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BREAKING BARRIERS: INTEGRATING PADLET TO INTRODUCE ENVIRONMENTAL EDUCATION TO PRE-SERVICE TEACHERS

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Abstract: *This study explores the integration of Padlet, a web-based digital platform, into environmental education for pre-service teachers at Tadris Bahasa Inggris (TBI) of IAIN Madura, Indonesia, using a mixed-methods approach. A purposive sample of 98 pre-service teachers from 47 Teaching Practice 1 pre-service teachers and 51 TEYL pre-service teachers from TBI participated. The research aims to bridge the gap between environmental education theory and teaching practice by utilizing Padlet as a learning medium. Data collection included pre- and post-surveys on pre-service teachers' perceptions and knowledge of environmental education and technology, along with interviews, observations, and course material analysis. Quantitative data were analyzed using descriptive statistics, while qualitative data underwent thematic analysis. Findings indicate that Padlet significantly enhances student engagement, collaborative learning, and understanding of environmental concepts. The platform's versatility allows for interactive activities that cater to diverse learning styles, fostering critical thinking and environmental consciousness. Despite challenges such as resource constraints and varying levels of digital literacy, the study highlights the potential of digital tools like Padlet to enrich environmental education. The research contributes to the scholarship on innovative pedagogical approaches in sustainability education and offers recommendations for integrating technology into teacher training programs. Findings provide insights into how Padlet supports critical thinking, collaboration, and environmental awareness in teacher education, demonstrating its value as a transformative tool for preparing environmentally conscious future educators.*

Keywords: *digital literacy; environmental awareness; environmental education; pre-service teacher; Padlet*

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INTRODUCTION

IAIN Madura, as a distinguished Islamic institution of higher education, occupies a unique position in shaping the future educators of Indonesia. It emphasizes the development of pedagogical skills among Pre-service teachers and ensures that these future educators are grounded in Islamic values and principles, fostering a teaching practice that is both ethical and spiritually informed (Rabbianty et al., 2019). The institution is deeply embedded within Indonesia's dynamic and ever-evolving educational landscape, a context marked by diverse challenges and opportunities. As such, IAIN Madura is committed to addressing contemporary educational issues, including environmental sustainability, through innovative pedagogical approaches rooted in Islamic teachings and values (Hadi & Mashur Abadi, 2021).

However, despite this progressive vision, integrating environmental education into the existing curriculum can face several challenges. Traditional pedagogical approaches within Islamic institutions have historically given precedence to religious studies, sometimes sidelining crucial topics like environmental science or sustainability education. Moreover, the constraints posed by limited institutional resources can create barriers to introducing new subjects or adopting modern teaching methodologies that are critical in today's global context (Abubakari et al., 2023). Nevertheless, environmental education remains indispensable as it fosters environmental awareness, imparts critical knowledge, and cultivates attitudes and skills to empower individuals to contribute meaningfully to sustainable development. This approach aligns with Islamic teachings emphasizing stewardship, or *khalifah*, and a deep sense of responsibility for safeguarding the environment.

Environmental education extensively draws from Islamic scriptures, including the Quran and Hadith, and offers a profound moral and ethical framework (Hayat et al., 2023). These teachings inspire an understanding of humanity's responsibility as custodians of the Earth. Through Islamic values, environmental education covers a broad range of interconnected topics such as biodiversity conservation, climate change mitigation, waste

management, and the sustainable use of resources. These areas provide future educators with the knowledge needed to address environmental issues and ensure they understand the intersection of environmental, English teaching and learning, and cultural factors. This integrated approach empowers them to view environmental challenges holistically, recognizing that solutions must be socially just, culturally sensitive, and pedagogically feasible.

IAIN Madura recognizes the pressing need to address modern issues, such as environmental sustainability, within its curriculum (Rabbianty et al., 2022) and the future mission to be green starting from having some campaigns on zero plastics program (Hadi et al., 2021). In line with its mission to produce educators who are pedagogically competent and morally responsible, the institution seeks to integrate digital technologies, such as Padlet, into environmental education courses (Rabbianty et al., 2024). Padlet, a highly versatile and interactive online tool, allows educators to create engaging, dynamic, and collaborative learning environments (Dianati et al., 2020). Padlet was chosen over other digital tools due to its ease of use, versatility, and strong support for interactive learning. Its user-friendly interface makes it accessible to pre-service teachers with varying levels of digital literacy, unlike more complex platforms. Padlet allows users to integrate text, images, videos, and links in a visually organized way, making learning more engaging and collaborative (Arfiani et al., 2021; Shuker & Burton, 2021).

Integrating Padlet into environmental education helps pre-service teachers engage with environmental education in a way that is interactive, collaborative, and deeply meaningful (Baidoo et al., 2022a). Rather than just reading about environmental issues, pre-service teachers actively explore them by sharing multimedia resources, participating in discussions, and working on group projects. For example, they can use Padlet to collect and reflect on Quranic and Hadith references about environmental responsibility, debate real-world sustainability challenges, and brainstorm solutions for issues like climate change and waste management. This hands-on approach makes learning more engaging and relevant, allowing pre-service teachers to connect environmental concepts with their daily lives and future teaching practices. At the same time, using Padlet builds digital literacy, preparing pre-service teachers to integrate technology into their classrooms effectively (Dianati et al., 2020). By combining sustainability education with interactive learning, Padlet helps pre-service teachers see the bigger picture—how environmental issues intersect with culture, ethics, and pedagogy—while also giving them practical tools to bring these lessons to life in their own classrooms.

Moreover, for Pre-service teachers at IAIN Madura, integrating digital technologies into environmental education is not merely a technical enhancement. It represents an essential pedagogical shift that merges modern educational tools with core Islamic values. In this context, technology becomes a vehicle for reinforcing ethical principles, as Pre-service teachers are trained to use these tools responsibly and with an awareness of their

potential for positive social and environmental impact. By embracing technology in this way, IAIN Madura prepares its future educators to navigate the complexities of 21st-century education while remaining steadfast in their commitment to Islamic values.

This research aims to assess the effectiveness of Padlet as a tool for introducing and enhancing environmental education among Pre-service teachers at IAIN Madura. To address these objectives, this study aims to answer the following research questions:

1. How effectively does Padlet introduce environmental education concepts to Future Teachers?
2. What is the impact of Padlet integration on Future Teachers' perceptions, attitudes, and readiness to incorporate environmental education into their future teaching practice?
3. What are the challenges and opportunities in integrating Padlet into environmental education for Future Teachers?

By identifying challenges and opportunities in integrating Padlet, such as resource and technological constraints, the research offers insights into how IAIN Madura and similar institutions can effectively use digital tools to prepare environmentally conscious educators.

LITERATURE REVIEW

Environmental Education in Teacher Preparation Programs

Environmental education plays an essential role in shaping the environmental consciousness of pre-service teachers and their ability to instill sustainable practices in their pre-service teachers (Ekantini et al., 2024; Kalsoom & Khanam, 2017). The rising global environmental challenges, such as climate change, resource depletion, and biodiversity loss, underscore pre-service teachers' need to be well-prepared in environmental literacy (Evans et al., 2016). For this reason, pre-service teacher preparation programs incorporating environmental education are believed to empower pre-service teachers to foster a generation capable of addressing sustainability issues and advocating for responsible environmental stewardship (Atif, 2024). However, including environmental education in teacher training is not without challenges.

One of the most significant challenges in embedding environmental education within teacher training curricula is the traditional prioritization of other subjects, which often marginalizes sustainability topics (Saiful, 2023). In many educational institutions, entrenched pedagogical paradigms limit the flexibility to introduce interdisciplinary subjects, such as environmental education, which requires integrating science, ethics, and social studies. Moreover, the shortage of resources—including both financial support and instructional materials—further exacerbates these barriers (Rabbianty et al., 2022). This scarcity prevents the widespread implementation of comprehensive environmental education programs (Parry & Metzger, 2023).

Despite these challenges, there is a growing consensus that teacher training programs must adopt innovative pedagogical strategies to overcome these limitations (Eliyawati et al.,

2023; Rabbianty et al., 2024). As environmental education spans a broad range of topics, its effective integration into teacher preparation programs calls for creative solutions (Martínez Valdivia et al., 2023). Educators and policymakers must advocate for interdisciplinary collaborations that bring together science educators, environmentalists, and digital technology experts to design comprehensive, engaging, and relevant curricula (Humairoh et al., 2024). These concerted efforts are necessary for pre-service teachers to cultivate environmental awareness in their classrooms, jeopardizing the long-term goal of sustainable development (Micalay-Hurtado & Poole, 2022). By addressing these gaps, this study contributes to the ongoing discourse on innovative pedagogical approaches in environmental education and offers insights for future research on digital tool integration in teacher training.

Digital Technologies in Environmental Education

Integrating digital technologies into environmental education has been revolutionary, offering new avenues for teaching and learning that transcend traditional classroom boundaries (Shadiev et al., 2024). The use of digital platforms, interactive tools, and multimedia resources has made environmental education more accessible, engaging, and relevant for both teachers and pre-service teachers (Rabbianty et al., 2024). Digital platforms like Padlet, virtual simulations, and interactive educational apps provide pre-service teachers with immersive experiences that bring environmental concepts to life (Deni & Zainal, 2018; Buchanan, 2019). For instance, virtual field trips and simulations enable pre-service teachers to explore ecosystems, witness the impacts of climate change, and experiment with sustainable practices without leaving the classroom (Bower et al., 2020). Such experiences are critical in fostering environmental literacy, as they allow pre-service teachers to visualize and engage with real-world environmental challenges in ways that traditional textbooks and lectures cannot (Saiful, 2023).

Despite the promise of digital tools, their implementation also has significant challenges. For one, effectively using these technologies requires teachers to be digitally literate and confident in integrating them into their pedagogy (Villar-Onrubia et al., 2022). Unfortunately, many Pre-service teachers lack sufficient training in using digital tools for educational purposes, particularly in the context of environmental education (Rabbianty et al., 2024). Moreover, institutional barriers, such as limited access to digital infrastructure and inadequate professional development, further hinder the effective use of technology in teacher training programs (Purmayanti, 2022). Moreover, empirical information on the comparative usefulness of these technologies is limited, particularly in terms of how different digital platforms impact student involvement and knowledge in environmental education (Karanjakwut & Sripicharn, 2024). This study addresses this gap by examining Padlet's specific role in fostering environmental awareness among pre-service teachers.

Pedagogical Implications of Padlet Integration in Environmental Education

Padlet stands out for its ability to create interactive, collaborative, and engaging learning experiences among the various digital tools available for environmental education (Mehta et al., 2021). As a versatile online platform, Padlet facilitates the co-construction of knowledge, enabling pre-service teachers to share ideas, resources, and reflections in a visually engaging format (Deni & Zainal, 2018). This collaborative aspect is particularly relevant to environmental education, where problem-solving and critical thinking are central to understanding and addressing environmental issues (Arfiani et al., 2021).

The pedagogical benefits of Padlet in environmental education are significant. First, it promotes active engagement by allowing pre-service teachers to contribute to discussions, post multimedia content, and interact with their peers in real-time. This collaborative learning environment encourages pre-service teachers to take ownership of their learning, fostering a deeper connection to the environmental topics they are exploring (Baidoo et al., 2022). Padlet also supports critical thinking and digital literacy, two essential skills for future educators (Readette & Harvey, 2022). By engaging with diverse resources and participating in online debates or project-based learning activities, pre-service teachers are encouraged to think critically about environmental issues and consider multiple perspectives (Arfiani et al., 2021). These activities enhance their environmental knowledge and prepare them to facilitate similar discussions in their future classrooms.

However, the traditional barriers of limited resources and rigid pedagogical frameworks necessitate innovative approaches (Rabbianty et al., 2024). The integration of Padlet into environmental education is also challenging. As with any digital tool, its effectiveness depends on the teacher's ability to facilitate meaningful interactions and ensure that the technology enhances, rather than detracts from, the learning experience. Therefore, teacher preparation programs must provide Pre-service teachers with the necessary training and support to use Padlet effectively (Abraham et al., 2022). This includes technical training and pedagogical guidance on designing activities that foster collaboration, critical thinking, and environmental consciousness.

In conclusion, the success in adopting these technologies requires robust teacher training programs that equip future educators with the skills and knowledge to integrate digital tools into their pedagogy. In doing so, this study seeks to address this gap by evaluating how effectively Padlet introduces environmental education concepts to future teachers' perceptions, attitudes, and pedagogical readiness.

METHOD

This study uses a mixed-methods approach to assess the impact of integrating Padlet into environmental education for ninety-eight pre-service teachers at IAIN Madura, where the researchers are the lecturers who make the research as classroom-based research. The population of this research is ninety-eight pre-service teachers. Forty-seven pre-service

teachers from the 2024 Teaching Practice 1 course and fifty-one pre-service teachers from 2024 Teaching English for Young Learners at *Tadris Bahasa Inggris* that were selected through purposive sampling to represent diverse experiences with digital tools and environmental topics teaching practices. This ensures a broad understanding of Padlet's effectiveness and challenges within an environmental topic on the Islamic pedagogical framework.

Both quantitative and qualitative data analysis methods were used. A pre- and post-likert-scale questions survey established a baseline of respondents ' perceptions, attitudes, and readiness and measured shifts following the intervention with Padlet. Semi-structured interviews provided deeper insights into respondents ' experiences, while observations documented engagement and collaboration using Padlet. Course materials, including projects and reflections, were analyzed to evaluate how effectively Padlet was integrated into environmental education activities.

To enhance the reliability of qualitative analysis, the researcher, who also teaches the two courses, and a lecturer colleague acted as independent coders. Both independently analyzed interview transcripts, observation notes, and documentation by assigning thematic codes (Creswell & Poth, 2016). For example, if both identified "increased engagement" as a common theme in multiple responses, it confirmed consistency in interpretation.

To ensure openness, all responses were anonymized by removing respondents' names and identifiable details. Instead, responses were labeled as "Participant 1, 2, 3," etc. This anonymity encouraged honest feedback without fear of judgment or professional consequences while also upholding ethical research standards and protecting respondents' privacy. This comprehensive approach provided valuable insights into using digital tools for environmental education within an Islamic educational context.

RESULTS AND DISCUSSION

The demographic analysis of the pre-survey and post-survey data provides a detailed snapshot of the characteristics of the 47 participating pre-service teachers across several factors.

Results

Demographic Analysis of Pre-Survey and Post-Survey Data

Table 1 provides an overview of the respondents' demographic information. This data offers insights into the composition of the sample population and serves as a reference point for analyzing the results from both the pre-survey and post-survey stages.

Respondent Demographic

Table 1.
the Respondent's Demographic Information

Demographic Factor	Category	Frequency	Percentage
Age Distribution	18-19	0	0 %
	20-21	34	72,3 %
	More than 21	13	27,7 %
Gender Distribution	Male	8	17 %
	female	39	83 %
Address Distribution	Pamekasan	30	63.8 %
	sampang	8	17 %
	Sumenep	9	19.1 %
	Bangkalan	0	0 %
	Other areas	0	0 %
Educational Background	SMA	13	21.3 %
	MAN	7	14.9 %
	SMA in Pesantren	17	36.2 %
	MAN in Pesantren	10	29,7 %

From Table 1, the age distribution of the respondents reveals that a majority (72.3%) fall within the 20-21 age range, indicating they are likely in the early stages of their undergraduate studies. Notably, there are no respondents aged 18-19, while 27.7% are over 21, suggesting a smaller representation of mature pre-service teachers. In terms of gender distribution, the sample is predominantly female, with 83% (39 respondents) being women and only 17% (8 respondents) being men. This gender imbalance could potentially influence the study's findings and impact the generalizability across different gender lines.

Regarding address distribution, a majority of the respondents (63.8%) are from Pamekasan, followed by 19.1% from Sumenep and 17% from Sampang. There are no respondents from Bangkalan or other areas, which may skew the results toward regional perspectives. In terms of the respondets'educational background, they have diverse educational backgrounds: 36.2% attended SMA in Pesantren, 27.7% completed MAN in Pesantren, 21.3% attended SMA, and 14.9% attended MAN. This variety, with many coming from Islamic boarding schools, could shape their views on digital tools and environmental education.

Pre - Surveys

The presurvey results provide insights into the respondents' familiarity with environmental education concepts, their perceptions of its importance in teacher preparation, and their confidence in incorporating it into their teaching practices to see the current state of environmental education and the potential role of digital tools in enhancing its effectiveness in their future classroom usage. The data also highlights their usage of digital technologies and familiarity with Padlet among the pre-service teachers.

Responses on Environmental Education

Table 2.
The Pre-Survey Questions and Respondents' Responses on Environmental Education

Survey Questions	Category	Frequency	percentage
Familiarity with Environmental Education Concepts	Not familiar at all	4	8.5 %
	Somewhat familiar	4	8.5 %
	Moderately familiar	28	59.6 %
	Very familiar	11	23.4 %
	Expert	0	0 %
Perception of the Importance of Environmental Education in Teacher Preparation	Not important at all	0	0 %
	Slightly important	1	2.1 %
	Moderately important	7	14.9 %
	Very important	31	66 %
	Extremely important	8	17 %
Confidence in Incorporating Environmental Education	Not confidence at all	4	8.5 %
	Slightly confidence	10	21.3 %
	Moderately confidence	23	48.9 %
	Very confidence	9	19.1 %
	Extremely confidence	1	2.1 %

Most respondents demonstrated moderate familiarity with environmental education, with 59.6% having basic knowledge, while 23.4% showed deeper understanding, and 17% lacked familiarity. None considered themselves experts, indicating a knowledge gap. Regarding its importance in teacher preparation, 66% viewed it as very important, 17% as extremely important, and only 2.1% saw it as slightly important, reinforcing the need for integration. Confidence in incorporating environmental education was moderate for 48.9% of respondents, with 19.1% feeling very confident, 21.3% slightly confident, and 8.5% lacking confidence altogether.

The Usage of Digital Technologies

Table 3.
The Pre-Survey Questions and Respondents Responses on the Usage of Digital Technologies

Survey Questions	Category	Frequency	percentage
How often do you use educational technologies?	Never	0	0 %
	occasionally	0	0 %
	Sometimes	7	14.9 %
	Often	18	%
	Very often	22	46.8 %
Familiarity with Padlet	Not Familiar at all	11	23.4 %
	Heard of it but never use it	4	8.5 %
	Slightly familiar	8	17 %
	Moderately familiar	4	8.5 %
	Very familiar	20	42.6 %

Use of Padlet for Educational Purposes	No I have not use it before	32	68.1 %
	Yes, but only a few times	7	14.9 %
	Yes quite often	6	12.8 %
	Yes i have use it regularly	2	4.3 %
	Yes i am very familiar with it	0	0 %

The survey shows that 46.8% of respondents use educational technologies very often, and 38.3% use them often, reflecting strong engagement, with none reporting rare or no usage. In terms of familiarity with Padlet, 42.6% are very familiar, while 23.4% are not familiar at all. Although 68.1% have never used Padlet for educational purposes, 31.9% have used it occasionally. Attitudes toward technology in education are mostly positive, with 51.1% agreeing and 29.8% strongly agreeing that it enhances learning. Finally, expectations for Padlet in environmental education are moderate to high, with 68.1% anticipating moderate effectiveness and 27.7% expecting high effectiveness.

Post Surveys Result

This survey assessed how respondents perceive the role of technology in education and their expectations for Padlet's effectiveness in environmental education. The findings provide insights into how pre-service teachers view technology's impact on teaching and learning, as well as their expectations for Padlet as a tool in environmental education. The following analysis details these perspectives, highlighting overall attitudes and anticipated benefits.

Environmental Education Awareness

Table 4.
The Post Survey Questions and Respondents Responses on Environmental Education Awareness

Survey Questions	**Category**	**Frequency**	**Percentage**
Change in Understanding of Environmental Education Concepts	Significantly Decrease	4	6.2 %
	Decreased	4	6.2 %
	Remained the same	9	13.8 %
	Increased	32	49.2 %
	Significantly increased	16	24.5 %
Preparedness to Incorporate Environmental Education into Teaching Practice	Not prepared at all	2	3.1 %
	Slightly prepared	4	6.2 %
	Moderately prepared	29	44.6 %
	Very prepared	26	40 %
	Extremely prepared	4	%

The survey results, as presented in Table 4, show that the Padlet-integrated intervention positively impacted respondents ' understanding of environmental education concepts, with 49.2% reporting an increase and 24.6% a significant increase. Only 13.8%

saw no change, and 6.2% reported a decrease. In terms of preparedness to teach environmental education, 44.6% felt moderately prepared and 40% very prepared, with just 6.2% feeling slightly or extremely prepared and 3.1% not prepared at all. Overall, the intervention effectively improved respondents' understanding and readiness to incorporate environmental education into their teaching practices.

Padlet Technology Integration

Most respondents found Padlet helpful in facilitating discussions and collaboration, with 49.2% rating it moderately helpful and 46.2% very helpful, while only 4.6% found it extremely helpful. Similarly, Padlet enhanced engagement with environmental education content, as 46.2% felt it moderately improved engagement and 43.1% saw significant improvement. Confidence in using Padlet also increased, with 41.5% feeling moderately or very confident.

Padlet positively impacted the overall learning experience, with 56.9% indicating a large improvement and 35.4% a moderate one. Satisfaction with the intervention was high, with 67.7% satisfied or very satisfied, though 27.7% remained neutral, suggesting room for improvement. Overall, the Padlet-integrated intervention was well-received, enhancing collaboration, engagement, and confidence in using the tool for educational purposes.

Table 5.
The Post Survey Questions and Respondents Responses Padlet Technology Integration

Survey Questions	Category	Frequency	percentage
Helpfulness of Padlet in Facilitating Discussions and Collaboration	Not helpful at all	0	0 %
	Slightly helpfull	0	0 %
	Moderately helpful	32	49.2 %
	Helpful	30	46.2 %
	Extremely helpfull	3	4.6 %
Enhancement of Engagement with Environmental Education Content	Did not enhance engagement	2	3.1 %
	Slightly enhance engagement	4	6.2 %
	Moderately enhance engagement	29	44.6 %
	Very enhance engagement	26	40 %
	Extremely enhance engagement	4	6.2 %
Confidence in Using Padlet for Educational Purposes	Not confident at all	0	0 %
	Slightly confidence	3	4.6 %
	Moderately confident	27	41.5 %
	Very confident	27	41.5 %
	Extremely confident	8	12.3 %
Improvement in Overall Learning Experience through Padlet	Not at all	0	0 %
	To a small extent	2	3.1. %
	To a moderate extent	23	35.4 %
	To a large extent	37	56.9 %
	To a very large extent	3	4.6. %

Satisfaction with Padlet-Integrated Environmental Education Intervention	Very dissatisfied	3	4.6 %
	Dissatisfied	0	0 %
	Neutral	18	27.7 %
	Satisfied	23	35.4 %
	Very satisfied	21	%

Based on the presurvey and post-survey presented in Table 5 above, elaborated with the following interview and observation results then, the analysis presents findings from this Padlet-integrated teaching approach, highlighting its impact on pre-service teacher participation, collaborative learning, concept comprehension, and digital literacy development. Through these insights, we evaluate the effectiveness of Padlet in achieving our educational objectives and identify areas for further improvement. In the evolving landscape of education, the integration of technology plays a crucial role in enhancing teaching and learning experiences. As part of an initiative to innovate teaching methodologies, Padlet, a digital collaboration tool, was incorporated into the Tadris Bahasa Inggris Teaching Practice 2 course. This intervention aimed to foster greater Future Teachers' engagement, deepen understanding of environmental education concepts, and improve technological proficiency among Future Teachers.

Effectiveness of Padlet in Introducing Environmental Education Concepts to Future Teachers

Integrating Padlet into environmental education has proven to be a powerful tool in enhancing student engagement, understanding, and collaboration (Mehta et al., 2021). By facilitating the easy sharing of ideas, fostering interactive discussions, and linking theoretical knowledge to real-world applications, Padlet creates a dynamic and engaging learning environment. The qualitative insights and examples provided underscore the transformative potential of integrating technology like Padlet into environmental education.

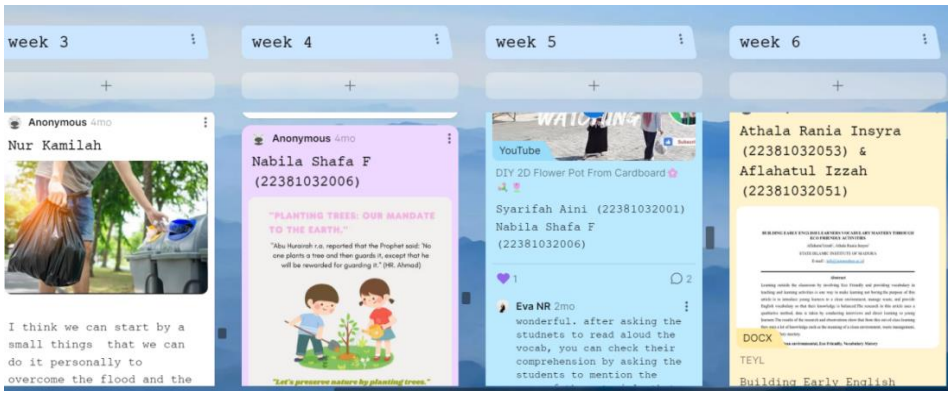

Figure 1. Teaching and Learning Activities through Padlet

Padlet serves as an effective digital tool for engaging pre-service teachers in environmental education through collaborative and creative learning. Figure 1 showcases

a week-by-week progression of student contributions, including personal reflections, eco-friendly projects, and sustainability-themed lesson ideas. Posts highlight individual actions like waste management, tree planting with religious values, recycling projects, and integrating environmental topics into language learning. Padlet's multimodal features—such as text, images, and videos—enhance engagement, teamwork, and environmental awareness, preparing future teachers to incorporate sustainability into their classrooms.

Student Engagement

The integration of Padlet into environmental education has significantly enhanced student engagement. Typically, passive pre-service teachers have become more active in discussions and collaborative activities. Padlet facilitates the easy sharing of ideas and resources, particularly during group work, where pre-service teachers use it to brainstorm and organize thoughts. Increased interaction through commenting on peers' posts fosters a collaborative learning environment. Lecturer feedback has also confirmed pre-service teachers' heightened engagement and enthusiasm through their contributions and interactions on the platform.

One future teacher emphasized how Padlet facilitated their learning process: "*Previously, I didn't know what Padlet was, but my lecturer taught me how to use Padlet. Padlet really helped me, and it also made it easier for me to learn, especially about the environment*" (Respondent 42). This underscores the crucial role of lecturers in guiding Pre-service teachers to effectively utilize new technologies and highlights Padlet's potential to simplify complex subjects, thereby enhancing overall comprehension.

Another future teacher highlighted Padlet's potential to make learning more interesting and less monotonous: "*I will use Padlet to make learning easier, such as for group projects and discussions, as well as to make learning more interesting and less monotonous so that it can increase student creativity too*" (Respondent 44). This reflects the importance of incorporating interactive and creative elements into the learning process to maintain Future Teachers' interest and foster creativity as the essential component of effective teaching and learning (Ramachandiran & Mahmud, 2018a).

Understanding of Environmental Education Concepts

The integration of Padlet into environmental education has significantly enhanced pre-service teachers ' understanding of the subject. The survey result shows that over 70% of the respondents have effectively improved their understanding and readiness to incorporate environmental education into their teaching practices. Their contributions to Padlet demonstrate a deeper grasp of environmental concepts, linking theory to real-world applications through articulate examples. The platform's interactive features improve both engagement and comprehension. Additionally, Padlet's visual nature promotes better retention, as pre-service teachers frequently revisit posts, reinforcing learning and facilitating long-term memory retention. This consistent interaction helps pre-service

teachers recall information during discussions, highlighting Padlet's effectiveness in supporting sustained learning in environmental education.

For example, pre-service teachers ' posts on Padlet about the concept of green noise or nature sounds showed a thorough understanding, as they linked the theory to practical, real-world examples. This type of engagement indicates that pre-service teachers are not only absorbing information but are also able to apply it contextually.

One future teacher articulated the critical role of environmental education: "*Environmental education is crucial for cultivating a sense of responsibility, fostering environmental stewardship, and preparing pre-service teachers to address pressing environmental challenges*" (Respondent 5). This sentiment aligns with the academic perspective that environmental education is fundamental in developing eco-conscious individuals who can contribute to sustainable development (Aliman & Mutia, 2021).

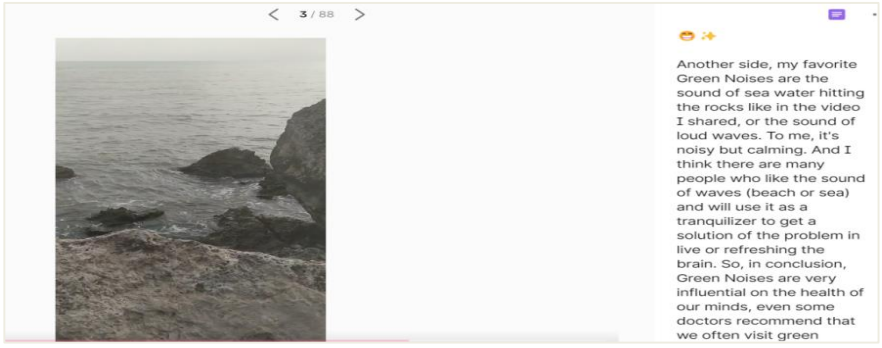

Figure 2. Students Comprehend About Green Noise or Nature Sound Concept

Figure 2 showcases a coastal scene with waves crashing against rocky cliffs, illustrating nature's calming effects. As part of the lesson, the lecturer attached a video about "Green Noise," explaining its benefits for mental well-being and relaxation. In response, pre-service teachers were encouraged to explore their own connections with nature by attaching their favorite green noise to a Padlet post. This activity aimed to deepen their understanding of environmental education by fostering appreciation for nature's role in well-being and encouraging sustainable interactions with the environment.

Technological Proficiency in Integrating Padlet into Environmental Education

After the research, all the respondents agreed that the integration of Padlet into the teaching process has proven highly successful, largely due to its user-friendly interface. Respondents found the platform intuitive and easy to navigate, enabling them to adapt quickly with minimal technical support. This ease of use facilitated the seamless incorporation of technology into the classroom. Regular use of Padlet throughout the course has enhanced respondents' digital literacy, improving their skills in navigating online tools and communicating in a digital context. This consistent engagement bolstered their

proficiency with Padlet and contributed to their broader technological competencies, which are crucial for modern education.

Given rising environmental concerns and advancements in educational technologies, the growing integration of environmental education and technology in educational settings is increasingly relevant. The qualitative insights presented here, derived from student feedback, highlight the perceived importance of these elements in fostering environmental awareness and responsibility.

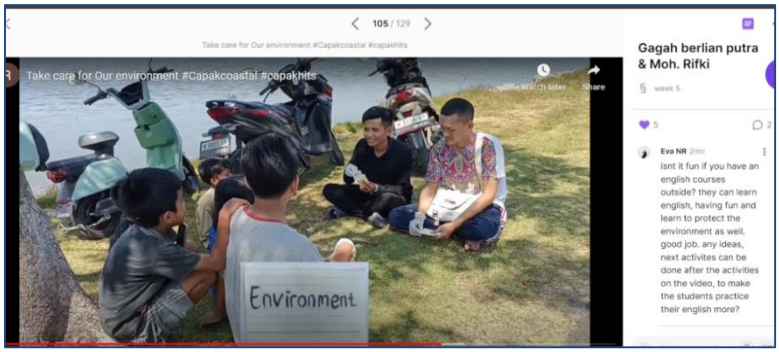

Figure 3. The Pre-service Teachers Can Easily Attach Several Types of Media Into Padlet

Figure 3 illustrates how pre-service teachers utilize Padlet to foster environmental awareness through outdoor learning activities. As part of the lesson, students engaged in a community-based project, integrating Padlet to document their discussions on environmental protection. In the video, they conducted an interactive outdoor English lesson, promoting both language skills and environmental responsibility. Their reflections were then posted on Padlet, demonstrating their growing technological proficiency in integrating digital tools into environmental education. This activity highlights the potential of Padlet as a collaborative platform to enhance engagement, critical thinking, and environmental consciousness in teacher training.

Enhancing Learning through Technology

The integration of technology into environmental education has been widely praised for its potential to enhance learning experiences. One student remarked, "*Integrating technology into environmental education can greatly enhance its effectiveness by providing interactive learning experiences, access to real-time data, and virtual simulations*" (Respondent 31). This perspective is supported by studies demonstrating that technology can make environmental education more engaging and effective, offering experiential learning and access to a wealth of information and simulations that traditional methods cannot (Barr & Prillwitz, 2014; Aliman & Mutia, 2021).

Using Padlet, respondents can participate in new activities by maximizing the features on it. Among so many other features and functions provided, they can watch real-time videos of wildlife, then have virtual field trips to various ecosystems from the videos shared by others, and interact with interactive maps and diagrams to show how their

environmental behaviors and discuss their opinion, learning from each other's experiences. These experiences help pre-service teachers visualize and understand complex environmental processes more concretely, making learning both engaging and effective.

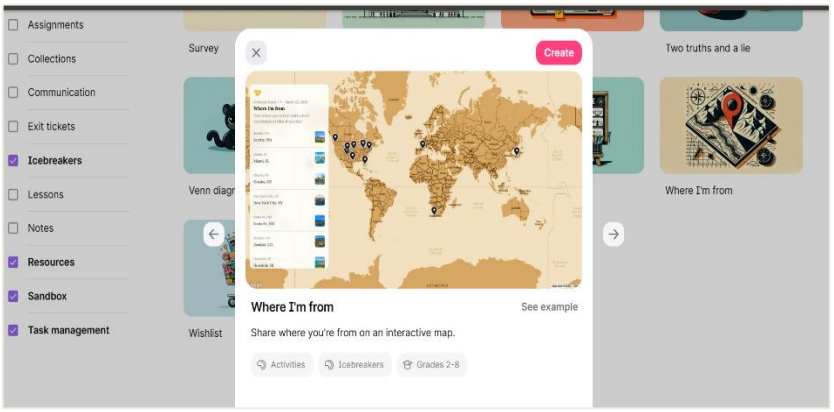

Figure 4. Sharing Each Other's Location and Experiences Dealing with Their Environmental Activities.

Figure 4 highlights an interactive map activity, *Where I'm From*, which enables preservice teachers to mark their geographic locations, fostering global awareness and connectivity. In the context of environmental education through Padlet, such technological tools can be adapted to encourage them to explore and share environmental issues in their regions, such as local sustainability efforts, climate challenges, or conservation initiatives. By integrating interactive mapping into environmental education, pre-service teachers can develop place-based learning strategies that connect environmental awareness to real-world locations. Through this activity, they can collaborate, exchange insights on environmental issues across different regions, and reflect on global ecological responsibility while leveraging technology for meaningful learning.

Empowering Informed Actions

Another important theme is the empowering nature of technology-enhanced environmental education. One student noted that such integration "*not only makes learning more engaging but also empowers individuals to take informed actions to protect the environmen*t" (Respondent 35). This aligns with constructivist educational theory, which posits that learners construct knowledge through experiences and reflections, leading to more informed and actionable understanding (Chawla, 2020; Boz & Cetin-Dindar, 2021).

For instance, by using Padlet to access real-time data on environmental changes, pre-service teachers can learn about the impact of human activities on ecosystems and develop strategies for sustainable practices. This empowerment is critical in fostering a sense of responsibility and agency among pre-service teachers, encouraging them to take proactive steps in environmental conservation.

Access to reliable information is a fundamental aspect of environmental education, enabling learners to stay updated on current ecological challenges and solutions. By integrating Padlet's Link List feature, pre-service teachers can curate and share clickable resources related to sustainability, conservation efforts, climate change, and environmental policies. This fosters critical thinking and informed decision-making, encouraging students to engage with real-world environmental issues.

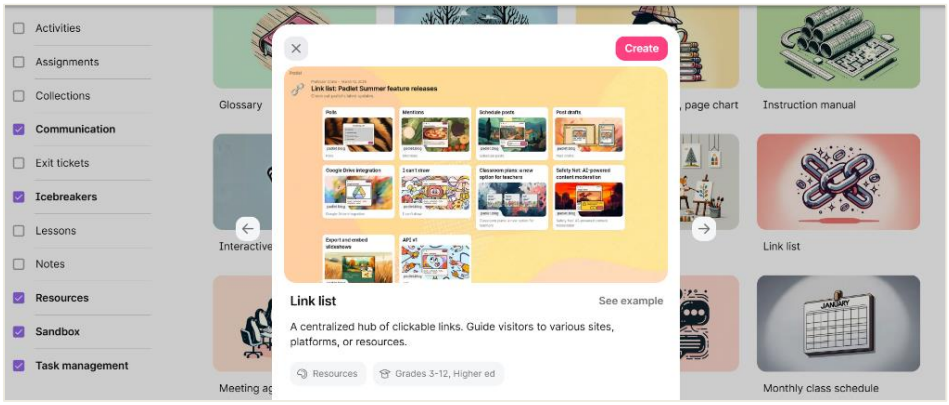

Figure 5. Pre-service Teachers Can Share Clickable Links for the Latest Information on Environmental Issues.

Figure 5 illustrates how Padlet can serve as a centralized hub where preservice teachers collect and organize valuable resources from diverse platforms. Through this approach, they can explore scientific reports, educational videos, government policies, and global initiatives, promoting active participation in environmental advocacy. By providing easy access to credible sources, pre-service teachers will empower their students to take meaningful actions toward sustainability, reinforcing the connection between knowledge and responsible environmental behavior.

Impact of Padlet Integration on Future Teachers' Perceptions, Attitudes, and Readiness to Incorporate Environmental Education into Their Future Teaching Practice

The integration of Padlet into environmental education for Pre-service teachers has profoundly impacted their perceptions, attitudes, and readiness to incorporate these concepts into their future teaching practices. By analyzing survey and interview data, this discussion explores the multifaceted benefits of using Padlet, including enhanced student engagement, creativity, and collaborative learning. Additionally, it addresses the challenges faced, particularly regarding access and application with younger learners, while highlighting the overall positive experiences and the potential for Padlet to transform educational practices.

Positive and Rewarding Experience

The integration of Padlet into learning environments has been reported as highly positive and rewarding by several future teachers. One pre-service teacher remarked, "*My experience using Padlet in a learning environment has been very positive and rewarding. I have used Padlet for a variety of activities, such as group discussions, collaborative projects, and learning reflections*" (Respondent 17). This indicates that Padlet effectively facilitates diverse learning activities, aligning with educational theories that emphasize learning enhancement through active participation and reflection (Ramachandiran & Mahmud, 2018a). Survey data support these positive experiences, showing that 67.7% of respondents were satisfied or very satisfied with the intervention.

Creativity and Interaction

Padlet's ability to foster creativity and interaction is another significant advantage. A pre-service teacher stated, "*I think it's quite unique; we can post something there as creatively as possible and can respond to each other. We can also add interesting ornaments, so it's fun and quite interesting*" (Respondent 42). This aligns with constructivist learning theory, which posits that learners construct knowledge more effectively through creative and interactive activities (Trott, 2020). The survey results also further highlight that Padlet enhanced engagement with environmental education content, with 46.2% of respondents feeling it moderately improved engagement and 43.1% observing significant improvement.

Enhanced Enjoyment and Learning

Pre-service teachers have also highlighted the enjoyment factor associated with using Padlet. One student commented, "*I learned that Padlet is a unique online platform that can make pre-service teachers or prospective teachers more enjoyable to learn because the platform has many kinds of features that can be used by the learners*" (Respondent 36). The various features of Padlet, such as the ability to post, comment, and add multimedia elements, enhance learning by making it more engaging and enjoyable. This is crucial for maintaining student interest and motivation (Shuker & Burton, 2021). The survey data indicate that Padlet positively impacted the overall learning experience, with 56.9% of respondents indicating a large improvement and 35.4% a moderate one.

Encouraging Thoughtful Dialogue and Debate

Padlet can also be used to encourage thoughtful dialogue and debate among pre-service teachers. One student noted, "*In the future, I will use Padlet for discussion boards and forums, where the pre-service teachers can post their thoughts, respond, and comment on each other's posts. This can encourage thoughtful dialogue and debate*" (Respondent 45). This highlights Padlet's role in fostering critical thinking and communication skills, which are essential for pre-service teachers ' academic and personal development (Ramachandiran & Mahmud, 2018a).

Facilitating Collaborative Projects and Interactive Discussions

Several pre-*service* teachers expressed their intention to use Padlet to facilitate collaborative projects, interactive discussions, resource sharing, and student feedback sessions. One student stated, "*I will use Padlet to facilitate collaborative projects, interactive discussions, resource sharing, and student feedback sessions, enhancing engagement and learning outcomes*" (Respondent 43). This indicates that Padlet is a versatile tool for promoting active participation and collaboration among pre-service teachers, aligning with theories that collaborative learning environments enhance student engagement and knowledge retention (Mehta et al., 2021). According to the survey data, 49.2% of respondents found Padlet moderately helpful in facilitating discussions and collaboration, and 46.2% found it very helpful.

Creating Dynamic Digital Learning Spaces

Padlet's collaborative features can create dynamic digital learning spaces. One student emphasized, "While I can't directly teach as a large language model if I were a teacher, I would leverage Padlet's collaborative features to create dynamic digital learning spaces for brainstorming, knowledge building, and showcasing student work" (Respondent 39). This underscores Padlet's potential to facilitate knowledge construction and sharing and provide a platform for pre-service teachers to showcase their work, thereby enhancing their learning experience.

Challenges and Opportunities in Integrating Padlet into Environmental Education for Future Teachers

Integrating Padlet into environmental education for Pre-service teachers offers numerous benefits, but it has its challenges. This section explores the various obstacles encountered, including barriers to access, issues with younger learners, and initial uncertainty among pre-service teachers. Through both survey and interview data, the discussion highlights these challenges and provides insights into how they can be addressed to make the most of Padlet's potential in educational settings.

Barriers to Access

Despite the myriad benefits of integrating Padlet into environmental education, significant barriers to access remain. Educational inequity poses a substantial challenge, as disparities in resource availability prevent all pre-service teachers from benefiting equally from advanced educational tools. One student highlighted this issue, stating, "*Environmental education and technology integration are good for educational purposes, but not every person has the opportunity to do it*" (Respondent 23). This sentiment aligns with UNESCO's (2017) (*UNESCO 2017*, 2018) findings that bridging the educational gap requires policy interventions and resource allocation. Ensuring equal access to technological resources is

vital for providing all pre-service teachers the opportunity to benefit from environmental education advancements.

In this research context, taken place in Madura, Indonesia, the respondents came from rural areas who are not supported by proper internet connection and sufficient technological educational tools that prohibited them from exploring Padlet for their educational advantages. In addition, their lack of experience in using any educational tools during their prior education can also create problems in maximizing their usage (Rabbianty et al., 2024; Shuker & Burton, 2021).

Addressing Challenges with Younger Learners

The application of Padlet presents distinct challenges when used with younger learners, who may not have access to the necessary technology. One student noted, "*Maybe if I teach young learners, it will be difficult to use Padlet because in elementary school, not all pre-service teachers use handphones. Or we can use it for homework*" (Respondent 11). This observation suggests that while Padlet is an excellent tool for older pre-service teachers, alternative methods must be employed for younger learners. For instance, Padlet can be utilized for homework assignments and other educational activities that do not necessitate real-time interaction, thereby accommodating younger pre-service teachers ' technological limitations (Dianati et al., 2020).

Initial Uncertainty and Growing Appreciation

Initial unfamiliarity with Padlet can act as a barrier to its immediate adoption among pre-service teachers. However, a gradual transformation in perception often occurs as pre-service teachers become more acquainted with the platform. One student shared their experience: "*At first, I didn't understand what Padlet was, but over time, I started to like using Padlet because there I would get a lot of information about the environment and how to keep it well, and also Padlet makes learning collaborative and creative, like a dynamic digital whiteboard*" (Respondent 27). This shift from uncertainty to appreciation highlights Padlet's intuitive interface and its ability to convey valuable environmental information effectively (Dianati et al., 2020).

Impact on Understanding and Preparedness

The positive impact of Padlet on respondents ' understanding of environmental education concepts is well-documented. According to survey results, 49.2% of respondents reported an increase, and 24.6% noted a significant increase in their understanding of environmental education concepts. Conversely, only 13.8% saw no change, and a minimal 6.2% reported a decrease. Additionally, respondents' preparedness to teach environmental education improved, with 44.6% feeling moderately prepared and 40% feeling very prepared. Only 6.2% felt slightly or extremely prepared, and 3.1% felt not prepared at all. These findings underscore the effectiveness of the Padlet-integrated intervention in

enhancing both understanding and readiness to incorporate environmental education into teaching practices.

Enhancing Collaborative Learning

Padlet's collaborative features significantly enhance the learning experience by fostering teamwork and collective problem-solving (Mehta et al., 2021). Survey data shows that 49.2% of respondents found Padlet moderately helpful in facilitating discussions and collaboration, while 46.2% found it very helpful. This sentiment is echoed in student interviews, where one student emphasized Padlet's role in making learning collaborative and creative. By enabling easy sharing of ideas and resources, particularly during group work, Padlet fosters a deeper understanding and critical thinking about environmental issues.

Addressing Diverse Learning Styles

From their research result, Baido et al. (2022a) mention that Padlet accommodates diverse learning styles through its incorporation of various types of media and interactive elements. The survey results revealed that attitudes towards technology in education are predominantly positive, with 51.1% of respondents agreeing and 29.8% strongly agreeing that it enhances learning. Interviews further support this by highlighting Padlet's ease of use and adaptability. This versatility allows pre-service teachers to engage with content in ways that suit their learning preferences, thereby making the educational experience more inclusive and effective.

Discussion

The demographic analysis of the pre- and post-survey data provides critical insights into the characteristics of the participating pre-service teachers, which may influence their engagement with Padlet and environmental education. The majority of respondents (72.3%) are aged 20-21, suggesting that most participants are in the early stages of their undergraduate studies. This aligns with findings from (Tondeur et al., 2018), who emphasize that younger pre-service teachers are often more adaptable to digital tools but may require structured guidance to integrate technology effectively in pedagogy. The gender distribution is predominantly female (83%), a pattern frequently observed in teacher education programs (Beauchamp & Thomas, 2009).

Regionally, the majority of respondents (63.8%) are from Pamekasan, with limited representation from other areas. This may lead to findings that are contextually specific rather than broadly generalizable. Zhao et al., 2024) highlight the importance of regional diversity in educational technology studies, as access to digital tools and prior exposure to technology can vary significantly across different locations. Furthermore, the respondents' educational backgrounds show that a significant portion (66%) attended Pesantren-based

schools, indicating a strong Islamic educational influence. Studies such as Huda et al. (2017) suggest that students from Islamic backgrounds may approach digital tools with a mix of enthusiasm and skepticism, particularly when integrating technology with religiously grounded learning values.

The findings also indicate that Padlet enhances student engagement, creativity, and collaboration, aligning with constructivist learning theory, which emphasizes active participation and knowledge construction (Trott, 2020). A majority of participants found their experience positive and rewarding, as Padlet provided an interactive platform for discussions, collaborative projects, and reflective learning. These findings are consistent with Ramachandiran & Mahmud (2018), who argue that digital tools foster more meaningful engagement when students take an active role in their learning.

Despite these benefits, A key challenge in integrating Padlet into environmental education is limited digital access, particularly in rural areas where weak internet connectivity and a lack of technological resources hinder effective use (Rabbianty et al., 2024). Many pre-service teachers in Madura also have little prior exposure to educational technology, making it difficult to maximize Padlet's benefits (Shuker & Burton, 2021). Additionally, its applicability with younger learners remains limited, as elementary students often lack personal devices, requiring alternative strategies for engagement (Dianati et al., 2020). But, despite the initial hesitation, pre-service teachers gradually embraced Padlet, appreciating its collaborative and creative features that enhanced engagement and knowledge-sharing (Dianati et al., 2020). The survey results confirm this shift, with 49.2% reporting increased environmental education understanding and 44.6% feeling more prepared to teach environmental education. Moreover, Padlet's collaborative tools strengthen teamwork and critical thinking (Mehta et al., 2021), and its multimedia features accommodate diverse learning styles, supporting engagement and inclusivity (Baidoo et al., 2022).

So, to maximize Padlet's potential, institutions should expand digital access, provide targeted training for educators, and explore adaptable technological teaching and learning strategies for younger learners. Future research should focus on long-term impacts on teaching preparedness and comparisons with other digital tools to refine best practices in environmental education. Overall, the findings underscore Padlet's transformative role in fostering engagement, collaboration, and critical thinking among pre-service teachers in environmental education teaching. While challenges such as accessibility and digital literacy gaps must be addressed, the platform also provides a dynamic and versatile tool for enhancing environmental education. Future research should explore long-term impacts on teaching preparedness and compare padlet's effectiveness with other digital learning tools to further refine best practices for technology integration in environmental education.

CONCLUSION

Padlet has proven to be a powerful tool for making environmental education more engaging, interactive, and meaningful for Future Teachers. Encouraging active participation, collaboration, and creativity helps pre-service teachers connect with environmental concepts in a dynamic and relevant way. Many pre-service teachers found the experience rewarding and enjoyable, as it enhanced their learning, sparked discussions, and encouraged teamwork through group projects and interactive activities. Beyond just introducing new ideas, Padlet also helped pre-service teachers develop technological proficiency, preparing them to integrate digital tools into their future classrooms. However, challenges such as limited access to technology, initial hesitation, and the difficulty of adapting digital tools for younger learners highlight the need for support and training. While some pre-service teachers were initially unsure about using Padlet, they grew to appreciate its potential as they became more familiar with its features. The platform also proved valuable in catering to different learning styles, making environmental education more accessible to all pre-service teachers.

To fully harness Padlet's benefits, institutions should ensure equal access to digital resources, provide hands-on training, and blend technology with traditional teaching methods. Educators can also make learning more engaging by using Padlet for collaborative projects, discussions, and reflective activities that deepen pre-service teachers' understanding and encourage thoughtful action on environmental issues. Looking ahead, future research should explore how Padlet works in different educational settings, its long-term impact on teaching, and how it compares to other digital tools. By continuing to refine its use, we can better equip Pre-service teachers to integrate technology into their classrooms and inspire the next generation of environmentally conscious educators.

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