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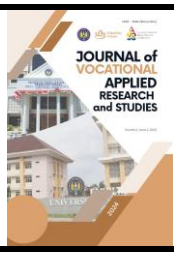

CHALLENGES IN PREPARING AN ADAPTIVE VOCATIONAL CURRICULUM IN THE SOCIETY 5.0 ERA: A LITERATURE STUDY

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ABSTRACT

This study aims to explore the challenges of preparing an adaptive vocational curriculum in the Society 5.0 era by analyzing trends in subject areas, researcher productivity, publication years, and countries, using Scopus-indexed data processed with VOSViewer. Results indicate that publications on "Vocational and Education" accumulated 279 citations from 1994 to 2024, with the peak number of publications occurring in 2019 at 29 articles. The United States leads in the number of published articles, while the most productive researchers are Mulder R. H. and Nurtanto, M., each contributing three publications. Title trend analysis reveals three clusters of ongoing research interests, including education, training, curriculum, teaching, learning, engineering, ethics, professional education, universities, and program evaluation. The main challenge in developing an adaptive vocational curriculum for Society 5.0 is fostering collaboration between government, industry, and educational institutions through the Technical and Vocational Education and Training (TVET) approach, alongside integrating digital technology effectively into vocational learning processes.

1. Introduction

Education is one of the most vital fields in human life. Socio-economic changes result from the continuous evolution of technology within the education system [1]. This transformation is driven by technological advancements such as artificial intelligence (AI), the Internet of Things (IoT), robotics, and big data (Popkova et al. [2]), impacting industry structure and labor markets. The education sector, particularly vocational education, must rapidly adapt to meet the demands of an increasingly dynamic workforce [3]. However, preparing vocational curricula aligned with modern industry needs presents complex challenges, including developing relevant skills, integrating technology in learning, and fostering collaboration between educational institutions and industries focused on competency development grounded in life skills [4]. The Fourth Industrial Revolution (Industry 4.0) is a widely discussed technological and socio-economic development with profound impacts on educational policy and strategy agendas [5]. Education in this era faces demands for greater flexibility and responsiveness to global changes, particularly relating to labor market shifts [1]. Vocational education aims to produce graduates who are not only resilient and competent but also possess strong character, thus creating high-quality, competitive human resources. This is

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achieved through competency-based vocational education and training (VET), industrial workforce infrastructure development, and strengthening vocational institutions [7,8].

Industry 4.0 brings challenges such as inadequate human resource skills, communication technology security, machine reliability, stakeholder adaptability, and job losses due to automation. Society 5.0 envisions a human-centered society balancing economic progress with solving social issues via highly interconnected cyber-physical systems [9]. While Industry 4.0 emphasizes artificial intelligence, Society 5.0 focuses on the human element. The transition to Society 5.0 offers opportunities for education development but also presents challenges. Popkova et al. [2] state that at least 50% of jobs globally will undergo skill changes in the coming decade, urging vocational institutions to continuously update curricula to remain relevant to emerging technologies and industry trends [10]. Unfortunately, curricula often lag behind rapid technological advances, leaving graduates underprepared for modern workforce challenges.

This study provides a literature review of the challenges in designing adaptive vocational curricula in the Society 5.0 era, highlighting the need for comprehensive and collaborative approaches. The challenges extend beyond technology and skills, involving the roles of various stakeholders. The study aims to identify key challenges in developing adaptive vocational curricula and offer strategic recommendations to enhance the relevance and effectiveness of vocational education.

2. Method

This study employs a qualitative approach, focusing on human phenomena occurring in the surrounding environment [11]. The method used is a Systematic Literature Review (SLR), which is utilized to identify and select research studies related to specific research questions to be evaluated and summarized in a fair, thorough, and transparent manner [12]. The aim is to provide an in-depth understanding of the challenges in preparing an adaptive vocational curriculum in the Society 5.0 era by collecting and analyzing various literature sources such as books, journals, articles, and official reports. This study uses the Scopus index as its primary data source over other databases due to its high-quality indexed information. By searching the keyword *vocational AND education* on Scopus and filtering for categories related to vocational education and curriculum within the period 1994 to 2024, a total of 279 relevant articles were identified. The Scopus data was then imported into *VOSViewer* to explore potential research topics on vocational curricula.

3. Results and Discussion

3.1. Results

The selection of articles based on the keyword *vocational AND education* in Scopus yielded an analysis of trends in subject areas, researcher productivity, publication years, countries, as well as interesting research topics to be explored.

3.1.1. Analysis Based on Subject Areas

Based on Figure 1 below, it can be seen that there are 11 subject areas. The three largest subject areas are: 1) Business, Management, and Accounting with 41.0% or 114 articles; 2) Social Sciences with 24.9% or 69 articles; and 3) Economics, Econometrics, and Finance with 7.1% or 48 articles.

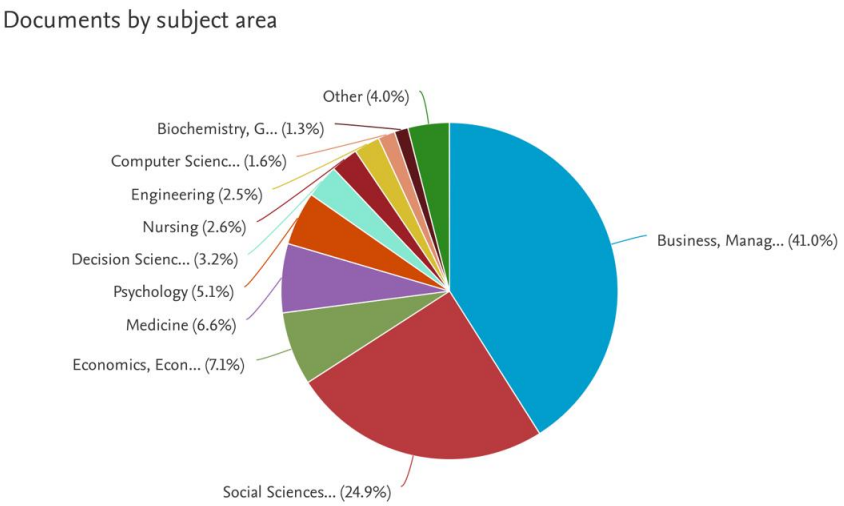

Fig. 1. Documents by Subject Area

3.1.2. Analysis of Researcher Productivity

Researcher productivity from 1994 to 2014 indexed in Scopus shows the top 10 researchers. Based on Figure 2, it can be seen that researchers Mulder, R.H. and Nurtanto, M. each have 3 publications. Meanwhile, researchers with the lowest output—Airey, D., Arifin, Z., Baartman, L.K.J., Backes-Gellner, U., Choy, M.W., Clarke, L., and Eicker, F.—each have 2 publications.

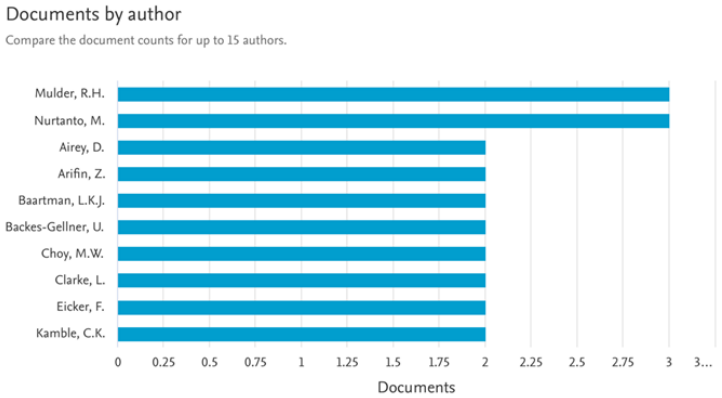

Fig. 2. Document by Author

3.1.3. Analysis of Publication Years

Based on Figure 3, the year 2019 recorded the highest number of publications with 29 articles. In 2017, there were 22 articles, and in 2024, there are also 22 articles. Observing the publication trend by year, this topic remains of interest for research as the graph shows an increasing trend from 2021 to 2024, which is suspected to be driven by the emergence of *Society 5.0*.

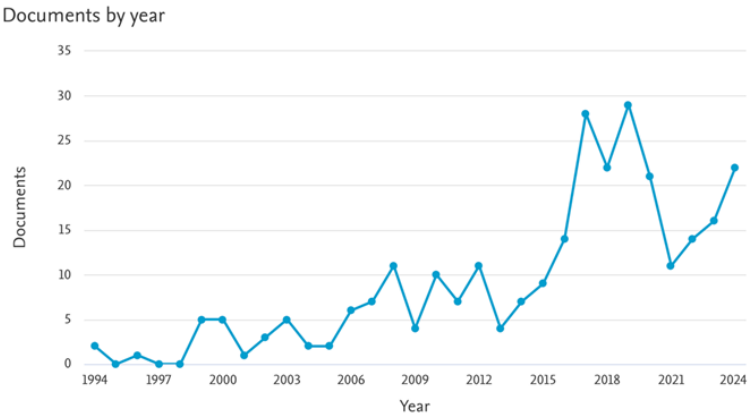

Fig. 3. Document by Year

3.1.4. Country Analysis

Articles on vocational education are contributed by various countries, with 50 publications from the United States, followed by 38 publications from the United Kingdom, 25 from Australia, 21 from Germany, and countries with fewer than 20 publications including China, India, the Netherlands, Russia, Canada, and Indonesia (see Figure 4).

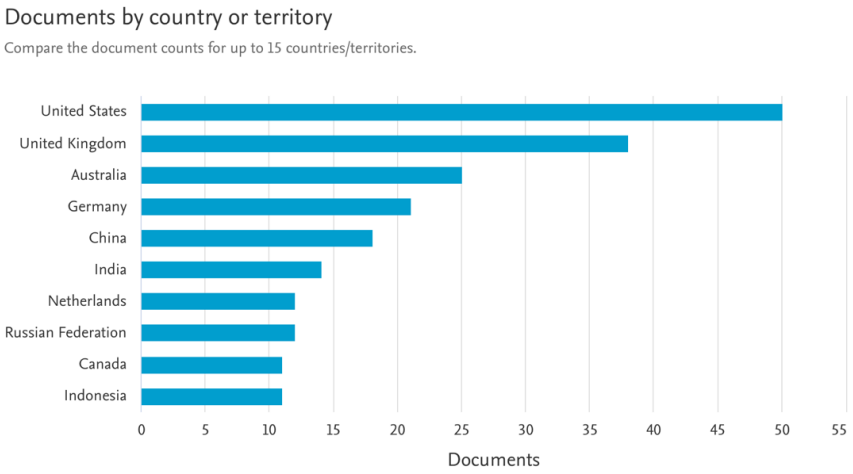

Fig. 4. Documents by *Country or Territory*

3.1.5. Topic Analysis

Using *VOSViewer*, topics are divided into several clusters based on network visualization. These clusters are represented by three colors: blue, red, and green. The topics with the strongest relationships are shown in blue. The blue cluster associates *vocational education* with education, training, and the United States. The red cluster connects *vocational education* with student, curriculum, teaching, learning, engineering, ethics, education professional, and university. The green cluster links *vocational education* with human, male, female, article, procedures, and program evaluation (see Figure 5).

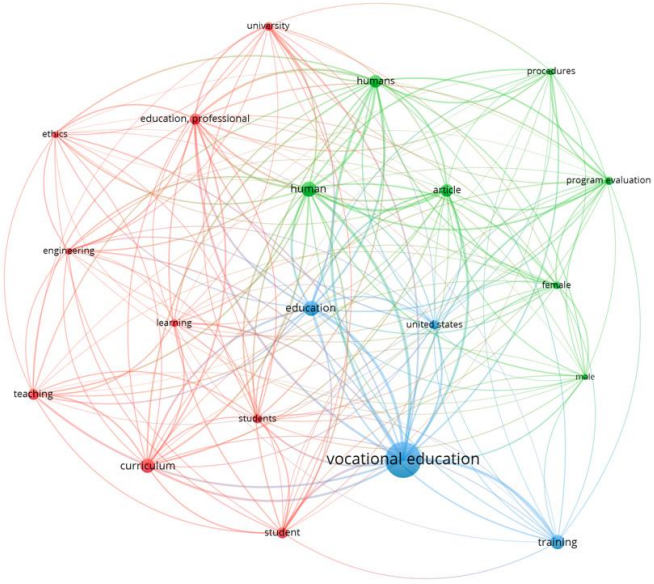

Fig. 5. Topic Visualization Based on Network Visualization

Based on Figure 6, the topic visualization using Overlay Visualization highlights recent research topics from 2017 to 2024 related to *vocational education* in the yellow cluster. The yellow cluster links *vocational education* with engineering, human, procedure, and students.

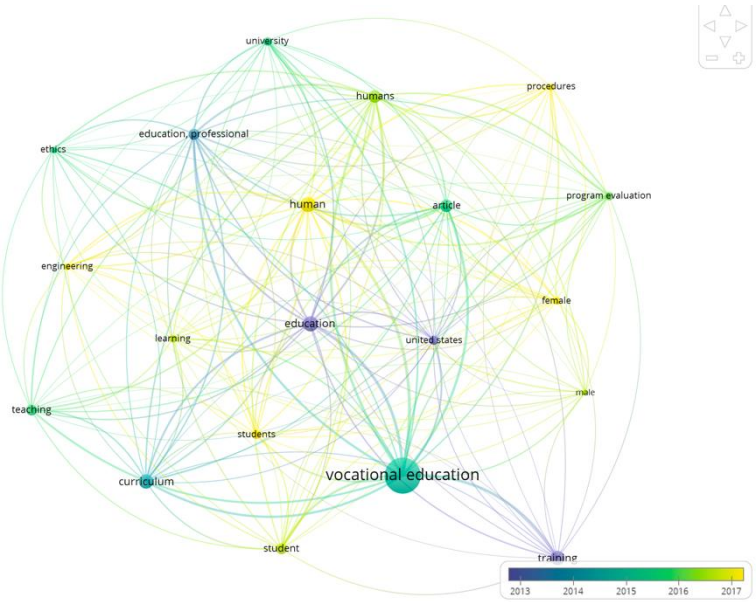

Fig. 6. Topic Visualization Based on Overlay Visualization

3.2. Discussion

Based on the analysis of Scopus and VOSviewer data, topics related to the development of vocational education during the period 1994–2024 include education, training, student, curriculum, teaching, learning, engineering, ethics, education professional, university, human, male, female, article, procedures, and program evaluation. One of the main challenges in preparing an adaptive vocational curriculum is aligning the skills taught with the ever-changing labor market demands. Educational institutions must develop curricula that not only emphasize technical skills but also foster critical thinking, creativity, and collaboration [13]. The key to success in facing the Society 5.0 era lies in the collaboration among government, industry, and educational institutions. The government needs to formulate policies that support innovation and education, while the industrial sector is expected to invest in workforce training and development. Meanwhile, educational institutions must ensure that the curricula remain relevant to evolving market needs [13]. With job shifts caused by automation, the world now demands workers to possess new skills relevant to digital technologies [14]. By providing adaptive vocational education aligned with current developments, the younger generation can be prepared not only to face this new era but also to become leaders and innovators who bring positive impact to society. The transformation toward Society 5.0 opens vast opportunities to create a more inclusive, sustainable, and prosperous society [15].

Technical and Vocational Education and Training (*TVET*) is considered a key factor in reducing unemployment, enhancing workforce competitiveness, and promoting inclusive and sustainable economic growth [8]. *TVET* plays a strategic role in preparing a workforce capable of adapting to these changes [17]. With an adaptive curriculum, *TVET* collaborates with industries to ensure the skills taught remain relevant and aligned with labor market demands [16]. Besides technical or hard skills, *TVET* also focuses on developing soft skills such as communication, collaboration, and problem-solving. These skills are increasingly important in a dynamic and ever-changing workplace [10]. With a holistic approach, *TVET* helps create a workforce ready to face challenges across economic sectors while supporting innovation and national competitiveness.

Reference [15] highlights the importance of developing 21st-century skills through an adaptive curriculum, so graduates are not only ready to face workplace challenges but also capable of contributing positively to society. For example, the use of artificial intelligence (*AI*) in healthcare can accelerate diagnosis and improve patient care, while the Internet of Things (*IoT*) enables the

creation of smarter cities that are safer and more energy-efficient [17]. Additionally, another challenge is how to integrate digital technologies into vocational learning processes. Technologies such as virtual simulation, augmented reality (*AR*), and artificial intelligence can be utilized to enhance the quality of vocational education [18].

However, implementing these technologies requires significant investment and training for educators to use them effectively. According to the study by [19], many vocational education institutions in developing countries still face difficulties adopting these technologies due to limited resources. Meanwhile, the study by [18] reveals a frequent gap between industry needs and what is taught in educational institutions, resulting in graduates lacking the appropriate skills. Reference [16] explains that to achieve these goals, collaboration among various parties—including government, educational institutions, and society—is essential. Collaboration among government, industry, and educational institutions is also a key factor in developing a responsive vocational curriculum in the Society 5.0 era. Industry plays an important role in providing feedback on skills needed in the workforce, while the government must establish regulations and policies supporting vocational education development [20]. Therefore, a curriculum that is relevant and responsive to evolving times is crucial to producing a generation prepared to face the Society 5.0 era.

4. Conclusions

Based on the results and discussion related to research indexed in Scopus, the keyword publications on *Vocational and Education* show a total of 279 cited articles indexed in Scopus from 1994 to 2024. The highest number of Scopus-indexed publications occurred in 2019, reaching 29 publications. The countries publishing the most articles are the United States. The most productive researchers are Mulder R. H. and Nurtanto, M., each with 3 publications.

Trend analysis of titles formed three clusters indicating topics that remain interesting for research, including education, training, student, curriculum, teaching, learning, engineering, ethics, education professional, university, human, male, female, article, procedures, program evaluation, and others.

The challenge in developing an adaptive vocational curriculum in the Society 5.0 era is to foster collaboration among government, industry, and educational institutions using the *Technical and Vocational Education and Training* (*TVET*) approach. Furthermore, an adaptive curriculum must pay attention to the integration of digital technology into the vocational learning process. Thus, a curriculum that is relevant and responsive to the times is key to creating a generation ready to face the Society 5.0 era.

Conflict of interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analysis, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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