Assessing the Impact of a Blended Learning Approach Utilizing an Ecoliteracy E-Module on Elementary School Students' Environmental Knowledge in Indonesia

Trisni Handayani [1, 2, *], Yufiarti [2], Etin Solihatin [2], Mohamad Syarif Sumantri[2]

[1] Faculty of Teacher Training and Education,
Universitas Muhammadiyah Prof Dr Hamka, Indonesia
[1, 2] Post-Graduate School of Elementary Education,
Universitas Negeri Jakarta, Indonesia

* Corresponding author: Trisni Handayani

Abstract

This study assessed how well an Ecoliteracy E-Module integrated into a blended learning approach improved the comprehension of environmental issues among Indonesian elementary school students. The study used a posttest-only control group and a quasi-experimental design. The Ecoliteracy E-Module was used in conjunction with project-based learning to enhance students' environmental literacy, creativity, and teamwork abilities. According to the research, blended learning, which includes incorporating the Ecoliteracy E-Module, is a suitable and successful educational model, particularly during the pandemic, where technology is crucial. According to the study, students in the experimental group achieved an average score of 88.45%, compared to 79.25% in the control group, which showed a significant difference in scores between the experimental and control classes. As a result, using the Ecoliteracy E-Module in project-based blended learning helped elementary school students better understand environmental concepts, underscoring the importance of the module in environmental education.

Keywords: Blended Learning; Ecoliteracy E-Module; Elementary School Students; Environmental Knowledge; Indonesia

Introduction

As we work to satisfy our fundamental survival needs, which Abraham Maslow classified as needing food, shelter, and clothing, human interaction with the environment is a necessary part of our existence. This interaction, whether positive or negative, significantly impacts the ecosystem. Unfortunately, with the progress of science, information, and communication technologies, and the emergence of concepts like the Internet of Things and ChatGPT, humans have become adept at exploiting the environment for their gains. This has resulted in environmental pollution, ozone depletion, and extensive damage to our surroundings, emphasizing the urgent need for students to learn about the environment.

With a population exceeding 270 million, Indonesia faces a significant challenge in managing its daily volume of organic and inorganic waste. One of the primary issues contributing to this problem is the low level of awareness among society regarding proper waste disposal, processing, and selection. This lack of

environmental care exacerbates the situation. For instance, the country produces a staggering 11,330 tons of garbage daily, with an average daily individual waste generation of 0.050 kg. When calculated annually, this amounts to a staggering 4,078,800 tons.

Based on data from the Environmental Fund Management Agency in 2008, the waste pile steadily increased from 315m3/day in 2005 to 365m3/day in 2010. Projections indicate that it will reach 42 m3/day in 2014, 498 m3/day in 2020, and a staggering 581 m3/day in 2025. However, with the trash carriage capacity currently only reaching 60%, the waste pile will continue to grow unless there is a significant improvement in society's awareness and practices regarding waste management.

Given the alarming reality of high trash production, the significant portion (40%) of uncollected waste, and the urgent need to discourage littering, it becomes imperative to promote environmental awareness both directly and indirectly. It is crucial for students who actively contribute to the progress of Indonesian education to receive education on environmental laws as part of their curriculum. In addition to the traditional legal-formal approach, an alternative strategy is required to ensure legal socialization effectively adapts to significant changes. One such approach is the knowledge enhancement model, also known as the Awareness, Interest, Desire, Action (AIDA) model, developed by Shoenfield (1987) as cited in (Singh et al. (2018) (Cangara, 2000). This model is anticipated to facilitate a responsive and comprehensive approach to legal socialization, promoting positive behavioral change towards environmental preservation.

The Ecoliteracy E-module has found applications in various sectors, including industry, medicine, and agriculture, for conducting socialization activities. Its usage has also expanded to public relations operations, which involve implementing socialization processes that begin with raising participants' awareness of their problems. Subsequently, communicators aim to generate interest and foster a sense of desire among participants. Once individuals have their awareness, interest, and concern aroused, they are more likely to be motivated to take action.

Through this awareness-focused socialization approach, individuals are expected to acquire knowledge, understanding, and awareness of their rights and responsibilities concerning environmental conservation. In the greater Jakarta area, socialization efforts have been initiated in schools, starting from primary education levels. The objective is to instill a sense of anti-littering awareness among students as a preventive measure to cultivate their consciousness about environmental cleanliness. As a result, schools in the Jakarta region of Indonesia actively participated in a campaign promoting no littering awareness.

Literature Review

Socialization can be seen as a type of communication that aims to influence the behavior of individuals. It involves a communicator conveying specific symbols, often verbally, to shape the recipient's actions. However, socialization goes beyond mere communication and is a form of influence. Establishing effective socialization requires more than a brief introduction, as numerous critical factors must be considered.

As defined by Indonesia's Department of Judicial Affairs (1998, pp. 1-5), legal socialization enhances society's legal awareness by providing informal legal explanations. The goal is for each member of society to learn and comprehend their rights, obligations, and authorities. Consequently, this fosters a legally conscious attitude and behavior where individuals possess knowledge, understanding, and compliance with the law.

Ecoliteracy approach

Promoting eco-literacy involves utilizing various dissemination mechanisms and popularizing emerging ecological concepts. To effectively socialize the Eco-literacy E-module, several models of developmental theories of socialization proposed by experts can be employed. These include the innovation diffusion model introduced by (Rogers, 1983), which later evolved into environmental care material by (Schoenfeld & Disinger, 1978). Additionally, the social marketing model by (Byatt, 2001), the communication planning model by (Amunugama, 1979), as well as social mobilization by (McKee, 1992), can be utilized. Each model involves a systematic process of disseminating ideas, albeit some are rooted in sociology (Rogers, 1983) and marketing (Byatt, 2001). Consequently, some individuals consider the approach to distributing developmental ideas as a field of study in socialization management.

The Eco-literacy E-Module is a socialization process that initiates with the awareness stage, where a communicator raises clients' consciousness about their issues. This module has been successfully employed in various socialization programs related to agriculture, health, and industry. Subsequently, efforts are made to generate interest and ignite the passion and desire of clients. The objective is to leverage clients' heightened awareness, interest, and curiosity to motivate them to decide and take action. However, when considering the environmental care concerns of students, a critical viewpoint arises, suggesting that such a model is more suitable for socializing tangible goods rather than intangible ones.

Environment Concern

The term "environment" encompasses the physical conditions, such as soil, water, solar energy, minerals, flora, and fauna, found on land or in the sea and the human-created institutions that determine how those conditions are utilized. The environment encompasses both the biotic and abiotic elements that surround us. The living environment is where living and non-living entities coexist, develop, and grow.

The environment comprises both abiotic and biotic components. Abiotic components include non-living entities such as soil, water, air, atmosphere, humidity, light, and sound. On the other hand, the biotic component includes all living organisms, including plants, animals, humans, and microorganisms like bacteria and viruses. Within this environment, there exists coexistence and interaction between humans, animals, plants, and inanimate objects. Based on their respective roles, the biotic components can be observed engaging and interacting with the environment.

Prioritizing environmental protection is paramount, given its fundamental significance to our way of life. Several principles rooted in ecocentrism theory and the acknowledgment of the ecological crisis as a result of human behavior can be applied to instil a sense of responsibility towards the environment. These principles, as

delineated by ~~(Puji, 2010)~~(Curry~~,~~ (2011) and (Molina-Motos~~,~~ (2019), encompass the following key points:

Firstly, the principle of respect for nature entails valuing the cosmos and all its constituents in line with biocentrism and ecocentrism. Secondly, moral responsibility for nature arises from the understanding that humans are an integral part of cosmic solidarity and, therefore, hold a moral obligation to safeguard the environment and all life within it, recognizing their equal value to human life. Moreover, the principle of taking care of nature emphasizes the moral responsibility to care for others without expecting anything in return. The "no harm" principle underscores the importance of avoiding actions that threaten the environment or the existence of other life forms in the universe. Lastly, embracing the concepts of modesty and environmental friendliness is crucial. Adopting a lifestyle that eschews materialism, waste, and exploitation and embraces modest living is essential for the environment's well-being. By adhering to these principles, individuals can contribute to the protection and preservation of the environment responsibly and sustainably.

According to the justification, environmental concern is a difficult condition resulting in environmental reactions. Different people are more or less concerned with their immediate environment. If there is environmental damage, someone who cares about the environment will respond. However, if they don't care about the environment, they won't care, even if environmental damage exists.

Blended Learning

Online distance education has been prevalent in highly urbanized and developed countries for many years. Still, in the developing world, including Indonesia, various challenges have impeded the implementation of online learning innovations, such as blended learning. Despite a few universities in Indonesia offering blended learning experiences to their students, there is a lack of assessment regarding its effectiveness in improving learning outcomes and resource efficiency (Budimansyah et al., 2019). Therefore, one effective way to evaluate the success of the investment is to gauge the level of satisfaction among students engaging in blended learning courses. Assessing student satisfaction at this early stage is crucial in predicting the viability and success of blended learning as a modality in Indonesian universities.

Blended learning has been recognized as a favorable learning system providing students with diverse diversified learning opportunities (Diep et al., 2019). Scholars like (Han & Ellis, 2019) and (Law et al., 2019) have found that the blended learning approach is meaningful, integrated, value-based, and challenging, surpassing traditional face-to-face instruction in promoting active student learning. Blended learning has the potential to address the weaknesses of offline face-to-face learning, which hinder students' development of self-regulated learning (López-Pérez et al., 2011), as well as the limitations of online learning in fostering social interactions (Boelens et al., 2017). This potential is clearly given that blended learning provides a range of advantages, such as better content delivery, improved social interaction, chances for reflection, opportunities for higher-order thinking and problem-solving skills, collaborative learning, and more authentic assessment methods (Moskal et al., 2013).

Due to its effectiveness, blended learning has gained traction in academic institutions and is frequently used in professional development and training settings (Lothridge et al., 2013). Numerous studies have shown that the blended learning approach outperforms traditional modalities to improve student learning. According to research, students in blended learning environments performed about one-third of a standard deviation better than students in traditional learning environments in terms of student achievement (Bernard et al., 2014). According to a thorough review of evidence-based studies, student achievement was consistently higher in blended learning experiences than in fully online or face-to-face learning experiences (Siemens et al., 2015).

According to (Moskal et al., 2013), blended courses typically produce higher levels of achievement and satisfaction compared to conventional face-to-face and fully online courses. Numerous studies carried out at the University of Central Florida over nearly two decades that consistently show higher student satisfaction, success, and lower withdrawal rates in blended courses provide substantial evidence to support this claim (Means et al., 2012). According to a survey on student satisfaction at the University of Central Florida, blended courses received the highest percentage (52%) of "excellent" responses, giving them a slight 4% advantage over online and face-to-face courses. In contrast, blended courses placed about 10% higher in student satisfaction than lecture capture formats (Means et al., 2012). Compared to other instructional modalities, blended courses create more hospitable learning environments from a policy perspective (Moskal et al., 2013).

Research Methodology

The research and development (R&D) design, also known as research-based development, was employed in this study, following the framework proposed by (Borg & Gall, 1984) for educational research and development. Educational research and development refer to the process used to create and validate educational products, whether by developing new ones or improving existing ones through research and development design.

In developing the Ecoliteracy E-Module based on the blended learning model in education, two main activities were undertaken: exploration (qualitative) and implementation (quantitative), as outlined by (Nasution, 2003) (Creswell & Creswell, 2005; Miles & Jozefowicz-Simbeni, 2010). Qualitative inquiry is grounded in the belief that the world, reality, and phenomena related to human behavior and social phenomena should be explored from various perspectives and understood through a humanistic lens. Concurrently, the research aimed to enhance students' environmental knowledge and implement the environmental care concept to foster their environmental competence.

The research was conducted with students from three State Primary Schools in Jakarta, utilizing participant observation, documentation study, interviews, and questionnaires as data collection methods. Both qualitative and quantitative data analyses were conducted. Analyzing qualitative data involves several steps, such as thoroughly examining all available data, condensing essential information through data reduction, organizing the data through coding, and validating the data (Ary et al., 2009). A quantitative analysis of the questionnaire data was performed to assess

the impact of the Eco-literacy E-Module on students' environmental awareness. Descriptive statistics, percentages, and correlation-regression statistical analysis were employed to analyze the data (Cohen et al., 2013).

Findings and Discussion
Factors Contributing to Student Littering
The following are some of the factors that have been identified as contributing to the low level of environmental awareness in society, particularly at the 3 State Primary School of Suntenjaya Village, Cibodas:

Inability to access certain facilities or the trash dump
When individuals encounter obstacles in accessing specific facilities or a trash dump, it creates a significant impediment to environmental preservation efforts. The difficulty in reaching facilities or trash dumps can hinder individuals, particularly students, in appropriately disposing of their waste. This limitation in accessibility significantly hampers the attainment of environmental preservation goals. Effective waste management stands as a pivotal element in maintaining environmental cleanliness, and restrictions in accessibility can obstruct these vital efforts. Consequently, due to limited accessibility, students may display reluctance in properly disposing of their trash in assigned areas. This hesitancy could stem from factors such as distance, inconvenience, or a lack of awareness regarding the importance of correct waste disposal. As a result of this behavior, trash is left unattended and lacks proper management. Over time, this leads to an uncontrolled accumulation of waste in the surrounding area. Unmanaged trash accumulation carries adverse effects on environmental aesthetics, public health, and the local ecosystem. Hence, addressing accessibility constraints is crucial for achieving environmental preservation goals through initiatives like education, infrastructure improvements, or other measures that actively promote participation in waste management.~~The limited accessibility of certain facilities or the trash dump significantly impacts achieving environmental preservation goals. Due to this limited accessibility, students exhibit reluctance to dispose of their trash in the designated location. As a result, trash is being left unattended, leading to its accumulation over time.~~

The absence of assistance from the school and parents
Insufficient support from both the school and parents can have detrimental effects on the educational landscape. The teaching-learning process and the provision of supportive facilities play integral roles in addressing challenges associated with facility availability. These components not only enhance the teaching-learning process but also ensure that school facilities fulfill their duty to guide and encourage students to adhere to expected norms.
The negative repercussions extend to the very heart of the teaching-learning process. The absence of support from both the school and parents adversely impacts the quality of education. This factor undermines the effectiveness of teachers in delivering instructional material and, concurrently, hampers students' capacity to comprehend and engage with lessons effectively.

The significance of support becomes particularly pronounced when addressing challenges related to facility availability. Adequate facilities are pivotal for creating an optimal learning environment. The absence of such support proves to be a substantial impediment to educational progress and hinders comprehensive student development.

These supportive aspects not only facilitate the teaching-learning process but also ensure that school facilities fulfill their role as guides and motivators for expected student behavior. It is imperative to have consistent support from both the school and parents to cultivate a positive and supportive educational environment. ~~The absence of assistance from the school and parents has a detrimental effect. The teaching-learning process and the provision of supportive facilities play a crucial role in addressing challenges related to facility availability. These aspects support the teaching-learning process and ensure that school facilities fulfill their obligation to guide and encourage students to act and behave expectedly.~~

The ignorance of society and students

Although most students come from well-regarded families, their parents' limited education level contributes to the emergence of undesirable behavior in the students. The lack of parental involvement in their children's education fails to foster the students' reliance on the learning process at school.

Based on the factors contributing to littering, an overall conclusion drawn from the analysis is that residents of Suntenjaya village predominantly come from affluent families, and their low educational attainment significantly affects various aspects of their quality of life. This includes their insufficient environmental awareness, limited abilities and skills, and lack of knowledge on maintaining cleanliness. Considering the societal context, our initiative was to develop a program to provide a broader perspective on the significance of health and education as indicators for improving overall well-being.

The school's efforts to stop students from littering

Based on the gathered information, it has been identified that the school has implemented certain measures to address the issue of littering, despite encountering challenges associated with an unstable environmental factor that has led to students' unfamiliarity with maintaining a clean school environment. The steps taken by the school thus far include: 1) employing cleaning staff, 2) supplying cleaning materials, and 3) establishing a nearby trash dump in the schoolyard.

These initiatives have proven effective in reducing the amount of littering. To further foster, develop, and encourage participation from the school community, the following suggestions should be considered:

- Implement a comprehensive program focusing on disseminating knowledge, raising awareness, strengthening attitudes, and shaping behaviors. This program should be carried out intensively and systematically to nurture and develop the participation of the school society.
- The program should be designed to help the school community understand the significance of environmental cleanliness and its impact on their daily lives.

- Emphasize the importance of systematic nurturing, development, and coaching of school society participation through program implementation.
- The program planning should aim to increase the awareness and appreciation of environmental cleanliness among the school community.

Eco-literacy E-module as the Material for Learning and Blended Learning
Learning Material

The materials used for socialization on environmental awareness encompass a range of perspectives, including persuasive delivery alongside descriptive or narrative presentations. However, these materials sometimes appear rigid and dogmatic, leading to difficulties for students in comprehending the content being taught. In response, the eco-literacy e-module material has been specifically designed to cater to students' unique circumstances and psychological characteristics, particularly considering their varying education levels. The implementation of the e-module in disseminating environmental awareness includes the development of tailored materials. These materials are carefully crafted to effectively convey the message of environmental care to a diverse student population.
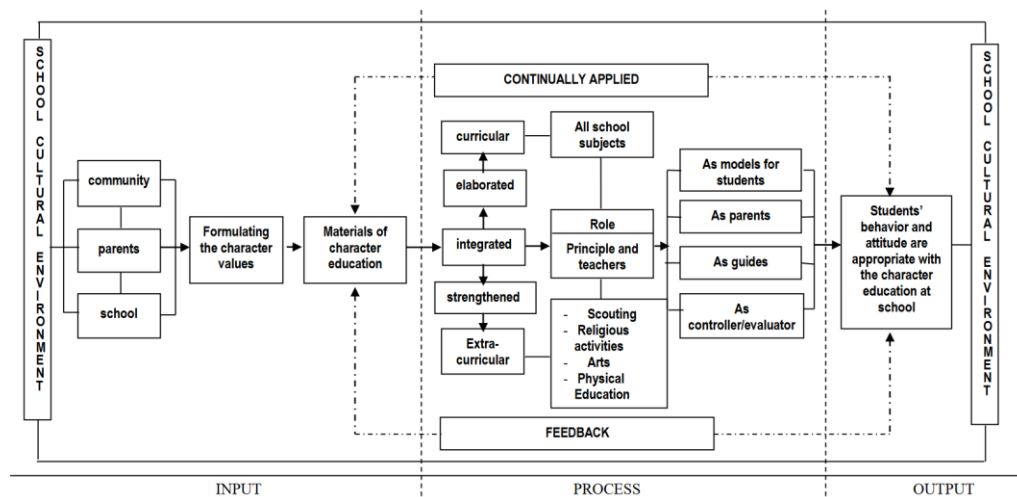

Figure 1. The Process of E-Module materials development

The information delivery described above was developed based on the research's environmental analyses conducted through surveys. The researchers' earlier socialization process observational work helped to facilitate these analyses. Legal, psychological, and environmental considerations were considered when developing the materials. To ensure the effectiveness of the materials, focus group discussions (FGDs) were held with professionals in the relevant fields. The primary objective of the FGDs was to achieve environmental awareness development, so they assisted in organizing and designing the materials. Acquiring knowledge and developing a conscientious attitude toward environmental issues are components of environmental awareness.

Integrated Strategies for Environmental Awareness~~Method~~

In order to enhance environmental awareness, the use of a campaign method incorporating both direct and indirect strategies has been a carefully planned choice. In the indirect approach, facilitators opt to utilize intermediaries or media as a means of conveying messages, such as through posters or leaflets. This decision is made with the aim of reaching the audience without direct interaction, leveraging the visual impact and understanding that can be conveyed through written media.

As an integral component of this campaign, participants are provided with environmental awareness stickers. The distribution of these stickers serves not only as a visual response to the campaign information but also creates a tangible form of engagement that participants can carry into their daily activities.

Furthermore, the campaign messages are strategically positioned through the use of posters and leaflets in key locations frequented by participants. This strategy is designed to create an environment where environmental awareness messages are not only received but also instill a motivation to take action. Carefully selecting locations for the placement of posters and leaflets can enhance the visibility of the campaign and increase the likelihood of the messages reaching the target audience.

Beyond merely increasing knowledge about environmental issues, this campaign also aspires to stimulate positive behavioral changes related to the environment. Through the combination of direct and indirect approaches, it is anticipated that the campaign will comprehensively achieve its goals, elevating the awareness and engagement of participants with environmental issues to a higher level.~~Direct and indirect campaigns were used to increase environmental awareness. In indirect socialization, the facilitator used intermediaries or media instead of directly interacting with the participants like posters or leaflets. Participants were given environmental awareness stickers, and the message was strategically positioned with posters and leaflets at key locations. These strategies aimed to effectively engage the target audience by educating them about environmental issues and the laws accompanying them.~~

Eco-literacy Procedure

The eco-literacy model has found use in several industries and fields, including socialization programs, agriculture, medicine, and industry. This model aids in the socialization process by raising client awareness of their problems, with the legal communicator playing a crucial part in doing so. Short films with environmental awareness themes were made available to increase this awareness, utilizing the audio-visual component to encourage better comprehension and simpler recall among students. As part of an outreach effort, the communicator visited school societies in different schools within Suntenjaya village, further extending the program's reach.

Once clients' awareness was raised, the subsequent step involved stimulating their interest and desire. The communicator achieved this by presenting a compelling example and inspiring individuals to lead in promoting environmental awareness. The outcome was a positive desire and willingness among society to change their problematic behavior. Consequently, the communicator promptly

imparted understanding to the students, enabling them to actively contribute to maintaining a clean environment.

Having raised clients' awareness, interest, and passion for the idea, the next step was to inspire them to make collective decisions and take action. The communicator and the Suntenjaya school's society entered into a mutual commitment to addressing the issues at hand. Additionally, they extended invitations to actively participate in and lead environmental awareness movements to accomplish the predefined goals.

Media and Source

The media employed two distinct methods or approaches to facilitate socialization and disseminate environmental awareness, using the AIDA (Awareness, Interest, Desire, and Action) model as a framework. The first method, known as legal socialization, employed multimedia tools such as PowerPoint slides, short movies or clips, and an LCD/projector to deliver the environmental message. This method aimed to guide participants through the sequential stages of the AIDA model, fostering awareness, generating interest, creating a desire for action, facilitating decision-making, and ultimately encouraging concrete actions.

On the other hand, the second approach, known as the indirect legal socialization method, took a different route by utilizing a diverse array of media tools. These included stickers, leaflets, posters, banners, as well as the integration of pictures and photographs. This indirect method aimed to convey the environmental awareness message through various tangible and visual means, creating a multi-faceted campaign to engage participants. By employing this combination of methods, the campaign sought to appeal to different learning preferences and ensure a more comprehensive and impactful environmental socialization process. ~~The media employed two methods/approaches to facilitate socialization and spread environmental awareness using the AIDDA (Awareness, Interest, Desire, Decision, and Action) model. The legal socialization method used PowerPoint slides, short movies/clips, and an LCD/projector to deliver the message. On the other hand, the indirect legal socialization method utilized various media tools such as stickers, leaflets, posters, banners, pictures, and photographs to convey the environmental awareness message indirectly.~~

Evaluation

Evaluation stands as a foundational element within the realm of legal socialization, comprising two crucial dimensions: program evaluation and management evaluation. Program evaluation acts as a meticulous examination, scrutinizing the effectiveness of the planned program's implementation in alignment with predefined objectives. This thorough assessment encompasses the execution of planned initiatives, the attainment of desired outcomes, and the overall impact on the target audience. Through this critical analysis, areas of success and opportunities for improvement within the socialization efforts come to light.

Simultaneously, management evaluation plays a pivotal role in assessing the overarching progress of the legal socialization process. It delves into the management and coordination of various elements within the socialization initiative, actively seeking to identify challenges or obstacles that may have surfaced during

implementation. This aspect of evaluation provides a valuable opportunity to promptly address and rectify issues, contributing to the refinement and optimization of the entire socialization process.

Recognizing the paramount importance of evaluation and understanding the factors that facilitate the initiation of a socialization process within established guidelines are imperative for the success of any legal socialization initiative. Routine and comprehensive evaluations not only ensure adherence to objectives but also lay the groundwork for continuous improvement and adaptation.

The insights derived from the evaluation process serve as an integral compass for the ongoing success of the program, holding equal significance in shaping the trajectory of future socialization initiatives. By assimilating lessons from past experiences and adapting strategies based on evaluation findings, legal socialization programs can dynamically evolve to better meet the needs of their target audience, ensuring sustained effectiveness in the long run. Evaluation plays a crucial role in legal socialization, encompassing two key aspects: program evaluation and management evaluation. Program evaluation examines whether the planned program has been effectively implemented in alignment with the established goals. Meanwhile, management evaluation assesses the overall progress of the process and identifies any challenges that may have emerged. Recognizing the significance of evaluation and the factors that facilitate the initiation of a socialization process within established guidelines is essential. The valuable insights from the evaluation process can greatly benefit the ongoing program and future socialization initiatives.

The influence of implementing the AIDA socialization model on establishing environmental awareness is significant

The relationship between the AIDA socialization model and the enhancement of students' environmental awareness was examined in classes 1-6 at 3 State Primary School of Cibodas, involving 120 students. From each class, 20 samples were selected for the study. Correlation and regression analyses were conducted using two instruments to assess variables X and Y and categorize the results.

Based on the correlation testing of variables and its impact on students' environmental awareness through the implementation of the AIDA socialization model (X), the following conclusions can be drawn:

Table 1. Findings on Correlational Analysis

		Ethnopedology (Pre-Test)	Character development (Pre-Test)
Variable X	Pearson Correlation	1	,556**
	Sig. (2-tailed)		,001
	N	120	120
Variable Y	Pearson Correlation	,556**	1
	Sig. (2-tailed)	,001	
	N	120	120

**. Correlation is significant at the 0.01 level (2-tailed).

The environmental awareness socialization implemented through project-based blended learning shows a strong positive relationship with students' environmental awareness, as indicated by a correlation coefficient 0.556. This correlation falls within the range of 0.60-0.799, which is considered a strong correlation according to Cohen et al. (2013). Therefore, it can be concluded that there is a significant correlation between the X variable (creation of environmental awareness-related content for the E-module) and the Y variable (students' environmental awareness).

The following table shows the findings of the regression test run after data processing.

Table 2. Result of the Regression Test

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,556a	,310	,288	8,65024

a. Predictors: (Constant), Y

Based on the descriptive static data analysis and hypothesis test, it is suggested that the socialization of environmental awareness can be enhanced by focusing on developing the E-modules (Awareness, Interest, Desire, and Action). The correlation test results demonstrate a significant positive impact (31%) between using the E-module in legal socialization and the effectiveness of socialization in influencing environmental awareness. However, it is important to note that the remaining 69% of the impact is attributed to unrelated factors. Thus, developing the E-module in legal socialization plays a crucial role in improving the quality of socialization and increasing society's environmental awareness.

In the study conducted by (Venkataraman, (2008), (Omoogun et al., (2016), and (Bergman, (2016), akin to our research, a comparable correlation was identified between environmental education programs and heightened awareness, specifically

among secondary school students. The consistency of these results across different educational levels implies the potential transferability of positive outcomes from one educational context to another.

The outcomes of our hypothesis testing reinforce the notion that students exposed to E-module socialization exhibit a heightened level of environmental awareness, evident in their behaviors and responses to their surroundings. This aligns with the findings of various studies, including those by (Markovitch et al., (2021), (Yocom et al., (2022), and (Calculli et al., (2021), suggesting that individuals indeed exhibit varying levels of awareness and sensitivity towards the environment. This observation underscores the crucial need for tailored educational interventions to address the diverse responses and attitudes individuals may have toward environmental degradation.

Moreover, a meta-analysis conducted by (Lin et al., (2015) and (Toncheva-Zlatkova, (2018) emphasized the significance of interactive and project-based learning methods, mirroring the project-based blended learning approach employed in our study. The positive correlation identified aligns seamlessly with the meta-analysis's overarching conclusion, emphasizing the substantial contribution of interactive and project-based methods to environmental awareness.

In contrast, the study by (Zhang et al., (2020), (Ardoin et al., (2020), and (Heimlich, (2010) sheds light on the importance of community involvement in augmenting the impact of environmental education. While our research predominantly focused on classroom-based interventions, the incorporation of community engagement strategies, as highlighted by Greenfield et al., may offer an avenue for further amplifying the effectiveness of legal socialization in fostering environmental consciousness. This underlines the potential synergies between classroom-based and community-driven initiatives.

The consistent theme across studies, including our own, regarding the percentage of variability explained by educational modules underscores the enduring impact of such interventions on environmental awareness. Research by (Abendan et al., (2023) and (Cross & Congreve, (2021) found similar percentages of variability explained in the context of environmental education interventions, reinforcing the recurrent theme that educational modules play a pivotal role in shaping environmental consciousness.

To cultivate environmental responsibility, principles related to biodiversity, such as respect for nature, moral responsibility, caring for nature, and the principle of modest and environmentally friendly living, are identified as helpful. Rooted in ecocentrism and motivated by our ecological crisis, these principles serve as guiding lights. Through legal socialization efforts, these principles can positively influence students' behavioral patterns, encouraging traits such as refraining from littering and adopting more environmentally responsible behaviors. This aligns with the broader literature on the transformative potential of ecocentric principles in shaping sustainable behaviors and attitudes toward the environment (Ferreira & Pitarma, 2021; Kopnina, 2013; Putilova et al., 2023). The results of the hypothesis testing indicate that students who received the E-module socialization exhibited a high level of environmental awareness, as evidenced by their behavior and responses to their surroundings. It is observed that individuals vary in their level of awareness and

~~sensitivity towards the environment. Those who deeply care about the environment will likely be attentive to the harm they witness. At the same time, individuals with low environmental awareness may exhibit indifference even in the face of environmental degradation. Given the significant impact of the environment on our lives, it is crucial to protect it.~~

~~To promote environmental responsibility, several principles related to biodiversity are helpful. These guiding principles include 1) Respect for nature, 2) Moral responsibility for nature, 3) Caring for nature, and 4) the principle of modest and environmentally friendly living. These principles are rooted in ecocentrism, the recognition of nature's rights and are motivated by our ecological crisis. Through legal socialization efforts, students' behavioral patterns can be positively influenced, leading to traits such as refraining from littering and adopting more environmentally responsible behaviors.~~

Conclusion

The researchers have designed an environmental awareness socialization activity encompassing materials, methods, sources/media, and assessment. This activity addresses the central issues students face in their engagement with blended learning courses. Indonesian universities face significant challenges in developing a more appealing design for Learning Management Systems (LMS) and blended learning courses to attract more students. The challenges include providing students with diverse, engaging, and stimulating materials and supporting faculty members in enhancing their professional skills and competencies. To ensure student engagement in blended learning courses, universities must address two major issues. Firstly, they should focus on developing a user-friendly website utilizing the latest platforms, which may involve hiring experienced professionals to optimize time and cost. Secondly, building institutional capacity within Indonesian universities is crucial to establish a sustainable mechanism for professional development. This system would enable faculty members to learn and grow in a supportive and professional environment continuously. By addressing these challenges, universities can enhance the quality of blended learning courses, satisfying students' engagement and promoting effective environmental awareness socialization. It is essential for Indonesian universities to continuously strive towards improvement to meet the evolving needs of students and foster a culture of lifelong learning within their institutions.

of transparency and integrity, the authors affirm that this research was conducted without any external influences that could compromise its objectivity.

Institutional Review Board Statement

This research involving human participants was conducted in accordance with ethical principles and guidelines. All participants provided informed consent before participating in the study, and their rights and welfare were protected throughout the research process.

Data Availability Statement

Any additional data or materials related to this study are available from the corresponding author upon reasonable request.

References

Abendan, C. F., Villa, F. L., Miñoza, C. A., & Carampatana, M. J. (2023). Senior High School Environmental Education Integration: A Systematic Review of Related Literature. *Excellencia: International Multi-Disciplinary Journal of Education*, *1*(3), 129–139.

Amunugama, S. (1979). Approaches to communication planning. *Media Asia*, *6*(4), 185–188. https://doi.org/10.1080/01296612.1979.11725979

Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, *241*, 108224. https://doi.org/10.1016/j.biocon.2019.108224

Ary, D., Jacobs, L., Razavieh, A., & Sorensen, C. (2009). *Introduction to Research in Education*. Cengage Learning.

Bergman, B. G. (2016). Assessing impacts of locally designed environmental education projects on students' environmental attitudes, awareness, and intention to act. *Environmental Education Research*, *22*(4), 480–503. https://doi.org/10.1080/13504622.2014.999225

Bernard, R. M., Borokhovski, E., Schmid, R. F., Tamim, R. M., & Abrami, P. C. (2014). A meta-analysis of blended learning and technology use in higher education: From the general to the applied. *Journal of Computing in Higher Education*, *26*(1), 87–122. https://doi.org/10.1007/s12528-013-9077-3

Boelens, R., De Wever, B., & Voet, M. (2017). Four key challenges to the design of blended learning: A systematic literature review. *Educational Research Review*, *22*, 1–18. https://doi.org/10.1016/j.edurev.2017.06.001

Borg, W. R., & Gall, M. D. (1984). Educational research: An introduction. *British Journal of Educational Studies*, *32*(3).

Budimansyah, D., Ruyadi, Y., Mulbar, U., Widyartomo, D., Umar, M. ., & Ahman. (2019). Does Blended Learning System Boost Student's Knowledge Sharing in General Education Course? The Indonesian Higher Education Challenge. *Official Conference Proceedings, The Asian Conference on Education*.

Byatt, A. (2001). From mass marketing to mass customization. *ABB Review*, *17*(2), 3.

Calculli, C., D'Uggento, A. M., Labarile, A., & Ribecco, N. (2021). Evaluating people's awareness about climate changes and environmental issues: A case study.

Journal of Cleaner Production, *324*, 129244. https://doi.org/10.1016/j.jclepro.2021.129244

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2013). Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences, Third Edition. In *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences, Third Edition*. Routledge. https://doi.org/10.4324/9780203774441

Creswell, J. W., & Creswell, J. D. (2005). *Mixed methods research: Developments, debates, and dilemma*. Berrett-Koehler Publishers Oakland, CA.

Cross, I. D., & Congreve, A. (2021). Teaching (super) wicked problems: authentic learning about climate change. *Journal of Geography in Higher Education*, *45*(4), 491–516. https://doi.org/10.1080/03098265.2020.1849066

Curry, P. (2011). *Ecological ethics: An introduction*. Polity.

Diep, A. N., Zhu, C., Cocquyt, C., De Greef, M., Vo, M. H., & Vanwing, T. (2019). Adult learners' needs in online and blended learning. *Australian Journal of Adult Learning*, *59*(2), 223–253.

Ferreira, M. E., & Pitarma, R. (2021). Enhancing Ecocentric Environmental Attitudes: An Experience of Science Teaching to Inspire Students to Value Trees. *Journal of Teacher Education for Sustainability*, *23*(1), 132–149. https://doi.org/10.2478/jtes-2021-0010

Han, F., & Ellis, R. A. (2019). Identifying consistent patterns of quality learning discussions in blended learning. *Internet and Higher Education*, *40*, 12–19. https://doi.org/10.1016/j.iheduc.2018.09.002

Heimlich, J. E. (2010). Environmental education evaluation: Reinterpreting education as a strategy for meeting mission. *Evaluation and Program Planning*, *33*(2), 180–185. https://doi.org/10.1016/j.evalprogplan.2009.07.009

Kopnina, H. (2013). Evaluating education for sustainable development (ESD): Using Ecocentric and Anthropocentric Attitudes toward the Sustainable Development (EAATSD) scale. *Environment, Development and Sustainability*, *15*(3), 607–623. https://doi.org/10.1007/s10668-012-9395-z

Law, K. M. Y., Geng, S., & Li, T. (2019). Student enrollment, motivation and learning performance in a blended learning environment: The mediating effects of social, teaching, and cognitive presence. *Computers and Education*, *136*, 1–12. https://doi.org/10.1016/j.compedu.2019.02.021

Lin, C.-S., Ma, J.-T., Kuo, K. Y.-C., & Chou, C.-T. C. (2015). Examining the efficacy of project-based learning on cultivating the 21st century skills among high school students in a global context. *I-Manager's Journal on School Educational Technology*, *11*(1), 1. https://doi.org/10.26634/jsch.11.1.3549

López-Pérez, M. V., Pérez-López, M. C., & Rodríguez-Ariza, L. (2011). Blended learning in higher education: Students' perceptions and their relation to outcomes. *Computers and Education*, *56*(3), 818–826. https://doi.org/10.1016/j.compedu.2010.10.023

Lothridge, K., Fox, J., & Fynan, E. (2013). Blended learning: Efficient, timely and cost effective. *Australian Journal of Forensic Sciences*, *45*(4), 407–416. https://doi.org/10.1080/00450618.2013.767375

Markovitch, N., Kirkpatrick, R. M., & Knafo-Noam, A. (2021). Are Different Individuals Sensitive to Different Environments? Individual Differences in

Sensitivity to the Effects of the Parent, Peer and School Environment on Externalizing Behavior and its Genetic and Environmental Etiology. *Behavior Genetics, 51*(5), 492–511. https://doi.org/10.1007/s10519-021-10075-7

McKee, D. (1992). An organizational learning approach to product innovation. *The Journal of Product Innovation Management, 9*(3), 232–245. https://doi.org/10.1016/0737-6782(92)90033-9

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2012). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. *Learning Unbound: Select Research and Analyses of Distance Education and Online Learning*, 41–133.

Miles, B. W., & Jozefowicz-Simbeni, D. M. H. (2010). Naturalistic inquiry. *The Handbook of Social Work Research Method*, 415–425.

Molina-Motos, D. (2019). Ecophilosophical principles for an ecocentric environmental education. *Education Sciences, 9*(1), 37. https://doi.org/10.3390/educsci9010037

Moskal, P., Dziuban, C., & Hartman, J. (2013). Blended learning: A dangerous idea? *The Internet and Higher Education, 18*, 15–23.

Omoogun, A. C., Egbonyi, E. E., & Onnoghen, U. N. (2016). From Environmental Awareness to Environmental Responsibility: Towards a Stewardship Curriculum. *Journal of Educational Issues, 2*(2), 60. https://doi.org/10.5296/jei.v2i2.9265

Putilova, E., Tsiplakova, Y., Diachkova, A., & Knysh, E. (2023). Environmental education and its principles. *E3S Web of Conferences, 431*, 9003.

Rogers, E. M. (1983). *Diffusion of Innovations* (Third). The Free Press.

Schoenfeld, C., & Disinger, J. (1978). *Environmental Education in Action-II: Case Studies of Environmental Studies Programs in Colleges and Universities Today.*

Siemens, G., Gasevic, D., & Dawson, S. (2015). Preparing for the Digital University. a review of the history and current state of distance, blended, and online learning. *Athabasca University Press, Athabasca AB Canada*, 1–234.

Singh, P., Teoh, S. H., Cheong, T. H., Md Rasid, N. S., Kor, L. K., & Md Nasir, N. A. (2018). The Use of Problem-Solving Heuristics Approach in Enhancing STEM Students Development of Mathematical Thinking. *International Electronic Journal of Mathematics Education, 13*(3), 289–303. https://doi.org/10.12973/iejme/3921

Toncheva-Zlatkova, V. (2018). Learning by Doing: Insights from Project-Based Teaching. *International Conference "Studies-Business-Society: Present and Future Insights IV ", Klaipeda State University of Applied Sciences, Klaipėdos Valstybinė Kolegija*, 103–114.

Venkataraman, B. (2008). Why environmental education? *Environment, 50*(5), 8–11. https://doi.org/10.3200/ENVT.50.5.8-11

Yocom, L., Ogle, K., Peltier, D., Szejner, P., Liu, Y., & Monson, R. K. (2022). Tree growth sensitivity to climate varies across a seasonal precipitation gradient. *Oecologia, 198*(4), 933–946. https://doi.org/10.1007/s00442-022-05156-1

Zhang, Y., Xiao, X., Cao, R., Zheng, C., Guo, Y., Gong, W., & Wei, Z. (2020). How important is community participation to eco-environmental conservation in protected areas? From the perspective of predicting locals' pro-environmental behaviours. *Science of the Total Environment, 739*, 139889.