

Knowledge Mapping of Vocational Education Employability Skills Research (2004-2024): A Visualized Analysis based on Citespace

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Abstract

This study provides a comprehensive knowledge of vocational education employability skills research conducted from 2004 to 2024. 1545 documents were downloaded from the Web of Science database for the study. Utilizing Citespace, a powerful bibliometric and visual analytical tool, the study was designed to reveal key trends, influential authors, seminal publications and emerging themes in the field. Data was carefully collected from the leading academic database, Web of Science, thus ensuring a robust analytical framework. Through co-citation and keyword analysis, to explore the trends in the research topic in recent years, to identify the main areas of research activity, to explore the evolutionary stages of the profession as well as the main dynamics of the current stage, and to better prepare for the development of relevant strategies in the future. This study informs researchers by providing basic background knowledge about employability skills for visual and quantitative research. Thus, this approach allows for the observation of research gaps and deeper academic discussions on employability skills in higher vocational education. The study demonstrates the hotspots and trends in research on employability skills in higher vocational education, which are discussed and summarized in the hope that it can give more inspiration to the researchers behind.

1. Introduction

The rising costs of higher education, and uncertainty in the graduate labor market, have led to increased interest in how universities can help graduates achieve their employment and career goals (Healy et al., 2020). Increasingly, governments are looking to universities to improve graduate employment. Universities are responding by implementing employability skills strategies within, on and off the curriculum (Cook, 2022). Having the right set of employability skills is necessary to satisfy employers (Alrifai & Raju, 2019). Some countries have developed long-term traditional subsidies, temporary employment and training programs to promote employment, but some researchers argue that these measures have questionable validity: all stakeholders (government, employers, social partners, educational institutions) must be involved in curriculum development with a clear division of responsibilities (Eichhorst et al., 2015). For individuals, employability skills depend on the knowledge, skills and attitudes they possess, the way they use these competencies and demonstrate them to employers, and the context in which they are looking for work (Hillage & Pollard, 1998). Some researchers have also defined employability skills as the basic functional and enabling knowledge, skills and attitudes needed in the workplace (Overtoom, 2000). Higher education institutions (HEIs) play an

important role in preparing graduates for employment and job readiness (Fallows & Steven, 2000). The theme of this study was to investigate one of the core issues of HEI graduates, employability skills. Employability skills are a comprehensive ability that includes many factors, and the current academic and theoretical consensus on the importance of employability skills is that college students' employability skills have many functions and roles for the college students themselves, for employers and society, and for the school (Dai, 2015). The topic of youth employment often resonates in social discussions in countries around the globe. The "New Skills for New Jobs" (European Commission, 2016) initiative has become a flagship goal of the European Union, aiming to anticipate future changes in the required knowledge and skills, harmonize the capacity of the labor market, and closing the gap between the world of education and the world of work (Horný & Ďurina, 2014). Currently, themes such as promoting youth employability and identifying tools to facilitate the transition of graduates to employment are at the center of global attention (Lisá, 2019).

The rapid development of science and technology has greatly changed the office operation, people's communication and cooperation. Some employers require employees to master various technical skills when recruiting employees to meet the needs of recruitment positions. Recruiting graduates not only prefer potential employees with good attitude, cheerful personality, excellent work, hard work and harmonious relationship with the team, but also employers are looking for employees with good communication skills, emotional intelligence, teamwork ability, work experience and leadership skills (Small & Marchant, 2018). The constant change of work content has brought great pressure to colleges and universities, requiring them to plan courses for graduates. Employers have found that recent graduates lack many basic skills due to outdated syllabus and theory-based learning (Lowden et al., 2011). This forces employers to spend a lot of money to train graduates in specific fields of work and general and basic skills to bridge the gap between theory and practice. Therefore, the education system needs to adjust and update its curriculum, teaching methods and evaluation practice to ensure advanced learning, not just accumulating credits (Camu, 2021). Ramlee (2002)' s research on the role of vocational and technical education in Malaysia's industrialization shows that educators and employers believe that Malaysian technical graduates have mastered their technical skills. However, employers are dissatisfied because their employees lack motivation skills, communication skills, interpersonal skills, critical thinking, problem-solving skills and entrepreneurial skills. Therefore, the importance of employment skills research is increasingly prominent. This study was downloaded from the extended database of scientific introduction index of Science Core Network (WOS). The following search terms "higher vocational education" and "employment skills" are used in the subject field, including title, abstract, author keywords and keywords after continuing the current search method. Using the advanced index, 1,545 records are searched, and it is found that researchers with educational academic background, economics, interdisciplinary social sciences, management, sociology, labor relations and other disciplines are paying close attention to this research.

Vocational education plays a crucial role in preparing individuals for the labor market by equipping them with specific skills tailored to various industries. In recent years, the emphasis on employability skills within vocational education has grown significantly, reflecting the changing demands of the global economy and the need for a workforce that is adaptable, innovative, and proficient in both technical and soft skills. Employability skills, which include communication, teamwork, problem solving, and critical thinking, are essential for individuals to navigate and succeed in today's dynamic work environments. Employability skills are increasingly recognized as vital components of vocational education. These skills complement technical training by enhancing an individual's ability to apply their knowledge effectively in real-world situations. The integration of employability skills into vocational education curricula aims to bridge the gap between educational outcome and labor market requirements, ensuring that graduates are not only technically competent but also versatile and ready to meet the challenges of the workplace.

Due to the high unemployment rate caused by the global economic recession, this is a very important and key research field (Roos & Zaun, 2016; Makin, 2019). In addition, universities are increasing all over the world. However, the labor market in developing countries cannot absorb the graduates produced by these universities, resulting in high unemployment rate (Mok, 2016; Mok & Jiang, 2017). The International Labor Organization (ILO) predicts that this unemployment trend will further increase (Kawohl & Nordt, 2020). Students should be prepared for work, and jobs need more than traditional qualifications. It emphasizes the need to provide young people with skills to promote the smooth transition from school to work and accelerate their adaptation to jobs (Romanova, 2022). Despite these findings, the research field is still far from being fully explored. In particular, in the new vocational education environment, a systematic study is made on narrowing the perceived employment skills gap between employers and graduates. Skills-based education is becoming more and more important, because the industry wants the new labor force to have competent technical skills and employment skills (Tiwari & Malati, 2020). Singh and Tolessa (2019) believe that the abilities related to work ability include: (1) learning ability; (2) technology; (3) communication; (4) teamwork; (5) solving problems; (6) Initiative and entrepreneurial spirit; (7) Planning organization; (8) self-management. Graduates of vocational education must have knowledge of specific disciplines and have the necessary practical skills (Roepen, 2017). Vocational education plays a vital role in helping individuals master specific skills suitable for all walks of life and prepare

for entering the labor market. In recent years, vocational education has paid more attention to employment skills, which reflects the changing needs of the global economy and the demand for labor with strong adaptability, innovative spirit and proficient in technology and software skills. Employment skills, including communication, teamwork, problem solving and critical thinking, are the necessary conditions for individuals to succeed in today's dynamic working environment.

As a quantitative method, bibliometrics is used to evaluate the development of a field, identify influential works, and prompt emerging trends, so as to fully understand the trends in the research field (Sabe et al., 2022). This study was downloaded from the extended database of scientific introduction index of Science Core Network (WOS). The following search terms "higher vocational education" and "employment skills" are used in the subject field, including title, abstract, author keywords and keywords after continuing the current search method, with a total of 1545 records. We analyzed the data and found that China did not appear in the top 15 records in the national/regional options, which shows that there are few relevant studies in China at present. However, as a country with a large number of students in higher education, China has little research on employment skills in higher vocational education, which should attract the attention of relevant departments. The existing research results can lay an important foundation for the reform and development of vocational education and training. Employment skills are increasingly regarded as an important part of vocational education. These skills are a supplement to technical training and can improve individuals' ability to effectively use knowledge in the real environment. Incorporating employment skills into vocational education curriculum aims to narrow the gap between educational achievements and the demand of labor market, and ensure that graduates not only have technical ability, but also are versatile and ready to meet the challenges in the workplace.

There are still a series of problems to be solved urgently in vocational education and training, such as the gap between the supply of vocational education skills and the demand for skills in the labor market, and the low enthusiasm of enterprises to participate in vocational education and training (Hui, 2019). There is an urgent need for bibliometric analysis to determine the development fields, the fields that researchers are most interested in, and to stratify the research according to countries, institutions and fields. This will make the efforts of new researchers more targeted and improve the quality of research (Tian et al., 2023).

This study aims to fill this gap and provide a comprehensive knowledge map for the study of vocational education employment skills from 2004 to 2024. Using Citespace, a bibliometrics and visual analysis tool, this study will analyze academic articles to find patterns, trends and relationships in the literature. The specific objectives of this study are as follows:

1. Identify Key Research Themes:
Determine the main topics and themes that have been the focus of research in vocational education employability skills over the past decade.
2. Highlight Influential Works and Authors:
Identify the most frequently cited studies and prominent researchers contributing to this field.
3. Analyze Temporal Trends:
Examine how the focus of research has evolved over the 2014-2024 period.
4. Geographical Distribution:
Investigate the geographical distribution of research outputs to understand the global landscape of vocational education employability skills research.
5. Emerging Trends and Gaps:
Identify emerging trends and gaps in the current literature to suggest.

2. Methods

2.1 Search strategy

The data was downloaded from the advanced index database of scientific citations of Web of Science (WOS) on May 10, 2024. Use the following search terms in the Topic field: ts = "employment skills" or "employment skills" or "employment skills" or "employment skills" or "skills" or "em. ployment capability" OR "job skills" AND TS="higher vocational education" OR "high vocational education" OR "vocational education" OR "advanced vocational education" OR "higher vocational and technical education" OR "higher occupation education" OR "senior vocational education" OR "vocational college education" AND ALL="higher vocational education" OR "high vocational education" OR "vocational education" OR "advanced vocational education" OR "higher vocational and technical education" OR "higher occupation education" OR "senior vocational education" OR "vocational college education" AND TS="employment skills" OR "employment skill" OR "employability skills" OR "employability" OR "skills" OR "employment technique" OR "employment capability" OR "job skills" AND TS="higher vocational education" OR "high vocational education" OR "vocational education" OR "advanced vocational education" OR "higher v Regional and technical education" or "higher occupation education" or

senior vocational education "or" vocational college education ",including title, abstract, author, keywords and keywords plus (Chong et al., 2021) after continuing to use the existing search method. Original articles and comments written and published in English in all years were included, and the survey result was 1545 records (Figure 1). When using CiteSpace software for quantitative analysis, considering that there are few papers published during 1971-2003, and there is no regularity, we choose 2004-2024 as the time slice analysis. The 1499 papers used in this study were written by 3507 authors from 718 organizations in 96 countries, published in 234 journals, and cited 18609 references from 1461 journals, come in 112 domains.

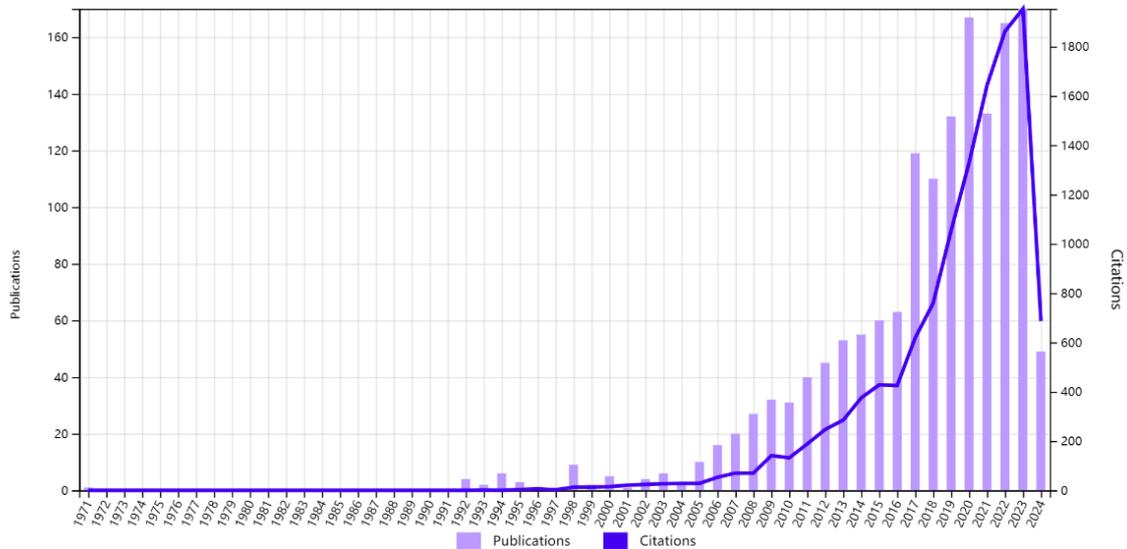


Fig. 1 Literature related to employment skills and higher vocational education 1971-2024

2.2 Research tools

Information visualization is a process of representing and visualizing abstract data with the help of computer software, which can enhance researchers' perception of abstract information (Bederson, B.B., & Schneiderman, B. (eds.), 2003). Visual analysis can be based on the existing literature and adopt scientific methods to find the discovery direction and hot spots in future research. Therefore, information visualization can help researchers understand and predict the frontiers and trends of scientific research in time, and open up new ideas in complex information (Tian, 2023).

In this study, the analysis software CiteSpace 6.2 R3 is used to conduct research cooperation, reference citation and co-occurrence analysis on the key words in the related documents of higher vocational education and employment skills. CiteSpace is an important software in bibliometrics (Chen, 2006). This paper will use CiteSpace to analyze, and the analysis elements include authors, institutions, countries, cited persons, cited journals and cited references. The co-occurrence network of references, co-authors and keywords can represent the field of scientific knowledge (Chen & Leydesdorff, 2014). The network systematically and scientifically describes the developing scientific knowledge field through knowledge map (a novel literature analysis method), which enables researchers to better understand the knowledge structure, research cooperation, research hotspots and trends (Chen & Liu, 2020).

2.3 Data Collection

Using advanced retrieval in WOS, the publication date is all years, the literature type is "thesis" and "review thesis", and the language is "English". The search results show that the publication time of the paper is from 1971 to 2024, which shows that researchers have been studying this issue since 1971. Since 2004, the related research began to show a relatively rapid positive growth, indicating that this issue has attracted worldwide attention and been the research topic. All the papers have been published in 96 countries/regions, among which the top 25 countries, such as Fig. 2a, are Australia and Britain, with 183 papers each, accounting for 11.85% of the total, followed by the Netherlands, with 129 papers, accounting for 8.35% of the total. China ranked seventh with 82 articles published. All papers were published in 1461 institutions, and the first one was the UNIVERSITY OF LONDON, with 58 papers published. The second place is Melbourne genomics health alliance, with 40 articles published; Ranked third is the University of Tun Hussein Onn Malaysia, with 37 articles published. It shows that the researchers of these three institutions pay more attention to this research topic. According to the WOS

category, there are 973 articles about education, which shows that this study is used to solve more educational problems.

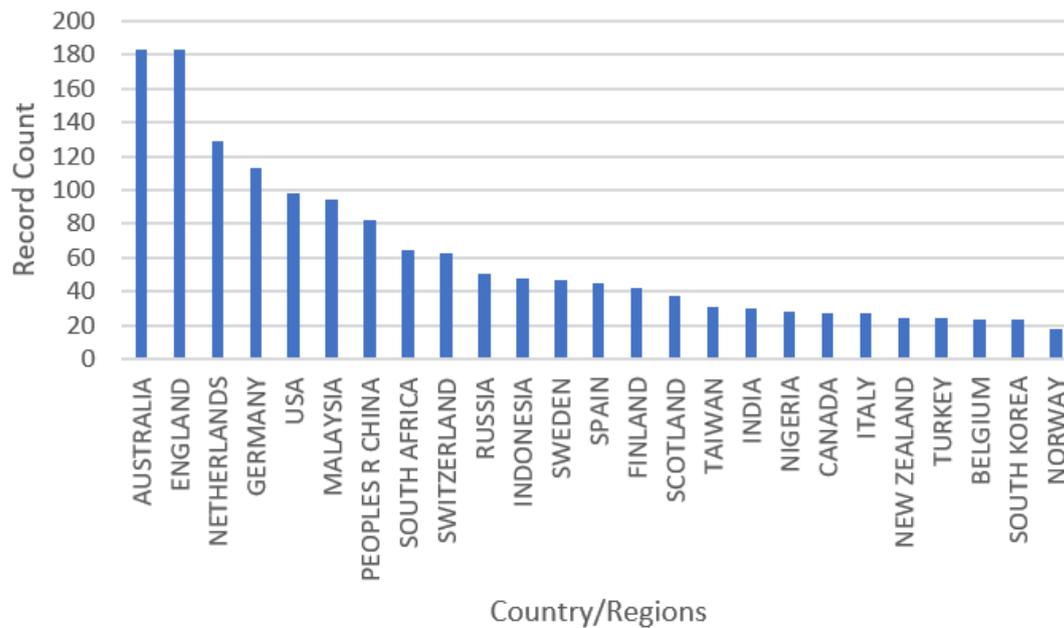


Fig. 2 Top 25 publications and analysis trends of radiomics (a) Countries/regions; (b) Affiliation

In this study, Citespace is used to merge journals, references and clusters, and a timeline view of merged references is further constructed, through which we can better understand the rise and development period of cluster field. In addition, Citespace can also capture keywords with strong citation bursts and build visual maps for all projects. Citation outbreak is a key indicator to identify emerging trends (Chen et al., 2014). We set "the number of years per slice" and "the number of years before each slice" to 1 and 50 respectively, so the network map is extracted from the top 50 references cited in the first year of each article.

3. Results

3.1 Analysis of Authors Co-Citation

By analyzing the authors, we can know the representative scholars and core research forces in this research field. Fig. 3 Each node represents an author, and the bigger the node, the more citations there are. The lines between nodes indicate the number of times their published documents were cited by the same author's third document, and the thicker the lines, the more times they were cited together. In the co-citation diagram Fig. 3, the number of co-citations comes from the references in the paper. ANONYMOUS is the most cited author in the co-citation diagram, with 884 citations, followed by OECD with 185 citations. BILLET S ranked third, with a total of 131 citations. There is a big gap between them, but the time gap between them is not big. The above analysis shows that the viewpoint of ANNONYMOUS is recognized by more researchers, and it is the core research force in this research field, with strong academic influence and peer recognition. Followed by the authors OECD and BILLET S.

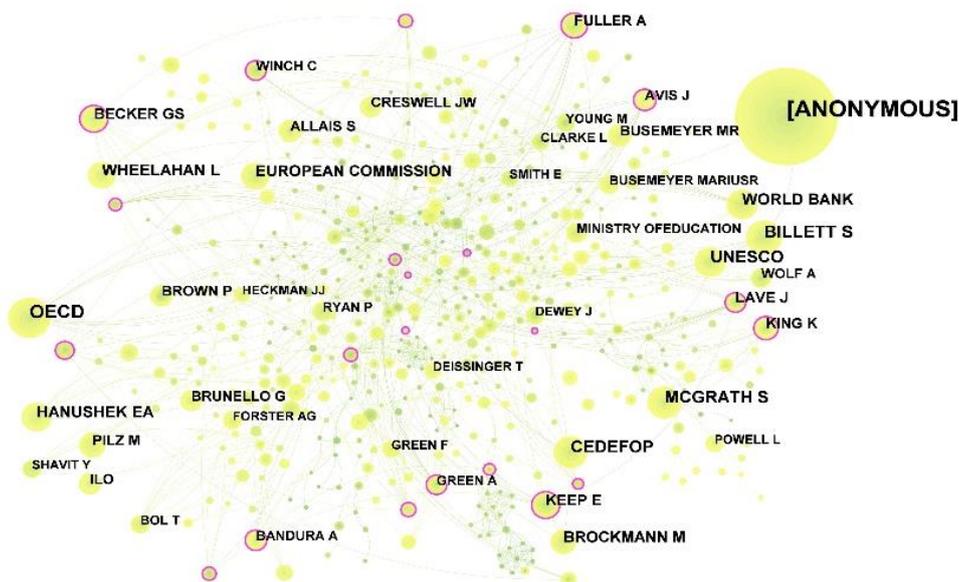


Fig. 3 Network map of co-citation authors engaged in research related to employability skills in higher vocational education

3.2 Distribution by Journal Co-Citation

In the citation network of periodicals, the larger the circle, the higher the frequency of citation. From 2004 to 2024, the analysis network of co-cited journals related to employment skills research in higher vocational education, such as FIG.4. The network is constructed according to the citation relationship between journals. The journal of vocational education and training has been cited for 429 times, ranking first, indicating that most of the papers in the field of employment skills research in higher vocational education are published in this journal, and the papers published in this journal are consistent with the contents of the journal title. The majority of these journals belonged to JCR divisions categorized as Q2, highlighting their significant academic impact. The JOURNAL OF EDUCATION AND WORK was cited 272 times, ranking second, the major of the journals believed to JCR divisions classified as Q2, and also the infrared significant academic impact. The journal International Journal of Educational Development was cited 181 times, ranking third, the major of the journals believed to JCR divisions classified as Q1, very highlighting the IR significant academic impact. The top three journals are all educational journals.

Table 1 Top 10 co-citation Journals

Count	Cited Journals	Centrality	Year
429	J VOCAT EDUC TRAIN	0.02	2007
272	J EDUC WORK	0.21	2005
181	INT J EDUC DEV	0.08	2007
161	THESIS	0.02	2006
146	VOCAT LEARN	0.02	2013
142	EDUC TRAIN	0.12	2008
139	J EDUC POLICY	0.08	2008
135	PROCD SOC BEHV	0.02	2014
127	OXFORD REV EDUC	0.06	2005
121	INT J TRAIN RES	0.07	2010

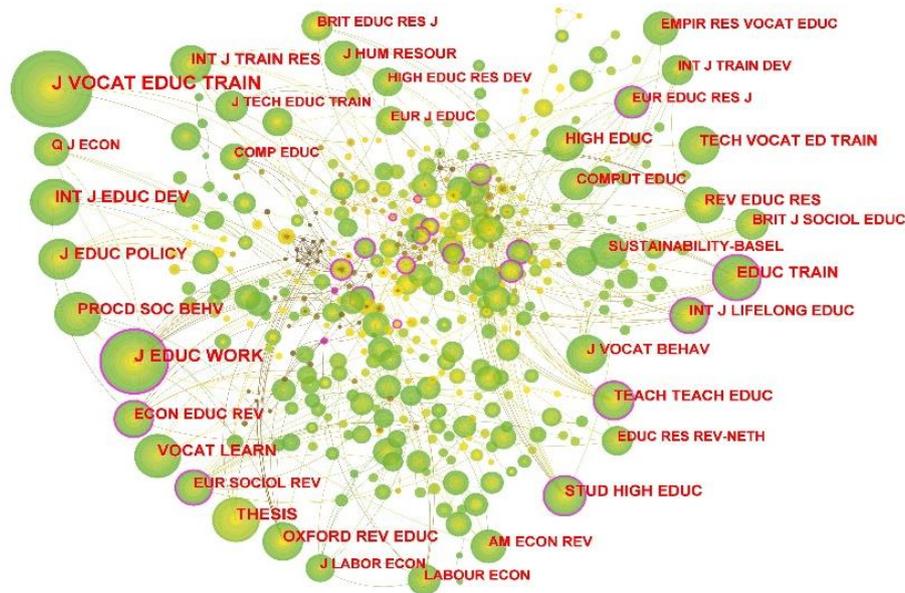


Fig. 4 Journal co-citation network

3.3 Analysis of Cooperation Among Cited Documents Countries

The number of cited literature in different countries (such as Table 2), explosive force (Fig. 5a) and distribution network diagram are shown in Fig. 5b. It can be seen that in the field of higher vocational education and employment skills, among the top 10 countries, the country with the highest frequency of cited articles is Australia, with a total of 177 papers; Followed by Britain, a total of 170 articles; The third is the Netherlands, with 124 articles in total. The top three countries account for about 36% of all literature cited by countries. China ranked 7th with 82 papers, accounting for 4% of all papers, far below Australia, indicating that China should increase the number of documents in this field, because it is increasingly difficult for China's growing university graduates to find jobs, and targeted research on graduates' employment skills can better serve as a reference for formulating more strategies to improve graduates' employment skills. On the other hand, in the aspect of the suddenness of the cited literature countries, Russia has a strong suddenness, which indicates that Russia may develop into the country with the highest cited frequency in the future.

Table 2 Top 10 of HVE employability skills research co-citation of country

Country/region	Frequency	Year
Australia	177	2004
England	170	2004
Netherlands	124	2005
Germany	109	2007
Malaysia	94	2007
Usa	84	2005
Peoples R China	82	2005
South Africa	64	2006
Switzerland	62	2009
Russia	50	2010

Burstiness (Fig. 5a) refers to the increase or decrease of publication activity or frequency, which destroys the continuity or mode of distribution. In this case, the higher the index, the more unbalanced the participation of the institution's publications in the studied fields. The results of Burstiness in countries active in the field of higher vocational education and employment skills show that Australia ranks first with a value of 23.3, but its explosive time was earlier, and its explosiveness decreased obviously in the near future, indicating that the number of Australian documents cited in this field has decreased in the near future. Russia ranks second with a value of 8.91, and its outbreak time is from 2018 to 2019, and there are not many cited documents in the near

Table 3 Settings of the parameters in CiteSpace

Parameter	Setting
Time slice	2004-2024
Terminology source	Title, abstract, author keywords, keywords plus
Node type	reference
Strength	Cosine
Pruning	Pathfinder/Pruning sliced networks/Pruning the merged network
Selection criteria	Select the top 15 cited bibliographies in each section

Links parameters are mainly used to calculate the correlation strength of network nodes (which can often be regarded as the standardization process of co-occurrence matrix), and the default Cosine method is used in this study.

$$\text{Cosine}(c_{ij}, s_i, s_j) = \frac{c_{ij}}{\sqrt{s_i s_j}} \quad (1)$$

In Eq. 1 c_{ij} means the number of times I and J co-occur, s_i is the frequency of I and s_j is the frequency of J.

After running Citespace, the knowledge mapping was achieved. MI ((Mutual Information)) is applied to extract cluster names related to higher vocational education and employment skills. Based on co-primer clustering information, 92 clusters were generated, including 10 main clusters.

Modular Q is a measure of visual network, ranging from 0 to 1. The higher the value, the better the network clustering effect. Generally speaking, a modular Q between 0.3 and 0.8 indicates that network clustering is acceptable.

Similar indicators of network clustering range from -1 to 1. The larger the weighted average profile s is, the higher the clustering homogeneity is. Generally, the average profile S of reinforcement weight below 0.5 means that the clustering results are acceptable, and higher than 0.7 means that the clustering results are more reliable (Chen et al., 2014). Figure 6 shows the modularization of visual network in the field of higher vocational education and employment skills.

Q value is 0.9307 and S value is 0.9543. The weighted average contour S values of all 10 main clusters are higher than 0.8. The above data show that the knowledge map is a high-quality cluster in the field of higher vocational education and employment skills knowledge.

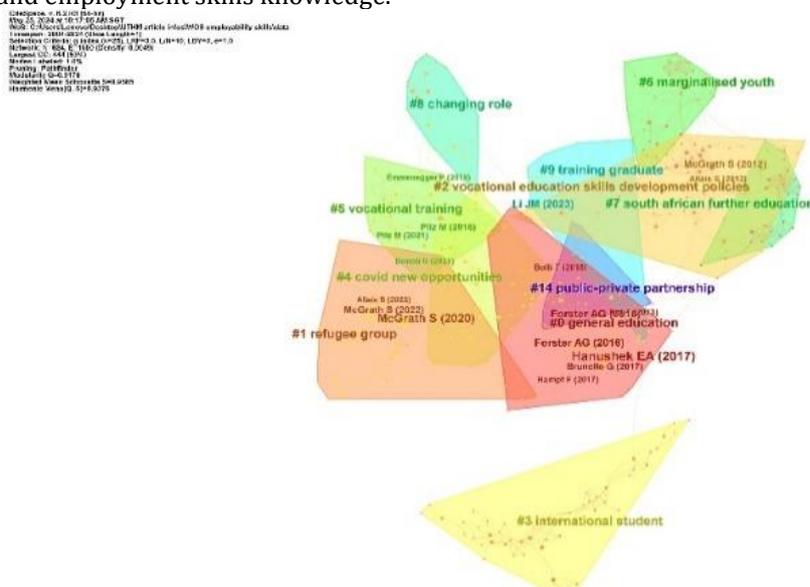
**Fig. 6** A landscape view of the co-citation reference network

Table 4 further provides a more detailed description of each knowledge group described. It can be concluded from Table 4 that Youth Labour-Market Performance Institution (# 0) includes Youth Labour-Market Performance Institution (2.44); cross-country analysis (2.44); vet system (2.44); social order (2.44); Australia (2.44) ranks first in the knowledge cluster, with a total of 77 co-cited documents, most of which were published before 2019. The weighted average silhouette S value of the cluster is 0.883, which indicates that the 77 co-cited documents in the cluster have high uniformity. Among them, Rozer, JJ's article Labor Market Effects of General and Vocative Education Over the Life-Cycle and Across Time: Accounting for Age, Period, and Cohort Effects published in the European Social Review was cited the most times, with 8 times. The second place is Oswald-egg, published by me in ECONOMICS OF EDUCATION REVIEW.No experience, no employment: the effect of vocational education and training work experience on labour market outcomes after higher educationThis article has been quoted seven times. The third place is BOL, T. The article School-to-Work Linkages, Educational Mismatches, and Labor Market Outcomes published in AMERICAN SOCIOLOGICAL REVIEW was quoted seven times.

The second cluster is Informal apprentice (#1), with 68 articles cited. The weighted average silhouette S value of clustering is 0.969, which indicates that the uniformity of 68 documents in clustering is high. The most cited document is Mcgrath, S published an article in EUROPEAN SOCIOLOGICAL REVIEW entitled Labor Market Effects of General and Vocative Education Over the Life-Cycle and Across Time: Accounting for Age, Period, and Cohort Effects, which was cited 10 times. The third cluster, about Keeping pace, consists of 55 documents, and the weighted average silhouette S value of the cluster is 0.956, with a high average. Details of each major cluster are shown in Table 4 and Table 5.

Table 4 Details of knowledge clusters

Cluster ID	Size	Silhouette	mean(Year)	Terms (mutual information)
0	77	0.883	2016	Youth labour-market performance institution (2.44); cross-country analysis (2.44); vet system (2.44); social order (2.44); australia (2.44)
one	sixty-eight	0.969	2019	Informal apprentice (1.54); capability approach (1.54); informal apprenticeship (1.54); human development (1.54); social order (1.54)
2	55	0.956	2012	Keeping pace (0.38); ageing workforce (0.38); social order (0.38); australia (0.38); aftermath (0.38)
three	51	one	2012	Finnish vocational student (0.21); social order (0.21); Australia (0.21); aftermath (0.21); vet teachers' interpretation (0.21)
four	41	0.944	2019	Public attitude (0.38); social order (0.38); australia (0.38); aftermath (0.38); vet teachers' interpretation (0.38)
five	35	0.966	2019	Dualisation education (0.3); south korea (0.3); knowledge economy (0.3); comparing germany (0.3); social order (0.3)
six	30	0.989	2010	Competence development (0.09); student perception (0.09); social order (0.09); Australia (0.09); aftermath (0.09)
seven	24	0.99	2007	Vocational education (0.1); general education (0.01); south african further education (0.01); training student (0.01); social order (0.01)
eight	20	0.961	2018	Vocational education (0.09); social order (0.03); vet teachers' interpretation (0.03); nordic countries (0.03); australia (0.02)
nine	20	one	2020	Electronic industry (0.24); industry player (0.24); tvet skills gap analysis (0.24); social order (0.24); australia (0.24)

Table 5 *The most active citation cluster*

Coverage	Author (Year)	Journal	Articles
Clusters #0	Youth labour-market performance institution		
eight	Rozer, JJ	European Sociological Review	Labour market effects of general and vocational education over the life-cycle and across time: accounting for age, period, and cohort effects
seven	Oswald-egg, ME	Economics Of Education Review	No experience, no employment: the effect of vocational education and training work experience on labour market outcomes after higher education
seven	Bol, T	American Sociological Review	School-to-work linkages, educational mismatches, and labor market outcomes
Clusters #1	Informal apprentice		
10	Mcgrath, S	International Journal Of Educational Development	Skills for development and vocational education and training: current and emergent trends
eight	Ramsarup, P	International Journal Of Educational Development	Reframing skills ecosystems for sustainable and just futures
seven	Dagar, P	Compare-A Journal Of Comparative And International Education	Evaluating and reframing vocational education and training for refugees: insights from five refugee groups across three cities of india
seven	Lotz-sisitka, H	Journal Of Vocational Education And Training	Oil, transport, water and food: a political-economy-ecology lens on vet in a climate changing world
six	Ramsarup, P	Journal Of Vocational Education And Training	A landscape view of emerging sustainability responses within vet
Clusters #2	Keeping pace		
19	Mcgrath,S	International Journal Of Educational Development	Vocational education and training for development: a policy in need of a theory
14	Tukendane,C	International Journal Of Educational Development	Building vocational skills for marginalised youth in uganda: a swot analysis of four training programmes.
13	Allasis,S	International Journal Of Educational Development	Will skills save us? rethinking the relationships between vocational education, skills development policies, and social policy in south africa
Clusters #3	Finnish vocational student		

nine	Thi, Tran Ly	Australian Educational Researcher,	'i'm not like that, why treat me the same way?' the impact of stereotyping international students on their learning, employability and connectedness with the workplace
eight	Thi, Tran Ly	British Journal Of Educational Studies	get foot in the door': international students' perceptions of work integrated learning
six	Thi, Tran Ly	Journal of Studies in International Education	Internationalisation of vocational education and training: an adapting curve for teachers and learners
Clusters #4	Public attitude		
seven	Esmond,B	Education, Skills And Social Justice In A Polarising World: Between Technical Elites And Welfare Vocationalism	Technical and further education after covid new opportunities or new inequalities?
seven	Fassbender,U	International Journal For Research In Vocational Education And Training- Ijrvet	Collective skill formation regimes in times of covid-19: a governance-focused analysis of the german dual training system.
five	Vincent,A	Journal Of Vocational Education And Training	Who participates in vocational education and training in india? an analysis of socio-economic determinants.
five	Klassen,J	Journal Of Vocational Education And Training	International organisations in vocational education and training: a literature review.



Fig. 7 Top 10 Reference with the strongest citation bursts

As can be seen from Fig. 7, there were not many co-cited literatures on this research before 2012, which shows that there was not much cooperation among researchers before that, and the deeper reasons are worth discussing. Since 2013, the number of co-cited documents has increased significantly, indicating that the most cited documents in this field represent the documents with important influence in this field. It also shows that the field has been completely developed. Among the research on topic clustering in the key cited documents in this study, it can be considered that the knowledge cluster of Youth Labour-Market Performance Institution can arouse the interest of researchers most, thus providing more basis for further research in this field.

3.5 Distribution of Co-Citation Institutions

In the field of higher vocational education and employment skills, the University of London ranks first with 35 articles, followed by the University of Tun Hussein Onn Malaysia with 30 articles. However, the ranking of research institutions based on inter-subjectivity is significantly influenced by other research centers. The top three institutions are Melbourne genomics health alliance (0.03), University of Nottingham (0.03) and Nelson Mandela University (0.03), which shows that these three universities or institutions have great importance and influence in the field of higher vocational education and employment skills. Deakin University leads with 4.63 in Burstiness, followed by Melbourne Genomics Health Alliance (3.23) and Umea University (2.98). See Table 6 and Fig. 7 for details.

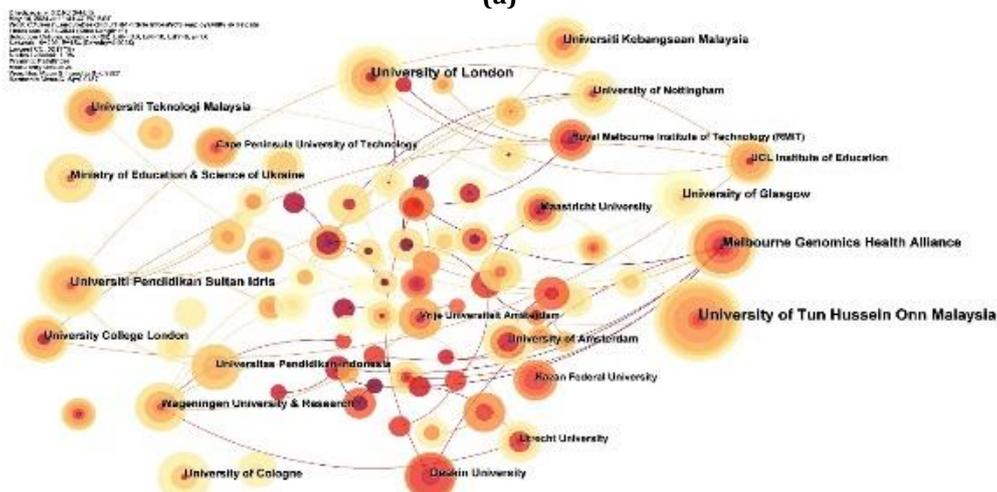
Table 6 Co-institution count

Institution	Count
University of London	35
University of Tun Hussein Onn Malaysia	30
Melbourne Genomics Health Alliance	29
Open University Netherlands	16
Universiti Pendidikan Sultan Idris	16
University of Glasgow Malaysia	16
University of Nottingham	15
Maastricht University	15
Royal Melbourne Institute of Technoloty(RMIT)	15
Deakin University	13

Top 10 Institutions with the Strongest Citation Bursts



(a)



(b)

Fig. 7 Co-institutions for HVE employability skills research. (a) Top 10 institutions with the strongest citation bursts; (b) Network of co-institutions

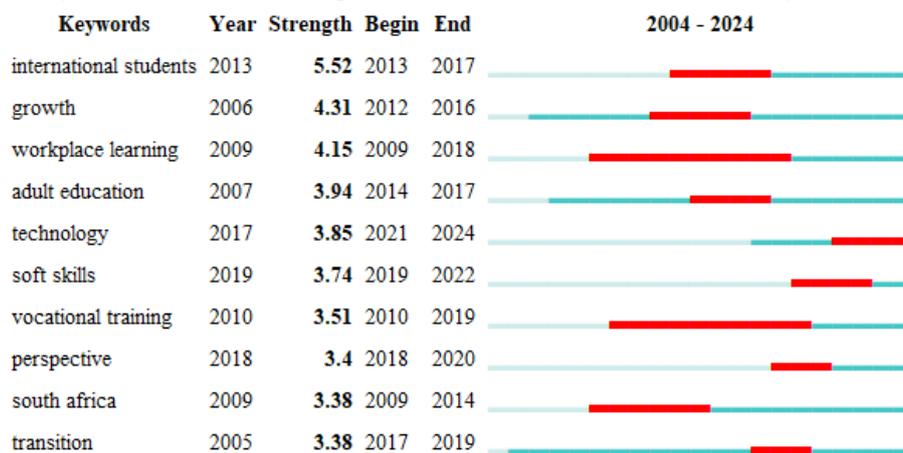
3.6 Keyword Co-Occurrence Analysis

Keyword co-occurrence analysis, can glimpse the high-frequency keywords in a certain field in statistical period and the correlation between high-frequency keywords, and reveal the current research hotspots. Keyword timeline analysis is the synthesis of keyword co-citation graph and keyword co-citation cluster graph, and the keyword clusters under each cluster can be arranged according to the time of keyword thorns.

With regard to the co-occurrence analysis of keywords in this research field, it can be seen from Fig. 8a that workplace learning is the strongest, lasting from 2009 to 2018, while Technology is the most frequently used keyword in recent years, followed by Strategy, indicating that Technology and Strategy are the hot spots in the research field of vocational education and employment skills in recent years.

From 2015 to 2024, the keyword ranges of various journals in this field, have a high degree of connectivity and a strong co-occurrence relationship, and there are many nodes that serve as a bridge between subgroups, and the keywords of various journals are connected through this node, as shown in Fig. 8b. The nodes in Fig. 8b are the focus of the topic selection scope of keywords from 2015 to 2024, and should be paid attention to. Such as Institutional change, international students, green skills, vocal education, on-demand education, skills development and vocal college. Because these keywords are more inclined to industry trends and audio-visual media, the co-occurrence relationship between their option keywords is stronger and the network density is higher. Many paper keywords are collocated with each other to discuss new technologies and new problems together.

Take #0 Institutional change as an example, this cluster contains multiple keywords, which are co-occurring by other documents in different years. When the document co-occurs for the first time in the local data set, the keyword will be fixed below the year of the first co-occurrence. Judging from the frequency of specific research topics, 2019 is relatively concentrated, and the frequency of occurrence is the highest in most years. There are many literatures about the key words of varieties of capitalism, labor market and occupational choice. At the same time, a large number of new research perspectives, technologies and methods will appear in modern communication every year, which shows the degree of concern of this keyword. It can be seen from the connection between the research hotspots in 2019 and 2014 in Figure 8 that the research in 2019 laid the foundation for the keyword selection and scope of this research field in the next few years.



(a)

CiteSpace v. 5.2.R3 (64-bit)
 May 28, 2024 at 20:36:04 GMT
 May 28, 2024 at 20:36:04 GMT
 Network: Modularity Q=0.9741
 Silhouette S=0.9741
 Weighted Mean Q=0.9741
 Harmonic Mean Q=0.9741
 Weighted Mean Silhouette S=0.9741
 Harmonic Mean Q=0.9741

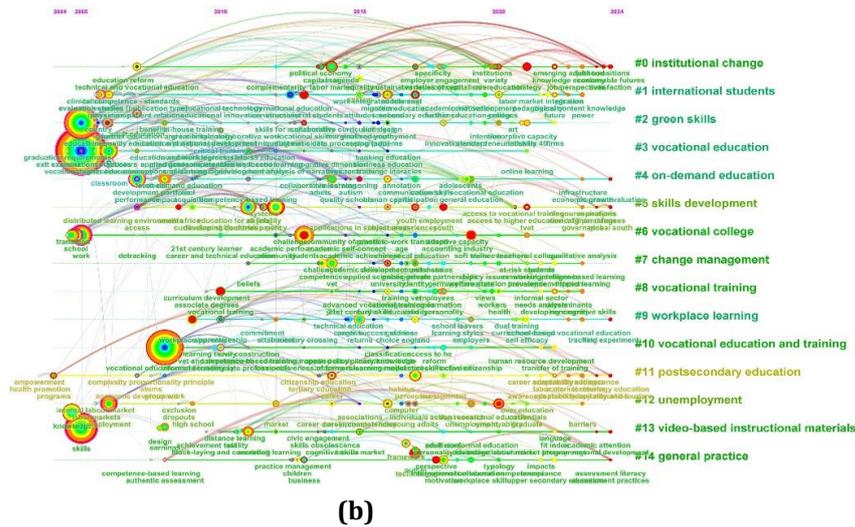


Fig. 8 A timeline visualization of the keywords. (a) is for top 10 keywords with the strongest citation bursts; (b) is for the largest clusters of the total of 631 clusters

4. Discussion

In this study, provides a comprehensive overview of the development of higher vocational education, and employment skills in the past 20 years by using Citespace software, and analyzes the relevant research hotspots and research frontiers. The main countries/regions, institutions and periodicals that have contributed to the study of employment skills, in higher vocational education have been identified. In addition, the cooperative network among countries/regions, institutions, authors and periodicals, and the common citation network analysis are also determined. Through the co-occurrence of keywords, this paper analyzes the hot spots and trends, and the research on this issue shows a continuous and steady upward trajectory from 2004 to 2024. However, this growth has been slow in recent years, especially since 2014, and the growth rate is relatively low. Mainly driven by the following factors. First, the academic level and discipline status of vocational education are not yet mature, and its knowledge field and discipline boundary are not clear enough, which leads to multiple identity crises for vocational and technical education disciplines (Nylund & Rosvall, 2016). Secondly, the interdisciplinary nature of vocational education makes its research power scattered in many disciplines such as pedagogy, economics, management, sociology, etc., while there are few academic groups specializing in vocational education.

In addition, from the perspective of studying countries, institutions, authors and periodicals, the main impetus of the research in the field of vocational education and employment skills come from Australia, Britain, the Netherlands, Germany and the United States. University of London, Melbourne genomics health alliance, University of Tun Hussein Onn Malaysia, has made important contributions to the study of vocational education and employment skills. In the analysis of Cited journal, J VOCAT EDUC TRAIN was cited for 429 times, followed by J EDUC WORK for 272 times. These journals have also made great contributions to the research in this field. This may be different from the results of other studies, because the samples are different, the time range is different and the results may be different. However, previous studies can only represent the characteristics of previous studies. This study is based on the latest research in the time range.

In this study, the co-occurrence words of nominal terms are analyzed from the title (T), and the high-frequency terms are Youth Labour-Market Performance Institution, Informal apprentice, keeping pace, Finishing Vocative Student, Public attitude, Dualisation education, competence development is document co-citation analysis, show that these high-frequency words are the focus of vocational education research, and researchers from all over the world pay more attention to these issues. Youth Labor-market Performance Institution is the evaluation of young labor force (including graduates of higher vocational education), by employers in the course of work. Australian employers think initiative, enterprise and emotional intelligence are all important, while British employers do not specifically mention these skills (CBI/UUK, 2009). Emphasis on the development of graduates' characteristics is usually described as lifelong learning, universal, transferable or soft skills, which is the concern for graduates' employability (Oliver,2011). Analysis here, will show that there is also a correlation between various high-frequency words. Competence development is one of the high-frequency words, and the ability of graduates affects employers' evaluation of them and employment level. Technological change, and

socio-economic development require that the focus of vocational education, and employment skills gradually shift to students' cross-industry ability (Hui, 2019), and let students have some practical work experience during their school years in advance, and pay close attention to the dynamic requirements of the labor market. In addition, this is also closely related to the segmentation of the industry. Informal apprentice is an important educational policy in vocational education. Apprenticeship is a situational learning, and learning is a visual process. Apprentices share resources and practices and participate together (Lave & Wenger, 1991). The modern apprenticeship system, currently implemented in China is a mode of educating people, based on the cooperation between schools and enterprises. By jointly determining the training objectives and establishing assessment standards with enterprises, the employability of graduates can be jointly improved (Niu & Yang, 2020). The study of modern apprenticeship in China vocational education, has also become a hot spot in the reform of higher vocational education. Scholars have conducted research in this field, at different levels and from different perspectives, and have achieved a lot. However, there is a lack of systematic visual analysis of the research literature, on modern apprenticeship in vocational education (Wang, 2022). The visual analysis of related fields in this study, can effectively focus on research hotspots and promote the better development of apprenticeship.

In Finnish vocational education, students' internship practice is a very important part in their study career, in addition to the compulsory and elective courses of the school. Because the school has established a good cooperative relationship with the enterprise, students' internship is arranged in the enterprise, and an internship evaluation form made by the school, based on years of practical experience is jointly completed by the instructor of the enterprise, the teachers of the school and the students themselves, which can clearly see the evaluation of the intern from all sides and encourage students to pay attention to practice (Zhang, 2014). The talent training mode of school-enterprise cooperation mode, currently implemented in China is to introduce Finnish characteristic education courses, integrate production and education, and cooperate with schools and enterprises, which can effectively improve the employment skills of students in higher vocational education.

In China, the dual structure of higher education, refers to the dual structure of academic education, and vocational education in higher education and their mutual relationship and order system. On the type characteristics of higher vocational education, one of the main features of dual differentiation is its application. Compared with traditional higher education, higher vocational education has typical application, which is mainly manifested in attaching importance to the application of knowledge in industrial production, the cultivation of production technology application ability and the training of production practical skills (Liu, 2021). Therefore, the dual system is also an effective talent training mode to improve graduates' employment skills in China.

Although the relevant research in the field of employment skills in higher vocational education in 2014-2024, was effectively visualized and analyzed, the data obtained could not fully represent the whole picture of the research, and development of employment skills in international vocational education. Limited by the research conditions and the level of researchers, this paper downloaded from the Web of Science the research on international vocational education employment skills from 2004 to 2024, which may contain fewer documents and periodicals than other data (such as google scholar or Scopus). Secondly, non-English articles are excluded from the database and analysis, which may lead to source bias.

5. Conclusion

The bibliometric analysis shows that the research field of employment skills in higher vocational education has a good research foundation, and the research prospect will be broader, and there will be an increase in related publications on the basis of the previous ones. The main contributors to this research area have been identified, and the related research is concentrated, mainly in the research related to student training mode (mainly policy changes, such as school-enterprise cooperation mode, apprenticeship system, 1+X certificate talent training mode, etc.), stakeholders, and competence development. Differences between regions and countries still exist. In the process of applying the data of trying to learn the employment skills of higher vocational education, there is the problem of a poor form of interpretation of the data image features, but with the development of bibliometric analysis, through the method of making over the mapping related software analysis, it greatly improves the efficiency and accuracy of the researchers in the related research, and promotes the development of vocational education.

The results of this study will contribute to the body of knowledge on vocational education, and employability skills by highlighting key areas of focus, influential research and emerging trends. This knowledge map, will not only inform educators and policy makers about the current state of research but will also guide future research thereby increasing the effectiveness of vocational education programs, in developing graduates' employability skills. Through this visual analysis, stakeholders can better understand how to integrate and emphasize employability skills, in vocational training, ultimately improving workforce readiness and economic outcomes.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

Xie Dongna is responsible for the following: study conception and design, data collection and manuscript preparation, meanwhile Mohd Hasril is responsible for the analysis and interpretation of results.

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