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ORIGINAL

Visualization and Bibliometric Analysis of Vocational Education Articles in ASEAN Member States on the Scopus Databases

Visualización y análisis bibliométrico de artículos sobre formación profesional de los Estados miembros de la ASEAN en las bases de datos Scopus

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ABSTRACT

Introduction: This study aimed to analyze the bibliometric characteristics and trends of Vocational Education articles in ASEAN Member States on the Scopus Databases, including co-ocurrence by keywords, citation, co-citation, and bibliographic coupling.
Methods: Data were obtained from the Scopus databases in January 2021. The articles were searched using the keyword “Vocational Education” with limited affiliations from ASEAN member states on the Scopus database. The search was limited in the last decade (2011 - 2020) with the article type. Descriptive statistics used in this study were visualization and bibliometric analysis using VOSviewer version 1.6.14.
Results: 642 articles on Vocational Education published in 160 journals, with the Journal of Technical and Education and Training as the most popular. Several keywords often appeared and used in the articles were vocational education, human, male, female, education, learning, student, and teaching. Bibliometric analysis showed that 21 documents had the largest citation, 24 journals had the largest co-citation network, and 185 documents had the largest bibliographic coupling.
Conclusions: Research in the Vocational Education field by Southeast Asia authors has increased significantly over the last decade. Researchers are increasingly active and productive in producing scientific work and a stronger collaborative network. The Vocational Education topic is increasingly interesting and relevant to current issues so that it is still very open and has an opportunity for future research according to research trends in the Vocational Education field.

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Keywords: Bibliometric analysis; ASEAN; Scopus databases; Vocational education; VOSviewer.

RESUMEN

Introducción: Este estudio tuvo como objetivo analizar las características y tendencias bibliométricas de los artículos sobre educación profesional en los Estados miembros de la ASEAN en las bases de datos Scopus, incluida la coocurrencia de palabras clave, citas, cocitaciones y acoplamiento bibliográfico.
Métodos: Los datos se obtuvieron de las bases de datos Scopus en enero de 2021. Se realizaron búsquedas de artículos utilizando la palabra clave "Educación vocacional" con afiliaciones limitadas de los estados miembros de la ASEAN en la base de datos Scopus. La búsqueda se limitó a la última década (2011 - 2020) con el tipo de artículo. Las estadísticas descriptivas utilizadas en este estudio fueron visualización y análisis bibliométrico utilizando VOSviewer versión 1.6.14.
Resultados: Se publicaron 642 artículos sobre educación vocacional en 160 revistas, siendo la revista Journal of Technical and Education and Training la más popular. Varias palabras clave que aparecieron y se usaron con frecuencia en los artículos fueron educación vocacional, humanos, hombres, mujeres, educación, aprendizaje, estudiantes y enseñanza. El análisis bibliométrico mostró que 21 documentos tenían la mayor cantidad de citas, 24 revistas tenían la red de cocitación más grande y 185 documentos tenían el mayor acoplamiento bibliográfico.
Conclusiones: La investigación en el campo de la educación profesional por parte de autores del sudeste asiático ha aumentado significativamente durante la última década. Los investigadores son cada vez más activos y productivos en la producción de trabajos científicos y una red de colaboración más sólida. El tema de la educación profesional es cada vez más interesante y relevante para los problemas actuales, por lo que sigue estando muy abierto y tiene una oportunidad para futuras investigaciones de acuerdo con las tendencias de investigación en el campo de la educación profesional.

Palabras clave: Mucosa Bucal; Menopausia; Enfermedad Periodontal; Bacterias; Candida Albicans.

INTRODUCTION

Periodontitis is one of the first human diseases recognized to be associated with mixed-species biofilms. This biofilm contains many microorganisms, including bacteria, fungi, and viruses. Several studies have reported increased subgingival colonization by yeasts, particularly C. albicans, in patients with chronic periodontitis compared to periodontally healthy subjects.

Several Candida species are recovered from the human oral cavity, including C. albicans, C. glabrata, C. Kruse, C. tropicalis, C. parapsilosis, and C. guilliermondii. The most common fungal infection of the oral mucosa is candidiasis, mainly caused by C. albicans species, a normal commensal of the oral cavity, behaving as an opportunistic pathogen. The oral mucosa constitutes the main reservoir of Candida spp, usually on the surface of the oral cavity's tongue and vestibular and lingual mucosa. The proportion of C. albicans in the oral yeast population can be as high as 50-80 %.

While there is no doubt that biofilm is the cause of periodontal disease, its expression results from the interaction of bacterial, host, environmental, and systemic factors. This interaction leads to the individuality of disease expression, which, in turn, leads to the individuality of treatment. Including fungi as commensals in the oral biofilm is an important and innovative concept in oral biology. Thousands of bacterial phylotypes and more than one hundred fungi can colonize the oral cavity. Taxonomic profiling combined with functional expression analysis has revealed that Candida albicans, Streptococcus mutans, and prominent periodontopathogens are not always present or numerically important in candidiasis, caries, or periodontitis lesions.

However, C. albicans combined with Streptococcus spp increase their virulence in invasive candidiasis, early childhood caries, or peri-implantitis. Recent studies revealed that not only periodontopathic bacteria but also herpes viruses, e.g., Herpes simplex virus 1, Epstein-Barr virus, human cytomegalovirus, and oral C. albicans are involved in periodontitis. C. albicans can be detected in subgingival sites of patients with periodontitis, indicating that C. albicans can colonize inflammatory periodontal pockets and is significantly implicated in periodontitis.4-6 Several studies report the presence of Candida spp in subgingival tissues from 10 to 30% in healthy patients, being even higher in immunocompromised and diabetic patients.

Normal periodontal aging results from cellular aging, the basis for the intrinsic changes observed in oral tissues over time. The aging process does not affect all tissues in the same way. Epithelial tissue, one of the periodontium's main components, is always being renewed. In the epithelium, a progenitor population of cells (i.e., stem cells) in the basal layer provides new cells.

Basal layer cells are the least differentiated cells of the buccal epithelium. A small subpopulation of these cells produces basal cells and retains the proliferative potential of the tissue. A larger subpopulation of these cells (amplifying) produces cells that are available for further maturation. This maturing cell population continually undergoes a process of differentiation or maturation. By definition, the differentiated cell (the epithelial cell) can no longer divide. In contrast, the basal cell remains part of the progenitor population of cells ready to return to the mitotic cycle to produce both cell types again. There is a constant source of renewal.

Substantial endocrine changes, transient, physiologic, or pathologic, can affect the periodontal condition through modulation of the inflammatory response and direct action on periodontal pathogens. Periodontal manifestations of sex steroid hormones can be observed in endocrine changes that occur during puberty, the menstrual cycle, pregnancy, and menopause. The endocrine and reproductive systems control these changes.

The totality of epidemiological studies shows that the increased prevalence and severity of gingivitis and periodontitis are closely associated with poor oral hygiene. Moreover, the imbalance between bone formation and resorption created by estrogen deficiency may manifest itself early in the alveolar structure by creating negative bone volume, which increases the risk of periodontal disease and tooth loss.

For this reason, the association between the endocrine system and periodontal diseases has been specifically addressed in the current classification system, emphasizing its importance in diagnosis and treatment. Hence, the importance of focusing research on the prevalence of yeasts in the oral mucosa of patients with periodontal disease in the menopausal stage.

METHODS

This study used bibliometric analysis with literature database from Scopus database [43-46]. Data were obtained from the Scopus databases in January 2021. Bibliometric analysis and visualization were carried out to observe and analyze articles in the VE field of ASEAN member states. The first step was to search for documents in the Scopus databases using the keyword “vocational education” for all years, before limiting the articles to the last decade. Then, the articles were filtered by defining ASEAN member states, namely Indonesia, Malaysia, Singapore, Thailand, Brunei Darussalam, Viet Nam, Lao PDR, Myanmar, Philippines, and Cambodia as affiliated countries to identify the origin of authors or researchers from ASEAN member states. After finding documents from the Scopus databases based on keywords and ASEAN member states affiliation, the articles were then filtered to limit the year of publication in the last decade namely 2011 - 2020. The third step was to filter by limiting the published documents to the journals indexed by Scopus. Then, the search was limited to the “article” using English only. Screening was carried out to exclude duplicate documents and irrelevant articles.

Documents obtained from the Scopus databases were then exported to VOSviewer version 1.6.14 [47,48] for analysis and visualization related to co-occurrence, citation analysis, co-citation, and bibliographic coupling. Co-citation analysis of referenced journals aids in the comprehension of linked scientific publications in a certain field. Descriptive statistics were used to analyze the distribution of articles. The visualization was generated from data processing using VOSviewer software.

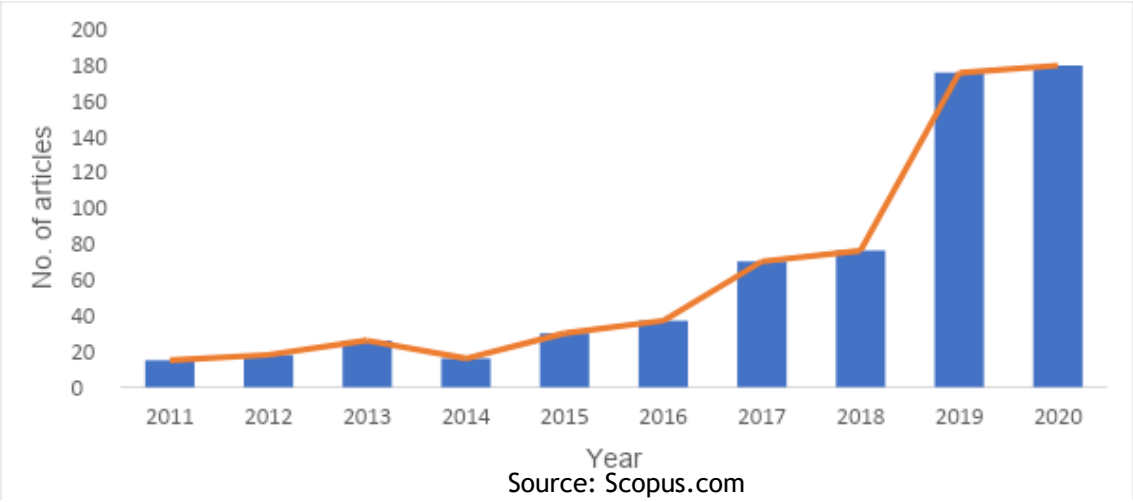
RESULTS

In the Scopus databases, the keyword "vocational education" showed 32,173 scientific publication documents, of which 1,297 documents came from ASEAN member states. Almost all of these documents were published in the last decade. The articles were then filtered to limit the year of publication in the last decade namely 2011 - 2020 which found out 1,193 documents. The third step was to filter by limiting the published documents to the journals indexed by Scopus which found out 690 documents. Screening was carried out to exclude duplicate documents and irrelevant articles. Thus, there were 642 articles with titles and abstracts from 2015 authors in 160 journals with 13,553 references and 2,942 keywords.

The education program in the VE field is growing quite rapidly, starting from the vocational school level to the university level, from undergraduate to doctoral programs. This also affects the rapid number of scientific publications. Research in the VE field is then published in "national journals" and reputable international journals. National journals are defined as journals published by publishers from the same country as the author. Meanwhile, international journals are limited to journals indexed by Scopus.

Based on the Scopus databases, there was an increasing number of Vocational Education articles from Southeast Asian authors year on year. In this study, the discussion was limited to Vocational Education articles published by Scopus indexed journals over the last 10 years (2011 - 2020). Based on Figure 1, the increase in the number of published articles tended to be stable from 2011 - 2014, although it decreased slightly in 2014, then there was a two-fold increase in 2015 - 2016. In addition, there was a very significant increase in the last 5 years. This shows that Vocational Education in ASEAN is increasingly interesting to study and is in line with the work plan of ASEAN member states in the education field 2016 - 2020 through Vocational Education and the top priority of the Southeast Asian Ministers of Education Organization (SEAMEO) (49).

Figure 1. Trend of VET articles over the last 10 years in ASEAN



Source: Scopus.com

Table 1 shows the top 25 journals that published vocational education articles in ASEAN. Of the 642 articles, nearly half (n = 320, 49.8% of 642) were published by these 25 journals. Meanwhile, the remaining 322 articles (n = 322, 50.2% of 642) were published spread across 135 journals. Based on Table 1, the

most popular journals publishing vocational education articles in ASEAN was the Journal of Technical Education and Training with 51 articles (7.94%).

Table 1. 25 popular journals published vocational education articles by ASEAN authors over the past 10 years

No.	Name of Journal	No. of Articles	Current status in Scopus	Publisher	Country
1.	Journal of Technical Education and Training	51	Q3	Universiti Tun Hussein Onn Malaysia (UTHM)	Malaysia
2	International Journal of Innovation Creativity and Change	42	discontinued	Primrose Hall Publishing Group	United Kingdom (UK)
3	Universal Journal of Educational Research	24	Q4	Horizon Research Publishing	United States
4	International Journal of Recent Technology and Engineering	22	discontinued	Blue Eyes Intelligence Engineering & Sciences Publication	India
5	Advanced Science Letters	18	discontinued	American Scientific Publishers	United States
6	International Journal of Scientific and Technology Research	18	discontinued	International Journal of Scientific and Technology Research	India
7	Pertanika Journal of Social Sciences and Humanities	16	Q2	Universiti Putra Malaysia	Malaysia
8	International Journal of Engineering and Technology UAE	14	discontinued	Science Publishing Corporation Inc.	United Arab Emirates
9	International Journal of Advanced Science and Technology	12	discontinued	Science and Engineering Research Support Society	Australia
10	Asian Social Science	9	discontinued	Canadian Center of Science and Education	Canada
11	Indian Journal of Public Health Research and Development	9	discontinued	R.K. Sharma, Institute of Medico-Legal Publications	India
12	World Transactions on Engineering and Technology Education	8	Q2	World Institute for Engineering and Technology Education (WIETE)	Australia
13	International Journal of Advanced Trends in Computer Science and Engineering	7	Q3	-	India
14	International Journal of Applied Business and Economic Research	7	discontinued	Serials Publications	India
15	International Journal of Engineering and Advanced Technology	7	discontinued	Blue Eyes Intelligence Engineering and Sciences Publication	India
16	Journal for The Education of Gifted Young Scientists	7	Q2	Genç Bilge Yayıncılık	Turkey
17	Journal of Theoretical and Applied Information Technology	7	Q3	Little Lion Scientific	Pakistan

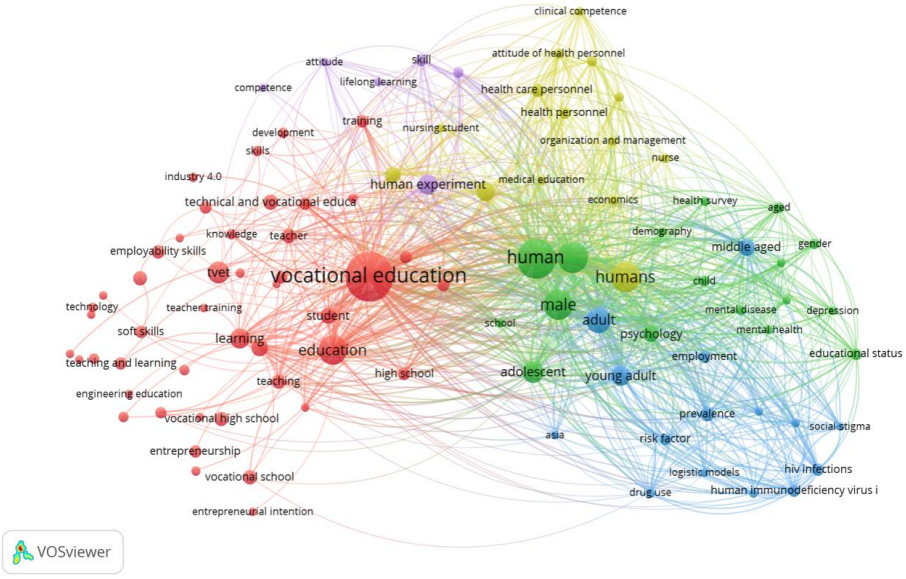
No.	Name of Journal	No. of Articles	Current status in Scopus	Publisher	Country
18	International Journal of Evaluation and Research in Education	6	Q4	Institute of Advanced Engineering and Science (IAES)	Indonesia
19	Journal of Advanced Research in Dynamical and Control Systems	6	discontinued	Institute of Advanced Scientific Research	United States
20	Indonesian Journal of Science and Technology	5	Q1	Universitas Pendidikan Indonesia (UPI)	Indonesia
21	International Journal of Emerging Technologies in Learning	5	Q2	Kassel University Press	Germany
22	International Journal of Instruction	5	Q2	Faculty of Education, Eskisehir Osmangazi University	Turkey
23	Journal of Critical Reviews	5	discontinued	Innovare Academics Sciences Pvt. Ltd	India
24	Malaysian Online Journal of Educational Management	5	Q4	University of Malaya	Malaysia
25	Turkish Online Journal of Educational Technology	5	discontinued	Sakarya University	Turkey

Source: Scopus.com

Analysis of co-occurrence

The keyword distribution network of VET articles can be seen in Figure 2. Based on the keywords filtered with a minimum of 5 views, 98 keywords fulfilled the threshold of a total of 2,942 keywords recorded. The size of the nodes and words in Figure 2 shows the weight of each keyword, the larger the size, the greater the weight. The word “Vocational education” was the most common keyword used namely 143 times. Furthermore, the keyword “human” was 93 times, “female” was 60 times, and “male” was 57 times. Complete information about keywords can be seen in supplementary materials 2.

Figure 2. Keyword distribution of VET articles



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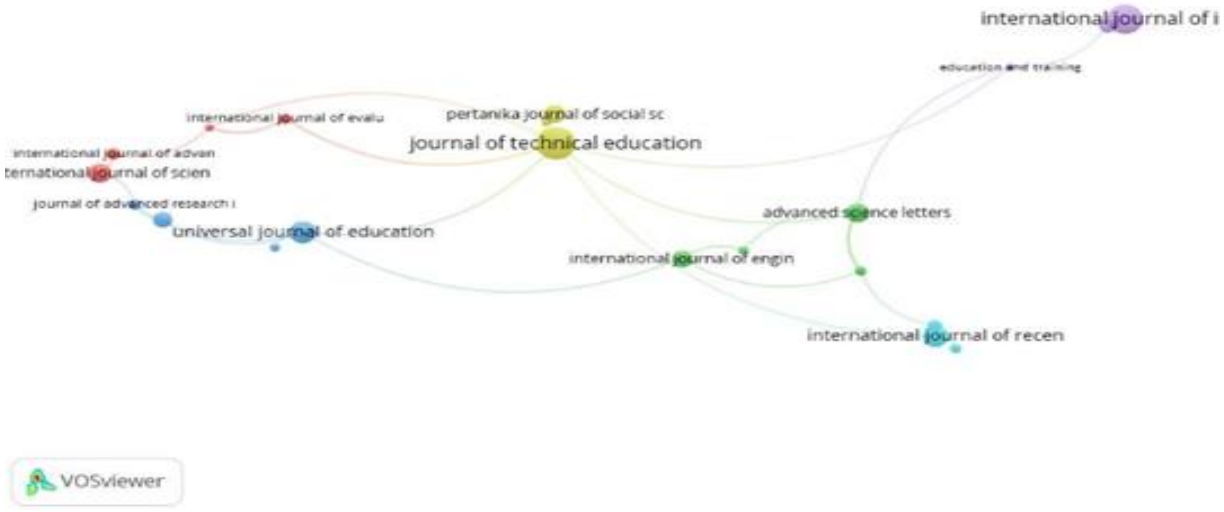
Source: VOSviewer analysis

Furthermore, the distance between nodes indicates the strength of the link between keywords. The shorter the distance, the stronger the link, and vice versa. The strength of the link is influenced by the frequency with which each keyword appears in the article. The same color nodes belong to a cluster. Based on figure 6, the “vocational education” node had a thick line linking keywords in the same cluster, namely “education” (21), “learning (14), “student” (10), and “teaching” (8). The “Education” node had a strong link with “vocational education” (21), “learning” (9), “students” (5), “teaching” and “vocational school (4). Based on the analysis using VOSviewer, the keywords in the VET articles were divided into 4 clusters. VOSviewer formed the overlay visualization of keyword based on the trends. The keywords emerged recently were "tvet", "industry 4.0", "blended learning" and "competence".

Analysis of Citation

Based on the analysis using the VOSviewer, there were 251 sources. However, when the filter was applied to sources with at least one document and three citations, 44 sources met the threshold, and the VOSviewer was divided into 6 clusters, 2 clusters consisted of 4 sources and 4 other clusters consisted of 3 sources each. Of the 44 sources meeting the threshold, only 21 documents had a strong link between each other, as shown in Figure 3.

Figure 3. Citation analysis of various journals publishing VET articles



Source: VOSviewer analysis

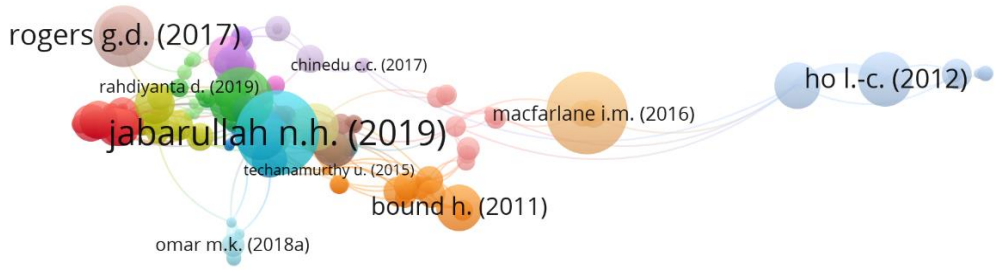
The node color corresponds to a separate cluster defined. The node size indicates the number of citations received by the source. Link thickness and node distance indicate the closeness and strength of links between nodes. Thicker nodes and closer distances indicate more frequent and stronger links. As shown above, the journal most frequently cited by the author was “journal of technical education and training” with 71 citations of 51 documents and had 8 links with 10 total strength links. The journal “advance science letter” took second place with 23 citations of 18 documents and had 4 links with 7 total strength links. In third place, there was “Malaysian online journal of education management” with 2 citations of 5 documents and had 3 links with 6 total strength links. After that, there was a “universal journal of educational research” with 18 citations of 24 documents and had 5 links with 6 total link strengths.

Analysis of Bibliographic Coupling

Of the 642 VET documents in the Scopus databases, there were 337 articles with at least 1 citation. However, the 337 documents published were not all linked to one another. The largest network consisting

of 185 documents in 17 clusters can be seen in Figure 4. These 17 clusters are shown as colored nodes. The visuals show the influential author or group of authors. The larger the nodes, the more influential the author. Jabarullah, N.H., et. al [50] was the most influential author with 62 citations, 5 links, and 11 total link strengths. The influential article of Jabarullah N.H., et. al [50] entitled "The effectiveness of problem-based learning in technical and vocational education in Malaysia" was published in the Education and Training Volume 61 No. 5 in 2019. Then, Guadamuz, T.E., et. al (2011) with 58 citations, 1 link, and 1 total link strength; Worthington, M. (2013) (36 citations, 2 links, and 2 total link strength) and Rogers, G.D., et. al (2017) (33 citations, 6 links, and 8 total link strengths). The distance between the two nodes represents the closeness between the two researchers. In other words, authors who are close to each other tend to cite the same articles.

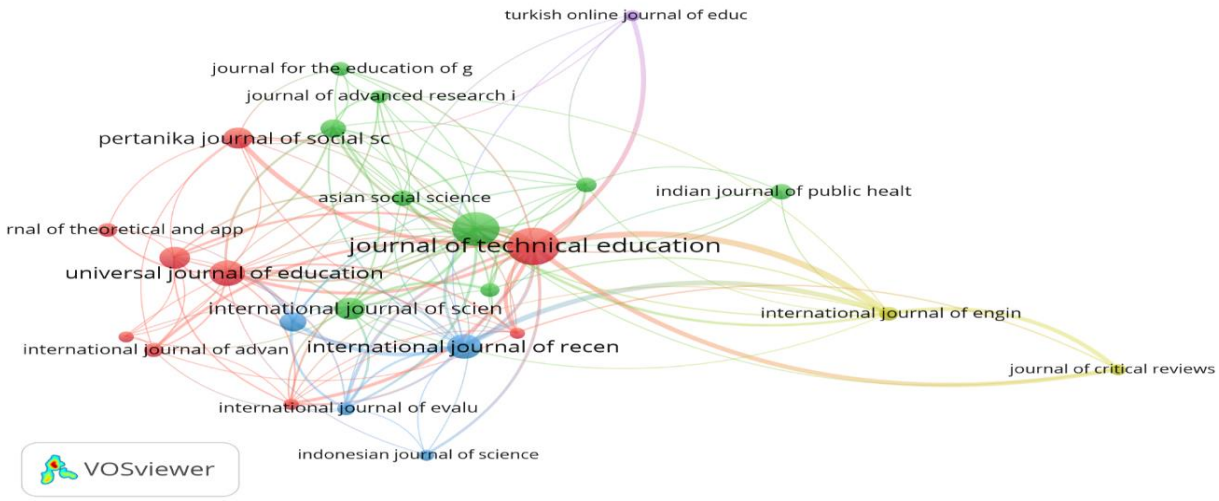
Figure 4. Bibliographic coupling



Source: VOSviewer analysis

Bibliographic coupling for journal source categories can be seen in Figure 5. Influential journals were visualized with larger nodes with colors matching the formed clusters. The most influential journal as a source of VET articles in ASEAN was the Journal of Technical Education and Training with 51 documents, 22 links, and 230 total strength links; followed by the International Journal of Innovation, Creativity, and Change (42 documents, 19 links, and a total link strength of 90) in cluster 2; and the International Journal of Recent Technology and Engineering (22 documents, 18 links, and 86 total link strengths.

Figure 5. Visualization of bibliographic coupling for the journal source

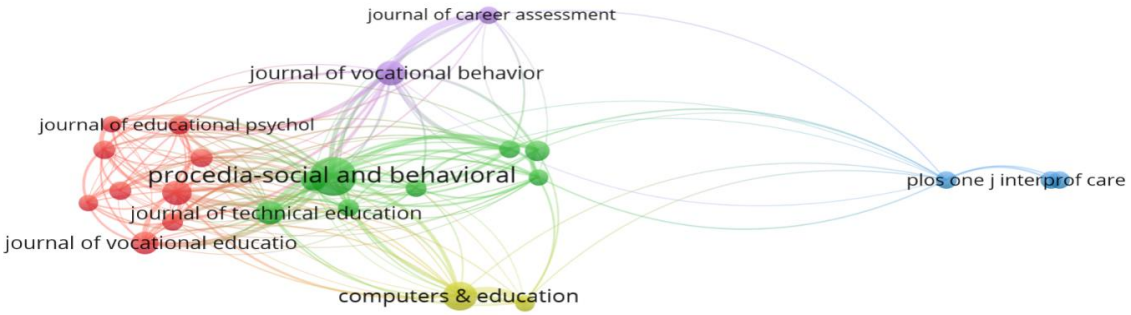


Source: VOSviewer analysis

Analysis of co-citation

Based on the analysis with VOSviewer, there were 13.3553 sources. After filtering with a minimum co-citation of 25, there were 25 sources, but only 24 sources were linked to each other with other sources. Figure 6 shows the co-citation visualization with 24 colored nodes. The node size indicates the frequency of the journal and the number of published articles.

Figure 6. Co-citation analysis of the journal source



Source: VOSviewer analysis

Distance between nodes shows the closeness of the links between journals. The greater the co-citation frequency, the closer the distance between the journal nodes will be. The color formed on the node shows the number of clusters consisting of 5 clusters, each colored red, green, purple, blue, and yellow. In cluster 1 (red node) there was the most active journal namely Teaching and Teacher Education with 54 citations, 17 links, and 213 total strength links. This journal had a link with the Journal of Vocational Education & Training and the Journal of Educational Psychology. In cluster 2 (green node), Procedia Social and Behavioral Science was the most active journal with 135 citations, 21 links, and 349 total link strengths. This journal had a link with the Journal of Technical Education and Training. In cluster 3 (blue node), the Journal Interprof Care (29 citations, 2 links, and 21 link strength) was the most active journal in this cluster. Cluster 4 (greenish-yellow node) had a link with clusters 1, 2, and 3. Computers & Education was the most influential journal in this cluster with 76 citations, 14 links, and 144 total link strengths. The last cluster was filled with the Journal of Vocational Behavior with the purple center node. This indicates that the Journal of Vocational Behavior was the most influential journal in cluster 5 and is the best journal in the VET field from Elsevier.

DISCUSSION

The bibliometric characteristics above show in detail the VET articles produced by authors originating from ASEAN member states in the last decade. The development of VET articles can be seen in Figure 1 that in 2011 - 2014 the number of articles still experienced a fluctuating increase and decrease with a small number. However, in 2015 - 2018 there was a significant increase. At its peak, in 2019 - 2020 there was a very significant increase, reaching 179 original research articles. This shows that the VET topic is growing rapidly with new and current issues. The results of this published research also serve as a reference for stakeholders and decision-makers in determining the direction of policies to be applied in the country.

The results of VET field research are published in various reputable international journals. A total of 160 different international journals serves as a forum for discussing VET topics in depth. The number of

journals also indicates the diversity of the topics discussed in the VET field according to the focus and scope of the journal. However, of the 160 journals, there were the top 25 journals publishing the greatest number of articles in the VET field. The best journal went to the Journal of Technical Education and Training (Q3) which has published 51 articles in the VET field. However, of the top 25 journals, nearly half were discontinued by Scopus. This can be a separate interesting discussion that can be discussed in the future.

Based on the co-occurrence analysis using VOSviewer, the VET articles analyzed were dominated by general keywords which also generally occur in articles with an educational theme. However, based on the results of the overlay analysis, there were several new keywords appearing with the small and yellow-colored nodes. The emergence of these keywords indicates a new trend in VET research in ASEAN. Therefore, the trend of VET research in the ASEAN region can be said to be quite responsive to the times, one of which is on the issue of industry 4.0.

Based on the analysis of citations, published articles actually appear in journals with the theme of advanced science, educational management, and educational research. This condition shows that VET researchers in the ASEAN Region mostly publish and also refer to non-VET journals in their research. Indirectly, this situation shows several indications, namely: 1) the lack of active VET researchers in ASEAN in publishing scientific papers in VET journals, 2) themes in VET research in ASEAN are closely related to general themes in educational journals, 3) The articles of the VET field researchers attracted the attention of educational science researchers in the ASEAN region.

Based on the co-citation visualization in Figure 6, the journal with the best co-citation can be seen with the largest node and becomes the center of the cluster. The journals were Teaching and Teacher Education (cluster 1), Procedia Social and Behavioral Science (cluster 2), Journal Interprof Care (cluster 3), Computers & Education (cluster 4), and Journal of Vocational Behavior (cluster 5). These journals were the most active journals in each cluster.

Based on the bibliographic coupling, there were 185 documents with the strongest network and divided into 17 clusters as shown in Figure 4. The most influential article was" the effectiveness of problem-based learning in technical and vocational education in Malaysia." The article was written by Jabarullah, N.H., et. al (2019) and published in the Education and Training Journal Volume 61 No. 5 in 2019. Meanwhile, the most influential journal source was the Journal of Technical Education and Training.

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CONCLUSIONS

Based on the results of bibliographic and statistical analysis, the number of VET articles in ASEAN member states published in Scopus indexed journals has increased, especially in the last decade. The highest increase occurred in 2019 - 2020. Furthermore, researchers are increasingly active in collaborating with other researchers. The Journal of Technical Education and Training had the highest number of VET articles published. In addition, there were new productive researchers and writers in the last 2 years. This shows that the topic of VET is getting more interesting and relevant to current issues so that it is still very open and has opportunities for future research in accordance with research trends in the VET field.

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