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SUSTAINABLE DEVELOPMENT GOALS (SDGS) IN SCIENCE EDUCATION: DEFINITION, LITERATURE REVIEW, AND BIBLIOMETRIC ANALYSIS

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Abstract

The objective of this study was to find out the Sustainable Development Goals (SDGs) in science education from a literature review and bibliometric analysis. The paper is also completed with an explanation of the definition of education for sustainable development (ESD). VOSviewer mapping was used to analyze bibliometric data on SDGs in science education. The reference manager application was utilized to get research data. The words "Sustainable Development Goals", "SDGs" and "science education" were used by us as a search for keyword data for this research. We searched for data from 2012 to 2022. The results showed that research on SDGs in science education was found from 2014 to 2022, while from 2012 to 2013 research on SDGs in science education had not been found. This is possible because the SDGs in science education was only declared in 2016. It is possible that before 2014, people had not researched or even knew about the SDGs in science education. In addition, the research results also showed that from 2014 to 2021 research increased, but in 2022 it decreased. This can be seen from the peak research data in 2021 totaling 193 but in 2022 it has decreased to 161. This study showed how important bibliometric analysis is to obtain information about this phenomenon. This study is prospective in helping and becoming a reference for scientists and researchers in conducting and deciding on research topics, especially regarding SDGs and science education.

Keywords: Bibliometric, Education for sustainable development, ESD, Sustainable development goals, SDGs, Science education.

1. Introduction

The Sustainable Development Goals (SDGs) are one of the important agenda, prepared by many countries for getting global human welfare [1]. The agenda is a program regarding a sustainable development, having 17 goals and 169 measurable targets. The SDGs have been confirmed and agreed upon by 193 member countries, including Indonesia. A total of 17 goals or pillars of SGDs include [2]: (a) No poverty; (b) Zero hunger; (c) Good health and well-being; (c) Quality education; (d) Gender equality; (e) Sanitation and clean water; (f) Affordable and clean energy; (g) Decent work and economic growth; (h) Industry, innovation, and infrastructure; (i) Reduce inequality; (j) Sustainable cities and communities; (k) Responsible consumption and production; (l) Climate actions; (m) Life under water; (n) Life on land; (o) Peace, justice, and strong institutions; and (p) Partnership for the goals.

One of the discussions on SDGs in point 4 is regarding quality education which discusses "ensuring education that is inclusive and of equal quality, also supports lifelong learning opportunities for all" [3].

Inclusive education includes the principle of education for all. This is of course on par with the goals of the SDGs on quality education. One of the indicators of quality education can be seen from the output of education by achieving the goals of education itself. One of the goals of education is the realization of independent individuals in everyday life. Phenomena in everyday life cannot be separated from scientific phenomena [4-7]. Science education needs to be owned by every individual to have knowledge about science. Science does not only include calculations and practicum of chemical substances, but science education includes scientific phenomena that occur in everyday life [8-10]. Science education is important to be learned by all students in schools at every level [11-13]. This is because science education material at every level of education is the basis for learning.

Currently, many studies discussing the SDGs broaden views on science education in addressing sustainable development, social transformation, and empowerment [14], discussions on biology of the 21st century about transformation about biology as well as education and data for supporting SDGs [15], soils and sustainable development goals in the United Nations (UN): International Union the Soil Sciences, point of view[16], perceptions of physics teachers on continuing physics education [17], and channel collaboration for citizen science and SDGs [18]. But until now, there has been no research discussing SDGs in science education: literature review and bibliometric analysis

This present research aimed to find out the SDGs in science education through a literature review and bibliometric analysis. We also explained the definition of SDGs. We used VOSviewer mapping to analyze the data. The keywords were obtained from the relationship "Sustainable Development Goals", "SDGs", and science education" to find data from 2012 to 2022. The research results showed research on SDGs in science education was only found in 2014, whereas before 2014 research related to this theme had not been found. Every year research on the relationship between SDGs and science education has increased, even though in 2022 it has decreased. This showed the importance of bibliometric analysis on SDGs and science education in the hope of helping and becoming a reference for

deciding research topics. The novelty of this research is about the topic of SDGs and science education.

2. Theoretical Framework

2.1. Definition of sustainable development goals (SDGs)

The SDGs aim to improve the welfare of a sustainable, prosperous, peaceful, and just life on Earth for all people for now and the future. In achieving the SDGs, the role of education for sustainable development (ESD) is one of the issues in SDGs. ESD has an objective to develop competencies. Thus, individuals can reflect on their actions by considering their current and future social, cultural, economic, and environmental impacts from a local and global perspective. Thus, ESD has to define skills, knowledge, values, and attitudes as well as an effective system for evaluation towards a new pedagogical system. It is in good correlation with the goals of the SDGs. Many aspects of the SDGs are considered successful and are recognized as the most successful global anti-poverty movement. Governments, international organizations, and civil society around the world are helping to reduce extreme poverty. The current condition is that many children can attend school well, and fewer children die due to disease and malnutrition. This is thanks to the focus on movements driven by the SDGs [19]. The SDGs are designed in a participatory manner involving all development actors together with the main focus and principle of the SDGs. The principle has been well-known as "Leave no one Behind". This principle covers two things, namely procedural justice, and substantial justice. Procedural justice refers to the extent to all parties. Specifically, it focuses on those who are considered left behind. It can be involved in the entire development process. Meanwhile, substantial justice can be referred to the extent to some points in the development policies. Then, the programs to fit and reach the target can answer community problems, especially for disadvantaged groups in society. The SDGs consist of 17 goals and 169 target points. The main idea is to take action and plan to end poverty. Also, it is done to reduce inequality as well as maintain and protect the environment. SDGs are now becoming popular to be applied in all countries universally. Thus, every country has a moral obligation, which is to get these SDGs objectives [20].

The goal of the first SDGs is to eradicate poverty anywhere and in any form (No Poverty). The main target is to eradicate extreme poverty, at least half of the number of poor people according to the national definition in every country. This target seeks to implement social protection for all levels of society, as well as make sure that the poor and vulnerable aspects have the same rights in accessing economic resources and obtaining way/access to science and technology. Eradicating poverty also includes mobilizing significant resources from various sources, including through expanding cooperation and implementing programs and policies that can end poverty in all its dimensions. The main target of this program is also to create policy frameworks at the national, regional, and international levels for development, especially which is pro-poor and gender-sensitive, and making faster investment in poverty alleviation actions.

Zero Hunger is the second target for SDGs, aiming to end hunger, get food security, and achieve better nutrition. It needs support from sustainable agriculture. The SDGs program hopes to end hunger and make sure access for all people to safe, sufficient nutritious, sufficient food, and end all types of malnutrition in all

categories of people. In the coming years, it is expected to double agricultural productivity and a sustainable food production system. Eradicating hunger includes maintaining ecosystems, maintaining the genetic diversity of seeds, increasing investment including expanding international cooperation in the rural infrastructure and agricultural research and development, as well as developing agricultural science and technology to increase food production capacity [21].

Good Health and Wellbeing aim to make sure healthy lives and bring well-being for all people in all ages and genders. This includes decreasing the focus on the ratio of maternal and infant mortality, ending the epidemic of several infectious diseases, strengthening prevention and treatment, and preventing the abuse of hazardous substances, narcotics, and alcohol. Health services are substantially aimed at reducing mortality and illness caused by contamination of environmental pollution, providing financial risk protection for basic health services, and strengthening the implementation of the WHO framework. Research on public health and welfare is also developed for public health, including research on basic drugs that can be used for risk reduction, as well as national and global health risk management. Quality of education is to make sure inclusive (special needs people) and quality, while supporting lifelong learning opportunities for all people. This target makes sure children to complete equivalent, getting appropriate quality primary, and secondary education. This can lead to relevant and effective learning outputs and outcomes [22]. The focus is also given to the development of quality in early childhood, parenting patterns, and pre-primary education. The quality of education also includes ensuring equal access to decent work based on relevant educational expertise, eliminating gender disparities, increasing the number of scholarships, and increasing the supply of teachers. Building and improving the quality of educational facilities is developed towards aspects that are sensitive to gender, as well as children and disabilities. It also provides a safe, inclusive, non-violent, and effective learning environment for all aspects [23]. That is why there is a standard in building and its utilizations [24-30].

The next goal is gender equality, especially related to the removal of all types of discrimination and violence, including human trafficking against women and children. It is to make sure that women are able to participate, getting equal opportunities in political, economic, and public life. They can gain access to sexual and reproductive health. They also can increase the use of applied technology, especially information and communication technology. Finally, it is for supporting women's empowerment. This topic has been the issue in some articles[31-32]. Clean water and appropriate sanitation are aimed to make sure the sustainable and availability management of sanitation and clean water for all aspects and levels in society. This relates to universal access to sanitation, hygiene, and clean water supply that can be reached by all people [33]. Increasing water quality is obtained by reducing pollution and managing the disposal of waste and residual chemicals to provide a sense of security to the environment. Substantively this target also focuses on increasing the efficient usage of water in all sectors, improving water-related ecosystems, and providing support for local community participation in enhancing sanitation and water management [34]. The SDGs focus on Affordable and clean energy to make sure access to energy. Thus, it is affordable, reliable for all people, and sustainable for all aspects [35]. Substantively access to energy can be well facilitated, including for clean energy research and technology, energy

efficiency, and encouraging investment in improving the quality of technology for a sustainable supply of modern energy services [36].

The next goal is related to a Decent workload and economic growth relating to inclusive (special needs people), sustainable economic growth, and a productive workforce in decent work. Maintaining economic growth to achieve a higher level of productivity can be done by certification, improving the quality of technology, and innovation which will then progressively improve economic growth. This target aims to encourage development-oriented policies. This can support productive activities, entrepreneurship, job creation, innovation, and creativity. The target also encourages the formation and the growth of micro/small/medium enterprises, including through access to funding/capital services. Industry, Innovation, and Infrastructure refer to building durable infrastructure, supporting inclusive, and sustainable industrialization, and promoting the development of innovation. Building quality, reliable, durable, and sustainable infrastructure is focused on supporting economic development and human welfare. It is also expected to significantly increase job creation and gross domestic product, increasing access to small industries. It further has an objective in increasing access to information and communication technologies. It also strives to setup universal and affordable access to industrial and infrastructure components in less developed countries. This becomes the main issue in some reports[37-39].

The next target is to decrease inequality within and between countries in the world. This is intended to provide equal opportunities for the inclusion of social, economic, and political perspective. It is regardless of age, gender, disability, nation, ethnicity, origin, ethnic group, religion, or economic status. Sustainable Cities and Communities have a target to build cities and human settlements that are inclusive, safe, durable, and sustainable[40-41]. The SDGs are to make sure access to decent, safe, and affordable housing and basic services. Substantively, it provides universal access to public spaces that are safe, inclusive, and easily accessible to all people, especially minorities such as children, women, elder people, and persons with disabilities. The SDGs target that is no less important is responsible consumption and production. The SDGs are to make sure society implements sustainable consumption and production patterns.

This sustainable consumption and production program encourages each country to achieve efficient management of natural resources, reduce global food waste, and create environmentally friendly production. Through this program, it is to make sure that everyone everywhere gets relevant information to build a sustainable lifestyle and pattern of consumption and production. Climate action is an SDGs target that aims to strengthen resilience and adaptive capacity to climate-related hazards and natural disasters. This becomes a hot topic in some reports [42-46]. This includes strategies to improve education, individual and institutional awareness of climate change mitigation, disaster impact reduction, and early warning of disasters [47]. Conservation and utilization of oceanic, marine, and maritime resources for sustainable development is the target of life below water. Preventing and reducing all kinds of pollution that occurs in the sea, especially as a result of land activities, is one of the efforts to achieve a healthy and productive sea. Every country has the right to have the policy to prohibit excessive and illegal extraction of marine resources and destructive practices. Instead, marine resources are directed at increasing economic benefits, increasing scientific knowledge, developing research capacity, and transferring marine technology.

Life on Land is concerned with protecting ecosystems on land including patterns of protecting, restoring, and supporting the sustainable use of land ecosystems. Terrestrial ecosystem management consists of managing forests in a sustainable manner, combating desertification, inhibiting and reversing soil degradation, and halting the loss of biodiversity [48]. The way how to restore and manage ecosystem has been well documented [49-51]. Each country integrates ecosystem and biodiversity values into national and local planning, development processes, and poverty reduction strategies. In addition, this program can also be carried out by increasing global support for efforts to combat poaching and the sale of protected species, including increasing the capacity of local communities to obtain sustainable welfare opportunities. Supporting peaceful and inclusive societies for sustainable development, providing access to justice for all, and building effective, accountable, and inclusive institutions at all levels are targets of peace, justice, and strong institutions [52].

This program is to make sure public access to information and protects the fundamental freedoms of society and the state following national laws and international treaties. Each country is expected to strengthen national institutions and provide legal protection for its people, fight violence and terrorism, and support non-discriminatory laws and policies for sustainable development. This has been a big issue and reported in some papers. Partnership for the goals is the latest SDGs target which aims to strengthen the implementation and revitalize the global partnership for sustainable development. Strengthening the mobilization of domestic resources, financial resources, improving macroeconomic stability, and expanding global partnerships to support sustainable development.

2.2. Science education

SDGs with 17 goals are the core of the 2030 agenda that must be achieved by UN member states. The goal of the SDGs in general is to provide security for a sustainable for all people, both now and in the future. As a preparation for achieving the SDGs, ESD is developed by developing competencies that empower individuals to reflect on individual actions, taking into account social, cultural, economic, and environmental impacts. Therefore, ESD must be able to describe new knowledge, skills, values , and attitudes. Thus, it can carry out an effective evaluation.

Education is one of the strategic and excellent ways to develop, implement, and apply SDGs values [53]. The education itself can promote sustainable development and can be a strategic way of addressing environmental and development issues and problems. Education in SDGs'target is basic a concept, It carries a new strategy on vision and mission in the field of education. The concept builted to empower community of all ages to be responsible for creating good quality sustainable development. Science education deal with the challenges of SDGs as well as ESD, but in different perspectives. There are three perspectives involved:

(i) playing an important role in supplying an adequate student with a comprehension of the complexities, reasons, and causes of the global competitiveness and challenges. For example, we can know from water scarcity, climate change, energy transition, and biodiversity loss;

(ii) looking for new strategies to combine and integrate science, knowledge, and skills into realistic conditions and explaining ways to relate knowledge to values and attitudes relating to sustainability; and

(iii) having a mandatory to overcome subjects and disciplinary border to understand a problem with comprehensive manners. It also provides specific knowledge to solve the current problems.

Science education has the goal of a growing understanding of scientific concepts and being able to solve and evaluate complex problems [54]. Science education has experienced significant developments, these developments are influenced by economics, technology, and the influence of globalization [55]. This rapid change in science education has had a significant influence on human life [56]. Science education has a considerable influence on sustainable development. Science education has a key point in enhancing the quality of life as well as the environment. Science education is used as a constructive tool in creating public awareness in changing mindsets as a solution in supporting sustainable development. Science education can prepare students to face the challenges of the world in the future and become a solution to the problems they face. Science education can be a solution to overcome problems faced in sustainable development, empowerment, and social transformation [57]. Science education must be able to teach students to face challenges and fulfill the 17 SDGs set by the UN.

The General Assembly of the UN agreed on a decision regarding achieving the SDGs in 2015, including 17 points for getting a better world future. The goals are in focus on specific topics, such as poverty alleviation have to go hand in hand with strategies, which promote economic growth and development. Countries under the UN must have a commitment to bring the successful implementation and application of the SDGs through many activities. They also have to take strategic steps to realize their dreams for becoming a prosperous country in 2030. One of the important points is ESD, which is classified as a key element of the 2030 Agenda for SDGs.

Based on the 17 SDGs goals for the 2015-2030 implementation period, the quality of education has an important contribution to achieving other goals. To realize sustainable development, quality education is needed in shaping humans as the holders of control over a sustainable future. The world is changing so fast, education plays a very important role in dealing with a changing world that is so fast. In particular, science education plays a key point in helping students to be able to interpret and understand global developments and be able to manage risks from uncertainty and technological developments and innovation.

Science education has a framework that can be implemented comprehensively, the framework for science education as part of the solution in making the SDGs successful can be a strong reference that can bring systemic, synergistic, and sustainable changes for good impacts [53]. There are six frameworks developed in science education as preparation for SDGs:

(i) science education is an important point of a learning continuum for all sectors. The sectors include activities from preschool to actively engaged citizenship;

(ii) science education must be focused on competences with an emphasis on learning through science and shifting from science, technology, engineering and maths (STEM) to science, technology, engineering, art, and maths (STEAM) by connecting science and technology with other subjects as well as other disciplines;

(iii) the quality of the teaching process. The quality perspective includes induction, pre-service preparation and in-service professional development, all of that factors must be enhanced to the depth and quality of learning outcomes;

(iv) Collaboration among ducational providers, corporation , and civil society can be increase, to make sure relevant and meaningful engagement of all community actors with science, increase science studies, science-based career, employability and competitiveness.

(v) greater attention can be get to promote Responsible Research and Innovation (RRI), improving public comprehension of scientific findings including the capabilities to explain their benefits, gains, and consequences; and

(vi) emphasis must be put, linking innovation, creativity, and science education strategies. The strategies are not only at local level but also at all levels, including regional, national, and international levels. This can bring into account societal needs and global developments.

2.2.1. Science education as an important component in a learning continuum for all sectors

Learning is important for every individual, learning is not only limited to cognitive activity but further how a person can develop. Science education contributes to personal well-being and fulfillment, encourages participation in all aspects of the economy and society and supports creativity and innovation, and enhances the quality of the person. The concept of life-long learning emphasizes that continuous learning is a series that must be carried out continuously [58]. Science education must be implemented in all schools starting from elementary to secondary schools to develop and increase student sensitivity and increase motivation and scientific knowledge [59]. A strong educational foundation and learning experience can inspire students. Thus, they can improve and deepen their learning process .

2.2.2. Science education's objective on competencies with an emphasis on learning through science and shifting from STEM to STEAM by linking science with other subjects and disciplines

The successful education in the 21st century depends on the acquisition of competence rather than conceptual learning. 21st-century skills focus on students' skills in collaborating, listening to other people's ideas, thinking critically, creatively, and having high initiative, being able to solve problems and take risks in making decisions and managing emotions, these are things that are considered important in lifelong learning. Fundamentally, science education focuses on learning in science, the OECD distinguishes between knowledge of science and knowledge of science. Science knowledge includes understanding of fundamental scientific concepts and theories; knowledge of science includes "understanding the nature of science as a human activity and the strengths and limitations of scientific knowledge". Understanding science education is quite important, in order to face big challenges, namely climate change, human health and healthy living, food and water security or sustainable cities [60].

2.2.3. The quality about teaching, from the induction, through pre-service preparation as well as in-service professional development to upgrade the depth and quality of learning output

The quality of the education system is a major factor underlying personal achievement and innovation in being competitive at the global level. Shifts in learning affect the quality of the education system, what students must master, what must be understood, and what must be mastered becomes important for students to master [61]. The results of quality education and learning become the foundation of society in the future to achieve goals to change the systematic and professional development of teachers [53].

2.2.4. The Collaboration between Educational Providers, Corporation, and Community to Increase Science Studies and Science Based Careers

Employment skills are becoming an issue in education, the demand for skilled labor in the economy exceeds the demand. Future qualifications and skills mean that the need for job skills will increase. These skills and qualifications are related to STEM, and due to the small number of students who choose to study this discipline, the skills and qualifications will decrease according to the needs of the industry. The results of the study show that women do not work in science compared to men. Improving skills and qualifications is carried out by collaborating between science education, formal, non-formal, and informal education providers, research centers, companies and industry, and other professionals who can have a role in increasing interest in science [62]. Partnerships built between teachers, students, and stakeholders in science can be a pretty good way to deal with real-life challenges, especially in ethical and social issues.

2.2.5. Greater attention to promote RRI and enhancing public understanding of scientific findings including the capability to discuss their benefits and consequences;

Knowledge of science and knowledge of science develops rapidly and sustainably [63]. Innovation and technology are solutions to developing learning in science education, this can assess and evaluate the quality as well as results of science education and research in the field of the science education which must cooperate and collaborate and involve policymakers. This can see new ways to define and measure what is considered appropriate to the goals of science education.

2.2.6. Emphasis on networking innovation as well as science education strategies, at regional, local, national, European, and international levels, taking into account global developments and societal needs

Science education reform is part of a systematic effort at various levels, this is following the needs and contributions to the strategies developed by decision-makers or policymakers. All policy stakeholders throughout the learning series, starting from schools, universities, companies, and community organizations must be able to develop strategies related to the goals of society at large [53]. Changes to policies are supported at different levels, they are part of the reality of society.

The relationship about science education as well as innovation strategy must be strengthened to eliminate regional, socio-economic differences, and gender [64].

3. Method

The data in the article that we gained in this study was based on research from publications. Specifically, we considered data that have been published in Google Scholar index. The reason we use it is that from an ergonomic standpoint, it's free. However, in future research, we will try to develop from Scopus data. We analyzed article data from 2012 to 2022 with the keywords the relationship between SDGs and science education. Research data was taken from the Publish or Perish (PoP) . The literature review was carried out directly through PoP, according to the chosen topics. The data taken was processed with Microsoft Excel. Each data according to the theme was visualized through VOSviewer with bibliometric mapping. Detailed information on how to use VOSviewer is reported elsewhere [65-66]. Figure 1 shows briefly the procedure for collecting data in this study. The stages include: we determined keywords, namely the relationship between SDGs and science education using the publish or perish application. Furthermore, the downloaded data is processed using Microsoft Excel. Analysis data is then presented visually through VOSviewer and bibliometric mapping.

Fig. 1. The procedure for collecting data in this study.

4. Results and Discussion

Bibliometric analysis is one of the best methods to analyzing, visualization, and exploring large total of scientific data [67]. There are many reports for bibliometric analysis [68-85]. In this study, we applied bibliometric analysis for understanding SDGs in science education.

4.1. Research developments of the field of SDGs in science education

Figure 2 shows the development of research on the relationship between SDGs in science education from 2012 to 2022. The development of research on SDGs in science education began to develop in 2014. Every year, the development of research on this theme has increased. The peak of research will occur in 2021. In 2022, research on this theme will experience a decline. The development of research on this theme was recorded in as many as 752 journal articles that developed over 10 years.

4.2. Visualization of SDGs in science education topic area using VOSviewer

In this study, two different representations in bibliometric mapping were generated from VOSviewer. The first is an overlay visualization (Fig. 3) and a density visualization (Fig. 4). Keywords are labeled by colored circles. Circle size is closely related to the number of keywords in the abstract and title. This results in the same size of the circles and letters being governed by the same frequency of occurrence

of the associated keywords. If the keyword is bigger, the circles and letters will be bigger [86-88]. Figure 3 shows the overlay visualization of the relationship between SDGs in science education. The brighter the color, the more recent the development of research on SDGs in science education. The most recent research is in 2022 which is yellow. Big balls indicate a lot of research. In 2022 analyzed data on the development of research on SDGs in science education mostly discussed matters related to students and covid.

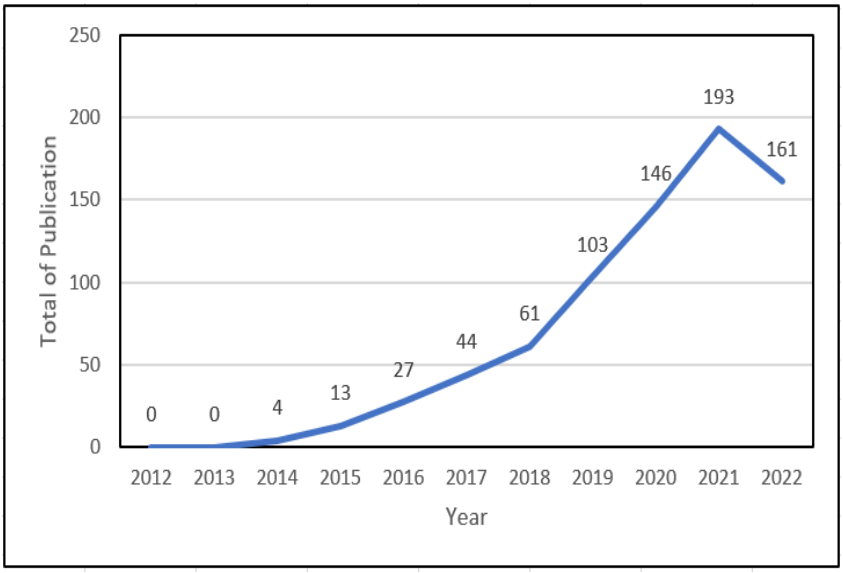

Fig. 2. Research development of SDGs in science education.

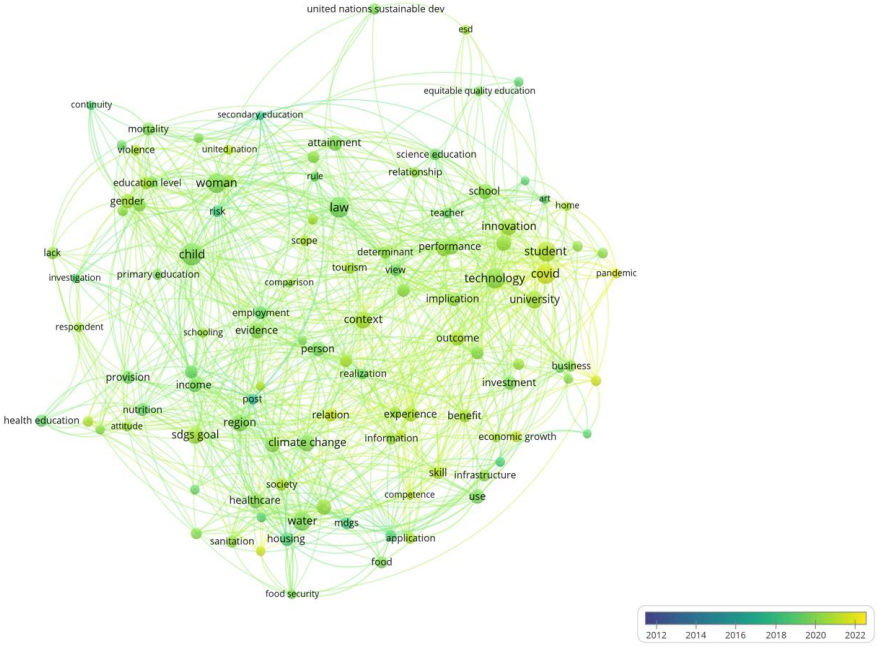

Fig. 3. VOSviewer results for the overlay visualization.

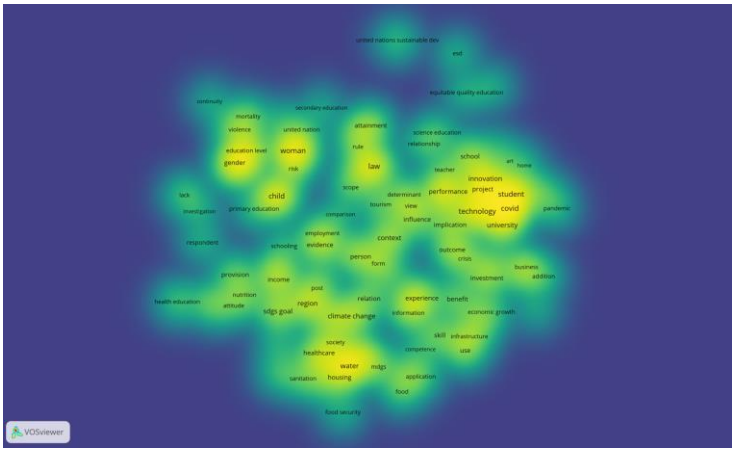

Fig. 4. VOSviewer results for the density visualization of materials keyword.

4.3. Network visualization SDGs in science education topic area using VOSviewer

Figure 5 shows the network visualization on Di VOSviewer. Each term, at least, had two relationships. VOSviewer then evaluated by visualizing all data. The resulting data is then evaluated by VOSviewer[89-91]. VOSviewer categorizes the data into 7 groups represented by green, red, blue, turquoise, purple, yellow, and orange. Science education is in the red color cluster (see Fig. 5). The results of the visualization analysis showed several terms that are directly related to the SDGs in science education including ESD, secondary education, attainment, society, technology, university, and innovation.

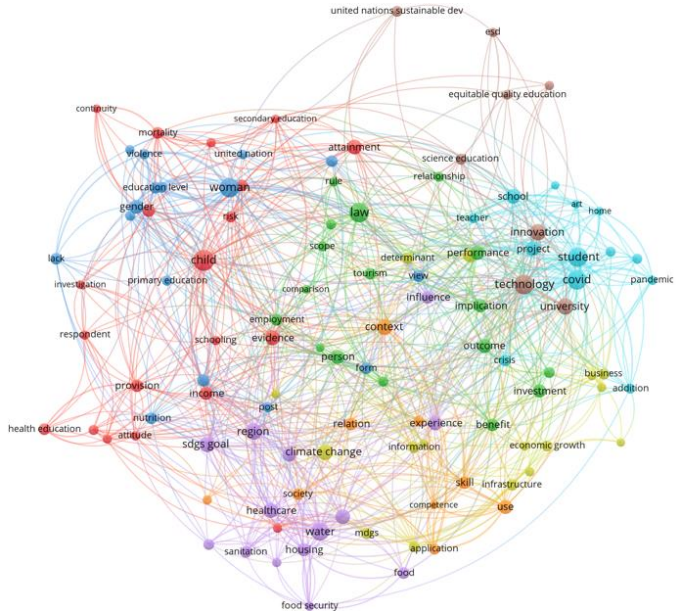

Fig. 5. VOSviewer results for the network visualization of material keyword.

Figure 6 shows the VOSviewer results for Network Visualization of the data in SDGs. Some several aspects or terms are directly related to the SDGs. The relationship is depicted using 7 colors. Data is visualized into 7 colors using VOSviewer [92]. The red color included aspects of effectiveness, health education, provision, income, responder, investigation, risk, and mortality. The green color is only directly related to the term ministry. The blue color is directly related to the terms reduction, education level, and lack. The color yellow is directly related to climate and livelihood. The color purple is directly related to the region, healthcare, hunger, housing, expertise, food security, experience, and influence. The color turquoise is directly related to the terms student, covid, pandemic, and addition. While the orange color is directly related to the term skill.

There are 18 terms directly related to the SDGs. If analyzed, research on SDGs is not directly related to science education. The relationship between Science education and SGDs is intertwined through several interconnections with other themes. The relationship between SDGs and science education can be established through the term education. Education is related to the objective aspect of SDGs in number 4, namely quality education. One of the goals of SGDs is to make sure that education is inclusive and of equal quality while also supporting life opportunities for all [93]. Apart from the education aspect, science education is related to the SDGs through aspects that are directly related, such as health which is the second goal of the SDGs and others. This is because when we talk about the 17 scopes of aspects included in SGDs, indirectly all of them are related to aspects of science and education. Scientific phenomena are not only related to formulas and numbers, but also to natural phenomena that occur around us, such as those related to food, water, and health. This is confirmed by the statement that scientific phenomena are related to phenomena related to everyday life [93].

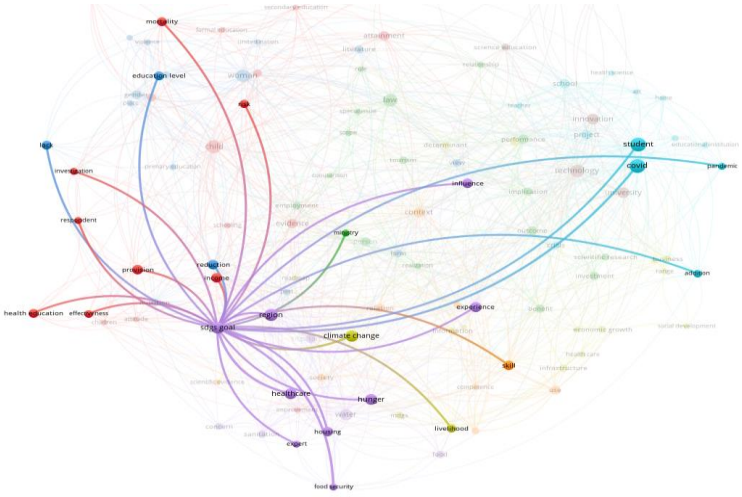

Fig. 6. Network visualization SDG's goal.

5. Conclusion

Discussion of SDGs in science education from a literature review and bibliometric analysis was the objective of this study. The VOSviewer mapping method was used to analyze bibliometric data on SDGs in science education. Data was taken from 2012

to 2022. The results showed that research on the highest SDGs was in 2021. In addition, the development of SDGs research also began in 2014. From the results of the analysis of the development of science education research, it does not have a direct relationship with the SDGs but is connected through the term theme. other research. This can be seen from the data presented on VOSviewer. The results of this study are expected to be gained for consideration by other scientists and researchers to study more deeply about research related to SDGs and science education.

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