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Wetland in science education: A systematic literature review (SLR)

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Abstract

Background: This study investigates and describes the wetland environment in science education from 1998 to 2024 using the PRISMA method, analyzed with one bibliometric technique, co-occurrence.
Aim: This Systematic Literature Review (SLR) aims to synthesize several studies related to the wetland environment in science education. Therefore, this research focuses on "Wetland Environment in Science Education".
Method: The methods used include article selection, inclusion criteria, and more objective analysis methods. The PRISMA article selection steps, known as the PRISMA flow diagram, recommended for SLR, resulted in 76 articles and journals.
Result: A bibliometric review was conducted on journals related to the wetland environment in science education, yielding 20 interrelated articles discussing the wetland environment in science education. This data was then visualized using VOSviewer.
Conclusion: The extracted articles concluded that there is a significant relationship between the wetland environment and other variables, particularly in science education.

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INTRODUCTION

Wetlands are acknowledged as crucial ecosystems that contribute significantly to ecological balance, socio-economic stability, and environmental services, such as carbon sequestration, climate regulation, and flood control. These ecosystems support biological diversity by providing essential habitats for numerous species, thus playing a vital role in maintaining global ecological health (Dadzie-paintsil & Mensah, 2022; Guo et al., 2024). Additionally, the educational potential of wetlands serves to enrich science curricula, as they offer a multidimensional context for teaching critical scientific concepts while fostering environmental stewardship among students (Aufa et al., 2021; Khairunnisa & Hafizah, 2024). Through the integration of wetland studies into educational frameworks, students can develop essential skills necessary for effective management of environmental resources, thereby promoting sustainable practices (Morales et al., 2025).

Despite the growing recognition of the value of wetland education, current research appears disjointed, focused predominantly on contextual and project-based learning rather than on comprehensive, interdisciplinary educational strategies that encompass vital competencies such as

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critical thinking, creativity, and environmental entrepreneurship (Le, 2019; Naparin, 2024). There remains a conspicuous absence of systematic reviews that address the implementation of wetland-focused educational reforms across various educational levels or assess the effectiveness of these approaches concerning student engagement and environmental awareness (Li et al., 2022; Listia et al., 2023). This lack of cohesive analysis represents a significant gap in scholarly literature and restricts the formulation of data-driven educational policies and teaching methodologies that effectively promote environmental conservation in the context of wetland ecosystems.

Lambung Mangkurat University (ULM) stands at a pivotal opportunity to pioneer locally relevant science education characterized by the sustainable management of wetland resources. By aligning its educational initiatives with the ecological characteristics of the surrounding tropical wetlands, ULM can not only uphold its vision of becoming a scientific hub but also contribute concretely to the advancement of sustainable practices and research (Osei, 2023; Zhipeng et al., 2023). However, to actualize this potential, systemic evaluations are required to examine how local ecological contexts can be incorporated into science education effectively, along with innovative curricular designs that can be adapted and replicated (Hadejia et al., 2020).

To bridge this research gap, employing a Systematic Literature Review (SLR) methodology is proposed as an effective strategy for identifying prevailing trends, pedagogical challenges, and successful models in wetland-based science education (Li et al., 2022). By systematically pooling and analyzing current studies, this approach can yield valuable insights into the pedagogical strategies that have been most successful in facilitating sustainable, entrepreneurial learning concerning wetland ecosystems (Kuijper et al., 2023; Yan et al., 2022). Ultimately, the anticipated findings aim to provide a robust academic foundation that informs curriculum development and instructional practices at ULM and serves as a strategic reference for establishing educational policies that leverage local ecological potentials (Bao & Gao, 2021; Sulaiman et al., 2019).

In summary, this study proposes to explore the intricate relationship between wetland ecosystems and science education, highlighting the trends and challenges inherent in this field. By comprehensively analyzing existing literature, the research aims to foster the development of innovative educational strategies that support sustainability and environmental entrepreneurship, ultimately enriching both academic discourse and practical applications within science education.

METHOD

This study employs a Systematic Literature Review (SLR) methodology (Adawiyah & Veri, 2024). Adopting the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure a transparent and replicable article selection process (Budiani & Sopiah, 2022). The primary database used for article retrieval was Scopus, with the search limited to articles containing the keywords **"wetland"** or **"science and education"** in their titles. This search initially identified 161 articles. The inclusion and exclusion process was guided by specific criteria: 1) Inclusion criteria: Articles published between 2020–2025, written in English, indexed in Scopus, and directly related to wetland ecosystems in the context of science and/or education. 2) Exclusion criteria: Articles not written in English, lacking relevance to either wetland or education themes, or duplicates. After screening for accessibility and relevance, 76 articles remained, of which 20 met all inclusion criteria and were deemed relevant to the study objectives. The other 56 articles were excluded due to lack of alignment with the thematic focus or other exclusion parameters.

To ensure transparency and reproducibility, the selection process is illustrated in the PRISMA flow diagram (Figure 1). The selected articles were organized and stored in a CSV file for further analysis. Key data extracted from each article included publication year, country of origin, top-cited authors, and keywords related to wetland and science education. Subsequently, VOSviewer software was utilized to conduct co-authorship analysis by country and keyword co-occurrence analysis. Co-authorship analysis was used to identify patterns of international collaboration among researchers, while keyword co-occurrence analysis helped to map conceptual structures and thematic trends in the literature. These analytical methods were selected because they provide a quantitative overview of the research landscape and support the identification of influential contributors and emerging research topics aligned with the study's aims.

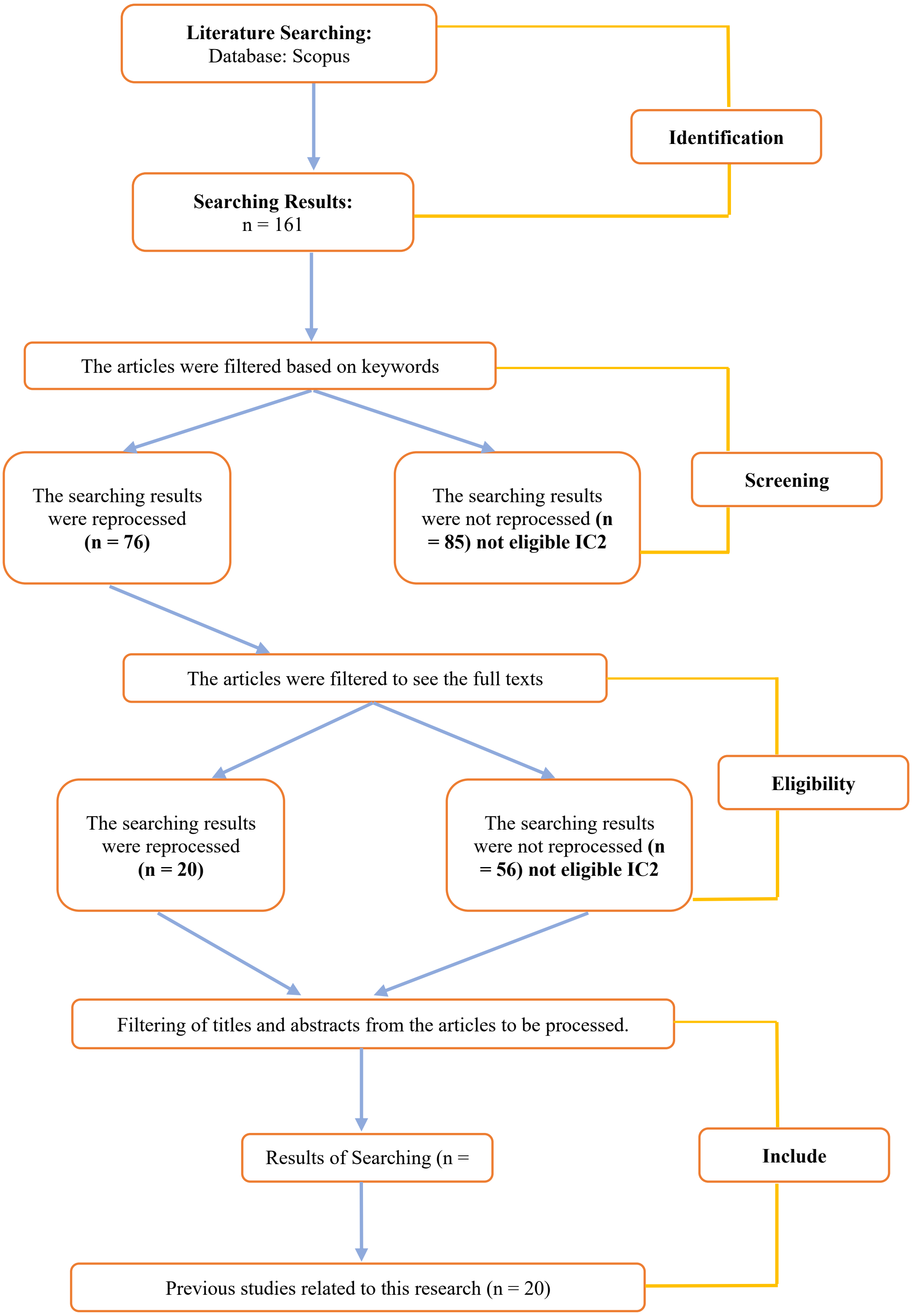


Figure 1. PRISMA Filtering Method

RESULTS AND DISCUSSION

Results

This research aims further to explore the literature on wetland environments in science education, categorized by the article's publication year, co-authorship countries, the top 10 authors with the most citations, and co-occurrence, using bibliometric analysis. Each metadata description from the article's publication year, co-authorship countries, top 10 authors by citation count, and co-occurrence is limited to one study, one publication year, and one co-authorship and co-occurrence. The bibliometric analysis description is as follows:

The studies used in this systematic review were published between 1998 and 2024. Figure 3 shows the distribution of primary studies from 2015 to 2021.

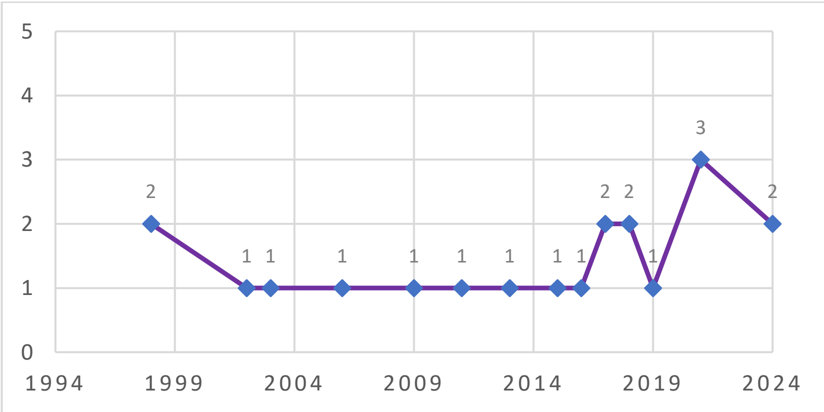


Figure 2. Article Publication Year

Figure 2 shows that the number of studies related to wetland environments in science education published from 1998 to 2024 has fluctuated year by year. The studies on wetland environments in science education using a qualitative approach were most published in 2021. Very few were published in 2002, 2003, 2006, 2009, 2011, 2013, 2015, 2016, and 2019.

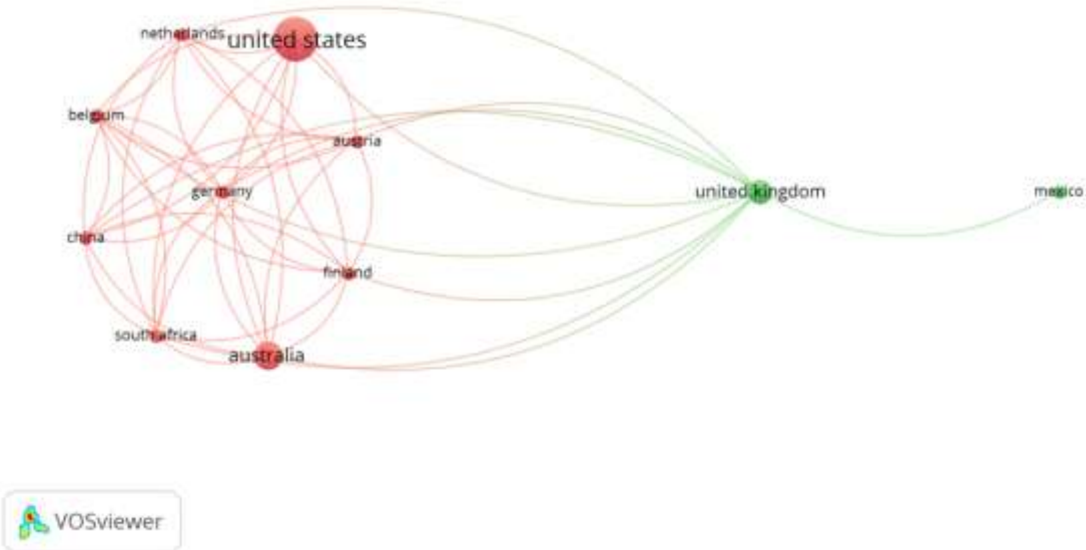


Figure 3. Co-Authorship "Countries" (Overlay Visualization)

Figure 3 shows the visualization of countries researching wetland environments in science education. The United States had 10 articles, followed by Australia (4), the United Kingdom (3), and Austria, Belgium, China, Finland, Germany, Netherlands, and South Africa with 1 article each.

The United States has 10 articles focused on science education related to wetland environments. These studies involved direct student participation in field research and the use of citizen science data to explore environmental issues. For example, the Wetland Connections project links university and high school students to collect data on wetland ecosystems. Other studies on citizen science in Carolina show that such data can help protect species from habitat degradation. Various educational programs engage students in analyzing the impacts of development on wetlands or using visual storytelling in biodiversity education. Field-based programs like the Prairie Science Class have positively influenced student learning outcomes, while remote sensing technology allows students to understand spatial and temporal changes on Earth. Australia contributed four articles exploring active participation in science education through citizen science, outdoor teaching, and place-based pedagogy. Research on citizen science found that participants improved their understanding of insects' roles in urban wetlands, although their initial interest was already high. Outdoor science teaching experiences increased the skills and confidence of future teachers, especially in wetland environments. Place-based pedagogy helped future teachers recognize the potential of teaching science in natural surroundings and overcome challenges related to teaching outside traditional classrooms.

The United Kingdom has three articles focusing on the challenges and needs for protecting ecosystems essential to sustainable natural resources, particularly land and freshwater management. One study highlights the importance of organic carbon management in soil for fertility and global food security. Freshwater fish populations face threats from overfishing, pollution, and climate change, necessitating conservation efforts through research, policy, and training. Freshwater ecosystems suffer significant pressure from habitat loss and pollution, leading to biodiversity declines. Global initiatives like the Alliance for Freshwater Life aim to combine research, policy, and education to preserve freshwater biodiversity. Other countries including Austria, Belgium, China, Finland, Germany, the Netherlands, and South Africa each contributed one article emphasizing education and community involvement in wetland conservation. Studies revealed many teachers in Spain, Portugal, and Belgium lack knowledge about wetland ecosystems and need specialized training. Community programs such as citizen science in Canada and South Korea show promise in gathering ecological data, although challenges in species identification accuracy remain.

The use of environmental wetland topics in science education to show the most cited articles. Table 1 provides details of the top 10 most cited articles in the subject of wetland environments in science education.

Table 1. Top 10 Most Cited Articles

No	Author(s)	Citations	Publisher	Findings	Sjr	Quartile
1	Powlson, D.S.; Gregory, P.J.; Whalley, W.R.; Quinton, J.N.; Hopkins, D.W.; Whitmore, A.P.; Hirsch, P.R.; Goulding, K.W.T.	390	Elsevier	The application of known strategies (through regulations or education), technology development, and ongoing research to improve understanding of basic processes will all play a role. Reducing soil erosion is crucial, both for preserving soil resources and minimizing downstream damage like river sedimentation that negatively impacts fisheries. Practical strategies are well-known but often have financial implications for farmers. Examples of ecosystem service payment systems that affect others exist in various parts of the world and can be modeled.	2.12	Q1
2	Darwall, William; Bremerich, Vanessa; De Wever, Aaike;	198	John Wiley and Sons Ltd	Introduces the Alliance for Freshwater Life, a global initiative that unites specialists in research, data synthesis, conservation, education and outreach, and	0.79	Q1

	Dell, Anthony I.; Freyhof, Jörg; Gessner, Mark O.; Grossart, Hans-Peter; Harrison, Ian; Irvine, Ken; Jähnig, Sonja C.; Jeschke, Jonathan M.; Lee, Jessica J.; Lu, Cai; Lewandowska, Aleksandra M.; Monaghan, Michael T.; Nejstgaard, Jens C.; Patricio, Harmony; Schmidt-Kloiber, Astrid; Stuart, Simon N.; Thieme, Michele; Tockner, Klement; Turak, Eren; Weyl, Olaf			policy-making. This expert network aims to provide the critical mass needed for effective representation of freshwater biodiversity at policy meetings, develop solutions balancing development and conservation needs, and better communicate the vital role of freshwater ecosystems in human wellbeing.		
3	Reid, G. Mcg.; Contreras Macbeath, T.; Csatádi, K.	89	ZSL: Zoological Society of London	Conservation-oriented science on threatened fish species is also needed in terms of taxonomy and biology. From this, the implementation and dissemination of appropriate conservation policies, strategies, and legislation can be developed. All of these factors enable practical direct actions for fish conservation, along with increased education, training, and public communication in zoos.	0.43	Q2
4	Doug Lombardi, Elliot S. Bickel, Janelle M. Bailey, Shondricka Burrell	37	John Wiley & Sons	The activities used in this research can help students develop their critical thinking skills by facilitating the evaluation of the validity of explanations based on evidence, a key scientific practice essential for understanding scientific content and science as a process.	1.54	Q1
5	Jenifer V. Helms	19	Taylor & Francis	Based on a case study of two ninth-grade classes involved in a project where students collected data and reported on newly restored wetlands in their communities, I argue that community-based and/or field projects focused on service learning can be a powerful way to address science literacy issues.	0.97	Q1
6	Julie (Athman) Ernst; Donna Stanek	18	Taylor & Francis	The Prairie Science Class and the research basis for this educational approach. Program evaluation was conducted during its first year, with results showing positive cognitive and affective outcomes. The Prairie Science Class demonstrates how a single NWRS location transitioned from providing one-time traditional awareness programs for school groups to an in-depth program where high school students attend school daily at this NWRS location.	0.82	Q1
7	Brian D. Todd, Jonathan P. Rose,	16	John Wiley & Sons	Opportunistically reported citizen science data can be used to identify	2.17	Q1

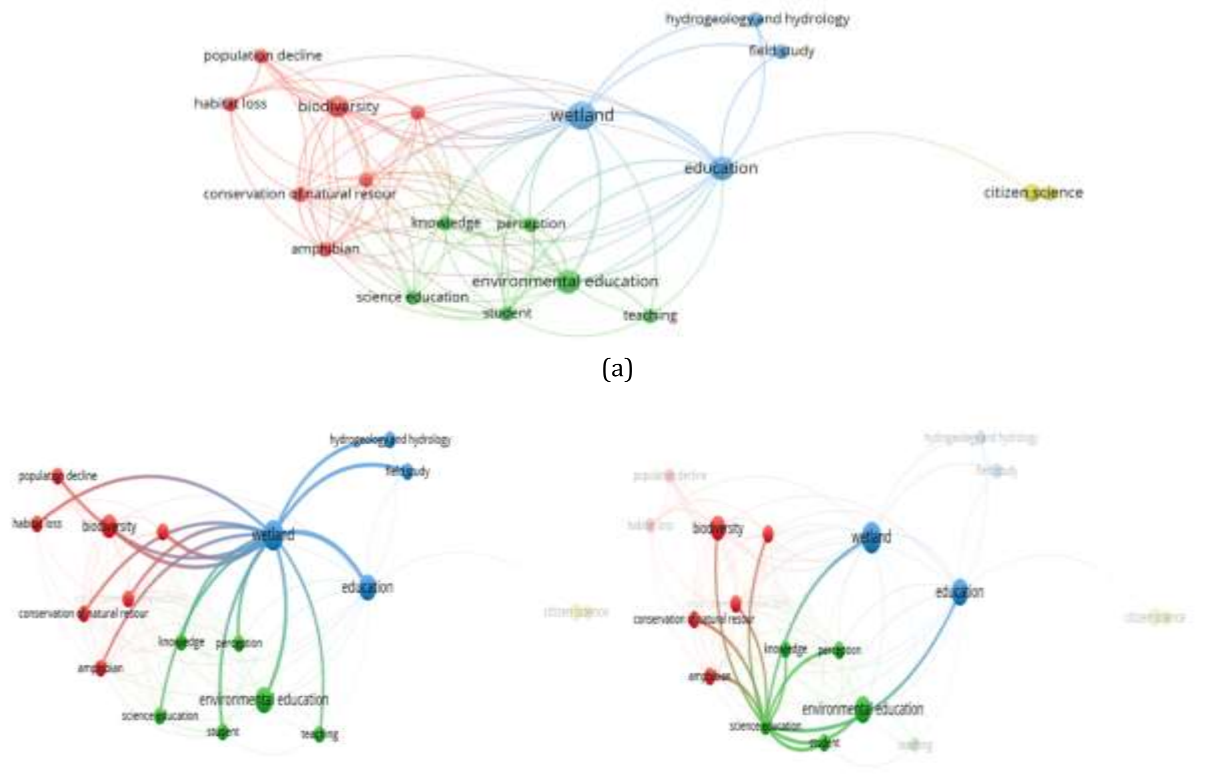
	Steven J. Price, Michael E. Dorcas			sensitive species, and that species currently limited to specific landscapes are most at risk of future habitat loss. Our approach shows the usefulness of citizen science data in prioritizing conservation and helping practitioners address species decline and extinction on a large scale.		
8	Craig R. Williams; Dawn Hawthorn-Jackson; Sofia Orre-Gordon; Shaun O'Sullivan	10	Taylor & Francis	Some improvement in knowledge and understanding of the role of insects in ecosystems, with participants nominating insect traps and subsequent fact sheets as their primary sources of new information. However, most participants seem to have existing interest in ecosystems and environments, reducing our ability to enhance understanding and attitudes in the community. The placement of sticky traps by volunteers proved successful in obtaining new community insect data and shows promise for future use.	0.25	Q2
9	Deniz Saribas; Zeynep Gonca Akdemir	9	Taylor & Francis	Participants usually described this relationship in descriptive and/or relational terms. Analysis also showed that participants listed various criteria to evaluate the trustworthiness of evidence sources; however, each percentage was low. The implications of this study suggest the need for scaffolding like MEL in various long-term educational settings and the need for targeted and systematic efforts to enable learners to evaluate evidence sources for different subjects.	0.97	Q1
10	Hope Klagges, Jon Harbor, Daniel Shepardson, Cheryl Bell, Jason Meyer, Willie Burgess; Ted Leuenberger	7	Taylor & Francis	Teacher participants' experience as learners was described as they conducted temporal wetland analysis using aerial photography in an inquiry-based activity.	0,79	Q1

Referring to Table 1, there are 10 journals with the highest citation counts as of December 2024, from several publishers. The highest citation is for research conducted by Powlson et al. (2011), cited 390 times. This study focuses on strategies to reduce soil erosion through regulation, education, technology development, and continuous research, emphasizing the importance of preserving soil resources and minimizing downstream damage such as river sedimentation.

The second highest citation is Darwall et al. (2018), which introduces the Alliance for Freshwater Life, a global initiative to unite experts in research, conservation, education, and policy to promote freshwater biodiversity. Reid et al. (2013), with 89 citations, emphasize the conservation of endangered fish species through taxonomy, biology, and the implementation of effective policies, strategies, and education. Lombardi et al. (2018) discuss activities that help students develop critical thinking skills by evaluating scientific explanations based on evidence. Helms (1998) reports on a case study involving ninth-grade students collecting data on restored wetlands, suggesting community-based projects can improve science literacy.

Ernst and Stanek (2006) evaluate the Prairie Science Class, showing positive cognitive and affective outcomes from field-based science education. Todd et al. (2016) highlight the use of citizen science data to identify sensitive species at risk due to habitat loss, aiding conservation prioritization.

Williams et al. (2017) find improvements in community knowledge about insect roles in ecosystems, though participant interest was initially high, limiting further gains. Saribas and Akdemir (2019) identify the need for scaffolding and targeted efforts to improve learners' ability to evaluate evidence sources critically. Klagges et al. (2002) examine teachers' experiences using aerial photography for inquiry-based temporal analysis of local wetlands.

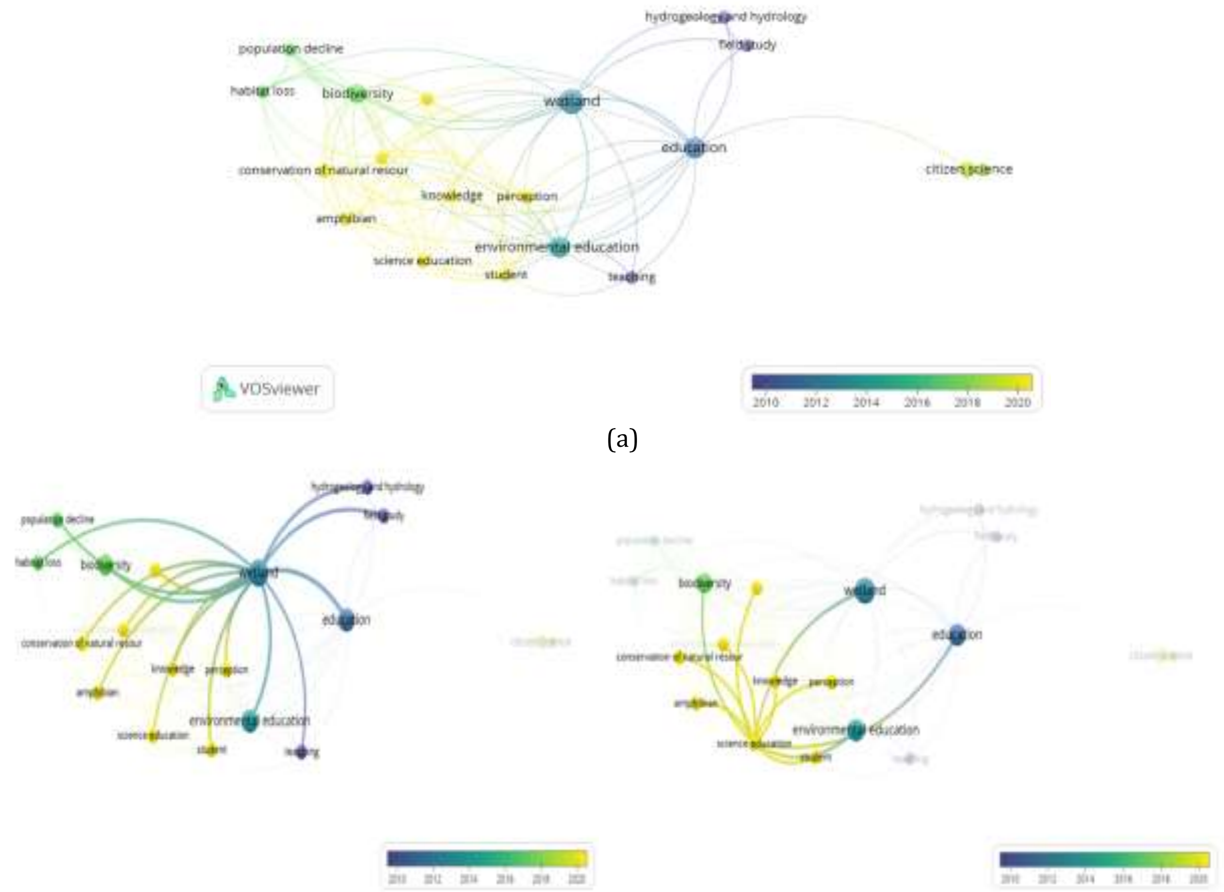


(a)

(b) (c)

Figure 4. Co-Occurrence (Network Visualization)

Figure 4 shows the visualization of keyword networks, revealing diverse data with multiple topics related to "wetland," "science," and "education." The network analysis identifies several keyword clusters that reflect potential areas for further study and development. The red cluster comprises keywords such as population decline, habitat loss, biodiversity, conservation of natural resources, and amphibians. The green cluster includes knowledge, perception, science education, student, teaching, and environmental education. The blue cluster involves wetland, education, field study, hydrogeology, and hydrology. Lastly, the yellow cluster highlights the keyword citizen science. Based on the wetland-focused analysis (Figure 4b), the keywords most prominently associated include education, field study, hydrogeology and hydrology, biodiversity, conservation of natural resources, amphibians, habitat loss, population decline, knowledge, perception, science education, student, environmental education, and teaching. Meanwhile, in the science education-focused analysis (Figure 4c), relevant keywords are environmental education, student, perception, knowledge, conservation of natural resources, amphibians, habitat loss, population decline, biodiversity, wetland, and education.



(a)

(b) (c)

Figure 5. Co-Occurence (Overlay Visualization)

Figure 5 presents an overlay visualization of keyword trends over time. The analysis shows that keywords in the blue cluster represent topics discussed in earlier research, whereas those in the yellow cluster indicate more recent research focuses. Keywords such as *science education*, *student*, *knowledge*, *perception*, *amphibians*, and *conservation of natural resources* appear predominantly in the yellow cluster, signifying their increasing prominence in current studies. In Figure 5b, which shows the co-occurrence of the keyword *wetland* over time, the term began gaining wider research attention starting in 2014. Conversely, *science education* became more commonly explored starting in 2020. This timeline suggests that the integration of wetlands into science education remains relatively new and holds potential for future exploration. Similarly, Figure 5c illustrates the overlay visualization of the keyword *science education*, which confirms its emergence as a significant topic around 2020, while the keyword *wetland* had already been a focus since 2014.

Discussion

The publication trend (See Figure 2) indicates a fluctuating interest in wetland environments in science education, with a peak in 2021 and sporadic contributions in earlier years. This trend mirrors similar patterns in ethnoscience and local wisdom topics, suggesting a growing awareness and integration of indigenous knowledge in environmental education (Ratih et al., 2024; Saefudin Sa & Hartini, 2024).

Visualization of countries researching wetland environments in science education (See Figure 3). Research from the United States demonstrates that direct student engagement in fieldwork and the use of creative media like visual storytelling effectively motivate students to deepen their understanding of environmental issues. Although there are biases due to more visually appealing approaches, field-based programs and remote sensing technologies help students grasp spatial and temporal environmental changes comprehensively (Athman) Ernst & Stanek, 2006; Calhoun et al., 2003; Darwall et al., 2018; Helms, 1998; Klagges et al., 2002; Lombardi et al., 2018; Mowry et al., 2021; Panno et al., 1998; Ricci et al., 2024; Todd et al., 2016). Studies from Australia highlight the significant potential of participatory science education approaches. Even when participants begin with a high level of interest, hands-on experiences in citizen science and outdoor teaching enhance their understanding and skills. Place-based pedagogy is particularly effective in helping future teachers leverage natural environments for science learning and in overcoming obstacles posed by teaching outside conventional classrooms (Ma & Green, 2021b, 2021a; Williams et al., 2017).

Findings from the United Kingdom emphasize the critical role of policy and international collaboration in sustaining vital ecosystems such as soil and freshwater. Integrating education, research, and policy is essential to address threats like climate change, pollution, and overexploitation that jeopardize biodiversity and natural resource sustainability (Ma & Green, 2021a; Reid et al., 2013; Williams et al., 2017). Research from other countries underscores the need for sustained educational efforts and community engagement to support wetland conservation. Improving teacher competencies and addressing data accuracy issues in citizen science are crucial for maximizing the benefits of these programs. A more profound and lasting educational approach is necessary to strengthen the knowledge and skills of both educators and communities in preserving wetland ecosystems and biodiversity (Cartwright et al., 2015; Fernández, 2017; Korovessis, 2009; Powlson et al., 2011; Saribas & Gonca Akdemir, 2019; Yeo et al., 2024).

Top 10 most cited articles in the subject of wetland environments in science education (See Table 1). The highly cited research by Powlson et al. (2011) underscores the importance of combining practical strategies, education, and policy to reduce soil erosion, although financial barriers for farmers remain a challenge. The model of payments for ecosystem services illustrates potential solutions for balancing environmental protection and economic interests. Darwall et al. (2018) highlight the significance of international collaboration and interdisciplinary approaches in conserving freshwater biodiversity, which is critical for human well-being. Reid et al. (2013) emphasize how integrating taxonomy, biology, and education can facilitate the implementation of conservation policies necessary for endangered fish species protection.

Lombardi et al. (2018) demonstrate the role of critical thinking activities in helping students understand science not only as content but as a process, vital for science literacy. Helms (1998) supports community-based and field service projects as effective methods for enhancing science literacy among students through direct engagement with local ecosystems. (Athman) Ernst & Stanek, 2006) provide evidence that immersive, place-based programs like the Prairie Science Class can yield significant cognitive and emotional benefits for students. Todd et al., (2016) show the potential of citizen science data to support large-scale conservation efforts by identifying vulnerable species and habitats. Williams et al. (2017) reveal that while citizen science initiatives can enhance ecological knowledge, initial participant interest levels may influence the degree of impact on attitudes. Saribas & Gonca Akdemir (2019) suggest that long-term educational scaffolds are needed to improve learners' critical evaluation skills of scientific evidence. Klagges et al. (2002) highlight the value of experiential learning for teachers using inquiry-based methods like aerial photography to analyze temporal changes in wetlands, which can improve teaching effectiveness and environmental awareness.

The keyword network analysis illustrates (See Figure 4) that research on wetlands in the context of science education is multidimensional. The presence of clusters such as *population decline*, *habitat loss*, and *biodiversity* in the red cluster underscores a recurring concern in ecological studies the degradation of natural habitats and its implications for species, especially amphibians.

This reflects the urgency of integrating biodiversity and conservation themes into science education curricula.

The green cluster's association with *science education*, *students*, and *teaching* emphasizes the pedagogical focus of many studies, particularly on how knowledge and perception influence environmental understanding. This supports the notion that education plays a crucial role in shaping student awareness and attitudes toward environmental issues. The blue cluster indicates a practical orientation in the form of *field study* and *hydrological understanding*, suggesting that experiential and place-based learning approaches are prevalent in wetland education (Fatmawati et al., 2021). These findings align with the idea that immersive learning environments like wetlands serve as effective contexts for deepening student comprehension of environmental systems.

Furthermore, the yellow cluster focused on *citizen science* shows a growing trend in participatory and community-based environmental education. This indicates that public involvement in ecological data collection is not only beneficial for science but also strengthens public understanding and stewardship. Overall, the data show that science education research on wetlands integrates ecological, pedagogical, and participatory dimensions. Education is not limited to formal instruction but includes environmental and community engagement, reinforcing the interdisciplinary nature of the field (Leu et al., 2021; Mukarromah et al., 2020; Riyana et al., 2022).

The temporal evolution of keywords in Figures 5 through 10 indicates a shifting research landscape. Initially, studies concentrated more on ecological and environmental aspects of wetlands, as shown by earlier topics in the blue cluster. The more recent appearance of terms like *science education*, *knowledge*, and *student* in the yellow cluster reflects a growing interest in pedagogical applications of wetland-related content. This progression highlights a relatively untapped opportunity for integrating wetlands into science education. The findings suggest that although ecological studies of wetlands have a longer research history, their educational potential has only recently begun to receive attention. As reported by Mahtari et al. (2023), the development of a Project-Based Learning (PjBL) book has proven effective in enhancing students' creativity and responsibility toward wetland environments. The ability to apply these skills in PjBL activities reflects the practical relevance of wetlands in fostering 21st-century competencies. Furthermore, Misbah et al. (2020) found that training science teachers with HOTS-based science questions achieved an effectiveness score of 3.39 (categorized as excellent), reinforcing the suitability of such programs in preparing educators to teach wetland-based content. Research by Rusmansyah et al., (2023) demonstrates the effectiveness of the PjBL-STEAM model in the context of wetlands, improving students' critical thinking and self-efficacy. Students responded positively to this model and expressed interest in its broader application. In parallel, Miriam et al. (2023) showed that through mentoring, teachers successfully incorporated local wisdom and wetland environments into subject-specific learning, proving the scalability and adaptability of wetland-based education across disciplines. These developments affirm that the integration of wetland contexts into science education is both feasible and impactful, with growing support from empirical evidence and teaching practices.

CONCLUSION

This study explores and describes the connection between wetland environments and science education from 1998 to 2024, using the PRISMA method and bibliometric analysis, specifically co-occurrence techniques. The article selection process followed the PRISMA flow as recommended for systematic literature reviews. A total of 161 articles were retrieved from the Scopus database using the keyword "Wetland Environment in Science Education" in the title. After filtering by publication year and relevance, 76 articles remained, of which 20 were deemed highly relevant. The findings reveal a meaningful relationship between wetland environments and science education, particularly in curriculum development, learning resources, and environmental literacy. However, a notable research gap exists few studies have deeply explored how wetlands can be contextually integrated into science teaching across educational levels.

A key limitation of this study lies in the relatively small number of articles that explicitly connect wetlands with science education, as well as the thematic and regional scope of the literature reviewed. Future research is encouraged to expand this scope, adopt interdisciplinary approaches, and incorporate local knowledge and environmental science more holistically. This study offers a valuable foundation for future work in curriculum design, contextual learning, and research focused on wetland-based science education. The authors hope it serves as a meaningful reference that inspires further exploration of wetlands as rich, authentic learning environments.

AUTHOR CONTRIBUTIONS STATEMENT

PS initiated the research idea and coordinated the overall direction of the systematic review. M and RA were primarily involved in formulating the research questions and conducting the systematic search and screening process. NM and MH contributed to data extraction, coding, and synthesis of findings. Q and SH reviewed relevant literature and supported the discussion and implications section. All authors were involved in editing, critically revising the manuscript, and approved the final version for submission.

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