

The existence of environmental education in the COVID-19 pandemic: A systematic literature review

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Abstract

The implementation of environmental education in the world is affected by the COVID-19 pandemic, so researchers must be responsive, adjust and creative strategies to survive, and think about future anticipations. The focus and concern of researchers towards the theme of environmental education and COVID-19 is highly expected, as evidenced by the research results published in reputable journals. The purpose of this systematic literature review was to review and compare investigations of research on articles published by Scopus indexed journals. We used the phrase "environmental education and COVID-19" in the disbursement menu in Scopus Database and found 1379 articles. Furthermore, only 21 articles met the criteria to be analyzed. The inclusion and exclusion model used is PRISMA. There has been a trend of increasing publications in the last four years. Environmental education issues can be approached through qualitative, quantitative, mix-method, case studies, and R&D. The authors most in the spotlight are Lowan-Trudeau, G. (reference), Aristovnik, A. (bibliographic coupling), and Mehmood, R. (co-citation). The keywords that are mostly used by the author are COVID-19, education, higher education, and sustainable development. This environmental education keyword has branches into climate change, sustainable development, and adaptation. There are 22 countries of origin of authors who published articles, dominantly from the United States and the Republic of Korea. Articles are published equally by authors from Europe, Asia, and America. It was found that there were more articles published in collaboration between universities within one country and between countries. Rarely are articles written by a single author. There are 20 institutions that provide funding for research and publications. Most publications have fulfilled one of the ethics by declaring funding status. We succeeded in formulating and discussing a description of the existence of environmental education during the COVID-19 pandemic. These findings can serve as a consideration or baseline for researchers to study environmental education and COVID-19 themes according to their respective backgrounds and objectives.

Keywords: COVID-19, existence of environmental education, reputable journals, Scopus Database, systematic literature review

INTRODUCTION

The COVID-19 pandemic that occurred from the end of December 2019 to 2023 has had an impact on the

world of education globally. Tens of millions of students at the primary and secondary school level as well as students at tertiary institutions were affected (Engzell et al., 2021; Hammerstein et al., 2021; Russell, 2022). The

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Contribution to the literature

- The researchers focus on the original publication about environmental education and an overview of the existence of environmental education during the pandemic, something that no other academics have done so that a baseline study may be provided.
- The review of the scope of material we utilize only contains research/original publications, offering an overview of the researchers' focus and alignments on this theme. The scope of information that the researcher use is limited to research/original articles; thus, it provides an illustration or description of the focus and partisanship of researchers regarding this theme.
- The researchers describe the form of environmental education existence during the COVID-19 pandemic so that it can become a reference or basis for researchers on this theme.

COVID-19 pandemic has specifically changed the pattern of study and learning that is carried out (Engzell et al., 2021; Fahmalatif et al., 2021; Gonzalez et al., 2020; Kumar et al., 2021; Pokhrel & Chhetri, 2021; Wilczewski et al., 2021), including environmental education. For students, parents, teachers, lecturers and education regulators as well as education practitioners, the COVID-19 pandemic is a big challenge that demands anticipatory, adaptive and even transformative steps (ECLAC-UNESCO, 2020; Iivari et al., 2020; Mishra et al., 2020; Pradhan et al., 2021; Sharif & Khavarian-Garmsir, 2020). The parties involved in the world of education need to be responsive in determining solutions to the ongoing pandemic (Reimers et al., 2020) post-pandemic, and even face the possibility of a pandemic in the future (Bashir et al., 2021).

Researchers, practitioners and actors in the field of environmental education must also be responsive to the challenges of learning during the COVID-19 pandemic. COVID-19 also has a real impact on the implementation of environmental education (Assaf & Gan, 2021; Brandão & de Souza, 2021; Grežo et al., 2021; Guerra et al., 2023; Servant-Miklos, 2022; Torres Parra et al., 2022). A study is needed regarding the implementation of environmental education according to the needs, expectations and demands of the COVID-19 pandemic era. Study on the theme of environmental education is needed to help find the right form of implementing environmental education and at the same time find the right solution to deal with a pandemic so that environmental education continues to exist (Brandão & de Souza, 2021; Damoah & Omodan, 2022; Khalifé et al., 2022; Otitojua et al., 2022; Probosari et al., 2021) and even plays a role in strengthening literacy and public awareness (Fang et al., 2023; Guo et al., 2022; Iwan et al., 2023; Nurwidodo et al., 2020; Servant-Miklos, 2022).

In this regard, based on the results of a search on the world's largest reputable database, namely Scopus, it is necessary to conduct an in-depth study. These publications need to be analyzed in depth to find valuable information regarding the existence of environmental education during the pandemic, apart from looking at the trend of publications at that time based on various categories. One of the most

recommended techniques for studying and analyzing is to do a systematic literature review (SLR). Several previous publications suggest that the categories that need to be analyzed are distribution year, research types/methods, authors and keywords, author's nationality, international collaboration, and funding (Husamah et al., 2022a, 2022b; Nurwidodo et al., 2023).

SLR is a rigorous and transparent review. SLR involves identifying, synthesizing, and evaluating all available evidence, quantitative and/or qualitative, to produce accurate answers (Mallet et al., 2012). SLR provides a number of advantages for the researcher, especially in presenting a clear and comprehensive overview of the evidence available in the database on the topics of interest to the researcher. SLR can also assist researchers in identifying research gaps, both methodologically and research challenges that require further research, developing new research ideas, and synthesizing various references obtained in a critical-constructive manner (Peričić & Tanveer, 2019).

Research Problem

We have found seven English-based review articles (SLRs and meta-analyses) in Scopus Database related to environmental education. Three SLRs focused on early childhood (Ardoin & Bowers, 2020), positive youth development outcomes (Ardoin et al., 2022), and civic engagement outcomes (Ardoin et al., 2023), all of which are related to environmental education. One of the SLR is focused on the aspect disabled people in environmental-education-focused academic literature (Salvatore & Wolbring, 2022). Another SLR tried to analyze environmental education benefit environmental outcomes in children and adolescents (van de Wetering et al., 2022) and the use of GIS in geographical and environmental education evaluated (Konstantakatos & Galani, 2023). Meanwhile, the latest SLRs are focused on terms of trends in environmental education studies (Masalimova et al., 2023). However, this SLR uses articles from a lower-level database, namely the ERIC electronic database, and does not relate to the current up to date conditions (COVID-19). Thus, it can be said that there has not been an SLR that is focused on aspects of

the existence of environmental education during the COVID-19 pandemic.

Research Aim

Therefore, the aim of this SLR is to investigatively review and compare various studies on articles published by journals indexed in Scopus Database related to the theme of environmental education and its relationship to aspects that show the existence of environmental education during the COVID-19 pandemic. This SLR is expected to contribute to the development of environmental education studies, which can become a reference for researchers and readers on this topic. We focus on the publication of original articles in relation to the theme of environmental education and its relation to the existence of environmental education during a pandemic, something that has never been done by other researchers so that it can provide a research baseline and even become a basis for determining the direction of environmental education during a pandemic, post-pandemic, and even facing/anticipating various possible pandemics that may emerge in the future. A review of the scope of the information we use only includes research/original articles, thus providing an overview of the focus and alignment of researchers regarding this theme. We describe an overview of the existence of environmental education during a pandemic, which is very likely to become a reference for policy makers, practitioners, environmental education and learning actors and the general public.

METHOD

Research Framework

This study is an SLR, which seeks to identify, evaluate, and analyze various articles found to answer research questions and analyze them in depth (Snyder, 2019; Xiao & Watson, 2019) carefully and seriously. SLR helps provide a brief description of the scientific topics discussed through a systematic and transparent method of answering research questions (Kurniati et al., 2022).

Research Question

Determination of research questions is used to define the scope to develop a clear focus for the study. This research question was made based on the needs of the chosen topic, namely:

- RQ1.** How are the publication trends related to the theme “environmental education” in Scopus Database indexed journals?
- RQ2.** How is the description of the existence of environmental education during the COVID-19 pandemic?

Search Article and Inclusion Criteria

The phrase “environmental education and COVID-19” was used in the search menu in Scopus Database. The data obtained is stored in *CSV and *RIS formats, which are then synchronized into the Mendeley. VOSviewer software is used to visualize data so that information is presented more communicative, interesting and clearer. The search history for articles on Scopus—as we have done—is, as follows: “TITLE-ABS-KEY (environmental AND education+covid) AND (LIMIT TO (PUBYEAR, 2023) OR LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT TO (PUBYEAR, 2020)) AND (LIMIT-TO (OA, “all”)) AND (LIMIT TO (DOCTYPE, “ar”)) AND (LIMIT-TO (SUBJAREA, “SOCI”)) AND (LIMIT TO (PUBSTAGE, “final”)) AND (LIMIT-TO (LANGUAGE, “English”))”. With these search terms (was conducted in July 2023) and patterns we managed to find 1,379 articles in the period 2020-2023 (out of a total of 12,266 for environmental education theme for the all-years category). We apply the preferred reporting items for systematic reviews and meta-analysis (PRISMA) model to perform inclusion and exclusion in order to find articles that really fit. This model refers to Gallagher et al. (2016) and has been used also by several authors in SLR that has been published before (Husamah et al., 2022a; Nurwidodo et al., 2023). The following important points form the basis of the inclusion criteria that we use in this SLR, namely

- (1) articles published from January 2020 to July 2023 (during the COVID-19 pandemic),
- (2) only articles that are open access,
- (3) publications include research/original articles,
- (4) the subject area of the article is social sciences, and
- (5) Articles published in English and articles only related to “environmental education and COVID-19” research.

The order of inclusion and exclusion that we do is, as presented in **Figure 1**.

Based on **Figure 1**, it can be seen that in the initial search authors found as many as 1,379 articles. Then authors take only articles published in 2020-2023. Articles that meet the criteria are all or still 1,379 articles, which means no articles are excluded. Next, authors use the open access article criteria, the result is that there are 947 articles that meet the criteria. This shows that there are 432 articles that are excluded. Authors only take articles that include original articles and with that criteria there are 743 articles that meet the criteria. Thus, it means that there are 204 articles that are excluded. Next, authors use the inclusion criteria in the field of science or the subject area “social science”, in English, and the final article. There were 227 articles that met the criteria, which means that there were 516 articles that authors omitted or excluded. Authors decline subject

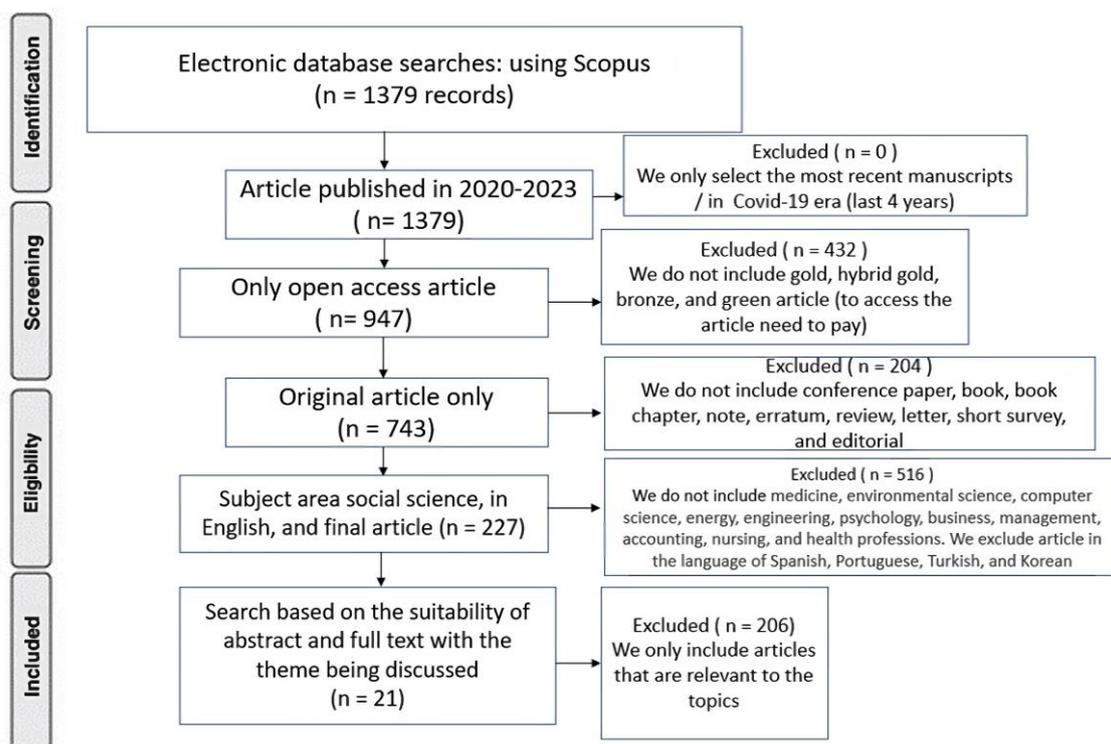


Figure 1. Systematic review of flow diagrams using PRISMA model (Source: Authors’ own elaboration)

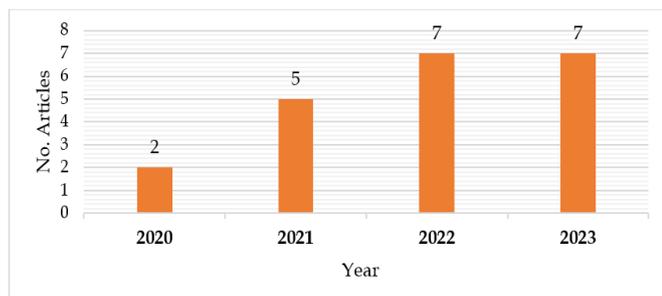


Figure 2. Distribution year of article (Source: Authors’ own elaboration)

areas that do not fit, such as medicine, environmental science, computer science, energy, engineering, psychology, business, management, accounting, nursing, and health professions. Authors exclude articles in the languages of Spanish, Portuguese, Turkish and Korean to avoid misinterpretation.

All authors do not have the ability to understand these languages. We deliberately do not use Google translate to avoid possible translation errors, misinterpretations, a process that takes a relatively long time, and requires a lot of money if you use the services of a professional translator. This is in line with Morrison et al. (2012) that restrictions are proven to have no bias effect. In the last phase, authors re-examine existing articles, ensure articles are in accordance with the themes discussed, ensure full text is accessible, and articles are published in English. Based on this, authors only got 21 articles that fit or met the criteria, which means that 206 articles did not meet the criteria and were eventually excluded.

RESULTS

Trends in Environmental Education Theme Publications

Distribution year

Figure 2 shows the number of articles published per year from 2020 to 2023. Based on Figure 2, it can be seen that the number of publications on environmental education and COVID-19 themes each year experiences an increasing trend. Even though the number of articles in 2023 is the same as in 2022, namely seven articles, it is very possible that this theme will increase considering that this data search was carried out until July 2023. There are still six more months in 2023, so it is possible that the number of articles will continue increase if traced to December 2023. Thus, it can be said that research in the field of environmental education has attracted much interest from researchers, is considered urgent by experts, and is very likely to be closely related to people’s response to the COVID-19 pandemic.

There is a trend of increasing the number of publications regarding environmental education during the COVID-19 pandemic in the 2020-2023 period. Even though the number of publications in 2022 and 2023 is stable/fixed, namely seven articles, this data is not final because the publication process in 2023 is still ongoing and it is still very likely that the number of publications on the theme “environmental education and COVID-19” in 2023 will increase because there are still many articles that have not been included in Scopus Database.

Table 1. Types of research on environmental education themes

No	Research type	n	References
1	Qualitative	12	Alves Pereira et al. (2023), Arenas (2021), Assaf and Gan (2021), Beery (2020), Casas et al. (2021), Corres Gallardo and Ruiz-Mallén (2023), Heslen et al. (2022), Iyengar and Shin (2022), Nichols et al. (2022), Ritchie and Phillips (2023), Servant-Miklos (2022), & Shaw et al. (2021)
2	Quantitative	5	Guerra et al. (2023), Iwińska et al. (2023), Kohler et al. (2022), Lee et al. (2023), & Sprague et al. (2022)
3	Mix-method	2	Dodson and Blinn (2022) & Quesada-Rodríguez et al. (2021)
4	Case study	1	Lee et al. (2023)
5	R&D	1	Rahmayanti et al. (2020)

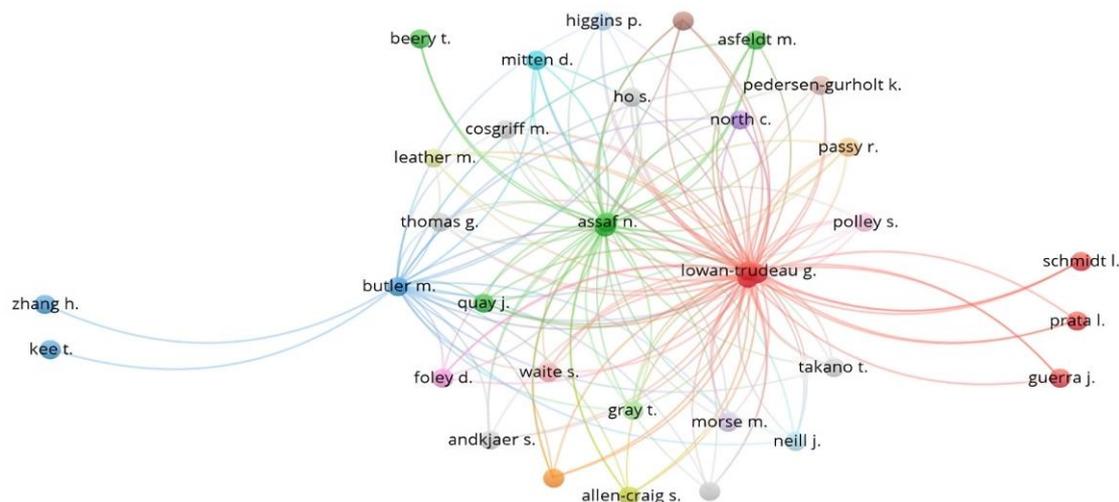


Figure 3. Authors who are dominant in theme of environmental education (Source: Authors’ own elaboration, using VOSviewer software)

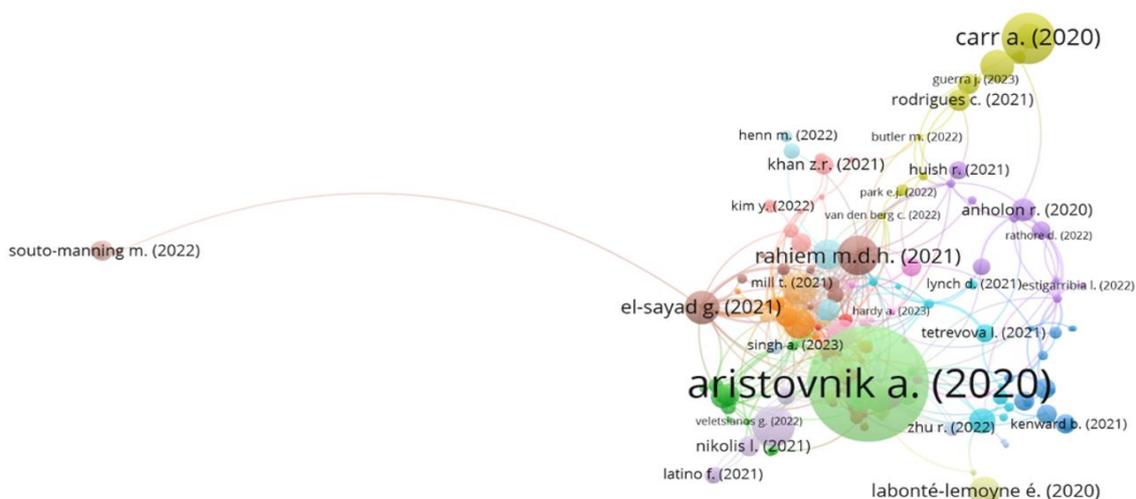


Figure 4. Dominant authors based on bibliographic coupling (Source: Authors’ own elaboration, using VOSviewer software)

This data was also obtained in July 2023, meaning that there is still six months remaining, which allows for the number of publications to increase.

Research types/methods

Trend of types of research related to “environmental education and COVID-19” themes is presented in **Table 1**. Environmental education research is more dominantly carried out using a qualitative approach (12 articles). Qualitative research is also relatively large, where the number reaches five articles. This shows that the issue of environmental education can be approached through

both quantitative and qualitative methods. Therefore, there are researchers who are also interested in using the mix-method (2 articles). Another interesting thing is the existence of environmental education issues, which are approached with case studies and R&D.

Author

Based on **Figure 3**, it can be seen that Lowan-Trudeau, G. is the one who is most often referred to in environmental education studies.

Meanwhile, based on bibliographic coupling, the dominant name is Aristovnik, A. (**Figure 4**).

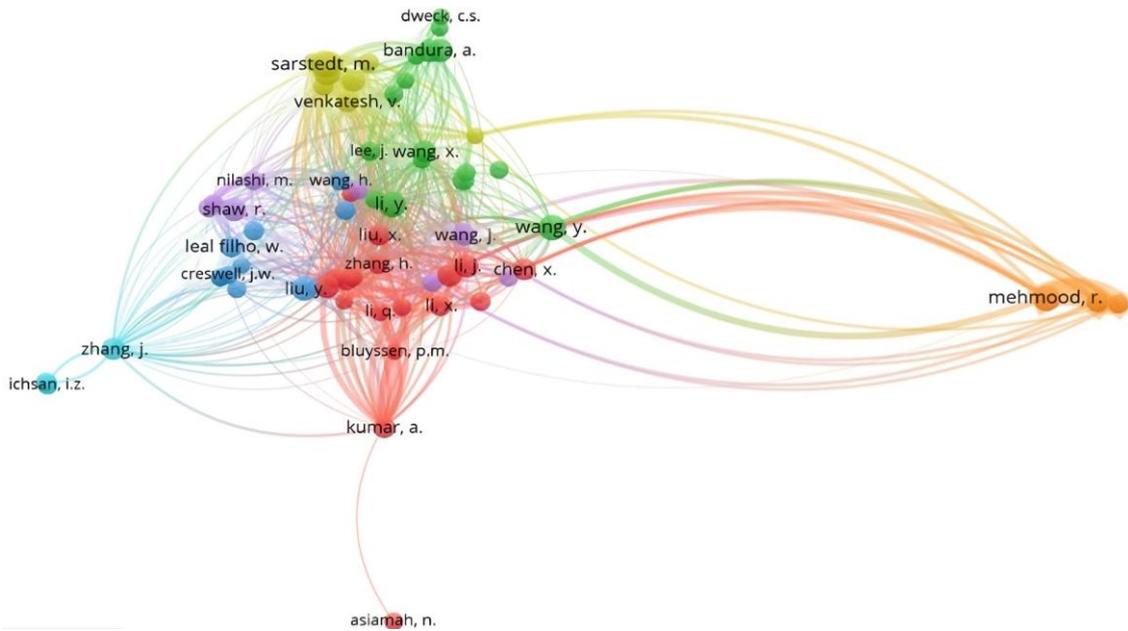


Figure 5. Author based on co-citation to cited authors (Source: Authors' own elaboration, using VOSviewer software)

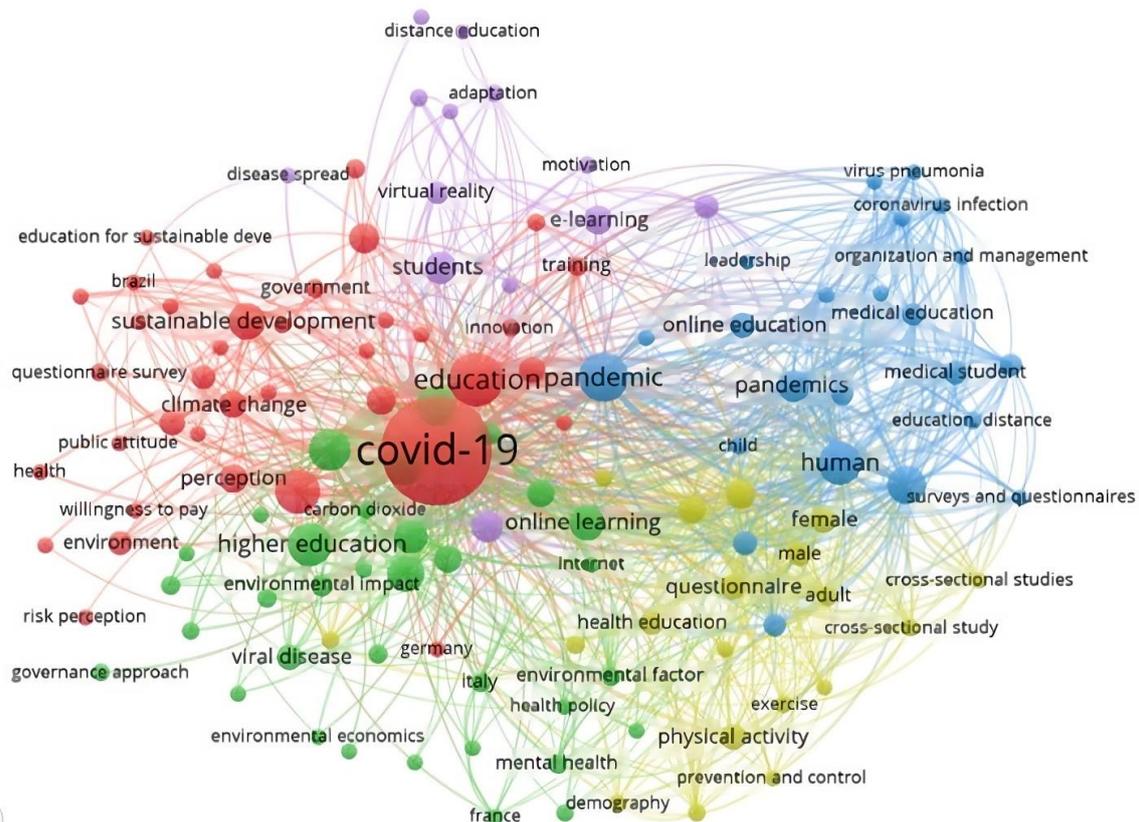


Figure 6. VOSviewer display for type of analysis "co-occurrence to keywords" (Source: Authors' own elaboration, using VOSviewer software)

This is different from the display based on co-citation the dominant cited authors or highlight is Mehmoor, R. (Figure 5). These three authors have an important role in environmental education studies. Role of each and extent of their involvement in research related to theme of environmental education is certainly interesting to study.

Keywords

Figure 6 shows the trend of keywords that are mostly used by the author in writing the theme "environmental education and COVID-19". As seen from Figure 6 that there are four main keywords (COVID-19, education, higher education, and sustainable development) appearing most frequently and interrelated.

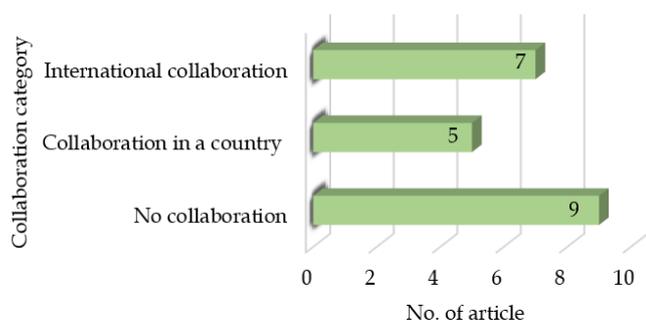


Figure 9. Author collaboration in writing articles (Source: Authors’ own elaboration, using MS Excel)

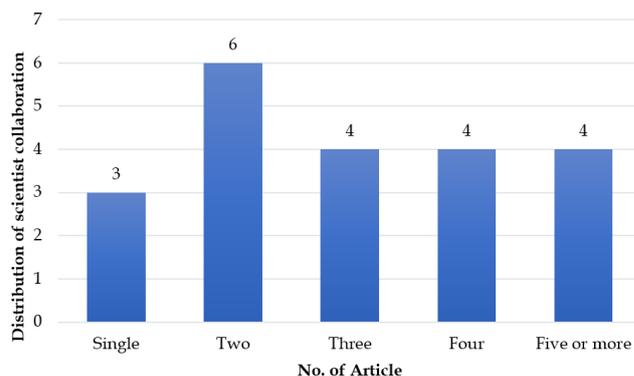


Figure 10. Number of scientists in writing one article (Source: Authors’ own elaboration, using MS Excel)

Table 3. Funding sponsor for environmental education themes

No	Funding Sponsor	Country	n
1	University of Arizona, US	US	6
2	Columbia University, US		
3	National Institute of Environmental Health Sciences, US		
4	Minnesota Agricultural Experiment Station, US	US	6
5	University of Minnesota, US		
6	World Bank Group, US		
7	Ministry of Education	Republic of Korea	4
8	Ministry of Environment		
9	Korea Environmental Industry and Technology Institute		
10	National Research Foundation of Korea		
11	Japan Society for Promotion of Science grant, Japan	Japan	2
12	Keio University, Japan		
13	Agencia Estatal de Investigación, Spain	Spain	2
14	Universitat Oberta de Catalunya, Spain		
15	Universitas Negeri Jakarta	Indonesia	1
16	Kristianstad University	Sweden	1
17	Sagkahan Central School	Philippines	1
18	Ecology Project International,	Costa Rica	1
19	Fundação para a Ciência e a Tecnologia	Portugal	1
20	Narodowa Agencja Wymiany Akademickiej	Poland	1

continents, showing the urgency of this theme so that it deserves global attention.

Figure 9 shows collaboration in the publication of articles carried out by authors, both cross-country collaborations, collaborations between universities within one country, as well as authors who carry out research/publication without collaboration.

Meanwhile, Figure 10 is an overview of the number of scientists in writing one article. Based on Figure 9, it can be stated that there are more articles published with non-collaborating status (as many as nine articles or 42.86%). However, if we combine international collaboration (seven articles or 33.33%) and collaboration in a country (five articles or 23.81%), it can be said that most of the articles were written and published with a collaboration system (total 12 articles or 57.14%). If we analyze the 21 articles found (the results are presented in Figure 10) it can be concluded that it is rare to find articles published by a single author (only three articles or 14.29%). Quite a number of articles are the result of international collaboration. In addition, even though there are several articles written only by

authors from one country and even one university, it can be seen that the authors still collaborate between fields of knowledge, where they join a research group at the university (85.71%).

Funding sponsor

The trend of funding sponsor of research related to “environmental education and COVID-19” themes are presented in Table 3.

Based on Table 3, it can be seen that there are only 20 institutions or institutions in the world that fund research and publications on “environmental education”. The institutions or institutions come from 10 countries. The US is the country that provides the most funding for research and publications related to environmental education in relation to COVID-19. However, the percentage of research funding on environmental themes in the US still needs to be increased because only 27% of the total research is funded or only one fifth. Of course, in a context, where the US is a country that is required to have a large share

in the success of environmental education, this number is still considered relatively low.

The second country that has a relatively large concern is the Republic of Korea. Japan and Spain each have two institutions that fund environmental education research in relation to COVID-19. Other countries such as Indonesia, Sweden, Philippines, Costa Rica, Portugal and Poland each have only one institution that funds environmental education research in relation to COVID-19. We can say that most of the publications have fulfilled one of the ethics in publication, which is to clearly state the names of institutions/institutions that fund their research and publications. Some have also emphasized that their research and publications do not receive external funding.

An Overview of Existence of Environmental Education Implementation During a Pandemic

Researchers reviewed 21 articles and tried to find information regarding the description of the implementation of environmental education so that it continues to exist during the COVID-19 pandemic, as presented in **Table 4**. Based on **Table 4**, it can find 21 "important recommendations" from each article. Based on that, we can formulate four things related to existence of environmental education during a pandemic.

DISCUSSION

Trends in Publications on Environmental Education Themes

Distribution year

The small number of publications on the theme "environmental education and COVID-19" in 2020 is very reasonable considering that 2020 was the start of a pandemic, which allows its implementation to still be looking for a form or pattern. The world of education, including environmental education, is trying to adapt to problems of the COVID-19 pandemic. Environmental education innovations and studies that have sprung up as an effort to survive amid the COVID-19 crisis/pandemic in 2020 will then be published in the following years. Various existing publications, with trends that tend to increase, provide an overview of how people's responses are to be sure environmental education must be flexible so that it can exist and continue even under the pressure of a pandemic (Assaf & Gan, 2021; Brandão & de Souza, 2021; Grežo et al., 2021; Khalifé et al., 2022; Torres Parra et al., 2022). This is also supported by the fact that environmental education has become a theme of concern and commitment to the global community (Benítez et al., 2019; Edsand & Broich, 2020; Marpa, 2020; Reddy, 2021). Chen and Liu (2020) is also of the view that environmental education is gradually attracting the attention of researchers with the

increasing intensity of sustainability and the urgency of inter-disciplinary topics on sustainable development.

Research types/methods

Research on "environmental education and COVID-19" is more dominantly carried out with a qualitative approach. This finding is slightly different from the results of Nurwidodo et al. (2023) who actually found that science learning research during a pandemic was dominated by quantitative. The theme of environmental education can indeed be approached through qualitative or quantitative methods or a mix-method combination, depending on the goals, mission and needs of the researchers. Baytak (2011) for example emphasizes that environmental education can be approached quantitatively or qualitatively, depending on the case. Ballantyne et al. (2001) have confirmed this for decades. Meanwhile, Yesilyurt et al. (2020), a qualitative approach can be used to obtain holistic data about students in environmental education.

This research still has in common that there are also those who conduct quantitative research, and some even use a mix-method. This is in line with the assertion of Sosu et al. (2008) that the mix-method approach is very appropriate to use in an effort to understand the complexity that underlies educators' commitment to environmental education. Using sequential and concurrent procedures, Sosu et al. (2008) succeeded in using different methodologies to highlight various aspects of teacher commitment so as to contribute to taking the right steps for the implementation of environmental education. In a bolder and futuristic way, Molina-Azorín and López-Gamero (2016) suggest the need for mix-method research, namely a combination of the use of quantitative and qualitative methods in environmental management research-and this includes environmental education, because this approach is already popular in several fields. However, its use in the field of environmental management and sustainable development has not been widely used. In the practical realm, Ikhsan et al. (2019) use mixed-methods related to "research based learning approach in environmental education". Ardoin et al. (2020) also believes that in order to strengthen the variety of research designs and data, it is necessary to apply a mixed-methods approach to the review of environmental education outcomes.

In other cases, the "environmental education and COVID-19" trend can be approached with R&D. This is in line with the statement of previous researchers that R&D is of much interest because it produces real products (Husamah et al., 2022c; Rahardjanto & Husamah, 2022) can be used in environmental education (Husamah et al., 2022a). According to O'Flaherty and Liddy (2018) various methodological and pedagogical approaches in environmental education are needed in order to have a broad impact on the implementation and

Table 4. Important information for each article

No	Important information connection with existence	Important information connection with existence	
1	Participatory risk management in outdoor environmental education settings deserves attention (Beery, 2020).	Environmental education during COVID-19 pandemic can be carried out outdoors by paying attention to risks in a participatory manner & strengthening teacher professionalism.	
2	Implementation of environmental education can be done with various activities in nature, outdoor teacher training, and creating a network of professional teachers (Assaf & Gan, 2021).		
3	Outdoor activities in the form of monitoring leatherback turtle nests (<i>Dermochelys coriacea</i>) (Quesada-Rodríguez et al., 2021).		
4	Online learning is a form of implementing environmental education during a pandemic that is able to develop aspects of higher-order thinking skills (Rahmayanti et al., 2020).	Environmental education during COVID-19 pandemic can be carried out by relying on technology (online, digital, virtual, & hybrid).	
5	Hybrid educational design and supported by the mutual efforts of educators and students can be applied during physical distancing (Hesen et al., 2022).		
6	Online learning by minimizing negative impact, encouraging content mastery, skills development, group work, place-based learning, teaching observation, student teaching experience, and professional development (Nichols et al., 2022).		
7	Application of digital formats is strengthened by training & further education for educators so that they create digital formats independently (Kohler et al., 2022).		
8	Expanding skill sets and digital resources for instructors, pedagogical modifications, and appreciation of field experience will have a positive impact (Dodson & Blinn, 2022).		
9	Application of virtual learning during disaster situations is especially appropriate (Sprague et al., 2022).		
10	Urgency of implementing digital technology (Corres Gallardo & Ruiz-Mallén, 2023).		
11	Environmental education must be oriented towards education that opens cognitive, cultural, material, environmental, & social adaptation spaces (Servant-Miklos, 2022).	Environmental education must be based on socio-cultural-traditional, and pluralist	
12	Community-based programs are strong & contextual, incorporating various important elements, namely space, environment, culture, & identity (Iyengar & Shin, 2022).		
13	There needs to be significant & ecologically wise human intervention on a fact-based, normative, & pluralist approach to environmental education (Guerra et al., 2023).		
14	Indigenous local onto-epistemology foundations can provide inspiration for environmental education in times of crisis (Ritchie & Phillips, 2023).		
15	Cultural factors and social norms are important in encouraging community appreciation and pro-environmental behavior (Iwińska et al., 2023).		
16	Eco-socialism-based pedagogy is an alternative that can be carried out by environmental education theorists & practitioners during a pandemic (Arenas, 2021).		
17	The eco-socialism paradigm must be applied (Alves Pereira et al., 2023).		
18	It is important to do education governance (about critical decision making); increasing school-community-family linkages; and risk communication and community behavior (Shaw et al., 2021).		Community-based environmental education can be in form of strengthening eco-socialism, which is manifested in form of data about risk & critical decision-making, green innovation ideas, & sustainability-oriented "smart consumers" campaigns.
19	Empowerment workshops to improve community competence need to be carried out, the form is the provision of knowledge about risks, then they translate it into narrative form, and then share it with other people (Casas et al., 2021).		
20	Need to put forward green innovation ideas that involve all stakeholders in hospitals as a manifestation of environmental education during a pandemic (Lee et al., 2023).		
21	It is necessary to promote a campaign of "smart consumers" who can make smart choices for sustainable development (Lee et al., 2023).		

assessment of learning used, reviewing the evidence of its impact on students.

Author

The author who is most often referred to in environmental education studies is Lowan-Trudeau, G. Lowan-Trudeau, G. is an associate professor at the Werklund School of Education, University of Calgary, Canada. Biography search results show that he has seven affiliations related to environmental studies and environmental education, namely the International Review Board in "Journal of Environmental Education", Editorial Board in "Journal of Environmental Studies

and Sciences", International Advisory Panel in "World Environmental Education Congress", member of "Association for Environmental Studies and Sciences", member of "North American Environmental Education Association", member of "American Educational Research Association-Environmental Education SIG", and member of "Canadian Association for Curriculum Studies". Some of his recent publications related to environmental education are about youth strike for climate, renewable energy and beyond (Lowan-Trudeau & Fowler, 2022), climate change curricula (Lowan-Trudeau, 2022), absurdist insights for environmental education (Lowan-Trudeau, 2023a), and digital technologies and environmental education (Lowan-

Trudeau, 2023b). Lowan-Trudeau, G. is also entrusted with being the editor of the “Special issue: Revisiting justice in environmental and sustainability education: What pandemics (can) reveal about the politics of global environmental issues”, which is published in The Journal of Environmental Education volume 52 issue 5 of 2021 (University of Calgary, 2023).

Based on the bibliographic coupling study, the author who stands out is Aristovnik, A. Aristovnik, A. is professor of economics and public management, University of Ljubljana, Slovenia. Aristovnik, A. does research in higher education, public management, macroeconomics, public economics, and international economics. Their current research projects are: “Transformation of governance and public service delivery mechanisms in the digital age” and “Developing a conceptual framework for citizen-centered smart public governance”. His disciplines are macroeconomics, public administration, and public economics (Aristovnik, 2023). A search result of his profile on Scopus (Author ID: 16024148900) shows that in the last four years he has published a lot about the relationship between digital learning (e-learning and hybrid) and aspects of higher education management during the COVID-19 era. There are 17 articles that have been published in various reputable journals, both as main authors, corresponding authors, and members (Aristovnik et al., 2021, 2022a, 2022b; Chandra et al., 2021; Hirsch et al., 2022; Keržič et al., 2021a, 2021b; Obadić et al., 2020; Raccanello et al., 2022; Ravšelj et al., 2022; Ravšelj & Aristovnik, 2020; Sever et al., 2020; Vujković et al., 2022).

The most commonly cited author is Mehmood, R. Mehmood, R. is a professor at King Abdulaziz University, Jeddah, Saudi Arabia (Scopus ID: 25643246000). He has published 310 Scopus indexed documents (h-index: 43, 6,278 cited). Together with his team, he has published a lot on themes related to sustainability and COVID-19 (Alomari et al., 2021; Go et al., 2009; Mehmood et al., 2022; MoE, 2020; Son et al., 2023; Usman et al., 2023).

Keywords

There are four main keywords that appear most often and are interrelated with “environmental education and COVID-19”, namely COVID-19, higher education, and sustainable development. The emergence of COVID-19 caused educational institutions in the world to enter into global chaos. Teachers, students and education administrators must change the way they teach and learn, including in terms of environmental education (Brandão & de Souza, 2021; Leal Filho et al., 2021). Integrating sustainability into the higher education system gives hope that it will result in informed decisions and more responsible change agents, and then help overcome the unexpected situation of COVID-19 (Hu et al., 2023).

The keywords for COVID-19 are related to environmental education, climate change, sustainable development, and adaptation. This is reasonable and in line, because climate change is the main issue taught in environmental education (Meilinda et al., 2017; Park et al., 2020; Sharma, 2012). Environmental education should be a tool to solve problems caused by climate change (Jurek et al., 2022; Nwona, 2013). The importance of climate change learning and action—especially place-based, participatory, and action-focused pedagogy—in environmental education needs to be strengthened. Climate change has a clear relationship with people’s welfare, and it will be a serious violation if we ignore it in the implementation of environmental education (The Pontifical Academy of Sciences [PAS], 2022).

Implementation of environmental education during a pandemic requires adaptation. The pandemic demands rapid innovation in reimagining and pivoting higher education around the world. Educational institutions must make rapid transitions. Implementation of environmental education, which is a transdisciplinary process that addresses cognitive, affective, and psychomotor domains during a pandemic, can make it difficult for educators, especially because they have to use distance learning mode. Adaptation is very important to be able to realize the goals of environmental education, namely the existence of knowledge, awareness, interests and attitudes towards the environment and sustainable development (Turkmen, 2022). Even though during a pandemic, environmental education must still carry a mission to promote sustainable development, students are encouraged to have ethics, abilities, and skills that help them influence positive changes in themselves and their communities.

Author’s nationality and collaboration

The highest order in publications on environmental education themes are the US and the Republic of Korea. Environmental policies in the US span the federal, state, and local levels. Environmental education in the US features an extraordinary variety in form, methodological directions and approaches, a deep penetration of environmental ethical ideas into the content of all disciplines, extensive involvement of the community and, in particular, non-public. The environmental education system in the US aims to ensure harmonious relations between society and the environment; contribute to the formation of lifestyles, behaviors and activities that are environmentally friendly; and construct environmental knowledge as a system of interrelated natural, economic, and social factors; as well as involving students in solving actual environmental problems around them (Fasolya, 2016).

US has a policy regarding environmental education that even needs to be started from early childhood. Environmental education needs to be in line with education for sustainability. Implementation of

environmental education in line with constructivist pedagogy and opportunities to carry out executive functions in an inquiry-based curriculum that supports environmental sustainability and social justice, the pillars of sustainability, and innovative schools (Carr & Plevyak, 2020). Specifically in the US, environmental education also considers equality, for example for those with disabilities. This is because data shows that there are more than four million students with emotional, cognitive, and behavioral disabilities reported in the US. Thus, educators need to think about how to implement environmental education, which is also able to improve academic and affective outcomes for many students, including students with disabilities (Szczytko et al., 2018). Meanwhile, like in many other countries in Asia, environmental education in the Republic of Korea has developed with commitment and hope to create a better environment. The implementation of environmental education in the Republic of Korea is strengthened by the presence of dedicated teachers, informal educators, and research in the field of environmental education in the form of conservation education, anti-pollution education, nature studies, climate change education, and education for sustainable development (Kim, 2017).

Specifically in the Republic of Korea, environmental education in primary and secondary schools has produced outstanding achievements in various forms since the importance of environmental preservation was briefly mentioned in the national curriculum. National curriculum stipulates that, "the environment is positioned as a separate elective subject, with teacher training programs established in tertiary institutions". Teachers in the field of environment who are specifically fostered so that they have qualifications. Schools of the "environmental education" model and schools of the "forest school" model was widely established. The Government of the Republic of Korea emphasizes core competencies and efforts to ensure the effective implementation of environmental education (Lee & Kim, 2017).

Specifically at the higher education level in the Republic of Korea, teacher training to support environmental education forms the core of strengthening environmental education at the higher education level. The Republic of Korea can be divided into two main categories—school-level environmental education and social-level environmental education (Ninomiya-Lim et al., 2019). As a result, currently it is necessary to encourage the effectiveness of environmental education with:

- (1) guidelines on living in harmony with nature and sustainability through collective cooperation,
- (2) building a culture that is environmentally friendly and sustainable and eliminating consumerism, and

- (3) content revitalization by incorporating knowledge of earth and environmental sciences (Lee et al., 2023).

Broadly speaking, in the Republic of Korea, a public survey program for awareness and attitudes toward the environment is conducted annually to see the results of environmental education, which is conducted by the Korea Environment Institute.

If based on continents (Figure 8), unique data is found, where Europe, Asia, and America each have 23 authors. It is interesting to find that articles on environmental education during a pandemic were written by authors from almost all continents, showing the urgency of this theme so that it deserves global attention (Chen & Liu, 2020; Scott, 2020). Environmental education is an important issue and a concern at various levels of education throughout the world. The importance of environmental education as one of the best solutions to overcome various environmental challenges and problems that continue to be faced (Ali et al., 2023). Education must be the leading vessel in preparing students to face the current crisis and shape the future (Durban, 2021).

Meanwhile, Australia-Oceania is only two authors, while Africa is not found at all. This shows that environmental education needs to be promoted in these two continents. It is important to understand that Africa and Australia-Oceania are regions that are highly vulnerable to the impacts of climate change far more than other regions. Countries on this continent should tend to incorporate climate change content into their national curriculum framework (UNESCO, 2021a). Natural disasters with all their impacts, energy and conservation are key themes that need to be part of Australian environmental education (Derman & Gurbuz, 2018). In Africa, environmental education that is integrated with local culture or local problems has the potential to be promoted because it can produce positive attitude changes (Williams et al., 2021). A similar pattern can also be applied in Australia (Eames & Barker, 2011) and Indonesia (Yani et al., 2021).

Based on the status of the collaboration, most of the articles were written and published using the collaboration system. It is very rare to find articles published by a single author. Quite a number of articles are the result of international collaboration. In addition, even though there are several articles written only by authors from one country and even one university, it appears that the authors still collaborate between fields of knowledge. This is in line with Ardoin et al. (2020) that the study and research of environmental education programs requires broad collaboration of scientists. This pattern supports program development efforts and documentation ideas as well as further opportunities for productive research implementation space. Vaughan-Lee (2016) even emphasized that there are no issues that

show the importance of global competence more than environmental issues; because survival on this earth really depends on how all the potential in the world collaborates to solve environmental problems.

Based on these findings, international collaboration in environmental education research needs to be encouraged. According to Furihata and Sakurai (2019) in Asian context, international collaborative research certainly has a number of obstacles. Several things can arise, for example language barriers, funds, and limited time for face-to-face meetings, and a number of political problems. If these obstacles can be overcome properly, it will enable formation of new solidarity in the field of environmental education, which cannot be obtained only through limited collaboration in one country.

Funding sponsor

Environmental education, both in terms of implementation and research and publication, needs to get widespread support, especially from funding. So far, there are 20 institutions or institutions in the world originating from 10 countries that have funded research and publications on "environmental education". Funding institutions mostly come from the US and Republic of Korea. The US has a high commitment in the implementation of environmental education. In particular, under the coordination of the US Environmental Protection Agency (EPA), there is an Environmental Education Grant Program. Since 1992, a total of 3,922 environmental education grants have been awarded by EPA nationwide for a cumulative total of \$91,483,978. Apart from that, there are also interesting programs in form of presidential award for environmental educators and president's environmental youth awards (EPA, 2023). The impact was most of the geographic location of study in environmental education research were based in the US (Ardoin et al., 2020).

The US is also the center of organizations that focus on environmental education, namely the North American Association for Environmental Education (NAAEE). For more than five decades, NAAEE has promoted excellence in environmental education throughout North America and the world. NAAEE are dedicated to strengthening the field of environmental education and increasing the visibility and efficacy of the profession. NAAEE's influence stretches across North America and around the world, with members in more than 30 countries. NAAEE and its 56 state, provincial, and regional affiliate organizations in the US, Canada, and Mexico have more than 20,000 members across business, government, higher education, formal and non-formal education, early childhood education, science education and STEM, and others sectors of society (NAAEE, 2023).

Various policies are also carried out by the US government, as a real example is the existence of climate

change mitigation and adaptation efforts in environmental educators (Johnson, 2019). In 2022, the US Department of Education established the 2022 sustainability plan in environmental education in the form of preparing an action plan to build a long-term strategy to reduce environmental impact (Cardona, 2022). In a real and concrete way in 2023, for example, the US Department of Education has invited over 30 organizations to share their bold commitments to advance school sustainability, encompassing infrastructure, health, environmental sustainability education, climate and environmental justice in the US. These commitments demonstrate the wide range and scope of actions needed to ensure sustainable schools for all students (the US Department of Education, 2023).

Meanwhile, the Republic of Korea was one of the first and foremost countries to enshrine green growth commitments in its national development strategy over the past decade. The Republic of Korea is investing billions of US\$ billions to realize clean energy technologies and implement green growth plans. This country emphasizes environmental sustainability aspects (Dollesin, 2012). More specifically, the Republic of Korea has a holistic-integrative policy in environmental education, the Republic of Korea assigned two ministries specifically responsible for climate change communication and education (a specific part of environmental education). The Ministry of Education is responsible for implementing school-based climate change education. The Ministry of Education does not stipulate climate change education as a separate subject but has placed climate change education content integrated with environmental education. There is a National Education and Training institute, which is responsible for training teachers to have competence on climate change and sustainable development. The Center for Environmental Education, which is under the Ministry of Environment is responsible for social environmental education. Social environmental education includes climate change education for community as well as community awareness regarding climate change outside of school. Ministry of Commerce, Industry and Energy, Korea Energy Agency is in charge of climate change communications. The agency provides social and school environmental education, with a focus on energy saving, energy conservation, and low-carbon lifestyles. Various non-governmental organizations and civil society organizations are also involved in environmental education (UNESCO, 2021b).

Donor agencies have a strategic role to support sustainable development. Several impressive achievements and long-term successes have been achieved through donor funding (Bayon et al., 2000). Research funding is the most important resource (Zhao et al., 2018). Research and publication funding is usually competitive grants (Neema & Chandrashekar, 2021). Research funding has a direct impact on the behavior of

academics (Vaughan, 2008). Funding for research and publications can have an impact on the quality of the programs, research and publications that are conducted (Ebadi & Schiffauerova, 2015; Gyórfy et al., 2020). An interesting finding was conveyed by Wang and Shapira (2015) that the publication of grant-sponsored research showed a higher impact and number of citations than non-grant-sponsored research. This shows confidence in the quality of the publications produced.

The SLR findings are in line with previous studies in the context of science learning research (Nurwidodo et al., 2023) that most of the publications have fulfilled one of the ethics in publication, namely the declaration regarding funding status. The funding declaration illustrates the honesty of the researchers (Álvarez-Bornstein & Montesi, 2020). With that, the public can also assess the extent of the independence of the researchers and the objectivity of the research (Hagve, 2020).

Existence of Environmental Education

The results of the analysis (as shown in **Table 4**) show four important points in the formula for the existence of environmental education during the COVID-19 pandemic. First, environmental education during the COVID-19 pandemic can be carried out outdoors by paying attention to risks in a participatory manner and strengthening teacher professionalism. Learning in the midst of the nuances of the COVID-19 pandemic must place the health and safety of students as the most important thing. Learning about environmental education through face-to-face activities should still be carried out while prioritizing health protocols while remaining constructive, active and fun. One of them is outdoor learning (Gaidelys et al., 2022; Quay et al., 2020; Vincent-Lancrin et al., 2022). Indeed, for outdoor learning teachers this seems troublesome and requires more professionalism. Implementation of outdoor classes does require careful preparation and challenges in providing logistics (Behrendt & Franklin, 2014; Claiborne et al., 2017; O'Brien et al., 2011; Robertson et al., 2015; van Dijk-Wesselius et al., 2020). Implementation of outdoor classes during a pandemic also provides other benefits, namely making the environment a source of learning (Afshar & Barrie, 2020; Mann et al., 2022; North & Dyment, 2021).

Second, environmental education during the COVID-19 pandemic can be carried out by relying on technology (online, digital, virtual and hybrid). As with other learning, environmental education during a pandemic can be tricked by carrying out learning that adopts the use of technology, namely virtual or online and a combination of face-to-face and online, known as hybrid learning (Baber, 2023; Barrot et al., 2021; Sum & Oancea, 2022). Digital transformation is key to online learning (Ibrohim et al., 2021). Digital transformation is the right answer so that students continue to learn even though

they are at home. Learning management system and synchronous classes using video conferencing tools are the best choice (Kim, 2021; Vincent-Lancrin et al., 2022). To reduce boredom and maximize impact, environmental education can use a hybrid system. Fieldwork-based hybrids are an alternative that students accept, while not leaving the advantages of traditional or face-to-face learning (Oktavianto et al., 2023).

Third, environmental education must be based on socio-cultural-traditional and pluralist. Social, cultural, and customary are the soul of environmental education (Taylor, 1996). However, the environment must be considered as a universal, regional and local value so that it requires an understanding of environmental phenomena as a socio-cultural phenomenon (Popov et al., 2021). The historical picture provides reinforcement that socio-cultural based participation is the key in democracy-oriented education for sustainable development (Læssøe, 2010). In a more advanced level, we can promote cross-cultural based environmental education. On the other hand, a pluralistic view is important to underlie environmental education and education for sustainable development (Öhman, 2006). "In this context, pluralism is a reaction to what educators fear to be totalitarian tendencies of the top-down curriculum, prescribing the right answers to sustainability challenges" (Kopnina, 2015). The adoption of pluralism is predicted to be able to encourage teachers and students to become more pro-environmental because of their humanist nature. This is in contrast to the exclusionary approach, which has proven to be divisive (Stables, 2020).

Fourth, community-based environmental education can take the form of strengthening eco-socialism, which is manifested in the form of knowledge about risk and critical decision-making, green innovation ideas and sustainability-oriented "smart consumers" campaigns. Eco-socialism is a principle of coexistence between communities that adheres to democratic values on the principle of the coexistence of humans and nature. The aim of eco-socialism is to build an environmentally conscious society by adhering to democratic control, realizing social equality, and infiltrating the principle of economic work based on use values. Intrinsically, the rationality of capitalism, which emphasizes economic profitability and fierce competition is in contrast to ecological rationality, which considers the balance of nature (Huan, 2010; StudySmarter, 2023; Xu, 2020). Eco-socialism can be applied in real terms in everyday life. Knowledge of risk and critical decision making is a reality. Strong knowledge of environmental problems, consequences and risks is a core target of environmental education. Making critical decisions-for example regarding climate change-is believed to have a large impact, although this attitude varies between people, culture, time and experience (Kirchhoff et al., 2013). Green innovation ideas and sustainability-oriented

“smart consumer” campaigns are efforts to “go green” and “green consumption” which are important issues at this time, especially for the younger generation (Prieto-Sandoval et al., 2022; Wang et al., 2021).

CONCLUSIONS

This SLR gives interesting results. First, it appears that there is an increasing trend in the number of publications on environmental education and COVID-19 themes each year. Second, it was found that the dominant research was conducted using a qualitative approach, followed by qualitative research. The issue of environmental education can be approached through a combination of the two, namely the mix-method. There is also a case study and R&D research. Third, authors can identify that the most widely referred expert is Lowan-Trudeau, G. Based on the bibliographic coupling, the dominant name is Aristovnik, A., while based on the appearance based on co-citation, the author who is dominant or in the spotlight is Mehmood, R. Fourth, the keywords that are widely used by the author are COVID-19, education, higher education, and sustainable development. This environmental education keyword has branches into climate change, sustainable development, and adaptation. Fifth, authors found that there are 22 countries of origin of the authors. The seven highest rankings in publications on environmental education themes are the United States, Republic of Korea, Indonesia, Germany, Costa Rica, Taiwan, and Japan. If based on continents, it can be said that this theme has become a global concern. Data found, where Europe, Asia, and America each have 23 authors (evenly). Australia-Oceania is very few, while Africa is not found at all. Sixth, authors can also say that if we combine international collaboration and collaboration in a country, then it can be said that most of the articles are written and published with a collaborative system. It is rare to find articles published by a single author. Authors continue to collaborate between fields of knowledge. Seventh, authors found 20 institutions or institutions in the world originating from 10 countries that fund research and publications on “environmental education”. Funding institutions mostly come from the United States and the Republic of Korea. Most of the publications have clearly stated the name of the institution/institution that funded their research and publication. Some have also emphasized that their research and publications do not receive external funding. Eighth, authors succeeded in formulating a picture of the existence of environmental education during the COVID-19 pandemic. These findings can serve as a consideration or baseline for researchers to study environmental education and COVID-19 themes according to their respective backgrounds and objectives.

Future researchers can use the description of the existence of environmental education during a

pandemic as a momentum to find a model for environmental education during a pandemic or crisis, which might occur in the future. Future researchers can use information about article trends, keywords, authors, types of research, collaboration between authors, and funding as a reflection and reference for the success of quality research in the realm of environmental education. Practically, researchers will know where to start research on environmental education themes and to what extent they can design the expected results in the future. The articles selected and used by us can be used as a reference and standard. The authors suggest that future researchers can provide more context on why these research trends are likely to be significant and how these trends compare to the number of publications on environmental education prior to the pandemic. This context will be interesting for further analysis.

Limitations

This SLR is only focused on trends and aspects that inform the existence of environmental education. The authors do not fail to analyze and discuss valuable lessons that are generally also needed by researchers, for example sample size, gender, institution level, main goal of each article, relation to literacy, and cross-disciplinary aspects, which are true characteristics of environmental education. In addition, we did not see how the research was before the pandemic (before 2020). This SLR limitation is also rigidly using the phrase “environmental education” in the search menu. Therefore, future researchers can combine their search results by using other terms or equivalent words in the environmental education category, so that the disbursement results are more complete and might provide interesting information.

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Ethical statement: The authors stated that searching for data on Scopus is done using an official subscription account, namely the Universitas Muhammadiyah Malang-Indonesia (affiliation of the first author). The authors further stated that the article does not require an ethics committee approval as it is a subject of comparison between theories and review of the literature.

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