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A DECADES OF CLIMATE CHANGE EDUCATION IN EXPERIENTIAL LEARNING - A BIBLIOMETRIC STUDY AND RESEARCH AGENDA

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Abstract

The study aims to describe a bibliometric approach to study trends in Climate change education and Experiential Learning in science education. We used the VOSviewer application for bibliometric analysis, 480 articles were collected from Scopus related to Climate Change and Experiential Learning in science education during the last decade from 2013 to 2022 using shared word analysis and text analysis. The number of articles throughout the year continued to increase. When viewed by country, the dominance of the US is clear with 83 articles. Research on climate change education and Experiential Learning in science education is still relatively less, with 31 documents during the 2013-2022 period and only a few countries have examined their relevance to science education. Additionally, the linkage with Case Study learning is still very minimal. This provides good opportunities for further research. The results of this bibliometric analysis provide an overview and opportunities for further research.

Keywords: Bibliometric, Climate change education, Experiential learning, Research agenda, Sustainable development goals.

1. Introduction

Climate Change Education in Experiential Learning for the last two decades using bibliometric analysis is an alternative study for trend mapping and exploring global concern about the damage to ecological systems in learning settings. Climate change issues are related to emerging regions, and the goal is to assist them in reducing emissions while achieving sustainable development. At the same time, countries in the world are attempting to address climate change from two perspectives, including technology and regulations. On the other hand, climate change themes involve a wide range of subjects, such as science learning. It emphasizes the importance of conducting a learning analysis to assess the expanding body of knowledge in the field for a better understanding of the relationship between climate change and education, including experiential learning. [1, 2].

Many reports have discussed climate change education. The industrial revolution has had a significant impact on global environmental change. These changes are largely due to widespread and destructive human behavior. An unsustainable lifestyle is the cause of this problem [3-6]. This problem cannot be separated from the low level of human awareness of the interrelationships between humans and natural systems. If this is allowed, current and future generations may have difficulty meeting their needs. This condition will not occur if we, as the best creatures created by God, care and act for sustainable development [7, 8]. Education is one of the most critical issues for promoting climate action. It will assist people in understanding and coping with the impacts of the climate crisis, including empowering them with the knowledge, skills, values, and attitudes needed to act as agents of change [9]. This climate action is one of ESD's key thematic priorities for 2030 within the global Education for Sustainable Development framework for the next 8 years. Through its program, UNESCO has worked to make education a more central and visible part of the international response to climate change.

The main objective of this paper is to provide a broad summary of the various studies of climate change education in experiential learning conducted over the last two decades using bibliometric analysis. As a result, this review is different from previous ones. In other words, it supplements existing review articles that use comprehensive methods to examine specific trends in climate change education in experiential learning. Earlier research also revealed that no study addressed the principle of bibliometrics on climate change education and experiential learning as integrated research. The scholarly literature has not discovered the hot trend theory of future research relevant to climate change education, which is a great disparity in the current article. The most widely focused research topics on climate change are not for climate change education.

2.Literature Review

Climate change is one of today's most urgent problems, having significantly reshaped or is in the process of altering the earth's ecosystems. Although climate change remains a continual cycle on Earth, in recent years, roughly in the final 100 years or more, the rate of variation has increased dramatically. Since the nineteenth century, the average temperature has increased by 0.9°C due to anthropogenic activities, primarily caused by greenhouse gas (GHG) emissions into the atmosphere. According to estimates, this rise will be 1.5°C by 2050, or even higher

depending on the rate of deforestation [10]. This increases the average temperature of the earth, which is known as global warming. All countries are thus acknowledging their responsibility to gradually prioritize carbon neutrality and develop global warming as climate change modules in educational content, namely climate change education (CCE). CCE can be a combination of formal, informal, or non-formal educational or instructional approaches, such as nature immersion research projects, global case studies, or higher-degree research. Figure 1 depicts a critical twin technique in which countries simultaneously decrease their own "carbon footprint" (by going to aim for net-zero emissions) while expanding the societal "carbon brain print" (by teaching knowledge and skills about carbon)

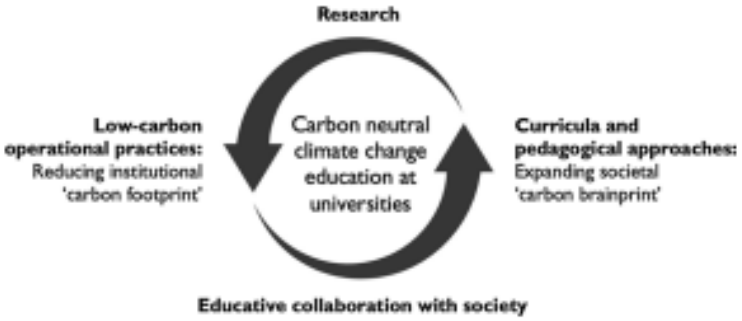

Fig. 1. Depicts a critical twin technique.

One of the well-known methods to introduce and raise student awareness about global warming in class is through experiential learning. Experiential Learning is a learning process that encourages the process of knowledge being created through the transformation of experience and the way to acquire knowledge is to understand an experience and apply the learning from that experience to other relevant situations [11-13]. Students are required to be able to find and be critical of the problems they face. Thus, they can prepare solutions to solve the problem [14]. Experience-based learning assumes that students' life experiences play a central role in their learning and understanding of new knowledge. The Experiential learning process is described as a circular circle, as shown in Fig. 2.

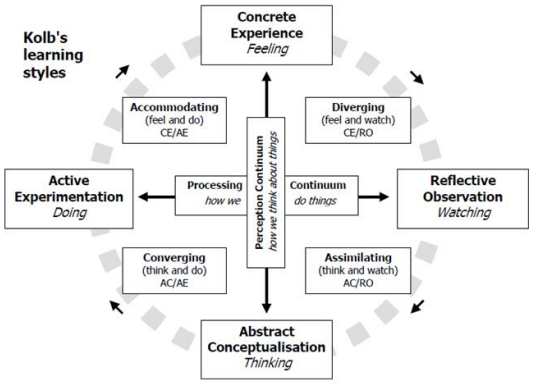

Fig. 1. Experiential learning process.

3. Method

This study uses a desk study with bibliometric analysis, which consists of five stages, namely research design; data collection; data analysis; data visualization, and interpretation [15]. The data in the articles obtained in this study are based on research from publications. In particular, we consider data that have been published in Scopus. Data collection was carried out in January 2023, and we analysed article data from 2013 to 2022 based on established criteria, namely experiential AND Climate Change in the last decade from 2013-2022. Additionally, the articles taken are limited to the Social, agriculture, Earth, and Physics sub-areas. Additionally, it is limited to the exact keyword sustainability, experiential development, environmental learning, education for sustainability education, transformative learning, environmental awareness, and Education for Sustainability Education (ESD). The data results are then filtered again by taking only journal article data. Based on the specified criteria, 480 articles were obtained from 4491 available documents. The articles have been analysed from Scopus-indexed international journals. Data from Scopus are stored in RIS and CSV, moreover, Mendeley Desktop has been used to reset article metadata. Furthermore, to visualize research trend data on the topic of Climate Change and Experiential Learning in the 2013-2022 range, the VOS viewer software is used as a tool. Detailed information for the use of VOSviewer is shown elsewhere [16], and examples of the use of Vosviewer are available in the previous studies [17-20].

4. Results and Discussion

Based on predetermined criteria, the number of publications related to Climate Change and Experiential Learning in 2013-2022 is presented in Fig. 3. Generally, it was found that the number of published articles related to Climate Change and Experiential Learning increased periodically, even though in 2014, 2017, and 2022 decreased in quantity. In previous articles, the experiential discussion discussed more related learning approaches, both related to STEM, project-based learning, and the use of technology in learning [21, 22]. However, this research is not much related to the case study learning method with task performance, which directly assesses students' real action activities related to climate action promoted by all countries with the encouragement of the UNESCO international institution. Much research related to Experiential Learning is also related to the theme of health, medicine, and pharmacy [23-25]. This is homework for educators in the field of science education to further promote real climate action through classroom learning.

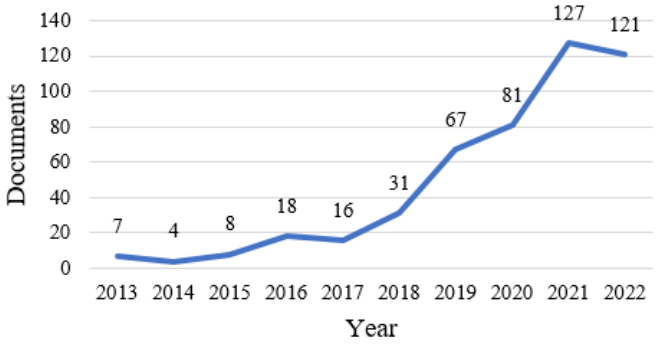

Fig. 2. Documents by year.

Regarding the number of articles across countries, the US dominates with 83 articles from 2013-2022. Countries such as Spain, the UK, and China respectively 68, 55, and 34 articles. Meanwhile, Australia, Taiwan, Sweden, the Netherlands, Germany, and Canada contributed many articles between 17-30 documents. The number of articles between countries can be seen in Fig. 4.

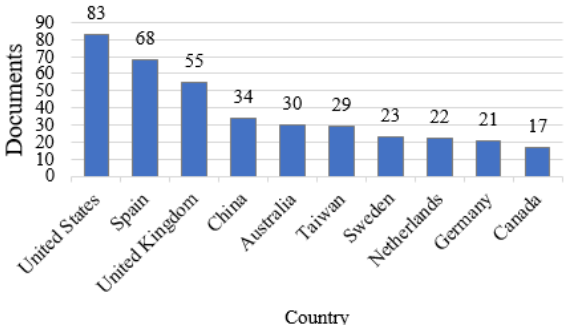

Fig. 3. Documents by country.

Based on author affiliation, the most productive affiliations sequentially are Tecnologico de Monterrey, Universitat d'Alacant, Oulun Yliopisto, Universidade de Lisboa, Universitat Politècnica de València, Cardiff University, Griffith University, Faculdade de Ciências, Universidade de Lisboa, Arizona State University, and Descend yliopisto (Fig. 5).

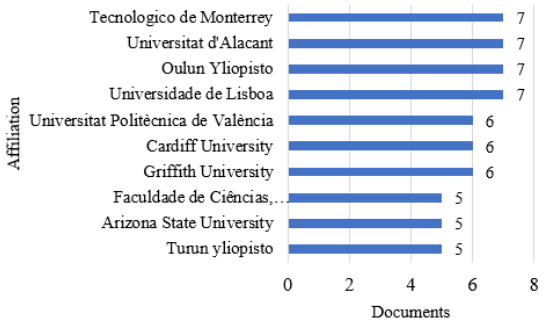

Fig. 5. Documents by affiliation.

Related to research on Climate Change and Experiential Learning, researchers are assisted by VOSviewer software. This effort finds novelty in research on this theme. The findings revealed that there are several parameters and the relationship between the variables sought (Fig. 6), which shows an overall picture of research on Climate Change and Experiential Learning. Research related to experiential learning is closely related to sustainability, sustainability development, ES, climate studies, environmental change, case development, ESD, virtual studies, teacher training, and literacy. This is logical because the themes of Climate Change and Experiential Learning are closely related to environmental themes, which are currently becoming the concern of the whole world regarding climate change that is increasingly worrying and climate action is echoed around the world.

Research related to Sustainability, Climate Change, and Experiential Learning is also related to a case study or field study learning method (Fig. 7). Although research related to this is still small assembling only 24 links and only 7 terms in common. This is an interesting theme and a gap that needs to be explored for further research related to Experiential Learning with Cases study.

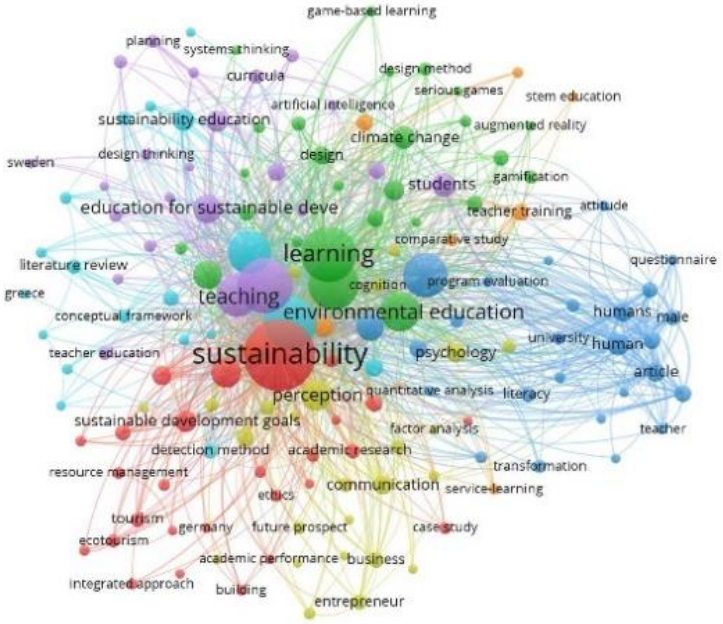

Fig. 6. Research on climate change and experiential learning during 2013-2022.

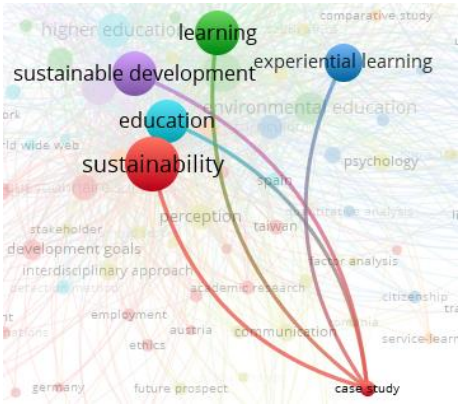

Fig. 7. Experiential learning results.

5. Conclusion

Important points have been reached on research trends on Climate Change and Experiential Learning during the 2013-2022 period. The number of articles throughout the year continued to increase. When viewed by country, the dominance of the US is clear with 83 articles. Based on article sources, the journal

Sustainability Switzerland dominates with a total of 235 articles, far outperforming other journals. Based on the author's institution, it shows a composition that is not too far from the top 4 institutions, namely Tecnologico de Monterrey, Universitat d'Alacant, Oulun Yliopisto, Universidade de Lisboa, and Universitat Politècnica de València. Meanwhile, Experiential Learning studies that are directly related to climate change are still minimal, with only 31 document articles during the 2013-2022 period. Additionally, the link Case Study learning is still very low. This provides a good opportunity and reference for future research.

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