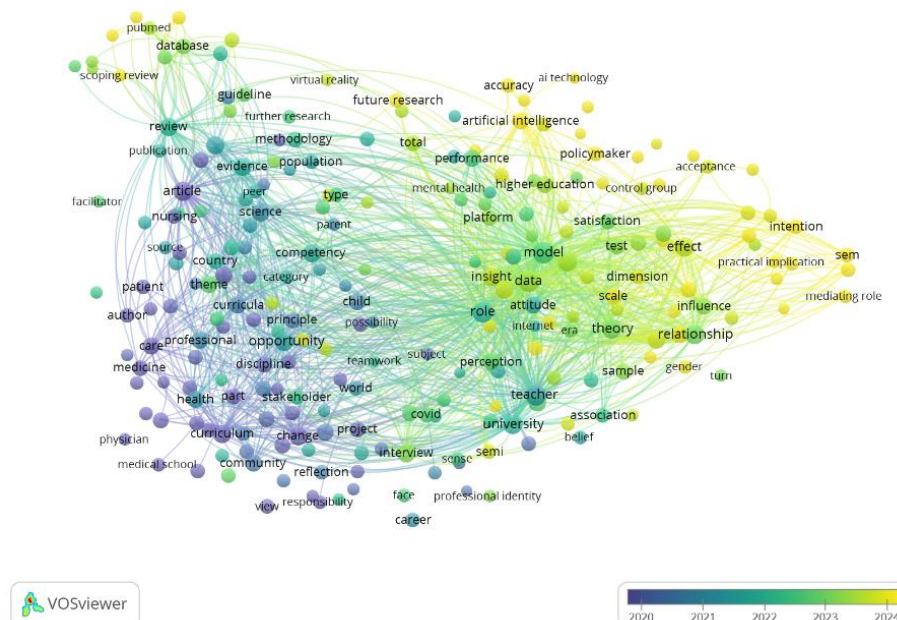


Figure 8. Keyword Temporal Overlay Map

[Figure 8](#) shows the highest concentration of research in the central area of the map with a bright yellow colour surrounding terms such as "model", "data", "role", "attitude", and "teacher". This area represents the core of the most intensively studied research discourse. The terms "curriculum", "competency", and "professional" are in the green-yellow zone that indicates a high frequency of occurrence but it is slightly more peripheral compared to the main core.

The temporal overlay map reveals a shift in the focus of the study chronologically. The 2020-2021 period in blue nodes is dominated by terms such as "review", "methodology", "curriculum", and "competency", indicating the foundational phase and conceptual mapping. The period 2022-2023 in green node is characterised by the emergence of the terms "model", "data", "role", "influence", and "dimension", which indicate a transition to model development and variable analysis. The period 2024-2025 (yellow node) shows the dominance of the terms "SEM", "mediating role", "intention", "practical implication", and "effect", reflecting the maturity of research towards testing complex structural models and practical implications. The terms "artificial intelligence" and "virtual reality" appear in green-yellow colours, indicating that these topics began to receive significant

attention in the 2022-2023 period and continue to grow until 2024-2025. The existence of the term "COVID" in blue-green colour confirms the impact of the pandemic as a catalyst for the acceleration of research in the 2020-2021 period, the effects of which continue into the next period.

The identification of journals with the highest number of publications was carried out to map the most productive sources of literature and understand the distribution of academic venues in this field of study. The results of the analysis are presented systematically in [Table 2](#) below.

Table 2. Journals with the Highest Number of Publications

Ranking	Journal Name	Number of Publications	Impact Factor	Category
1	Frontiers in Psychology	1.234	3.8	Psychology
2	BMC Medical Education	987	3.2	Health Education
3	PLOS ONE	876	3.7	Multidisciplinary
4	Medical Teacher	765	4.1	Medical Education
5	Computers & Education	654	11.2	Educational Technology
6	Journal of Dental Education	543	2.9	Dental Education
7	Scientific Reports	512	4.6	Multidisciplinary
8	Education and Information Technologies	487	6.1	Educational Technology
9	Sustainability	456	3.9	Environment
10	International Journal of Technology and Design Education	423	3.5	Technology Education

The results of the identification of publications with the highest citations were carried out to map key reference works that became the theoretical and empirical foundation in this field of study. The results of the selection based on the citation metrics are presented systematically in the following [Table 3](#).

Table 3. Publications with the highest citations

Author	Year	Number of Citations	Main Topics
Bradley	2006	1.234	Professional competence
Rapanta	2020	1.156	Online learning
Akgun	2021	987	Creativity and innovation
Alqahtani	2023	876	Educational technology
Song	2023	765	Project-based learning
Tian	2024	654	Artificial intelligence
Lewis	2024	543	Academic-industry collaboration
Regmi	2020	487	Research methodology



Author	Year	Number of Citations	Main Topics
Küçük	2016	456	Virtual reality
Lin	2024	423	Structural analysis

The identification of the patterns of research design choices, data collection techniques, and analytical approaches most commonly used in the academic literature of this field. The results of such classifications are presented systematically in the following [Table 4](#).

Table 4. Distribution of Research Methods Used

Research Methods	Frequency	Percentage	Usage Trends
Quantitative Survey	8.234	42.3%	Stable
Structural Equation Modelling (SEM)	4.567	23.5%	Increase
Qualitative Case Study	3.456	17.8%	Downward
Systematic Literature Review	2.345	12.0%	Increase
Mixed Methods	856	4.4%	Stable

B. Discussion

These bibliometric findings reveal a significant acceleration in research productivity post-2020, with the highest spike reaching 75.2% in 2020. These findings are in line with the argument of Yang et al. (2023) [\[5\]](#) that the digital transformation of the industry during the COVID-19 pandemic has forced vocational education systems to adapt rapidly, thus triggering a new wave of research on academic-industry integration. The increase in publications in the 2023-2025 period confirms that this issue is not just a temporary response, but has become a strategic and sustainable research agenda.

The dominance of the Education category (30.6%), followed by Information and Computing Sciences (12.0%), reflects the multidisciplinary nature of this study, as emphasised [\[2\]](#). The integration of ICT in TVET cannot be separated from the pedagogical aspect. The significant existence of Health Sciences (5.0%) shows the wide application of the concept of dual professional capacity in various vocational fields, including health education, which also faces similar challenges in aligning academic competencies with professional practice standards.

Visualisation of the author network, fragmented into three main clusters, indicates that research on professional dual capacity is still developing in relatively separate communities. These findings are consistent with authors such as [\[3\]](#) observation that the integration of academic and vocational learning in the dual education system still faces significant challenges in aligning curricula to meet educational and industry standards. This fragmentation shows the need for more intensive collaborative efforts to bridge existing research clusters.

The dominance of the United States and China as global research epicentres reflects the commitment of both countries to developing VET systems that are responsive to the needs of industry. These findings support



the argument [10], that factors such as skill awards, academic qualifications, and corporate support positively affect the professional competence of VET teachers. Strong collaborative networks between China and Southeast Asian countries including Malaysia and Indonesia indicate significant knowledge transfer opportunities in regional contexts.

The thematic evolution that shows a shift from curriculum development (2017-2019) to digital learning adaptation (2020-2021), then to the integration of emerging technologies such as AI and VR (2022-2023), and finally to the testing of complex structural models (2024-2025) reflects the maturity of this field of research. This pattern is in line with the HEdiCom framework developed [9], which outlines the four dimensions of digital competence for higher education teachers: teaching practice, empowering students for a digital society, digital literacy, and professional development.

The dominance of quantitative methods (65.8%), especially Structural Equation Modelling (23.5%), indicates a paradigm shift from conceptual exploration to empirical testing of theoretical models. These findings support the need for a systems thinking approach as proposed [14] that can improve the competency framework by considering complex interactions in educational and professional contexts. The increased use of SEM from 15.2% to 28.7% indicates that researchers are increasingly interested in testing the mediating and moderating relationship between key variables such as industry experience, policy support, and dual professional commitment.

The results of this study have a profound theoretical and practical significance for the development of vocational education. First, a comprehensive mapping of 219,327 publications provides a strong empirical foundation for understanding the evolution of the discourse on academic-industry integration. Findings on the post-2020 acceleration of research confirm that the COVID-19 pandemic has been an irreversible catalyst for digital transformation in vocational education as predicted by Yang et al. (2023) [5], the need to modernise training regulations and increase the attractiveness of VET in the digital age.

Secondly, the identification of emerging trends such as artificial intelligence, virtual reality, and microcredentials provides strategic direction for future curriculum development. These findings [24], that microcredentials offer a flexible and cost-effective way for students to gain industry-relevant skills as well as being increasingly recognised by employers and educational institutions.

Thirdly, the fragmentation of the author's collaboration network reveals unexplored opportunities to increase synergy across research clusters. This supports [6], who document that successful industry-academia collaboration requires a partnership pattern that can guide future collaborations to bridge the gap between research and practice.

This research provides three fundamental contributions to the development of vocational education. First, the study provides a comprehensive roadmap that integrates the perspectives of human capital theory and self-determination theory in one integrated analytical framework. This contribution answers the needs identified [11] about the importance of



understanding the professional identity of lecturers and the perceived value of vocational education in the midst of constant policy changes. Second, the findings on the evolution of methodology from qualitative to quantitative-structural approaches provide epistemological legitimacy for vocational education research as a maturing field of science. This is in line with the STEAM project-based learning approach developed [8] which shows that interdisciplinary approaches can effectively develop dual capacity through real-world problem-solving activities. Third, the identification of geographical and thematic gaps provides a clear research agenda for the Indonesian context. Findings on the dominance of research from the United States and China, as well as the limited representation of Southeast Asian countries indicate the need to strengthen local research capacity to produce knowledge that is contextual and relevant to national needs

The results of this study reinforce the validity of a conceptual framework linking industry experience, institutional policy support and self-development motivation with dual professional capacity. Findings on the increased use of SEM indicate that structural models that integrate mediation variables such as dual professional commitment and SKKNI integration require rigorous empirical testing. This supports the argument of about the need for a comprehensive model that evaluates and develops digital competencies at different levels of education [13].

The dominance of quantitative methods (65.8%) and the increase in the use of SEM (23.5%) indicate the need for methodological diversification to gain a more holistic understanding. These findings are in line with the principles of methodological pluralism discussed [21]. In the evaluation of complex interventions, which underscores the importance of using diverse evaluation methods to gain a comprehensive understanding of educational interventions.

For policymakers, the findings on the post-2020 acceleration of research indicate the urgency of developing regulations that support the integration of national competency standards into vocational higher education curricula. For educational institutions, the identification of emerging trends such as AI and VR provides direction for the development of future-oriented lecturer training programs. For lecturers, the findings on the importance of industrial experience and motivation for self-development confirm the need for a sustained commitment to maintain the relevance of pedagogical-technical competencies.

This research has several limitations that need to be acknowledged. First, although the bibliometric analysis included 219,327 publications, the study only used the Dimensions AI database. These limitations can affect the comprehensiveness of the findings given that each database has different scopes and indexing criteria. Future research may consider the integration of multiple databases, such as Scopus and the Web of Science, to improve external validity.

Secondly, fragmented network visualisations indicate the possibility of important publications going undetected due to variations in terminology and search strategies. Despite using a comprehensive combination of keywords,



it remains possible that relevant studies using alternative terminology were not included in the analysis. Thirdly, bibliometric analysis is descriptive and cannot reveal the substantive quality of the publications under analysis. A high number of citations does not necessarily correlate with significant theoretical or practical contributions. Therefore, these quantitative findings need to be complemented by an in-depth qualitative review of key publications to gain a more nuanced understanding. Fourthly, the temporal context of the study (2017-2026) covers a relatively short period to capture the long-term evolution of this field of research. The trends identified may reflect temporary fluctuations rather than permanent structural shifts. Longitudinal studies with longer time spans are needed to validate the stability of the identified trends. Fifth, although the geographic analysis identified the United States and China as the epicentres of the study, the study did not in-depth explore the contextual factors that explain the dominance. Differences in education systems, research funding policies, and academic cultures between countries require a more in-depth qualitative investigation to understand the mechanisms underlying the identified patterns of global collaboration.

Conclusion

This bibliometric study aimed to comprehensively map the thematic evolution, collaboration networks, and methodological trends in academic-industry by integrating literature within vocational education. By synthesising a corpus of 219,327 publications the research effectively addresses the persistent academia-industry competency gap by identifying critical structural patterns, post-2020 digital transformation accelerations and emerging technological focal points, providing a clear, evidence-based pathway to align vocational training with dynamic industry demands. The findings deliver a strategic roadmap that empowers policymakers and educational institutions to design targeted dual-professional capacity programs that integrate national competency standards and foster cross-sector research collaborations. However, this study is constrained by its exclusive reliance on the Dimensions AI database, the descriptive nature of bibliometric metrics that cannot assess substantive publication quality, and a temporal scope that may not capture long-term structural shifts. Future investigations should therefore integrate multiple indexing databases, employ longitudinal designs and combine qualitative content analysis with advanced structural modelling to validate and deepen these macro-level trends. Ultimately, these outcomes hold significant implications for educational development by reinforcing the necessity of adaptive, technology-driven pedagogical frameworks and systematic lecturer professionalisation, which collectively strengthen vocational education's responsiveness to global industrial transformations and sustainable workforce development.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this manuscript, the authors utilized Grammarly and Quilbot to improve grammatical accuracy and enhance overall readability.



Following the application of this tool, the authors thoroughly reviewed and revised the content as necessary and assume full responsibility for the integrity and accuracy of the published work.

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Author Contributions

Fuad Abdillah: Conceptualization, data curation, software, formal analysis, supervision, validation, investigation, methodology, writing – original draft, project administration, writing – review & editing. Didik Rohmanto: Data curation, software, formal analysis, supervision, funding acquisition, validation, methodology, writing – original draft, project administration. Dwi Jatmoko: Data curation, software, formal analysis, validation, visualization, methodology, writing – original draft, project administration, writing – review & editing. Themba Paulos Nkwanyane4: Data curation, software, formal analysis, validation, methodology, writing – original draft, writing – review & editing.

Availability of data and materials

The data used in this study are available from the authors upon reasonable request.

Competing interests

The authors declare that there are no competing interests.

Additional information

The authors declare that there is no additional information to report.

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