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Computational Thinking in Indonesian Vocational Education: A Bibliometric Analysis

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ABSTRACT

This study presents a bibliometric analysis of research focused on computational thinking (CT) in the context of Indonesian vocational education, aiming to map its development, thematic focus, and scholarly impact. CT has gained recognition as a critical 21st-century skill that supports problem-solving, digital literacy, and adaptability. These competencies are essential for vocational learners preparing to enter Industry 4.0 environments. Despite its growing importance, the landscape of CT research in Indonesia's vocational education system remains fragmented and underexplored. Using the Dimensions AI database, this study retrieved open access publications from 2014 to 2025 based on the search query: ("vocational education") AND ("Indonesia") AND ("computational thinking"). A total of 219 documents were analyzed using Microsoft Excel for data cleaning and VOSviewer for network visualization. The findings show a significant increase in publication output beginning in 2019, which aligns with national education reforms such as Revitalisasi SMK and Kurikulum Merdeka. The dominant research categories include educational technology, STEM education, and curriculum innovation. Key themes identified through keyword co-occurrence include CT as a foundational skill, the integration of CT into vocational curricula, and the relevance of CT to employability and digital transformation. Influential journals such as Sustainability and IJERE appear frequently in the citation network, indicating the interdisciplinary appeal of CT and its relevance to both educational policy and practice. This study contributes to the field by offering a structured overview of research trends and providing a foundation for future inquiry and curriculum development focused on strengthening CT in Indonesian vocational education.

Keywords: Bibliometric, Computational Thinking, Vocational Education

INTRODUCTION

Background and Research Problem

Indonesia's transition into a digital economy has made technological literacy and problem-solving competencies fundamental for its emerging workforce. In this context, integrating Computational Thinking (CT) into vocational education (SMK) is both an educational imperative and a strategic national priority. CT includes essential skills such as abstraction, decomposition, algorithmic thinking, and debugging, which are widely recognized as critical for preparing students to navigate the complexities of Industry 4.0 and future technological

landscapes [1], [2]. For vocational schools that are tasked with equipping students for specific industrial roles, CT provides a framework that connects theoretical understanding with practical application, enabling graduates to engage in adaptive problem-solving and innovation.

The urgency of this integration is underscored by the economic potential of digitalization in Indonesia. According to Meidyasari (2024), optimizing digital transformation could contribute up to USD 150 billion to the country's GDP by 2025 [3]. However, this economic promise is at risk if the workforce remains underprepared. Many vocational schools continue to rely on outdated curricula and teaching practices that fall short of developing digital competencies or fostering critical thinking. This gap between education and the needs of the labor market raises serious concerns about the nation's readiness to compete in a rapidly evolving global economy [4], [5]. Moreover, employers increasingly seek graduates who possess not only technical skills but also the cognitive abilities to engage with digital tools and information effectively. Tee et al. (2024) emphasize that competencies like data literacy, digital content creation, and digital communication are now considered essential by employers across sectors.

Despite policy-level encouragement for innovation in vocational education, there is often a disconnect between strategic aspirations and on-the-ground implementation. Pratama and Diwyarthi (2024) argue that without aligning vocational education closely with technological advances, Indonesia risks creating a workforce that is technically trained but not digitally empowered [6]. Even where curricular adaptations are being made, these often fail to systematically embed CT across learning domains. Rahmawati et al. (2021) highlight that while some vocational programs have embraced adaptive curriculum models, the emphasis tends to be on surface-level updates rather than on deep structural integration of higher-order thinking skills [7].

Although individual studies have explored CT-related themes in vocational settings such as the use of TPACK approaches to enhance problem-solving [1], collaborative learning for digital competencies [8], and higher-order thinking challenges these studies remain fragmented [9]. There is no comprehensive synthesis of research trends, key contributors, dominant themes, or the overall scope of CT in Indonesian vocational education. Without such an overview, it is difficult to evaluate the effectiveness of existing efforts, identify best practices, or determine where further research and intervention are needed.

This lack of a consolidated knowledge base reveals several critical research gaps. Questions remain unanswered regarding the volume of CT-related research in vocational education, how the body of literature has evolved over time, and which authors, institutions, or regions are contributing most significantly. There is also limited understanding of how researchers collaborate, what themes dominate the discourse, and which studies are most influential. Without these insights, stakeholders are left without the evidence base needed to make informed decisions on curriculum development, teacher training, or policy formulation.

This study addresses these gaps by conducting the first bibliometric analysis focused on Computational Thinking in Indonesian vocational education. It provides a systematic map of the existing research, offering a bird's-eye view of the field's development. For researchers, the analysis highlights leading scholars, collaborative networks, and emerging themes, thereby supporting more targeted and impactful future studies. For policymakers and school leaders, the findings offer evidence that can support curriculum updates, investment decisions, and the design of professional development programs. For educators, the study identifies instructional approaches and content areas where CT is being successfully implemented, which can be adapted for broader classroom use.

In practical terms, this research contributes to aligning educational strategies with national economic goals. Mahfud et al. (2022) emphasize the importance of industry engagement in vocational education, noting that effective programs require alignment between educational objectives and workplace expectations [10]. Meanwhile, studies like that of Sucipto et al. (2020) point to the importance of evaluating alumni outcomes to assess whether CT skills translate into job readiness [11]. A bibliometric mapping of the field allows these micro-level findings to be contextualized within a broader, data-driven understanding of the national research landscape.

Ultimately, Indonesia's ability to harness the potential of its digital economy depends on its success in reforming vocational education to meet 21st-century challenges. Integrating Computational Thinking into vocational training is a promising and necessary step. However, the absence of a comprehensive overview of existing research has hindered progress. This study fills that void by offering a structured analysis of how CT is being studied and applied within Indonesia's SMK system. By identifying research patterns, gaps, and opportunities, the study provides a foundation for more informed educational policymaking, research collaboration, and pedagogical innovation.

Research Objectives

1. To identify and analyze publication trends.
2. To identify leading contributors (authors, institutions, countries).
3. To map and visualize core research themes and their relationships.
4. To analyze collaboration networks.

LITERATURE REVIEW

Computational Thinking (CT)

Computational Thinking (CT) is a structured approach to problem-solving that incorporates concepts derived from computer science, but its application extends well beyond the field. Wing (2006) introduced CT as the ability to formulate problems and represent their solutions in a way that can be effectively carried out by a computer or a person [12]. This foundational definition has been expanded by scholars such as Brennan and Resnick (2012), who categorized CT into four primary components: decomposition, pattern recognition, abstraction, and algorithm design [13]. These skills are now widely acknowledged as core competencies for learners in the digital age [14], [15].

Decomposition involves breaking down complex problems into smaller, more manageable parts. This cognitive process is essential in vocational fields where systems must be understood at both component and operational levels, such as in automotive repair or electronic diagnostics [16]. Pattern recognition enables individuals to identify recurring issues or trends, which is valuable in maintaining industrial machinery or troubleshooting technical faults [17]. Abstraction allows learners to focus on essential features of a problem while omitting unnecessary details, helping them identify generalized solutions that can be reused across contexts [18]. Algorithm design, or the development of a logical sequence of steps to solve a problem, is critical for process optimization and efficiency across vocational tasks [19].

In addition to these core components, evaluation and debugging are frequently cited as integral to the CT process. These involve testing, refining, and iterating on solutions to ensure functionality and efficiency. This is particularly relevant in technical and vocational settings where quality control and real-time adjustments are part of routine operations [15], [20]. CT, therefore, provides a mental model for structured reasoning that aligns well with vocational education goals, particularly in fields influenced by digital technologies and automation.

Relevance to Vocational Education

The integration of CT into vocational education is increasingly seen as necessary to prepare learners for rapidly evolving industries. As vocational training moves toward more complex and digitized systems, learners must develop not only hands-on skills but also analytical and cognitive competencies that support adaptability and innovation [21] CT contributes to this by enhancing students' ability to analyze problems, plan and execute solutions, and evaluate outcomes. These are skills that are transferable across trades.

For example, in mechanical engineering or logistics, CT supports troubleshooting and workflow optimization. In digital fabrication or design, abstraction and algorithmic thinking are fundamental to using modeling software or programming automated equipment. These competencies are also vital for interpreting sensor data, managing smart technologies, and maintaining systems that interact with digital networks. Therefore, CT does not merely support technical proficiency but also cultivates a mindset of logical and systematic thinking necessary for long-term career adaptability.

Vocational Education and Training (VET) in Indonesia

Structure and Significance

Indonesia's vocational education and training system plays a strategic role in national economic and workforce development. SMK (Sekolah Menengah Kejuruan) are the main institutions delivering vocational education at the secondary level. They offer specialized programs in sectors such as electronics, hospitality, creative industries, and agribusiness. These institutions are expected to supply industry-ready graduates who can contribute to national productivity and economic equity.

The government has prioritized SMK reform in response to shifting labor market demands and the broader goals of Indonesia's digital economy strategy. Programs like the Revitalisasi SMK and Kurikulum Merdeka emphasize curriculum updates, industry engagement, and alignment with global competencies. These reforms are intended to enhance the relevance of vocational education, strengthen partnerships with private sectors, and prepare learners for the demands of Industry 4.0 [22], [23].

Challenges and Reform Needs

Despite these efforts, the SMK system continues to face significant challenges. Skills mismatches persist between what is taught in schools and what is required in the workplace. Many graduates lack digital competencies and higher-order thinking skills necessary for thriving in automated and data-driven environments [24], [25]. Employers increasingly demand not only technical expertise but also soft skills such as communication, collaboration, and problem-solving [26].

Curriculum modernization is therefore a key issue. Traditional instructional models do not always incorporate digital literacy or CT explicitly. This results in graduates who are competent in routine tasks but unprepared for new technologies and non-linear problem-solving. Integrating CT into vocational education could bridge this gap by cultivating logical reasoning and adaptive skills that support job readiness and lifelong learning [27].

The Role of Bibliometric Analysis in Mapping Emerging Fields

Bibliometric analysis refers to the application of quantitative methods to the study of scholarly publications. It enables researchers to assess the development, scope, and structure of a research field by examining publication patterns, co-authorship networks, citation trends, and thematic clusters. This methodology has proven effective in evaluating fragmented or rapidly evolving domains, such as digital education and computational thinking [28], [29].

Applying bibliometric analysis to the intersection of CT and Indonesian vocational education offers several advantages. First, it provides an objective overview of the volume and distribution of existing research. Second, it helps identify the most influential authors, institutions, and themes in the field. Third, it reveals knowledge gaps and underrepresented topics, guiding future research agendas. Finally, bibliometric mapping supports strategic planning for curriculum developers, policymakers, and teacher educators who seek evidence-based directions for innovation [30], [31].

Studies in adjacent areas have demonstrated the utility of bibliometric methods. For example, Aispuro et al. (2023) conducted a global analysis of CT research [32], while Li et al. (2020) mapped the evolution of computational thinking literature over a decade [17]. In Indonesia, bibliometric studies are emerging in education research but remain rare in vocational or CT-specific contexts [29]. This underscores the novelty and value of applying bibliometrics to this underexplored intersection.

In conclusion, CT and vocational education are increasingly interconnected, particularly in economies transitioning toward digital industries. However, research on their intersection in the Indonesian context remains fragmented. Bibliometric analysis offers a robust tool to synthesize this body of knowledge, providing clarity on who is contributing to the field, what themes are most prominent, and where opportunities for growth lie. This review lays the conceptual foundation for such a mapping effort, supporting the broader goal of strengthening Indonesia's vocational education system for the digital age.

METHODOLOGY

This study applies bibliometric analysis to examine the research landscape of Computational Thinking (CT) within the context of Indonesian vocational education. Bibliometric methods enable the quantitative mapping of research trends, influential works, and scholarly networks, making them suitable for identifying knowledge gaps in emerging interdisciplinary fields.

Data Source and Search Strategy

Data were retrieved from the Dimensions AI database, selected for its broad coverage of multidisciplinary scholarly publications and robust metadata. The search used the Boolean query: *("vocational education") AND ("Indonesia") AND ("computational thinking"),* filtered for publications from 2014 to 2025 which resulted in 218 literatures. This period aligns with the increasing policy and academic focus on digital skills and curriculum reform in Indonesian vocational education.

Inclusion Criteria and Data Processing

The study included only open access publications such as journal articles, conference papers, and book chapters published from 2014 to 2025.

The metadata were exported and cleaned using Microsoft Excel. Duplicates were removed, and inconsistencies in author names, institutional affiliations, and keywords were standardized to ensure consistency in subsequent analyses.

Analysis and Visualization Tools

The cleaned data were analyzed using VOSviewer, a tool for constructing and visualizing bibliometric networks. Analyses included:

1. Co-authorship networks to map collaboration among researchers,
2. Keyword co-occurrence to identify dominant research themes,
3. Citation analysis to highlight influential publications.

The resulting visual maps illustrate the structure and dynamics of CT research in Indonesian vocational education

FINDINGS AND DISCUSSION

Publication Trends

The bibliometric analysis shows that scholarly interest in computational thinking (CT) within Indonesian vocational education increased steadily from 2014 to 2025. Initial publication numbers were low, but a marked rise occurred from 2019 onward. This growth corresponds with national policy shifts emphasizing digital competencies, such as the Revitalisasi SMK initiative and the implementation of Kurikulum Merdeka. The highest number of publications appeared between 2021 and 2024, reflecting heightened academic attention on integrating CT into the vocational education system.

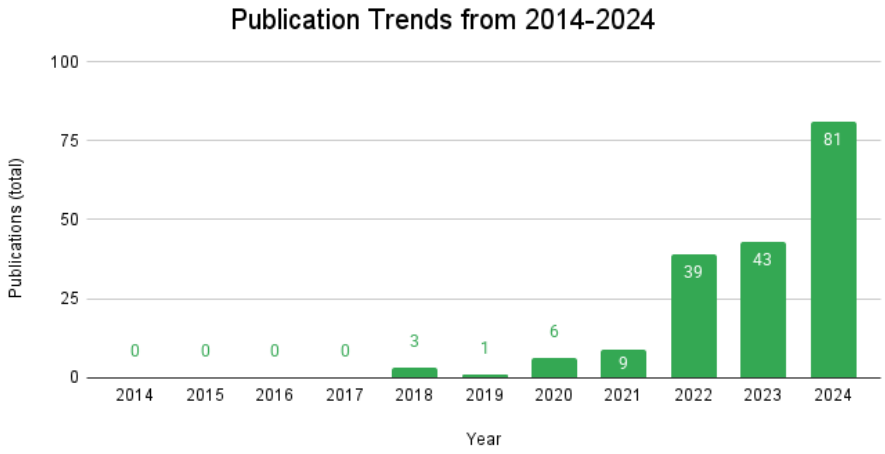

Figure 1. Publication Trends from 2014-2024

The Research Categories

Publications in this domain span several academic fields. Most belong to categories such as educational technology, vocational education, and curriculum innovation, while others intersect with STEM education and computer science. This categorization reveals that CT is viewed both as a technical skill and as a cross-cutting cognitive framework. It also indicates the interdisciplinary nature of CT and its relevance across vocational domains, particularly in preparing students for technology-enhanced workplaces.

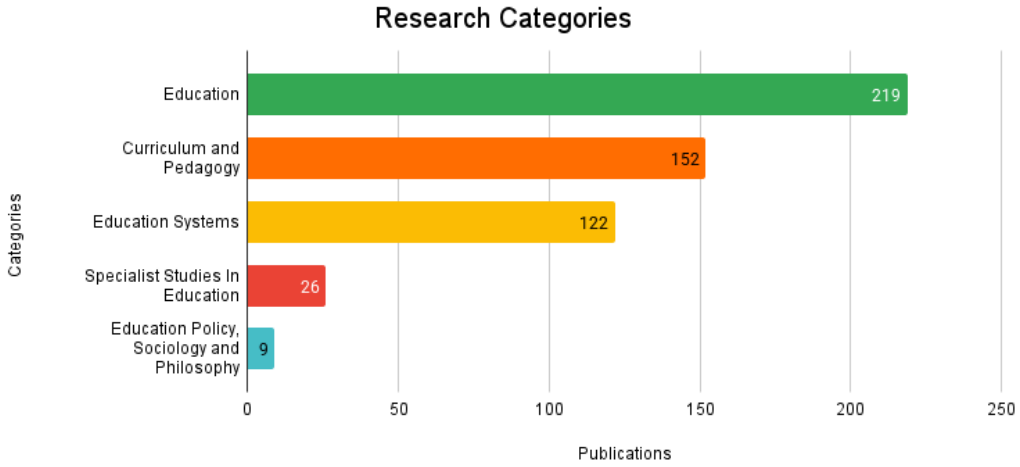

Figure 2. Research Categories

Key Themes

Keyword co-occurrence analysis highlighted dominant themes in the literature. Frequently appearing terms include computational thinking, STEM, vocational education, problem-solving, and curriculum development. These keywords clustered around three major research focuses:

1. CT as a core 21st-century skill,
2. CT integration into vocational curricula,
3. The role of CT in employability and Industry 4.0 readiness.

Emerging keywords such as project-based learning, digital literacy, and automation suggest a shift in research interest toward the development of future-oriented, transferable competencies in SMK students.

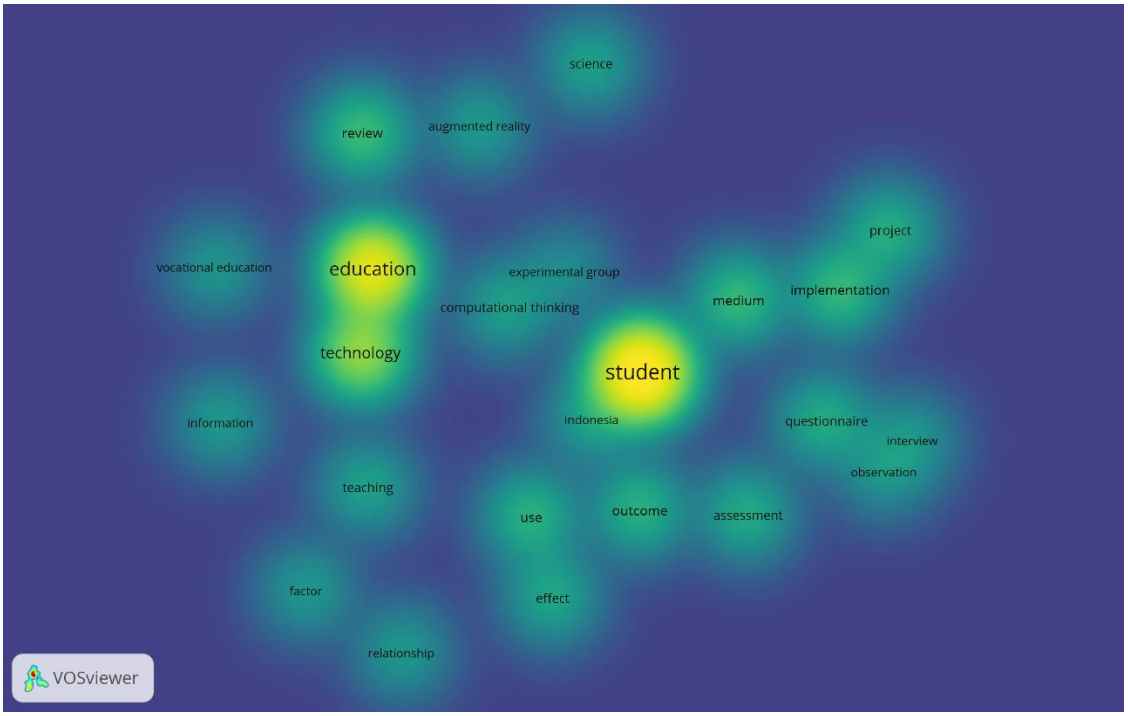

Figure 3. Analyzed Using VOSviewer

Most Cited Sources

Citation analysis identified influential sources shaping this field. Sustainability ranked highest with 98 citations across 7 documents, reflecting the growing connection between CT and sustainable development goals. Other leading sources include:

1. *International Journal of Evaluation and Research in Education (IJERE)* – 51 citations,
2. *European Journal of Educational Research* – 30 citations,
3. *International Journal of Information and Education Technology* – 27 citations,
4. *Journal of Education Technology* – 21 citations.

These sources collectively emphasize digital competence, pedagogical innovation, and vocational training reform.

Table 1. Cited Sources

Source	Citations	Documents
Sustainability	98	7
International Journal of Evaluation and Research In Education (IJERE)	51	7
European Journal of Educational Research	30	6
International Journal of Information and Education Technology	27	16
Journal of Education Technology	21	5

Discussion

The findings of this bibliometric analysis offer a comprehensive view of how research on computational thinking (CT) in Indonesian vocational education has evolved and where it currently stands. The steady increase in publications since 2019 corresponds with national education reforms focused on integrating digital competencies into the vocational curriculum [7]. This growth reflects a broader recognition of CT not only as a technical skill but also as a necessary cognitive framework for preparing vocational students for Industry 4.0 environments [27].

The dominant research categories, which include educational technology, STEM education, and vocational pedagogy, confirm that CT is being understood as both content and method. This dual nature supports earlier

findings that CT encompasses skills such as decomposition, abstraction, and algorithmic thinking. These skills are highly relevant for problem-solving in technical fields [15], [16]. For instance, in automotive or electronics programs, students apply decomposition to diagnose systems effectively. Abstraction and pattern recognition help them generalize procedures for troubleshooting across different models and tools [18].

The recurring themes of employability and Industry 4.0 readiness highlight the practical importance of CT in vocational education. CT enables learners to manage data, understand automation, and interact with digital systems. These competencies are increasingly demanded by employers [21], [26]. This is particularly relevant given Indonesia's current efforts to modernize its vocational education system through initiatives such as the *Revitalisasi SMK* and the *Link and Match* program. These initiatives aim to address the mismatch between vocational training and labor market demands [24].

Moreover, the emergence of research focused on pedagogical strategies that support CT, including project-based learning and digital literacy, aligns with current curriculum modernization efforts. These strategies resonate with the goals of *Kurikulum Merdeka*, which promotes student-centered learning, interdisciplinary approaches, and the development of higher-order thinking skills [23]. CT naturally complements these approaches by offering structured, logical reasoning frameworks that enhance both academic and vocational competencies.

The citation analysis further reveals that influential journals such as *Sustainability* and *IJERE* frequently publish on CT, vocational training, and digital transformation. This suggests that the integration of CT in vocational education is not merely a pedagogical trend. It is also a response to broader educational and policy challenges, including sustainable development and technological equity [22]. These findings indicate that CT is positioned at the intersection of educational innovation and socio-economic development.

In conclusion, the increasing research output, thematic diversity, and growing presence in leading journals reflect the academic significance of CT in Indonesian vocational education. At the same time, the analysis highlights the need for more context-specific research and stronger collaborative networks among local scholars. Strengthening these areas can enhance both the theoretical development and practical implementation of CT, ultimately supporting Indonesia's broader education and workforce goals.

CONCLUSION

This bibliometric analysis provides a comprehensive overview of the growing body of research on computational thinking (CT) in Indonesian vocational education between 2014 and 2025. The findings reveal an increasing trend in publication activity, particularly in response to national reforms such as Kurikulum Merdeka and Revitalisasi SMK, highlighting CT's emerging role as both a technical skill and cognitive framework in vocational learning. Dominant themes in the literature include CT integration in curricula, employability, and Industry 4.0 readiness, with research largely concentrated in interdisciplinary areas such as STEM, educational technology, and vocational pedagogy. Influential sources indicate that CT research is aligned with broader goals of educational innovation and sustainable development. Despite this momentum, gaps remain in localized studies and collaboration among Indonesian scholars. This study contributes by mapping the intellectual and thematic structure of the field, offering evidence to guide policy, curriculum development, and future research. Strengthening CT integration in vocational education is essential to equipping learners with the problem-solving and digital competencies needed for a dynamic, technology-driven workforce.

REFERENCES

H. Sa'diyah, S. Sucipto, and V. M. T. L. Tobing, "Pengaruh Pembelajaran dengan Pendekatan TPACK terhadap Problem Solving Skill dan Kemandirian Belajar Siswa pada Mata Pelajaran Administrasi Infrastruktur Jaringan di SMK Negeri 1 Sepulu," *EDUKASIA Jurnal Pendidikan dan Pembelajaran*, vol. 5, no. 1, pp. 373–396, Feb. 2024, doi: 10.62775/EDUKASIA.V5I1.779.

S. Nurfauziyah, I. Hamidah, S. Suntini, and F. Z. Fadhly, "ELEVATING LEARNING: DEVELOPING HOTS CHALLENGES FOR SENIOR STUDENTS AT SMK PUI CIKIJING," *Indonesian Journal of Learning and Instruction*, vol. 7, no. 1, p. 53, May 2024, doi: 10.25134/IJLI.V7I1.9604.

S. Meidyasari, "The Impact of Digital Economy in Driving Economic Growth and Development in Indonesia," *Interdiciplinary Journal and Hummanity (INJURITY)*, vol. 3, no. 11, pp. 777–783, Nov. 2024, doi: 10.58631/INJURITY.V3I11.1306.

R. Qurniawan and T. Jasmina, "The Effect of General and Vocational High School Quality on Labor Market Outcomes in Indonesia," *The Journal of Indonesia Sustainable Development Planning*, vol. 2, no. 3, pp. 307–323, Dec. 2021, doi: 10.46456/JISDEP.V2I3.194.

B. Nadeak, "Principal Leadership and School Climate on Vocational High Schools' School Productivity in Bekasi Regency," *Interdisciplinary Social Studies*, vol. 1, no. 8, pp. 994–999, May 2022, doi: 10.55324/ISS.V1I8.180.

I. Wayan, A. Pratama, N. Desak, M. Santi Diwyarthi, and W. A. Pratama, "Optimization of Human Resources and Utilization of Information Technology in Driving the Digital Economy," *West Science Information System and Technology*, vol. 2, no. 01, pp. 49–57, Apr. 2024, doi: 10.58812/WSIST.V2I01.829.

Y. Rahmawati, L. Alhapip, M. S. Barliana, A. A., and V. Dwiyanti, "Adaptive Curriculum Development on Tourism Vocational Secondary Education," *Applied Science and Innovative Research*, vol. 5, no. 1, p. 39, Jan. 2021, doi: 10.22158/ASIR.V5N1P39.

N. P. W. P. Sari, J. Artsanthia, S. A. Marcello, S. Suvaree, and N. Prachyakoon, "Examining the digital skills of nursing students: the power of information for problem-solving," *International Journal of Public Health Science (IJPHS)*, vol. 13, no. 3, pp. 1111–1120, Sep. 2024, doi: 10.11591/IJPHS.V13I3.23873.

S. Maharani *et al.*, "THE DEVELOPMENT OF HOTS-BASED TECHNICAL MECHANICAL SUBJECT INSTRUMENTS USING A CLASSICAL TEST THEORY APPROACH," *Jurnal Pensil : Pendidikan Teknik Sipil*, vol. 13, no. 1, pp. 13–23, Jan. 2024, doi: 10.21009/JPENSIL.V13I1.40225.

T. Mahfud, N. M. Aprily, I. N. Saputro, I. Siswanto, and S. Suyitno, "Developing and validating the multidimensional industry commitment scales: The perspective of vocational high school students," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 11, no. 1, pp. 361–368, Mar. 2022, doi: 10.11591/IJERE.V11I1.21840.

S. Sucipto, E. K. Dewi, N. C. Resti, and I. H. Santi, "Improving The Performance of Alumni Achievement Assessment by Integrating Website-Based Tracer Study Information Systems and Telegram API," *TEKNIK*, vol. 41, no. 1, pp. 72–77, May 2020, doi: 10.14710/TEKNIK.V41I1.25307.

J. M. Wing, "Computational Thinking." Accessed: Aug. 05, 2025. [Online]. Available: https://www.researchgate.net/publication/274377900_Computational_Thinking

K. Brennan and M. Resnick, "New frameworks for studying and assessing the development of computational thinking," *AERA*, vol. 2012, p. 1.

C. E. Robertson, N. Pröllochs, K. Schwarzenegger, P. Pärnamets, J. J. Van Bavel, and S. Feuerriegel, "Negativity drives online news consumption," *Nat Hum Behav*, vol. 7, no. 5, pp. 812–822, May 2023, doi: 10.1038/S41562-023-01538-4,.

Y. Allsop, F. Kalelioglu, and M. A. Unlu, "Using Card Sorting Activity as a Strategy for Evaluating Students' Learning of Computational Thinking Concepts," *International Journal of Computer Science Education in Schools*, vol. 6, no. 4, Nov. 2024, doi: 10.21585/ijcses.v6i4.215.

B. Ozturk, M. Yildiz, K. Yildiz, and S. Gun, "Maintaining the postharvest quality and bioactive compounds of jujube (Ziziphus jujuba Mill. Cv. 'Li') fruit by applying 1-methylcyclopropene," *Sci Hortic*, vol. 275, Jan. 2021, doi: 10.1016/J.SCIENTA.2020.109671.

L. quan Li *et al.*, "Response to Char's comment: Comment on Li et al: COVID-19 patients' clinical characteristics, discharge rate, and fatality rate of meta-analysis," *J Med Virol*, vol. 92, no. 9, p. 1433, Sep. 2020, doi: 10.1002/JMV.25924,.

E. YOKUŞ and R. KAHRAMANOGLU, "An Overview of Computational Thinking," *Anemon Muş Alparslan Üniversitesi Sosyal Bilimler Dergisi*, vol. 10, no. 1, pp. 157–173, Apr. 2022, doi: 10.18506/ANEMON.1033403.

A. Moore, A. Nguyen, S. Rivas, A. Bany-Mohammed, J. Majeika, and L. Martinez, "A qualitative examination of the impacts of financial stress on college students' well-being: Insights from a large, private institution," *SAGE Open Med*, vol. 9, 2021, doi: 10.1177/20503121211018122.

A. S. A. Hamed, S. L. Wong, M. N. M. Khambari, N. A. A. Rahim, F. Khalid, and P. Moses, "A bibliometric analysis of computational thinking skills: definition, components and assessment tools," *Res Pract Technol Enhanc Learn*, vol. 20, Jan. 2025, doi: 10.58459/RPTEL.2025.20035.

L. Hermans and T. E. O'Sullivan, "Send it, receive it, quick erase it: A mouse model to decipher chemokine communication," *Journal of Experimental Medicine*, vol. 221, no. 7, Jul. 2024, doi: 10.1084/JEM.20240582,.

B. Bastian, C. R. Crimston, C. Klebl, and P. A. M. van Lange, "The moral significance of prosstecting environmental and cultural objects," *PLoS One*, vol. 18, no. 2 February, Feb. 2023, doi: 10.1371/JOURNAL.PONE.0280393,.

S. Suryati, A. M. Tamam, and W. Supraha, "Pendidikan perilaku untuk anak Sekolah Dasar." Accessed: Aug. 05, 2025. [Online]. Available: https://jurnal.ucy.ac.id/index.php/fkip/article/view/2273/2141

I. Nugraha, N. K. Putri, and H. Sholihin, "An Analysis of the Relationship between Students' Scientific Attitude and Students' Learning Style in Junior High School," *Journal of Science Learning*, vol. 3, no. 3, pp. 185–195, Jul. 2020, doi: 10.17509/JSL.V3I3.22873.

U. Hippach-Schneider and E. Rieder, "Between pressure to act and framework for action – the actors in the German and Swiss vocational education and training systems in the face of digitalisation," *Res Comp Int Educ*, vol. 17, no. 4, pp. 620–637, Dec. 2022, doi: 10.1177/17454999221118741.

U. Salahuddin, J. Sun, C. Zhu, and P. Gao, "Filtration Methods for Microplastic Removal in Wastewater Streams - A Review," *International Journal of High Speed Electronics and Systems*, vol. 32, no. 2–4, Dec. 2023, doi: 10.1142/S0129156423500192.

W. Wagiran, P. Pardjono, M. B. Triyono, G. N. I. P. Pratama, and T. Köhler, "The Future of Vocational Competence: Perspective of Vocational Teachers, Industries, and Educational Expert," *International Journal of Instruction*, vol. 16, no. 4, pp. 543–560, Oct. 2023, doi: 10.29333/IJI.2023.16431A.

P. Kokol, H. B. Vošner, J. Završnik, J. Vermeulen, S. Shohieb, and F. Peinemann, "Serious Game-based Intervention for Children with Developmental Disabilities," *Curr Pediatr Rev*, vol. 16, no. 1, pp. 26–32, Aug. 2019, doi: 10.2174/1573396315666190808115238,.

S. Maesaroh, P. Andriani, and A. M. Astuti, "Studi Systematic Literature Review (SLR): Pembelajaran Matematika Berbasis STEM pada Sekolah Menengah di Indonesia dan Malaysia Tahun 2020-2024," *Jurnal Riset dan Inovasi Pembelajaran*, vol. 4, no. 3, pp. 2293–2308, Jan. 2024, doi: 10.51574/JRIP.V4I3.2602.

S. Castañeda *et al.*, "Advances in the Treatment of Giant Cell Arteritis," *J Clin Med*, vol. 11, no. 6, Mar. 2022, doi: 10.3390/JCM11061588,.

M. Cebral-Loureda, E. Tamés-Muñoz, and A. Hernández-Baqueiro, "The Fertility of a Concept: A Bibliometric Review of Human Flourishing," *Int J Environ Res Public Health*, vol. 19, no. 5, Mar. 2022, doi: 10.3390/IJERPH19052586,.

A. A. Aispuro, V. Canoine, M. Illa, L. Fusani, and I. Maggini, "Stopover territoriality in songbirds crossing the Sahara: aggression and energetics during migration," *Behav Ecol Sociobiol*, vol. 77, no. 5, pp. 1–13, May 2023, doi: 10.1007/S00265-023-03336-4/FIGURES/1.

