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Integrating Ecotheology into Biology Instruction Through The Digitalization of Environmental Information Based on Campus Trees

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ABSTRAK

The global environmental crisis, marked by climate change, ecosystem degradation, and declining biodiversity, demands an educational transformation capable of fostering learners' sustainable ecological awareness. Within Islamic education, ecotheology emerged as a paradigm integrating religious values with human responsibility for environmental preservation. This article aimed to analyze the conceptual integration of ecotheology into Biology learning through the digitalization of environmental information based on campus trees. The study used a literature review method with a conceptual approach, drawing on scientific articles published between 2018 and 2025, analyzed through data reduction, classification, synthesis, and conclusion drawing. The findings indicated that Biology learning held a strategic position in strengthening students' environmental literacy using the campus environment as a contextual learning resource. The digitalization of environmental information through barcode/QR Code systems on campus trees enabled the simultaneous integration of technology, environmental conservation, and ecotheological values, while supporting biodiversity literacy and the development of a green campus culture in higher education

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INTRODUCTION

The impacts of climate change, land conversion, and shrinking biodiversity are now not only felt in natural ecosystems in general, but also penetrate into the realm of higher education, including campuses which should act as green spaces as well as conservation laboratories. This condition encourages the need for a new perspective in understanding the relationship between humans and nature, which is no longer short-term oriented but rather based on the principle of sustainability (Cholil & Parker, 2021; Nasr, 1996). Efforts to build people's ecological awareness cannot rely only on a technical-scientific approach, but also need to be supported by ethical, social, and religious dimensions.

One strategic space for instilling ecological awareness is higher education. Among the various fields of science, science subjects, especially biology, play a unique role because the object of study is directly related to life phenomena, ecosystem dynamics, and patterns of human interaction with the surrounding environment. Ideally, Biology learning outcomes do not stop at understanding scientific concepts, but rather encourage students to develop environmental literacy as well as real concern for preserving the ecosystem around them.

The equivalent of this idea in Islamic education can be found in the concept of ecotheology, an approach that links religious values with human ecological responsibility, and views humans as caliphs who are entrusted with maintaining the balance of nature (Nasr, 1996; Zabidi et al., 2021). Various studies show that incorporating ecotheological values into the educational process helps shape the ecological character of students while strengthening awareness of sustainability, so that the environment is no longer simply seen as an object of learning, but rather becomes a space for practicing religious teachings in everyday life (Rohman et al., 2024; Sapitri et al., 2025).

At the same time, digital transformation is also coloring the world of education. Barcode and QR Code technology is now widely used to digitize environmental information in botanical gardens and plant collections, because this technology makes it easy for anyone to access data on species names, morphological characteristics, benefits, and ecological functions of a plant with just one scan using a smartphone (Pratiwi et al., 2024; Rani et al., 2025).

The diversity of trees that grow in the campus environment is actually a natural laboratory whose potential has not been widely utilized for contextual Biology learning, especially for material on biodiversity, taxonomy, ecology, and conservation. Digital documentation of campus trees through a barcode system has the opportunity to be a link between efforts to realize a green campus and increase students' biodiversity literacy, as seen in similar practices at UIN Raden Intan Lampung, which is known as one of the most sustainable campuses in Indonesia based on the UI GreenMetric ranking (Fatah & Waro, 2025; Pratiwi et al., 2024).

However, studies that specifically combine these three elements-ecotheology, biology learning, and digitization of campus tree-based environmental information are still relatively minimal. Most of the literature on QR Codes in education tends to stop at

the technical aspects of plant identification, while ecotheological studies in Islamic education focus more on the curriculum or character formation in general without linking it specifically to digital innovation based on the campus environment. This gap is the basis for writing this article.

Based on this gap, this article was prepared to examine the integration of ecotheology in Biology learning through the digitization of campus tree-based environmental information. It is hoped that this study will be able to provide a conceptual contribution to the development of environmentally based Biology learning, which is in line with strengthening ecological literacy and implementing the ecotheological paradigm in higher education, especially in the Islamic Religious Higher Education environment.

METHOD

This article was prepared using a library research method with a conceptual approach, which aims to build a comprehensive understanding of the relationship between ecotheology, biology learning, and the digitization of campus tree-based environmental information through searching various relevant scientific sources. Through this approach, the author attempts to combine existing theories, research findings, and ideas into a new framework of thought that can become the basis for developing environment-based learning.

The sources studied include national and international journal articles as well as proceedings related to ecotheology, biology learning, environmental education, digitization of environmental information, application of QR Codes in education and the green campus concept. Priority is given to publications in the 2020–2025 period so that this study continues to reflect the latest research developments.

Literature searches were carried out through the Google Scholar, Crossref, DOAJ, ResearchGate, Springer, and Taylor & Francis databases, as well as a number of accredited national journals, using a combination of keywords such as ecotheology, Islamic environmental education, biology learning, environmental literacy, QR Code learning, plant tagging, tree barcode, green campus and digital environmental information.

All data collected was then analyzed through four stages, namely data reduction in order to select literature that is truly relevant to the focus of the study, grouping based on main themes, presentation in the form of a conceptual synthesis, and drawing conclusions. The analysis process was carried out descriptively-qualitatively with emphasis on the relationship between ecotheology concepts, biology learning and the digitization of campus tree-based environmental information.

RESULT AND DISCUSSION

Ecotheology as a Paradigm for Sustainable Education

In the midst of the complexity of the environmental crisis, ecotheology emerges as a new approach offered in the world of education; a perspective that places human relations with nature not just as a relationship of use, but as part of a moral and spiritual

responsibility. In an Islamic perspective, this responsibility is inherent in the human position as caliph who is entrusted with maintaining the balance of the ecosystem while managing natural resources responsibly (Nasr, 1996).

Cholil and Parker's (2021) research on Franciscan schools in Jakarta is a clear example of how ecotheological values can be internalized by students. Their findings show that the success of internalization is determined more by students' daily experiences than just the teaching material presented. This is important for Islamic education, because it emphasizes that incorporating ecological values into learning needs to be accompanied by contextual experiences, so that the environmentally caring character that grows does not stop at the cognitive level alone, but also touches the affective and spiritual realms.

The need for contextual experience is what makes ecotheology in line with the direction of developing an environmentally friendly culture in Islamic Religious Universities, as can be seen from several green campus initiatives based on the values of the Koran which are starting to be implemented on various campuses (Fatah & Waro, 2025). When religious values are juxtaposed with a sustainability agenda, the expected achievement is not only the growth of ecological awareness, but also the spiritual awareness that accompanies it.

Man as Caliph on Earth

The concept of the caliph is the philosophical starting point for ecotheology in this study. Allah SWT said:

> "And (remember) when your Lord said to the angels, 'I will make a caliph on earth.'" (QS. Al-Baqarah [2]: 30)

In the context of campus tree-based Biology learning, the position as Linked to campus tree-based Biology learning, the position as caliph can be interpreted more operationally. Students who study and document the existence of trees through a barcode system are basically fulfilling a small part of that mandate (recognizing, caring for, and recording the existence of creation around them) rather than just using them for academic purposes.

Environmental Damage Caused by Human Activity

The Qur'an explicitly links ecological degradation to human actions. Allah (SWT) states:

> “Corruption has appeared on land and at sea because of what the hands of people have earned, so that Allah may let them taste the consequences of some of their deeds, that perhaps they might return to the right path.” (QS. Ar-Rum [30]: 41)

The message of this verse offers a subject for critical reflection among students. The loss of trees on campus due to unplanned development, or the academic community's indifference toward the preservation of vegetation, constitutes a form of the degradation alluded to in the verse. It is precisely this situation that makes the digital documentation of campus trees a relevant and tangible expression of concern.

Plants as Signs of Allah’s Greatness

The Qur'an presents plants as one of the *ayat kauniyah* (cosmic signs) that invite both scientific and spiritual reflection. Allah the Almighty states:

"And it is He who sends down rain from the sky, and We produce thereby all kinds of plants..." (QS. Al-An'am [6]: 99)

Within the framework of this study, every tree on the campus grounds can be viewed as an object of dual learning. Scientifically, a tree is a taxonomic specimen whose structure and function can be studied; theologically, it is a sign of Allah's power that evokes both gratitude and a sense of responsibility. The barcodes attached to each tree serve as a bridge connecting these two dimensions of understanding; consequently, eco-theology moves beyond mere theoretical study to become a foundation for developing educational practices oriented toward environmental conservation.

Biology Education and Strengthening Environmental Literacy

As a discipline that examines life and the relationships between organisms and their environments, Biology holds a strategic position in fostering environmental literacy—defined as the ability to understand environmental issues, analyze their impacts, and make responsible decisions for ecosystem sustainability. Topics such as biodiversity, ecology, the classification of living things, and conservation serve as the most relevant entry points for gradually building this understanding.

This understanding becomes more meaningful when it extends beyond the textbook and is directly experienced by students in their immediate surroundings. When the campus environment functions as a natural laboratory rather than merely an object of fleeting observation, students gain the opportunity to connect biological concepts with the real-world phenomena they encounter daily. This aligns with the principles of experiential and contextual learning, which place direct experience at the core of the learning process (Duchatelet et al., 2024).

Digitization of Environmental Information Based on Campus Trees

Digital transformation opens up new possibilities for utilizing technology in education, one of which is the digitization of environmental information using QR codes or barcodes on biological objects. This system has proven capable of expanding access to information while enriching the learning experience, as users can obtain data—ranging from scientific names, classification, and morphological characteristics to benefits and ecological roles—for a given species with just a single smartphone scan (Rani et al., 2025). Similar principles can be applied to the various tree species growing on campus grounds, allowing these trees to serve as living educational resources for topics such as biodiversity, taxonomy, plant morphology, and ecology. Beyond merely acting as a teaching aid, the digital documentation of campus trees contributes to local biodiversity record-keeping and integrates three elements that have historically operated in isolation—technology, education, and environmental conservation—into a unified system.

Tree Barcodes as a Medium for Contextual Learning

The use of barcodes or QR codes on campus trees can serve as a medium for contextual, experiential learning. Through this medium, students do not simply absorb material from textbooks but also interact directly with the subject matter within their immediate environment. Each tree equipped with a barcode system can provide a wealth of information, including:

1. Local and scientific names;
2. Plant family;
3. Ecological benefits;
4. Conservation status;
5. Uses within the community;
6. Chemical composition or health benefits;
7. Qur'anic verses related to the plant; and
8. Ecological messages from an Islamic perspective.

This blend of scientific information and religious values ensures that tree barcodes function not merely as plant identification tools, but also as a medium for instilling eco-theological values in students. Such environment-based learning models have the potential to enhance biodiversity literacy while fostering a deeper emotional connection between students and the natural world around them. Integrating Ecotheology into Biology Instruction

The convergence of the three elements in this study lies in the design of learning resources: rather than merely presenting biological concepts, they integrate these with religious values so that the two reinforce one another. In the context of campus trees, this means students do not simply study plant taxonomy or morphology; they are also encouraged to understand that preserving these trees is an act of practicing religious values. With this shift, biology instruction moves beyond mere conceptual mastery toward the cultivation of ecological character, positioning the environment as a sacred trust.

CONCLUSION AND RECOMMENDATION

This study shows that ecotheology can act as an educational paradigm that answers the challenges of the environmental crisis without ignoring its spiritual dimension, and that biology learning plays a strategic role in making this happen concretely through the use of campus trees as a contextual learning resource. Digitizing campus tree information through barcodes or QR Codes is a mechanism that unites three achievements at once, namely strengthening biodiversity literacy, increasing students' ecological awareness, and concrete steps towards a green campus culture so that technology, environmental conservation, and religious values no longer operate as separate agendas.

The conceptual model offered in this study has the potential to be an alternative for developing environment-based Biology learning in Islamic Religious Universities. In future research, this model needs to be tested empirically at various levels of education and different campus contexts, and further developed by integrating tree barcodes into a more interactive digital platform, so that environmental literacy and the application of ecotheology in Islamic Religious Higher Education can continue to be strengthened on an ongoing basis.

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