

# How Green Campus Policy Can Empower Ecoliteracy for Pre-Service Teacher in Digital Era Transformation

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## Abstract

This study aims to develop a conceptual framework that integrates Green Campus policies, ecoliteracy enhancement, and digital pedagogy competencies as empowerment strategies for prospective elementary school teachers in the era of digital transformation. The method used is a conceptual approach through literature synthesis and policy analysis. Data were obtained from the Green Campus policy documents of Malang State University, scientific literature on ecoliteracy, and studies on digital pedagogy. The framework was developed in three stages: identification of key concepts, analysis of interrelationships between concepts, and construction of a conceptual model. The research findings indicate that the synergy between Green Campus as an institutional foundation, ecoliteracy as an individual core competency, and digital pedagogy as a medium for learning transformation can produce prospective teachers who are adaptive to sustainability and technology issues. The practical implications of this framework are the need for teacher education institutions to design integrative curricula and training programs that combine sustainability values with digital literacy. This research is expected to serve as a reference in efforts to strengthen the capacity of prospective elementary school teachers as agents of change in the 21st-century education era.

## 1. Introduction

The 21st century presents education with significant interrelated challenges, namely the global environmental crisis and rapid digital transformation. The environmental crisis is marked by extreme climate change, deforestation leading to the loss of biodiversity, and ecosystem degradation. In light of these indications, there is an urgent necessity to cultivate ecological awareness among all societal segments through the educational sector (United Nations, 2023; UNESCO, 2024). Concurrently, the 4th Industrial Revolution is precipitating digital transformation in educational practices, thereby necessitating the cultivation of digital competencies among educators and prospective educators, particularly in elementary schools (Caena and Redecker, 2019; OECD, 2023; El-Hamamasy et al., 2024; Aleksieva, 2025). These two major challenges are interrelated in shaping the future landscape of education. This commitment is further articulated in the Sustainable Development Goals (SDGs), particularly Goal 4 on quality education and Goal 13 on climate action.

In response to global challenges, the concept of environmental education — now more commonly referred to as the Green Campus — has begun to be implemented in academic circles. The Green Campus concept is believed to mark the beginning of a cultural transformation in academia, promoting environmentally friendly practices and integrating sustainable education into higher education curricula (Gandasari, Hotimah, & Miyarsah, 2020; Mahdee, Abu Bakar, & Oh Kim Seng, 2022; Bakaruddin, Afriyeni, & Algusri, 2023). The Association for the Advancement of Sustainability in Higher Education (AASHE) first popularized the concept of the Green Campus in the United States. In 2005, AASHE launched the Sustainability Tracking, Assessment & Rating System (STARS) to identify and report on universities' sustainability efforts. STARS serves as a guideline for higher education institutions to measure their sustainability performance. In Indonesia, the University of Indonesia established the UI GreenMetric World University Rankings in 2010 to support the implementation of the green campus concept. These annual rankings are based on environmental sustainability performance. State University of Malang (UM) green campus policy is reinforced by Rector's Decision No. 15.7.23/UN23/OT/2020 on the Environmentally Friendly Campus. This policy encompasses various initiatives, including waste management, renewable energy use, and car-free days on campus. Implementing this program is expected to impact not only the campus's physical

environmental conditions but also shape students' character and ecological awareness, particularly those in the Primary School Teacher Education (PGSD) program.

As future elementary school teachers, we must raise awareness about the importance of educating younger generations about the environment to create sustainable lives in the digital age. The process of developing an awareness of the interdependence between humans and the environment, reflected in behavior, is called ecoliteracy. Ecoliteracy is a new paradigm that not only imparts knowledge, but also raises awareness about maintaining the relationship between humans and the environment to ensure the sustainability of both (Capra, 2003; Keraf, 2014; Goleman, Bennett, & Barlow, 2012). Research findings suggest that prospective teachers with high ecoliteracy are more effective at integrating environmental education into elementary school curricula, thereby fostering a generation that is sensitive to environmental issues (Spinola, 2015; Hermawan et al., 2022).

Today's rapid technological advances can be leveraged to integrate sustainability values into the learning process. Higher education institutions are responsible for equipping their graduates with digital competencies and ecological awareness so they can provide a holistic education to their students (Markauskaite, Carvalho, & Fawns, 2023; Huang et al., 2024). Digital competencies encompass more than just mastering technology; they also entail the pedagogical ability of prospective teachers to integrate technology into environmental awareness. This statement emphasizes the importance of exploring the synergy between green campus policies, ecoliteracy, and digital competencies to transform elementary education in the face of global challenges.

However, academic studies that integrate these three elements are still limited. In fact, developing a conceptual framework that connects these elements could serve as a reference for creating a primary school teacher education curriculum that is more relevant to current demands. Thus, this article is intended to guide higher education institutions in preparing ecologically conscious prospective teachers who can adapt to the digital transformation of education.

## **2. Method**

This study employs a conceptual approach, combining literature synthesis and policy analysis, to develop a framework that empowers prospective elementary school teachers. Data sources include UM green campus policy documents and scientific literature on ecoliteracy and digital pedagogy. The framework was developed in three stages: 1) identification of key concepts, 2) analysis of relationships between concepts using a thematic synthesis approach (Thomas & Harden, 2008), and 3) construction of a conceptual model. This approach follows the procedures for developing a conceptual framework outlined by Jabareen (2009) and Torracco (2016).

## **3. Results and Discussion**

### **3.1. Implementation of Green Campus as a Foundation for Educational Transformation**

Green campuses are positioned as an institutional foundation in forming a sustainability-based education ecosystem. As stated in the UM Rector's Decree No. 15.7.23/UN23/OT/2020, the form of green campus implementation at UM includes sustainable structuring and infrastructure programs, energy and climate change, waste management, water management, sustainable transportation to sustainable education and research. The implementation of the program is not only targeted at students but also the entire university academic community.

A study conducted by Nugrahaningsih, Setyaningsih, and Pudyaningrat (2023) explained that the implementation of green campuses involving four main pillars, namely green infrastructure, green attitude, green lifestyle, and green rose, yielded results in the form of changes in attitudes and environmentally friendly habits on campus. Furthermore, it was found that data from research conducted by Keliat et al (2024) show that green campus policies that target education indicators encourage the integration of sustainability in curriculum and research. Through ecological cultural education in the campus area, it can be harmoniously intertwined. This strengthens that the green campus program is not only a

sustainability in the physical operations of green space but also a foundation for sustainable education transformation. Implementation that is carried out comprehensively in the academic community can also provide positive support for the success of the program. This is in accordance with Aedi (2024) research which reveals that the success of green campuses depends on the overall involvement of everyone and also the existence of sustainable systematic management.

### **3.2. Ecoliteracy: Core Competencies Based on Practice and Values for Prospective Elementary School Teachers**

Green campus policies actually act as an enabler of ecoliteracy, where ecological competence is not only theoretical but also displayed in behavioral practices in the campus environment. A study conducted by Hermanto et al (2025) shows that although there is still an imbalance between ecological knowledge and practice in students, students' understanding and actions towards climate change have increased. An individual's optimal ecoliteracy ability can increase active contributions to the development of the surrounding natural environment (Permata, Agung, 2023).

The integration of ecoliteracy in learning is essential because it teaches complex aspects of environmental issues from a local to global perspective and also involves a wide range of disciplines (Rijke, Osgood, 2025). This statement is in line with research conducted by Saribas, Kucuk & Ertepinar (2016) that the unification of environmental science in learning provides significant value to a person's concern and policy in actively contributing to environmental issues. Thus, strengthening ecoliteracy for prospective elementary school teachers is a strategic step of green campus sustainability which is internalized into future learning practices.

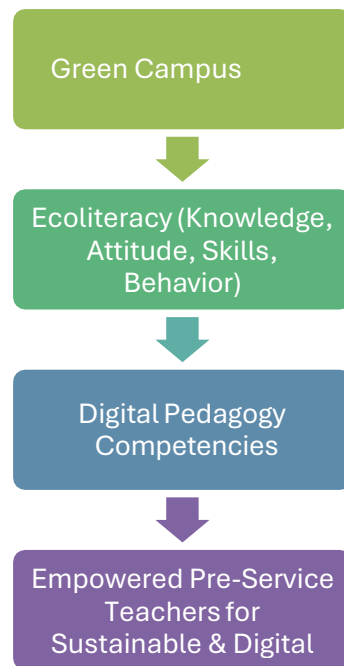
### **3.3. Ecological Digital Pedagogy as an Innovative Tool**

In addition to ecoliteracy, prospective 21st-century teachers need to master digital pedagogy competencies. Digital transformation requires educators to be proficient in using innovative, contextual technology pedagogically. In the context of green campuses, these competencies enable prospective teachers to use technology to optimize contextual learning about sustainable environmental issues.

The results of the study indicate that the digital ecology pedagogical model enhances the readiness of prospective elementary school teachers in Indonesia to engage in technology-based environmental innovation (Kurniawan et al., 2024). Additionally, Filho, Borsatto, and Marcolin (2025) conducted a study involving 45 countries and found that using artificial intelligence in sustainable education greatly enhances students' understanding of complex environmental issues. Using technology and AI creates a more interactive, innovative, and enjoyable learning experience for students. Consequently, students' critical thinking and problem-solving skills regarding environmental issues can be optimized. These findings highlight that digital pedagogy within this framework is a transformative medium for ecological learning.

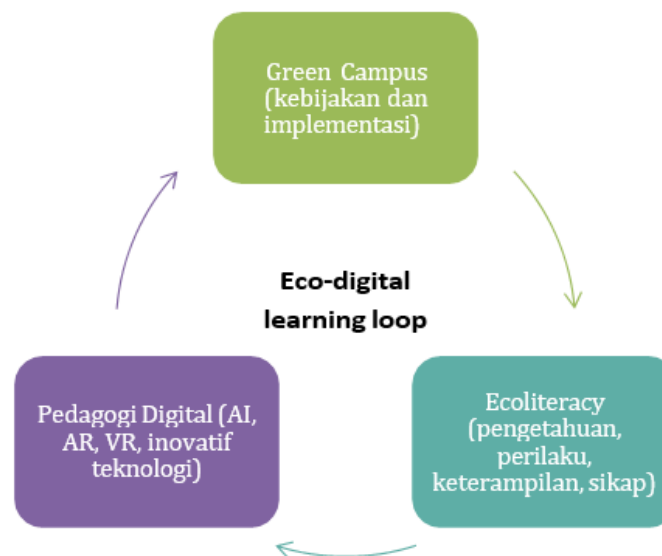
### **3.4. A Conceptual Framework for Holistic Mechanisms**

A sustainable learning ecosystem is created through the mutually supportive conceptual framework of green campuses, ecoliteracy, and digital pedagogy. Green campuses provide the infrastructure and culture of sustainability through institutional policies. At the individual level, ecoliteracy provides prospective teachers with the knowledge, skills, and attitudes necessary to drive behavioral change in elementary schools. Digital pedagogy enables the integration of interactive, innovative technology into sustainable educational practices that align with real-world experiences and hold educational value. Wardhani et al. (2022) emphasize that an ecopedagogical approach by teachers can enhance environmental awareness and strengthen students' social responsibility toward environmental issues.



**Figure 1. Conceptual Framework of Green Campus Policy in Enhancing Ecoliteracy in the Digital Age**

These three components, which interact dynamically, can form an eco-digital learning loop. This model visualizes the flow of sustainability from campus policy to innovative learning practices. Green campuses provide opportunities for prospective teachers as an integral part of sustainability education, which internalizes ecological values through ecoliteracy. Furthermore, ecological digital pedagogy enables prospective teachers to translate these values into technology-based learning practices, such as AI and AR. Tasdemir and Gazo (2020) emphasize the importance of a transdisciplinary approach in higher education to embed sustainability in the curriculum. Meanwhile, Arif, Ismail, and Irfan (2025) demonstrate that smart technology can foster ecological awareness from primary to higher education.



**Figure 2. Eco-digital Learning Loop**

The Eco-Digital Learning Loop model encourages prospective teachers to become agents of change capable of designing inclusive, contextual, technology-based learning experiences. Daracott (2024) states that ecopedagogy integrated with digital technology effectively shapes students' ecological awareness. Additionally, Hajj-Hassan, Chaker, and Cederqvist (2024), in their systematic review, found that digital tools, such as virtual reality (VR) and augmented reality (AR), enhance student engagement and help build a deep understanding of environmental issues. Thus, the synergy between Green Campus, ecoliteracy, and digital pedagogy offers a comprehensive approach to the challenges of 21st-century education

### **3.5. Challenges, Opportunities, and Strategic Recommendations**

This conceptual framework offers a holistic approach, but applying it to teacher education presents various practical challenges. One such challenge is the limited infrastructure and resources supporting sustainability practices on campus. Ivada (2024) found that the digital literacy gap among prospective teachers significantly hinders the optimization of technology for sustainable education. Barth & Rieckmann (2016) also noted that sustainability is often integrated into higher education curricula in a fragmented manner, focusing more on operational aspects than on pedagogical transformation.

Therefore, institutional and individual capacity-building strategies are crucial. Teacher training institutions must design programs that integrate sustainability and digital technology to prepare elementary school teachers for 21st-century challenges. Filho et al. (2019) emphasize that transdisciplinary approaches and cross-disciplinary collaboration can enrich teacher education curricula and make them more adaptive to global dynamics. Continuous evaluation using indicators such as the UI GreenMetric index is also necessary to monitor the implementation's effectiveness and long-term impact on prospective teachers' competencies.

### **3.6. Conclusion**

This study produced a conceptual framework integrating Green Campus policies, ecoliteracy, and digital pedagogical competencies as pillars for empowering prospective elementary school teachers. The framework illustrates the strategic relationship between institutional policies, individual competencies, and the pedagogical innovations necessary to develop educators responsive to sustainability and digital transformation issues. The framework's practical implications highlight the necessity for teacher education institutions to design integrated curricula and training programs that incorporate sustainability and digital literacy. Recommendations for further research include piloting and empirically validating the framework in various educational contexts to strengthen its effectiveness in shaping a generation of adaptive, competitive 21st-century educators.

### **Author Contributions**

Santy Dinar Permata contributed to the conceptualization of the study, literature analysis, development of the conceptual framework, and drafting of the manuscript. Ni Luh Sakinah Nuraini was responsible for literature retrieval, in-depth review of related studies, and editing the manuscript for academic coherence. Candra Utama provided validation of the conceptual framework, methodological critique, and final revisions for publication. All authors read and approved the final version of the manuscript. All authors have equal contributions to the paper. All the authors have read and approved the final manuscript

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