

A Bibliometric Analysis of Green Skills Research in Vocational Education: 2018-2022

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Abstract

Green skills (GSs) have become one of the important strategies for achieving sustainable development. It can make the environment effective for social and economic development. The aim of this research is to reveal data on the evolution and development of green skills and trends in the development of green jobs throughout the world. This research uses R Studio and Bibliometrix to analyze 198 papers related to green skills in green jobs published from 2018 to 2022 in the Scopus database using Bibliometrix and visualization mapping methods. The results show a substantial increase in the number of studies GSs in recent years, with the focus area in European and American countries leading this research. Aspects of Will, manufacturing and Energy, and Journals of Green Environmental Management are the first three journals cited in the study of GSs. Studying the cited literature together on environmentally friendly skills includes, among other things, the relationship between other skills and ecosystems with human good health, green construction, evaluation and green management of environmentally friendly competencies, and analysis of specific aspects of environmentally friendly skills. The results of the analysis of green skills grouping keywords show that there is research that concentrates on green skills in the fields of education, ecosystem services, climate change, and biodiversity protection. In conclusion, this research provides a reference for future studies of green skills necessary for the development of a sustainable educational environment, such as a multidisciplinary approach, adaptation of new technologies, partnerships with sustainable technology green industries, and environmental awareness.

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INTRODUCTION

A new economic paradigm known as the "green economy" seeks to advance development while also preserving the environment [1]. The expansion of the green economy necessitates the creation of new skills for both new occupations in the green sector and existing jobs that are changing to be more environmentally sustainable [2]. In order to create green occupations that support the growth of a green economy, inclusive raising society's awareness of environmental challenges and sustainable development (SDGs), green skills are required [3]. Cedefop's latest 2020 interprets green skills (GSs) as the knowledge, ability, value, and attitude needed to live, develop, and support sustainable and resource-efficient societies. The Organisation for Economic Co-operation and Development (OECD) confirms that GSs are needed to adapt services, products, and processes to climate change and

environmental regulations. Consequently, GSs can help reduce unemployment and lead to the emergence of new types of jobs in the future [4].

Competitors in the green job market need to possess the following competencies: (1) environmental awareness, attitudes, and readiness to learn about environmental issues and challenges, as well as sustainable development. (2) The ability to coordinate solutions to address ecological, social, and economic needs through holistic coordination and management. (3) The ability to seize opportunities to promote ecologically friendly products through entrepreneurship. (4) Innovation Skills: To respond to green employment, see opportunities and develop fresh approaches. (5) STEM Skills: a general understanding of how science, technology, engineering, and mathematics may support greener communities and economic processes. (6) Analytical thinking skills as a step for business and industry toward a model that is genuinely sustainable [5]. Green skills play a key role in contributing to skilled manpower. Transformation of Vocational Education needs to be emphasized on aspects of sustainable development in producing competent graduates.

Generic green skills are required by almost all jobs in green growth, which include cognitive competencies (e.g. environmental awareness and innovation skills), interpersonal skills (e.g. communication skills), technological skills (e.g. waste management systems), and intrapersonal competencies [6]. Thus, green skills become an integral part of graduate competence. Industry players are currently looking for workers with the GSs needed to support SDGs in the social, economic, and environmental fields [7]. This method aims to systematically expound and produce a new strategy in the form of green skills construction in training and educating prospective workers that contributes to sustainable development.

The development of green jobs (GJs) is currently also influenced by the development of information technology, and many innovations are born from utilizing digital resources. In this case, the soul listens to a style that is closely related to work skills that lead to environmentally friendly and sustainable products [8]. This change in market behavior also stimulates changes in the curriculum of campuses, schools, and training institutions. All of this is done to prepare today's young generation so that they can learn the various skills needed for green jobs, and in the years to come, they can take on a bigger role [9].

Green skills that lead to environmental sustainability are the demands of future HR demands. Every future workforce must be equipped with green skills. Vocational Education is education that trains a person to have good work skills or skills. Good work skills can be built through good work attitudes (attitude), good industry insight (knowledge), as well as work skills based on sustainability and friendly to the environment (green skills) that are suitable to the needs of the attempt world and the industrial world today [10]. The concept of "green skills" can be broken down into four categories: (1) Taking responsibility for environmental protection, including managing water and energy resources and disposing of solid waste; (2) Social skills like playing a part in preventing discrimination at work; (3) The ability to assume economic duties, including inventiveness, entrepreneurship, and financial responsibility; (4) Health, personal life, work, the environment, and society are all areas of skill at the local and global levels [11].

Sustainability approaches, problem-solving, and creativity are examples of general abilities that are combined with vocational skills to form "green skills." Necessarily due to the need for sustainability due to the effects of climate change, GSs are required in all industrial sectors. GSs also imply "green work skills", essentially persons who contribute to the environment and promote the sustainability of the environment in a better direction [12]. Green talents are those created and preserved from technical elements, values, and attitudes with an eye toward a sustainable environment. The workforce requires each of these abilities to grow and sustain communities, businesses, social activities, and economic results.

METHODS

The Systematic Literature Review, or what is called SLR, is a systematic literature review aimed at primarily identifying, evaluating, and interpreting study findings [13]. The way to synthesize the findings can be by means of qualitative technique or meta-synthesis (MS). Thus, MS is part of systematic reviews. However, SLR must be distinguished from reviews that are not systematic reviews (traditional reviews). Traditional review methods in which data search and synthesis techniques are carried out at will (subjectivity), and there are no clear steps as in the method of systematic review.

SLR is also called a systematic review. The meaning of "systematic" here is to make protocol or the first step in conducting research. Every stage must be "recorded" clearly. The initial steps that must be made include: 1) objective of the research, 2) inclusion criteria, 3) study selection, 4) data collection, 5) study quality, and 6) data synthesis results.

Since the early 20th century, bibliometric analysis has been used to examine the world's published literature [14]. Information about books, writers, libraries, academic journals, and other sources can be compiled using bibliometrics, a branch of statistics [15]. Therefore, we require the data provided by this analysis to comprehend the current state of publication patterns and their prospective practicality.

RESULT AND DISCUSSION

In order to ensure the quality of document retrieval, the retrieval time range for this study was set to "1989–2021," and the four types of articles, proceedings papers, book reviews, and articles were selected. A total of 196 papers were obtained. The primary data for this research were united of the core collected from the Scopus database by the keywords "green" and "skills" as the object of retrieval. The earliest study in "green skills" was known to be included in the Scopus database in 1989.

Based on statistical analysis of literature search results, it was found that less than 10 studies on GSs were published from 1993 to 2003. Rapid growth occurred from 2011 to 2013, surpassing 100 in a short time. A significant increase in research has been recorded since 2015, and the number of published studies is increasing by hundreds per year (Figure 1). Of course, "green skills" is a topic worthy of discussion and in-depth study.

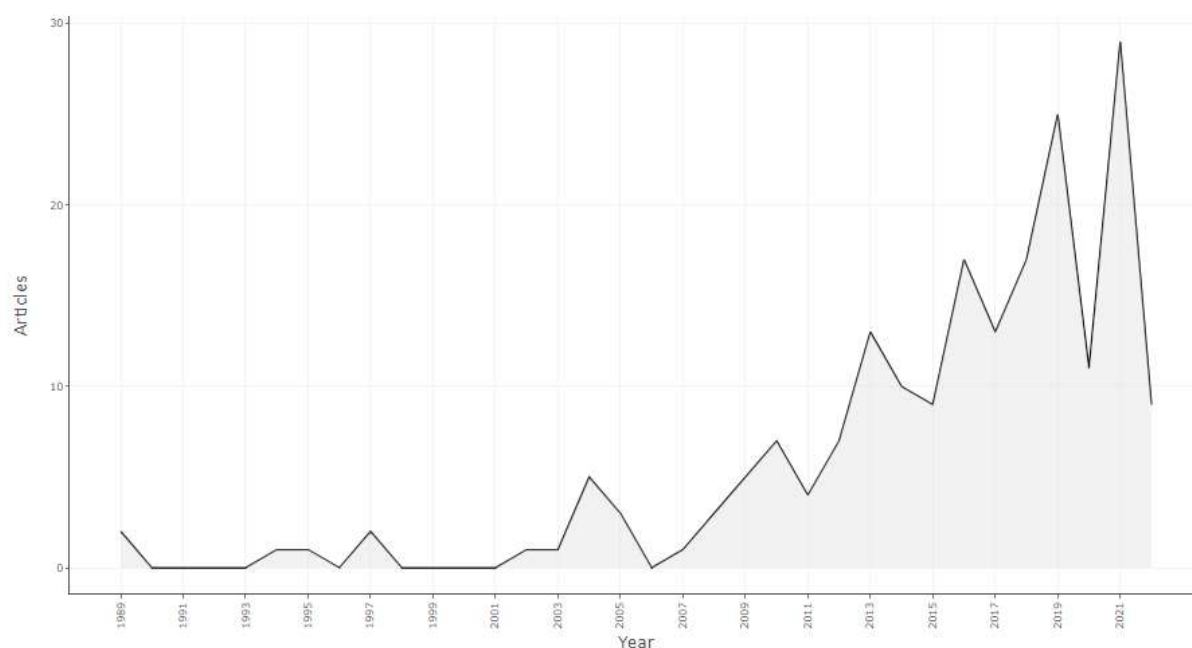


Figure 1. Studies on GSs were collected in the Scopus database.

Distribution of countries publishing studies GSs

In the three-plane plot, nodes are defined as countries, and the cited sources are used to draw a period domain evolution map of countries and regions studying GSs. By specifying keywords, the number of studies in the years when more than 20 studies were published and 20 key points were obtained (Figure 2). Currently, the United States, which published 161 articles, is in first place, followed by Spain with 118 articles in second place, England with 110 articles in third place, Italy with 56 articles in fourth place, and Malaysia in fifth place with 51 articles. The other proportion of countries are all under 50 articles. Especially European and American countries have conducted a lot of research in GSs, and their research results have great reference significance.

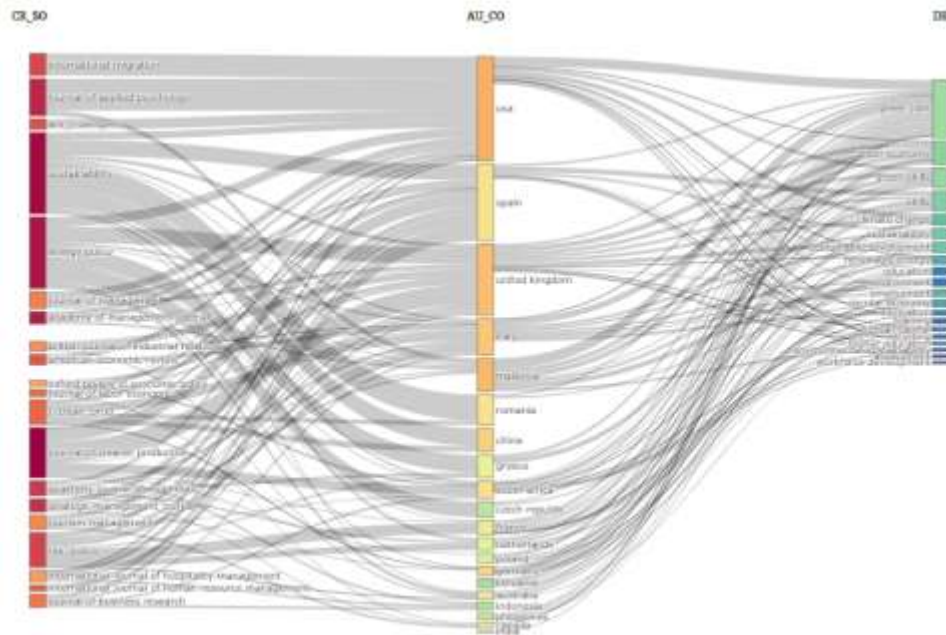


Figure 2. Period domain evolution map of countries and regions studying GSs

Distribution of institution publishing studies Green Skills

In three Field Plots, the nodes are set as institutions, and the threshold is set to N 20 to display the knowledge map classified by the institution. One node represents a scientific research institution/university, and the conclusion size represents the number of papers published by that institution. The larger node and clearer label font (weighted font and high opacity) indicate that the institution has published a lot of research (Figure 3). The analysis results show that the top six institutions that publish papers in green infrastructure (including parallel ranking) are 20 papers based on bibliometrics (library) with bibliophily; Tun Hussein University in Malaysia won first place with the keywords exiting skills and environmentally friendly environment, second place was the Mineral Energy Economics Research Institute with the keywords exiting environmentally friendly jobs, training and education. In third place is the Malaysian Technological University with the keywords environmentally friendly jobs, environmentally friendly economy and renewable energy.

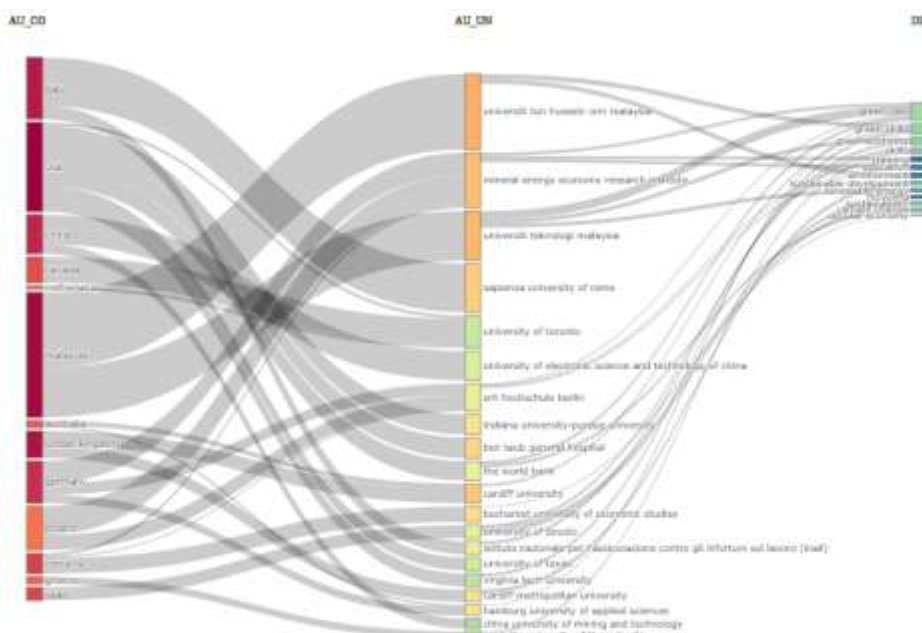


Figure 3. Period zone evolution map of the institution and the centrality studying GSs

Distribution of Most Relevant Sources

Bibliometrix source nodes are set as quoted journals to generate a knowledge map of cited journals. Table 1 below is a list of the 10 green skills research journals cited, as well as a summary of their impact factors and half-lives. Flagship initiatives and research are books that are not recorded in the table. The highest frequency h index is 4. The following conclusion can be drawn after comprehensively analyzing the areas covered by the 10 journals and other journals to high centrality. Firstly, currently, the majority of GS journals focus on issues of sustainability and energy and are often related to Technical and Vocational Education and Training. Second, journals by the best citation frequency have a good impact factor (a sign that published papers have a strong influence in the academic world) and half-life (a sign that published research has a long lifespan; that is, many papers have been published for lots years -past years continue to be quoted). These three indicators show that the sustainability journal (Switzerland) has a strong impact factor.

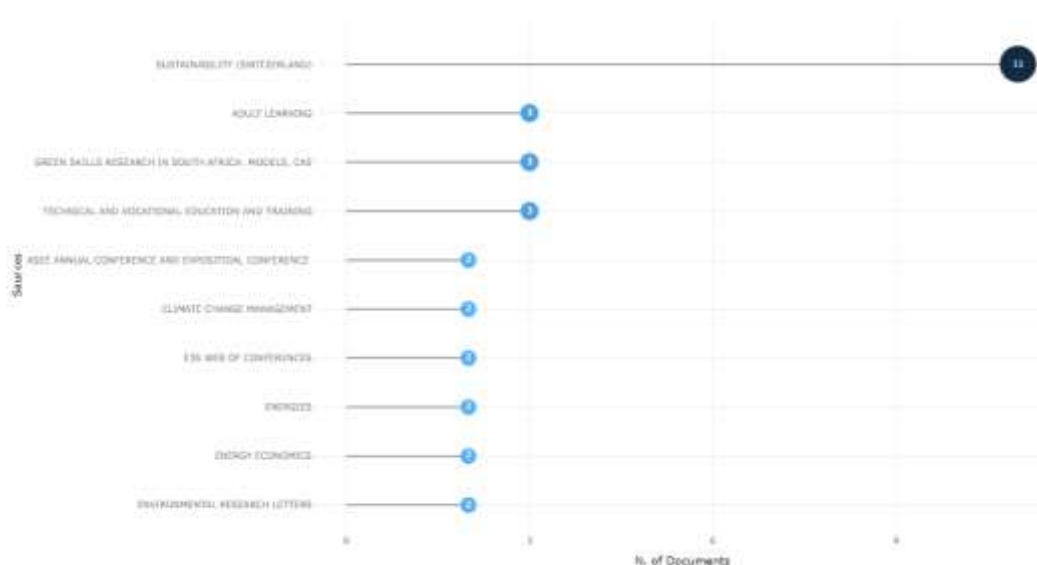


Figure 4. Disciplinary distribution structure research of green skills

Table 1. List of 10 cited green skills journals research, the impact factors and the half-life period

Element	h_index	m_index	Total Citation
Sustainability (Switzerland)	4	1	24
Adult learning	2	0.2	6
E3s web of conferences	2	0.4	8
Energies	2	0.667	15
Energy economics	2	0.286	65
Research policy	2	0.286	138
Technical and vocational education and training	2	0.4	7
Worldwatch paper	2	0.133	9
International conference on industrial informatics	1	0.053	6
International construction specialty conference	1	0.167	1

Distribution of Disciplines

Trend topics were used to draw a knowledge map of the distribution structure at 193 scientific discipline documents, resulting in 17 nodes (Figure 5). The results of the analysis are as follows. (1) Analysis from mainstream scientific disciplines: Climate change science is the scientific discipline with the largest number of studies, namely more than 50%, and commerce is the mainstream scientific discipline. Frequency studies of sustainability, green economy, engineering education, and green jobs thus show strong centrality. These results indicate that much research on green skills has been conducted in this discipline. (2) Disciplinary analysis of time distribution and grouping: the timeline display in bibliometric is used, keywords are taken as grouping elements, and the burst function is utilized. As time goes by, the distribution of "green skills" disciplines is getting wider. The base trends of discipline distribution are summarized based on visualization analysis. Next, from 2010 to 2022, the

study mainly focuses on "environmental science" and "labor research". After that, the distribution discipline shows clear widespread trends, including climate change, trade, sustainability, the green economy, and economic conditions. It should be noted that "environmental skills" have a broad scope of study, and the depth of study in various scientific disciplines should be further developed. (3) Analysis of research directions for policy potential.

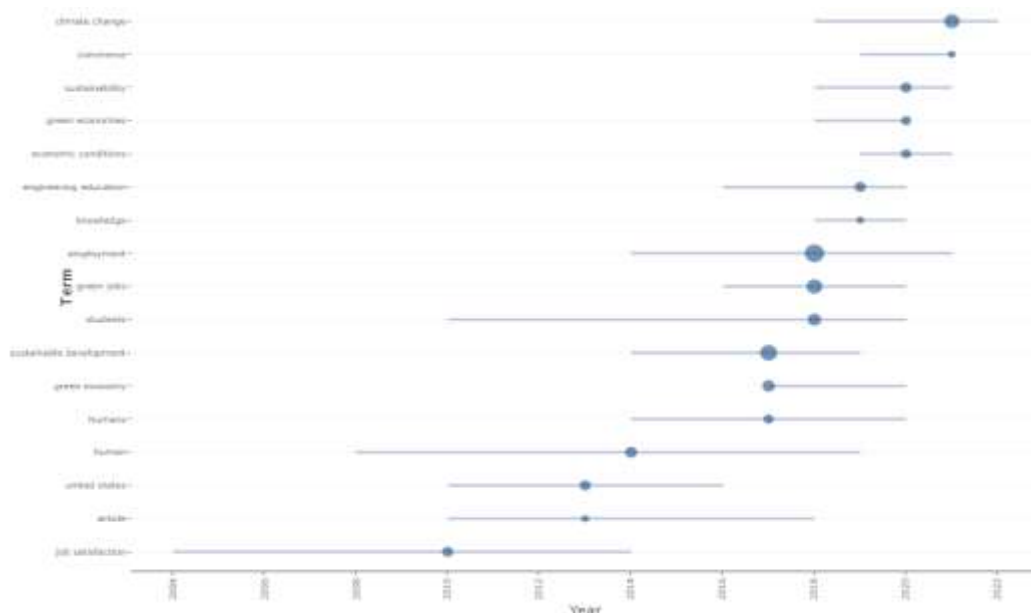


Figure 5. Trend Topics of Green Skills Studies

Result

This study uses R Studio and Bibliometrix for analysis and interpretation of 198 studies in GSs collected on the Scopus database from 2018 to 2022 from aspects of country and publishing institutions, widely cited journals and literature, distribution disciplines, research evolution, and keyword clustering. Here, we will discuss our main focus on green skills research and provide suggestions for future inventions.

In this study, performance is published quantitatively using the bibliometric method, and it was discovered in terms of a number of publications. Publishing organizations in Europe AS sit on the first rank, followed by Spain, English, and Italy. Starting from Malaysia, there are several studies in Asia that are starting to address green skills. So, it is necessary to conduct studies in other developed countries. They are currently undergoing a rapid urbanization process, which is associated with the severity of ecological environmental crises in developing countries. In addition, research on green skills is still in its early stages, and the practice of green skills is sufficient. In the future, much research on green skills will be carried out in developing regions, and these countries and regions also provide wide practical space for GS development.

Conceptually, GSs come from various scientific disciplines, including environmental, civil, manufacturing, renewable energy and agriculture. Thus, environmentally friendly skills involving various ecosystems and targets have been adopted in various disciplines related to repair, reuse, design, protection, and planning. However, no clear and standardized definition for green skills was provided in the existing literature. Understanding green skills was achieved through various scientific disciplines based on research background that is in accordance with conceptualization, so green skills have benefits and multi-functions. What is meant by green skills are basic competencies and planning strategies as well as essential skills possessed. Clear and structured definitions for deep understanding and comprehensive interdisciplinary research based on unity from understanding. Thus, interdisciplinary research needs to be well mapped out to form an appropriate definition of GSs.

GSs are a concept of skills that emphasizes environmental elements in life and how individuals living at that time can ensure SDGs through their economy, society and social life. GSs are the skills needed to service and adapt products and processes to be environmentally friendly [16]. The

development of GSs needs to be done through education as one of the life skills which aims to support an efficient and sustainable society.

GSs are aspects of vocational skills, as well as generic skills which include sustainability approaches, problem-solving, and innovation (innovation, sustainability approaches, problem-solving). GSs are needed in all industrial sectors in response to climate change and the need for sustainability. GSs also means “green work skills”, namely individuals who contribute to the environment and improve the sustainability of the environment in a better direction [17]. GSs are skills towards a sustainable environment that are conserved and developed from technical aspects, values and attitudes. All of these skills are needed by the workforce to develop and support social activities, economic outcomes, industry, and communities.

Table 2. Key gaps in GSs research and provide suggestions for next future research

Focus Area	Research Gaps	Future Research
Green/environmental policies into national education policies and the country's long-term strategic plans	Demands for the implementation of green jobs that focus on the efficiency of raw materials, water and energy, energy diversification, eco-design and low-carbon technology with the aim of increasing productivity and minimizing waste are getting higher.	The government should continue to implement the national strategic policies and plans by encouraging government agencies, vocational schools, universities, and companies to cooperate in developing and offering environmental/green management education programs/curricula to produce graduates with suitable qualifications for these companies.
Encourage vocational schools and universities to equip their students with green skills to be industry-ready in real work contexts, green jobs	Vocational Education has not played its role in introducing GSs in the process of teaching and learning in order to provide better exposure to the importance of sustainability in producing a workforce that is not only skilled but also environmentally conscious.	To address the problem of skills shortages in the labor market, the government should encourage companies, especially private companies, to focus on upgrading their skills and upgrading the skills of existing employees. With this action, their existing employees will have eco-skills, be able to do green jobs effectively and be an important driver in helping the country move towards a green economy.
Encourage companies to develop green products by offering various types of incentives, including tax reductions or tax exemptions	There are still a few companies that develop environmentally friendly/green products by offering various types of incentives, including tax reductions/tax exemptions are still not visible	Stakeholders must give serious attention to the implementation of cross-level environmental/green management policies in the country so that the country's transition to a green economy is finally realized in the future.

Vocational Education (VE) is education that trains someone to have good workability or skills. Good work skills can be developed through a good work attitude (attitude), good industrial insight (knowledge), as well as work skills based on sustainability and friendly to the environment (green skills) that are relevant to the current needs of the business world and the industrial world. GSs are a thought process that can be divided into 4 categories: (1) skills in taking responsibility for protecting the environment, such as water resources, managing energy, and disposing of solid waste. (2) social abilities such as taking a responsible role to prevent discrimination in the workplace. (3) skills in taking responsibility in the economic field, such as financial accountability, innovation, and entrepreneurship. (4) skills at the local and international levels covering the fields of health, personal life, employment, environment and society [18].

The findings in this study are in line with the findings [19]; the process of cultivating skills needs to include elements of knowledge, attitude, ability, value, awareness, and understanding, sustainability skills so that students can acquire technical skills, values and attitudes related to environmental preservation for future generations [20]. The acquisition of skills requires more than just an accumulation of factual knowledge [21]. Thus, recognition mechanisms need to recognise a

repertoire of actions, and skills recognition necessary for the greening of jobs must be done continuously and holistically.

The element of Value consists of a relationship with God, a relationship with a teacher, a relationship with best friends, a relationship with oneself, and a relationship with the environment; the findings in the study are in line with the findings [22]. Numerous studies both in European as well as developing countries' context show that enterprises place a higher value on employee competencies such as communication, problem-solving, flexibility, and abilities related to learning methodologies than they do on formal qualifications [23].

The Awareness with sub-indicators of self-control, understanding oneself appropriately, awareness of thoughts, feelings, and self-evaluations, understanding other people's expectations of oneself, reading social situations in understanding others, and capacity to place oneself in time (present, past and future). Because so few individuals understood the significance of these green activities, very few people heeded the notice. This was done with the intention of raising awareness of sustainable development, green jobs, and green occupations [24]. Since these abilities are applicable to everyone, including those working in private businesses of all sizes, it is the role of all parties to raise public awareness of the significance of GSs [25].

CONCLUSION

GSs become skills towards a sustainable environment that are preserved and developed from the technical aspects, values, awareness, and attitudes. These GSs will be revealed through indicators which include (1) Environmental awareness, (2) Management and coordination, (3) Entrepreneurship Skills Entrepreneurship skills, (4) STEM Skills or STEM skills, (5) Analytical thinking skills or analytical thinking skills, (6) Green practice skills. Patterns of education and training with stages of building knowledge, attitudes that are triggered by habituation, abilities that are carried out regularly, values that are embedded in one's soul and self, awareness that makes a person try to do something positive, so that it gives birth to a strong and embedded understanding, and making a person skilled in taking care of himself, protecting his environment, and protecting his future which is applied to become a green skill.

The final result is an in-depth analysis of GSs research from various perspectives, which has implications for exploring the evolution of GSs on vertical development trends and providing references for GS research. Suggestions for future researchers are to expand the Scopus data mining results with many selected core data sets, as well as several research results from other reputable sources. On the other hand, although theme knowledge evolution, context, and research topics are discussed comprehensively, this research still needs to analyze interdisciplinary content thoroughly because GSs are complex systems involving various scientific disciplines. This aspect will be the direction of the promotion and development of further research.

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