Bibliometric Analysis of Mapping Trend Ecopedagogy Research in Education

Shahibah Yuliani[1], Enok Maryani[2], Siti Nurbayani[3], Disman[4]

[1] Department of Social Studies Education, Faculty of Social Science Education, Universitas Pendidikan Indonesia, Indonesia
[2] Department of Geography Education, Faculty of Social Science Education, Universitas Pendidikan Indonesia, Indonesia
[3] Department of Sociology Education, Faculty of Social Science Education, Universitas Pendidikan Indonesia, Indonesia
[4] Department of Economic Education, Faculty of Economics and Business Education, Universitas Pendidikan Indonesia, Indonesia

shahibah-yuliani@upi.edu

Abstract. The purpose of this study is to examine the scientific articles about ecopedagogy in terms of bibliometric indicators to determine the mapping of ecopedagogy research trends in education and was conducted using a bibliometric approach, with 437 journal publications from Scopus. The data was sourced on a large scale for the last 10 years from 2013 to 2023 and narrowed to focus on ecopedagogy, education, and social science learning. Bibliometric analysis was conducted using VOSviewer software to visualize the network based on the literature data provided in the literature records specifically co-citation aanalysis, coupling analysis and co-word analysis. The results showed that ecopedagogy continued to exist from 1983 to the present. Based on mapping co-citation, bibliographic coupling, and co-word analysis shows that ecopedagogy is related to education and the environment. Therefore, understanding the basic structure will help teachers and students thoroughly. There were certain limitations in conducting this study. First, the references obtained from Scopus for the last 10 years were below 500, affecting the mapping analysis. Second, the database employed consisted of all forms of publication, including journals, books, book chapters, conference proceedings, and reviews. The majority of bibliometrics were limited to journals, while others were omitted for fear of affecting the quality of the documents retrieved. After in-depth analysis, a comprehensive agenda was suggested for upcoming trends that significantly benefit academics and policymakers. In this context, this study evaluated and contributed to the field of education and the environment, especially in school learning.

Keywords: Ecopedagogy, Ecology, Pedagogy, Environmental Education, Teaching and Learning.

ICESDM 2023, November 02, Banjarmasin, Indonesia

DOI 10.4108/eai.2-11-2023.2348019

1 Introduction

The environment is very important in human life but the concept is often ignored, leading to a lack of balance and resulting in damage. Indonesia, which has the third largest population with the capital city of Jakarta remains connected with environmental challenges, such as seawater mercury pollution, abrasion, mangrove forest erosion, availability of drinking water, flooding, and air pollution [1]. Therefore, people must be environmentally educated to ensure the motivation of addressing the problem.

The system needs to improve the transcultural curriculum which transforms students' knowledge and skills, enhancing responsible citizens in solving environmental problems. Furthermore, teachers should embrace innovation to encourage environmental justice. Freirean introduced ecopedagogy as a more humanistic approach to environmental education [2]. This concept also refers to the impact of damages on social structures, inherently against (anti) the environment[3]. In this context, social and environmental aspects are balanced through knowledge [4].

The application of ecopedagogy enhances students' intelligence, thereby contributing to increased knowledge and active management. This enables a greater spirit and responsibility for environmental preservation [5]. Ecopedagogy assists students in deepening and broadening their knowledge of the environment globally and as part of the earth [6]. In this context, the learning space must be democratic, which means teachers and students must collaborate to develop socio-environmental issues through reflection, and by trying to understand diverse perspectives beyond the learning space [7].

In recent years, several reviews and studies have been explored, [5] regarding the learning method as an effort to increase ecoliteracy and develop environmental care characters. In a study conducted by [8)], the interaction between motivation and ecological phenomena on students' cognitive and affective outcomes through ecopedagogy-based learning models. Meanwhile, [2] implemented the method as an experiential approach to decolonizing science education, and [9] analyzed the extent to which courses taught at a university in Tanzania applied the ecopedagogical principles.

This study proposes a review based on bibliometric analysis. Although there are several studies related to ecopedagogy in education, no one specifically addresses the concept with a similar approach. Therefore, this study aimed to determine the mapping trend of ecopedagogy research in education.

This study is structured as follows, with section 1 providing an explanation of the concept and outlining the objectives. In section 2, the methodology, bibliometric analysis was described. Section 3 states the results and analysis of all studies, and section 4 discusses the conclusion.

2 Methods

The data was sourced from Scopus, one of the most reliable and high-quality databases with 437 journals. The design was conducted using bibliometrics which comprised

methods for quantitative analysis and pattern description related to scientific and public issues [10]. Furthermore, this study categorized journals based on publication year, and the novelty of the study [11].

The data was sourced on a large scale for the last 10 years from 2013 to 2023 and narrowed to focus on ecopedagogy, education, and social science learning. Bibliometric analysis was conducted using VOSviewer software to visualize the network based on the literature data provided in the literature records [12].

The aim was to identify quantitative characteristics of publications that reflected changes in studies for the period [13]. To achieve this, the following bibliometric analysis was conducted:

A. Co-citation Analysis
   Co-citation analysis was applied to identify documents that shared thematic similarities and could be interpreted to form semantic relationships with one another [14]. The results provided an understanding of the relationship between each pair of the most cited e-book studies [15]. The threshold for the 20759 cited references was set at articles with 47 or more citations.
B. Bibliographic Coupling Analysis
   Bibliographic coupling uses common articles to assess conceptual relevance for developing fields. This analysis showed patterns related to age and distance, which provided an intrinsic relationship to the degree of integration[16]. Furthermore, connected literature was useful for predicting technological breakthroughs [17], and out of 437 articles, 23 met the threshold of 68 for literature.
C. Co-word Analysis
   A co-word analysis reported that academic publications were the most described keywords [18]. Additionally, it identified relationships between words before combining social network and cluster analysis techniques in identifying research hotspots and the evolution rules of subjects [19]. The threshold for analysis was set at articles that had 5 or more keyword occurrences out of the 1838.

3 Results

3.1 Co-citation Analysis

Articles with 47 or more citations were set as thresholds. Table 1 summarizes the most frequent [20] (16 times), [21] (15 times), and [21] (14 times) out of the 20759 cited references.

The co-citation network of ecopedagogy and environment-based learning has been shown using VOSviewer software in Figure 1. Table 2 presents the ecopedagogy trend based on the co-citation analysis which consists of the cluster number and color, labels, as well as number and representative articles.

The conclusion shown in Table 2 is based on the network of ecopedagogy and environmental-based learning.

Table 1. Top 15 From 47 publications with the highest cited reference

No	Authors	Publication	Citation	Total Link Strength
1.	Lave and Wenger (1991)	Creative Education	16	14
2.	Freire (2000)	Continum, New York	15	78
3.	Freire (1970)	Routledge, New York	14	13
4.	Gadotti (1996)	State University of New York Press	10	74
5.	Misiaszek (2018)	Routledge, New York	10	70
6.	Ingold (2011)	Routledge, New York	10	31
7.	Barad (2007)	JSTOR	10	23
8.	Freire (2004)	Routledge, New York	9	65
9.	Misiaszek (2020)	Bloomsbury Publishing	9	65
10.	Gruenewald (2003)	Educational Researcher	9	18
11.	Misiaszek (2021)	Routledge, New York	9	18
12.	Dewey (1938)	Macmillan Company New York	9	9
13.	Gadotti (2009)	Institute of Social Studies The Hague	8	70
14.	Misiaszek (2015)	Bloomsbury Publishing	8	66
15.	Bennet (2010)	Duke University Press	8	18

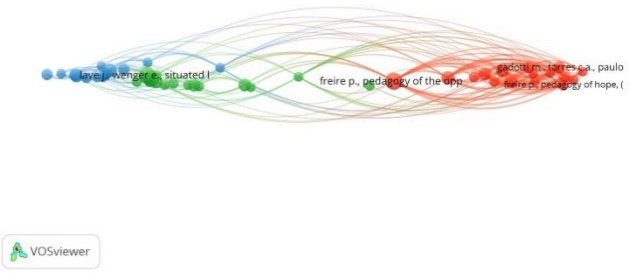

Fig. 1. Co-citation analysis

Table 2. Co-citation cluster

Cluster 1 (Red)	Cluster 2 (Green)	Cluster 3 (Blue)
Freire (1998)	Bowers (2001)	Barad (2007)
Freire (1992)	Braun (2006)	Bennett (2010)
Freire (2004)	Dewey (1938)	Bonnett (2004)

Freire (2000)	Freire (1970)	Braidotti (2013)
Freire (2005)	Freire (1973)	Carson (1962)
Gadotti (2008)	Gruenewald (2003)	Guattari (1987)
Gadotti (1996)	Kahn (2010)	Dunkley (2018)
Gadotti (2009)	Kahn (2010)	Gibson (1979)
Gadotti (2008)	Kopnina (2014)	Ingold (2011)
Illich (1983)	Lave (1991)	Ingold (2000)
Misiaszek (2015)	Lefebvre (1991)	Payne (2014)
Misiaszek (2020)	Louv (2008)	Pink (2009)
Misiaszek (2018)	Sobel (1996)	Rodrigues (2018)
Misiaszek (2012)	Tuck (2014)	Thrift (2008)
Postma (2006)	Wenger (1998)	
Torres (2009)		

- Cluster 1 (Red): With 16 articles, cluster 1 represents "Freire's Pedagogy".
  This cluster explains pedagogy derived which centers on the idea of empowering individuals to shape the world [7]. A fundamental tenet of this concept is the belief that when humans play a role in constructing the present world, the capacity to transform is processed[26]. Furthermore, [23] stated that Paulo Freire discovered a theme of ecology and sustainability called "ecopedagogy". Over the years, this concept still circulated amongst the newest studies and was used in [61] finding post-truth ideologies through ecopedagogical literacies.
- Cluster 2 (Green): This represents environmental education with 15 articles.
  This cluster describes the vision of education to increase public awareness of the environment and the ethics of education [46]. Environmental education can rebuild the future with settlers and communities [56]. For example, the inability to address environmental crises without social justice can increase concern for the surrounding [28] to improve critical learning in students[43], and provide direct experience in strengthening responsibility [53].
- Cluster 3 (Blue): This represents ecopedagogy with 14 articles.
  The cluster describes ecopedagogy from several perspectives. A critical environment promises constructive criticism of education that shapes social and environmental injustice. This is seen as a radical curriculum practice that explores dark matter to examine the ecologically oriented and nomadic curriculum[50]. Additionally, [44] reports that the developing field offers limited conceptual, methodological, and empirical reflection on the importance of the spatial and temporal elements of learning. The development of ecopedagogy provides an empirically based explanation of the concept of ecomotricity, embodied in the bodies of living things that interact with nature [54].

3.2 Bibliographic Coupling Analysis

A total number of 23 articles met the threshold of 68 out of 437 literature in the bibliographic coupling analysis. The 10 most cited publications are presented in Table 3. (Huckle, 2013) (161 citations) and (Mcbride et al., 2013) (150 citations) were the most cited articles. The remaining 10 most cited articles are shown in Table 3.

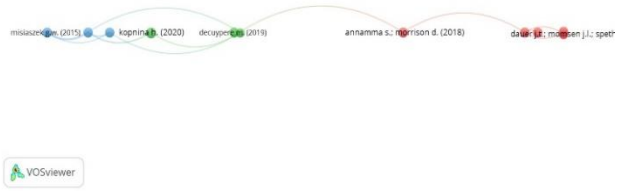

Fig. 2. Bibliographic coupling analysis of ecopedagogy

Table 3. Top 10 bibliographic coupling cited articles

Articles	Citation	Total Link Strength
Huckle dan Wals (2015)	161	0
Mcbride (2013)	150	2
Guerettaz (2013)	119	0
Kopnina (2020)	108	4
Lai (2013)	103	0
Dauer (2013)	74	2
Styers et al (2018)	66	2
Annamma (2018)	61	2
Barton (2020)	59	1
Barreau (2016)	58	0

Table 4. Bibliographic coupling cluster

Cluster 1 (Red)	Cluster 2 (Green)	Cluster 3 (Blue)
Annamma dan Morrison (2018)	Decuypere (2019)	Male dan Palaiologou (2015)
Barton (2020)	Jandrić dan Ford (2022)	Misiaszek (2015)
Dauer (2013)	Kopnina (2020)	Misiaszek (2022)
Harris (2020)		
Styers (2018)		

- Cluster 1 (Red): This represents “ecopedagogy and environmental education” with 5 articles.
  This cluster explains how ecology is implemented in education, leading to the development of ecopedagogy. Furthermore, [69] identified the importance of bringing cultures into our education ecologies. Furthermore, students experience pedagogical challenges in science literature, including a variety of cultural, and cognitive constraints [67]. Education in ecology uses field instruction to teach key learning outcomes [70]. In this study conducted by [75], multicultural and ecology in education is a must to increase equity for all academics. Similarly, [68] stated that environmental students should improve their critical thinking through active learning strategies in a partially or fully flipped–classroom model.

- Cluster 2 (Green): This represents “ecology and future education with 3 articles.” This cluster explains how ecology in education should grow beyond and within technological development. In addition, [72] stated that learning can be fun and interactive with new technologies. Humans cannot be separated from the earth, because of the need to visualize natural elements as a unity in one ecosystem by post-digital ecopedagogies [74]. Ecological knowledge is as endangered as some species, but ecology education is a way to solve the problem [65].
- Cluster 3 (Blue): This represents “environmental teaching and planetary justice” with three articles.
  This cluster explains how environmental teaching and awareness are important in providing sustainable development on Earth. According to [7], ecopedagogies are an essential element to understanding and respecting socio-environmental connections fully. Realizing the importance of the basis for creating pedagogy is a learning environment that focuses on the interaction of teachers and students who understand the ecology of their community [73]. Furthermore, in a study conducted by [6], ecopedagogy is a very important contribution to critical environment studies in education.

3.3 Co-word Analysis

The threshold for analysis was set at 5 or more occurrences. Table 5 shows an overview of the 15 highest keywords out of 55 occurrences, with "pedagogy" (71 occurrences), "ecology" (54 occurrences), and "ecopedagogy" (45 occurrences) as those with the highest occurrences out of a total of 1938 keywords.

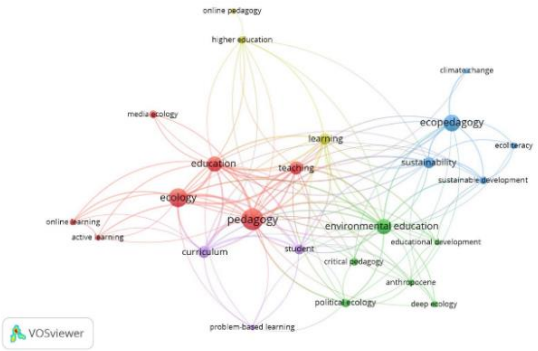

Fig. 3. Co-word analysis of ecopedagogy

Figure 3 shows the network of co-words for ecopedagogy. Table 6 presents the summary based on the co-word analysis, which consists of cluster numbers, color, labels, numbers, and representative articles.

Table 5. Top 15 ecopedagogy keyword analysis

Rank	Keyword	Occurrences	Total link strength
1.	Pedagogy	71	119
2.	Ecology	54	149
3.	Ecopedagogy	45	64

4.	Education	36	101
5.	Environmental Education	35	82
6.	Teaching	27	79
7.	Curriculum	21	77
8.	Learning	19	60
9.	Sustainability	19	44
10.	Student	15	67
11.	Political Ecology	12	25
12.	Sustainable Development	10	29
13.	Higher Education	10	18
14.	Anthropocene	7	15
15.	Educational Development	5	15

Table 6. Co-word ecopedagogy cluster

Cluster no and color	Cluster label	Number of keywords	Representative keywords
Cluster 1 (Red)	Pedagogy	7	"active learning", "ecology", "education", "media ecology", "online learning", "pedagogy", "teaching"
Cluster 2 (Green)	Environmental Education	6	"anthropocene", "critical pedagogy", "deep ecology", "educational development", "environmental education", "political ecology"
Cluster 3 (Blue)	Ecopedagogy	5	"climate change", "ecoliteracy", "ecopedagogy", "sustainability", "sustainable development"
Cluster 4 (Yellow)	Learning	3	"higher education", "learning", "online pedagogy"
Cluster 5 (Purple)	Curriculum	3	"curriculum", "problem-based learning", "student"

From the result of a co-word network of study, this study interpreted the cluster shown in Table 6.

- Cluster 1 (Red): Consists of 7 keywords representing "pedagogy."
  The main words are pedagogy, ecology, and education. These relatable terms should be included in pedagogy. According to [76], ecology is a necessity for the public especially through media that portrays environmental issues in the socio-environmental substructure.
- Cluster 2 (Green): Consists of 6 keywords representing "environmental education."
  The main and important words for development are environmental education, deep ecology, and critical pedagogy. Meanwhile, [77] concluded that students with a deep ecology reality from news reports gave a symbolic idea of representing the way to solve the problem through pedagogy and environmental education.

- Cluster 3 (Blue): Consists of 5 keywords representing “ecopedagogy.”
  The main keywords are ecopedagogy, ecoliteracy, and sustainable development. These terms are relatable with the core of ecology knowledge for earth sustainability. Ecopedagogical literacies have an impact on developing the awareness of maintaining sustainability [61].
- Cluster 4 (Yellow): Consists of 3 keywords representing “learning.”
  The main keywords are learning, higher education, and online pedagogy. These words are relatable and more suitable for higher education learners. In a study conducted by [78], online pedagogy helped higher education students to develop creative thinking in their learning process.
- Cluster 5 (Purple): Consists of 3 keywords representing “curriculum.”
  The main keywords are curriculum, problem-based learning (PBL), and student. These words are relatable in including problem-based learning for students. Integrating PBL into the undergraduate curriculum creates a real impact based on the problem. For example, [79] implemented PBL in the curriculum, increasing the awareness and empowerment of students through real-case problems such as Carbon Footprinting.

4 Discussion

The term ecopedagogy was introduced by Paulo Freire, and all forms of pedagogy came to be collectively referred to as Freirean[74]. The results of the analysis show the continuous existence from 1983 to the present. Over the past 40 years, the term experienced meaningful growth and benefits, particularly in the digitalization and development of world technology. Moreover, eco-pedagogy was required for human desires and needs while building civilization and accompanied by education with maintenance in sustainability [6].

The result showed that ecopedagogy was based on co-citation analysis and known as the understanding obtained through ecological sustainability to increase the ethics and awareness of the environment. According to Freire, students have experiences that improve their responsibility for the environment.

Bibliographic Coupling Analysis serves as a valuable method in determining the level of suitability between several cited documents. The higher the frequency and strength of bibliographic pairs, the closer the suitability and similarity of searching information. Citation indexes can be used to map documents based on the size of proximity of one document to another. In addition, there were *3* clusters spread across 10 studies to conclude that ecopedagogy is a very important contribution to the critical environment. Co-word analysis identified trends in certain studies to measure the relationship between different topics. This analysis has 15 keywords, namely (1) pedagogy, (2) environmental education, (3) ecopedagogy which focuses more on ecoliteracy, and sustainable development, (4) learning, and (5) curriculum. Therefore, ecopedagogics can be an approach to learning and environmental education in every subject and relevant content.

5 Conclusion

In conclusion, the bibliometric review was a presentation of trends in ecopedagogy within the field of education using, co-citation, bibliographic coupling, and co-word analysis. A total of 437 publications were retrieved from the Scopus database. The three clusters present, (1) Freire pedagogy, (2) environmental education, (3) ecopedagogy. Bibliography coupling analysis produces three clusters, namely (1) ecopedagogy and environmental education, (2) ecology and future education, (3) environmental teaching and planetary justice. Co-word analysis presents 5 clusters, (1) pedagogy, (2) environmental education, (3) ecopedagogy, (4) learning, (5) curriculum. These clusters showed that ecopedagogy was related to education and the environment. To ensure successful trends of application in education, knowledge was required. Therefore, understanding the basic structure will help teachers and students thoroughly.

There were certain limitations in conducting this study. First, the references obtained from Scopus for the last 10 years were below 500, affecting the mapping analysis. Second, the database employed consisted of all forms of publication, including journals, books, book chapters, conference proceedings, and reviews. The majority of bibliometrics were limited to journals, while others were omitted for fear of affecting the quality of the documents retrieved.

After in-depth analysis, a comprehensive agenda was suggested for upcoming trends that significantly benefit academics and policymakers. In this context, this study evaluated and contributed to the field of education and the environment, especially in school learning.

Acknowledgements

The author would like to thank the Ministry of Education and Culture for providing grant funding in this research. The researcher also thanked to LPPM Universitas Pendidikan Indonesia (UPI) for supporting this research.

References

[1] Steinberg F. Jakarta: Environmental problems and sustainability. Habitat Int. 2007;31(3–4):354–65.

[2] Zocher JL, Hougham RJ. Implementing Ecopedagogy as an Experiential Approach to Decolonizing Science Education. J Exp Educ. 2020;43(3):232–47.

[3] Misiaszek G. Transformative Environmental Education Within Social Justice Models: Lessons from Comparing Adult Ecopedagogy Within North and South America. In: Second International Handbook of Lifelong Learning. Springer, Dordrecht; 2011. p. 423–40.

[4] Walter P, Kluttz J. Ecopedagogy: Critical environmental teaching for planetary justice and global sustainable development. Int Rev Educ. 2021;67(1–2):253–5.

[5] Fadjarajani S, As'ari R. Ecopedagogy based learning as an effort to increase student ecoliteration and the development of environmental care characters. IOP Conf Ser Earth Environ Sci. 2021;683(1).
[6] Misiaszek GW. Ecopedagogy: Freirean teaching to disrupt socio-environmental injustices, anthropocentric dominance, and unsustainability of the Anthropocene. Educ Philos Theory [Internet]. 2022;0(0):1–15. Available from: https://doi.org/10.1080/00131857.2022.2130044.
[7] Misiaszek GW. Ecopedagogy and Citizenship in the Age of Globalisation: Connections between environmental and global citizenship education to save the planet. Eur J Educ. 2015;50(3):280–92.
[8] Napitupulu ND, Munandar A, Redjeki S, Tjahyono B. Interaction of Students Motivation and Ecological Phenomena toward Learning Outcomes using Problem-Based Ecopedagogy. J Phys Conf Ser. 2019;1157.
[9] Kinyota M. Implementing Ecopedagogy in Highly Centralised Curricula Contexts: A Critical Analysis of An Environmental Education Course Taught At One Tanzanian University. Int Stud Sociol Educ. 2020;30(1–2):153–72.
[10] Jiang H, Qiang M, Lin P. A topic modeling based bibliometric exploration of hydropower research. Renew Sustain Energy Rev [Internet]. 2016;57:226–37. Available from: http://dx.doi.org/10.1016/j.rser.2015.12.194.
[11] Carvalho MM, Fleury A, Lopes AP. An overview of the literature on technology roadmapping (TRM): Contributions and trends. Technol Forecast Soc Change [Internet]. 2013;80(7):1418–37. Available from: http://dx.doi.org/10.1016/j.techfore.2012.11.008.
[12] Leo Willem Menzemer, Enrico Ronchi, Mette Marie Vad Karsten SG, Frederiksen J. A scoping review and bibliometric analysis of methods for fire evacuation training in buildings. Fire Saf J [Internet]. 2023;136. Available from: https://doi.org/10.1016/j.firesaf.2023.103742.
[13] He S, Zhu D, Chen Y, Liu X, Chen Y, Wang X. Application and problems of emergy evaluation: A systemic review based on bibliometric and content analysis methods. Ecol Indic [Internet]. 2020;114(January):106304. Available from: https://doi.org/10.1016/j.ecolind.2020.106304.
[14] Kumpulainen, M., & Seppänen M. Combining Web of Science and Scopus datasets in citation-based literature study. Scientometrics.
[15] Tang KY. Paradigm shifts in e-book-supported learning: Evidence from the Web of Science using a co-citation network analysis with an education focus (2010–2019). Comput Educ. 2021;175(September).
[16] Kuan CH, Chen DZ, Huang MH. Bibliographically coupled patents: Their temporal pattern and combined relevance. J Informetr [Internet]. 2019;13(4):100978. Available from: https://doi.org/10.1016/j.joi.2019.100978.
[17] Shen S, Zhu D, Rousseau R, Su X, Wang D. A refined method for computing bibliographic coupling strengths. J Informetr [Internet]. 2019;13(2):605–15. Available from: https://doi.org/10.1016/j.joi.2019.01.012.
[18] Lin TC, Tang KY, Lin SS, Changlai ML, Hsu YS. A Co-word Analysis of Selected Science Education Literature: Identifying Research Trends of Scaffolding in Two Decades (2000–2019). Front Psychol. 2022;13(February):1–14.
[19] Zhu X, Zhang Y. Co-word analysis method based on meta-path of subject knowledge network. Scientometrics. 2020;123(2):753–66.

[20] Lave J, Wenger E. Legitimate peripheral participation in communities of practice. Distributed Learning: Social and Cultural Approaches to Practice. 1991. 56–63.
[21] Freire P. Pedagogy of the oppressed. The Community Performance Reader. 1970. 24–27.
[22] Gadotti M. Pedagogy of Praxis: A Dialectical Philosophy of Education. 1996.
[23] Misiaszek GW. Educating the global environmental citizen: understanding ecopedagogy in local and global contexts. Learning Through Community Engagement: Vision and Practice in Higher Education. 2018. 1–53.
[24] Tim Ingold. Being Alive: Essays on Movement, Knowledge and Description. Routledge; 2011.
[25] Barad K. Meeting the Universe Halfway : Quantum Physics and the Entanglement of Matter and Meaning. JSTOR. 2007;
[26] Freire P. Pedagogy of Indignation. Routledge; 2004.
[27] Bourn D. Ecopedagogy: Critical environmental teaching for planetary justice and global sustainable development. Policy Pract. 2021;(32):147–9.
[28] Gruenewald DA. The Best of Both Worlds: A Critical Pedagogy of Place. Educ Res. 2003;32(4):3–12.
[29] Misiaszek W, Academic B, Epstein-halevi DY. Ecopedagogy : critical environmental teaching for planetary justice and global sustainable development. Int Stud Sociol Educ [Internet]. 2021;30(1–2):233–5. Available from: https://doi.org/10.1080/09620214.2021.1880334.
[30] Dewey J. Experience and Education. 1938.
[31] Gadotti M. Education for Development, Development and Change. 2009.
[32] Bennet J. Vibrant matter: a political ecology of things. 2010;9(1):118–20.
[33] Freire P. Pedagogy of freedom: ethics, democracy, and civic courage. 1998.
[34] Bowers C. Educating for eco-justice and community. 2001.
[35] Freire P. Pedagogy of hope. 1992.
[36] Braun V, Clarke V. Using thematic analysis in psychology, qualitative research in psychology. Qual Res Psychol [Internet]. 2006;3(2):77–101. Available from: http://www.tandfonline.com/action/journalInformation?journalCode=uqrp20%5Cnhttp://www.tandfonline.com/action/journalInformation?journalCode=uqrp20.
[37] Bennett J. A Political Ecology of Things. 2010;9(1):118–20.
[38] Bonnett M. Retrieving Nature: Education for a Post-Humanist Age. J Philos Educ. 2004;37(4):551–731.
[39] Braidotti R. The Post Human. Polity Press; 2013. 237.
[40] Carson R. Silent spring. Member of American Book Publishers Council. 1962.
[41] Gadotti M. Education for sustainable development: what we need to learn to save the planet. 2008.
[42] Guattari D. A thousand plateaus: capitalism and schizophrenia. Vol. 26, University of Minnesota Press. 1987. 181–210.
[43] Kahn R. Critical pedagogy, ecoliteracy, and planetary crisis: The ecopedagogy movement. Int Rev Educ. 2012;58(1):129–31.
[44] Dunkley RA. Space-timeScapes as ecopedagogy. J Environ Educ. 2018;49(2):117–29.
[45] Gibson JJ. The Ecological Approach to Visual Perception. 1979.
[46] Kopnina H. Future scenarios and environmental education. J Environ Educ. 2014;45(4):217–31.
[47] Illich I. Deschooling society. 1983.

[48] Tim Ingold. The Perception of the Environment: Essays on Livelihood, Dwelling and Skill. Soc Environ Account J. 2000;32(2):121–3.
[49] Lefebvre H. The Production of Space. Vol. 53, College English. 1991. 320.
[50] Payne PG. Vagabonding Slowly: Ecopedagogy, Metaphors, Figurations, and Nomadic Ethics. Can J Environ Educ [Internet]. 2014;19:47–69. Available from: https://cjee.lakeheadu.ca/article/view/1308/713.
[51] Louv R. Last child in the woods - saving our children from nature-deficit disorder. Acta Paediatr. 2008.
[52] Pink S. Doing Sensory Ethnography: From Academia to Intervention. Doing Sens Ethnogr. 2009;7–22.
[53] Sobel D. Beyond ecophobia: eclaiming the heart in nature education. 1996.
[54] Rodrigues C. MovementScapes as ecomotricity in ecopedagogy. J Environ Educ [Internet]. 2018;49(2):88–102. Available from: https://doi.org/10.1080/00958964.2017.1417222.
[55] Misiaszek GW. Transformative Environmental Education Within Social Justice Models: Lessons from Comparing Adult Ecopedagogy Within North and South America. Second Int Handb Lifelong Learn. 2012;1–958.
[56] Tuck E, McKenzie M, McCoy K. Land education: Indigenous, post-colonial, and decolonizing perspectives on place and environmental education research. Environ Educ Res [Internet]. 2014;20(1):1–23. Available from: http://dx.doi.org/10.1080/13504622.2013.877708.
[57] Thrift NJ. Non-Representational Theory: Space, Politics, Affect. Emot Sp Soc. 2008;4(3):195–6.
[58] Postma DW. Why care for nature?: in search of an ethical framework for environmental responsibility and education. 2006.
[59] Wenger E. Communities of practice: learning, meaning, and identity. Resour Eng Technol Sustain World. 1998;16(1):21–2.
[60] Torres CA. Globalizations and education: collected essays on class, race, gender, and the state. 2009.
[61] Misiaszek GW. Countering post-truths through ecopedagogical literacies: Teaching to critically read 'development' and 'sustainable development.' Educ Philos Theory. 2020;52(7):747–58.
[62] Huckle J, Wals AEJ. The UN Decade of Education for Sustainable Development : business as usual in the end. (April 2015):37–41.
[63] Ride BBMCB, Rewer CAB, Erkowitz ARB, Iteracy L, Al MET. Environmental literacy , ecological literacy , ecoliteracy : What do we mean and how did we get here ? 2013;4(May).
[64] Marie A, Johnston B, Marie A, Bill G. Materials in the Classroom Ecology Materials in the Classroom Ecology. 2013;97(3):779–96.
[65] Kopnina H. Education for the future? Critical Evaluation of Education for Sustainable Development Goals. J Environ Educ. 2020;0(0):1–12.
[66] Lai K, Khaddage F, Knezek G. Blending student technology experiences in formal and informal learning. 2013;414–25.
[67] Dauer JT, Momsen JL, Speth EB, Makohon-Moore SC, Long TM. Analyzing change in students' gene-to-evolution models in college-level introductory biology. J Res Sci Teach. 2013;50(6):639–59.
[68] Styers ML, Van Zandt PA, Hayden KL. Active learning in flipped life science courses promotes development of critical thinking skills. CBE Life Sci Educ. 2018;17(3):1–13.

[69] Annamma S, Morrison D. DisCrit Classroom Ecology: Using praxis to dismantle dysfunctional education ecologies. Teach Teach Educ [Internet]. 2018;73:70–80. Available from: https://doi.org/10.1016/j.tate.2018.03.008.
[70] Barton DC. Impacts of the COVID-19 pandemic on field instruction and remote teaching alternatives: Results from a survey of instructors. Ecol Evol. 2020;10(22):12499–507.
[71] Barreau A, Ibarra JT, Wyndham FS, Kozak RA. How Can We Teach Our Children if We Cannot Access the Forest ? Generational Change in Mapuche Knowledge of Wild Edible Plants in Andean Temperate Ecosystems of Chile How Can We Teach Our Children If We Cannot Access The Forest ? Generational Change In Map.
[72] Decuypere M. Researching Educational Apps: Ecologies, Technologies, Subjectivities and Learning Regimes Subjectivities and Learning Regimes. Learn Media Technol. 2019;00(0):1–16.
[73] Male T, Palaiologou I. Pedagogical leadership in the 21st century: Evidence from the field. Educ Manag Adm Leadersh. 2015;43(2):214–31.
[74] Jandrić P, Ford DR. Postdigital Ecopedagogies: Genealogies, Contradictions, and Possible Futures. Postdigital Sci Educ. 2022;4(3):692–710.
[75] Malisch JL, Harris BN, Sherrer SM, Lewis KA, Shepherd SL, McCarthy PC, et al. Opinion: In the wake of COVID-19, academia needs new solutions to ensure gender equity. Proc Natl Acad Sci U S A. 2020;117(27):15378–81.
[76] Misiaszek GW. Transformative Environmental Education Within Social Justice Models: Lessons from Comparing Adult Ecopedagogy Within North and South Africa. Second Int Handb Lifelong Learn. 2012;423–40.
[77] De Oliveira A, Rodrigues B, Rodrigues V, dos Santos KP, Freire LM, Merino C. A Critical Look at the Sustainable Development Goals from an Experience Carried Out by Elementary School Students: To Be or Not to Be, Is That the Question? Pensam Educ. 2020;57(2):1–23.
[78] Songkram N. E-learning System in Virtual Learning Environment to Develop Creative Thinking for Learners in Higher Education. Procedia - Soc Behav Sci. 2015;174:674–9.
[79] McGibbon C, Van Belle JP. Integrating environmental sustainability issues into the curriculum through problem-based and project-based learning: A case study at the University of Cape Town. Curr Opin Environ Sustain. 2015;16:81–8.