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Assessing the Effectiveness of Design Thinking to Foster Green Entrepreneurship Among Students: A Case Study in Mangrove Ecotourism

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ABSTRACT

Introduction; Environmental issues in coastal areas, such as the reduction of mangrove forest area in Pesisir Timur Surabaya (PAMURBAYA), are driven by urban development and pose threats to human activities. This environmental challenge has sparked interest in entrepreneurship as a means to develop innovative and sustainable solutions. Increasing youth participation is seen as essential to balancing economic, social, and environmental benefits. **Method**; This study explores the effectiveness of Design Thinking in fostering a green entrepreneurial attitude among youth. The research focused specifically on business administration students participating in Design Thinking activities held at the mangrove ecotourism site in Gunung Anyar, Surabaya. A thematic analysis was conducted on the findings alongside a review of current literature to gain a deeper understanding. **Results**; The study found that the Design Thinking process successfully encouraged students to shift their mindset, enabling them to identify environmental problems as business opportunities. Students generated innovative, sustainability-oriented ideas, reflecting a change in attitude toward green entrepreneurship. **Conclusion**; This study contributes theoretically by demonstrating that Design Thinking can act as a catalyst for green entrepreneurship practices. Practically, it suggests integrating Design Thinking workshops into entrepreneurship courses to stimulate youth-led green business initiatives.

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1. Introduction

Coastal areas are ecosystems that play an important role in maintaining environmental balance and supporting the socio-economic life of communities. Coastal areas have ecological value and offer opportunities for environmentally-based economic development (Pablo Valenciano et al., 2021) However, coastal areas have faced challenges in recent decades. These challenges, which include land degradation caused by urban development and unsustainable human activities, have led to a significant decrease in the area of mangrove forests (Puryono & Suryanti, 2019).

This phenomenon has a direct impact on the loss of mangrove ecological functions, such as coastal protection, carbon sequestration, and the provision of habitats for various marine biota. One of the impacts of this condition is the reduction in the area of mangrove forests in the *Pesisir Timur Surabaya* (*Pamurbaya*). *Pamurbaya* was selected as the location for this study.

The *Pamurbaya* area is one of the vital mangrove conservation zones in the city of Surabaya, Indonesia. Currently, this area is threatened by rapid urban expansion and human activities that do not take into account environmental sustainability. Data from a study conducted by Yusuf & Susetyo, (2019) shows that the mangrove conservation area in this region has experienced significant loss. Starting from 0.3% in 2019, it is predicted to reach an alarming level of 24.02% in 2034. The development of built-up land is predicted to expand eastward by a maximum of 738 meters, encroaching upon the coastal area. Based on the spatial model's prediction for land use development in 2034, the identification of potential violations in the *Pamurbaya* conservation area revealed a progressive loss of the protected zone. The simulation showed that the conservation area was predicted to have a loss of 0.53% by 2019, 0.82% by 2024, 8.7% by 2029, and a significant 24.02% by 2034.This high rate of degradation highlights the urgent need for innovative interventions that can balance economic development with ecological conservation, specifically involving the younger generation (students) as agents of change.

This phenomenon cannot be resolved with a conservative approach. The participation of community, entrepreneurs, and youth is needed to solve this complex issue. Entrepreneurship-based approaches are increasingly being directed not just toward profit-orientation but also toward the sustainable creation of social and environmental impact (Belz & Binder, 2017). Therefore, green entrepreneurship has emerged as an innovative approach that not only aims to generate economic profits, but also provides sustainable social and environmental impacts.

Increased youth participation in this context is important for the development of green entrepreneurship. Youth play an important role as potential agents of change and are key actors in social and environmental change movements (Percy-Smith & Burns, 2013). The lack of relevant and interesting approaches has resulted in low youth participation in environmental conservation activities. Therefore, innovative approaches are needed to increase youth participation so that their commitment to environmental issues, especially green entrepreneurship, can be built.

One relevant method for fostering a green entrepreneurial spirit is design thinking, which focuses on creative problem solving and user needs (Bender-Salazar, 2023). This method enables youth to develop empathy for environmental issues and explore creative, innovative, and applicable ideas. In the context of green entrepreneurship, design thinking can serve as a bridge between environmental awareness and sustainable business opportunities.

This study has two main objectives. First, this study aims to explore the effectiveness of Design Thinking in encouraging active student participation and fostering a green entrepreneurial attitude among them. Second, this study aims to conduct an in-depth analysis of the mechanisms of how Design Thinking specifically encourages the development of business ideas oriented towards environmental sustainability so that they reflect the principles of Triple Bottom Line (TBL), which consists of Profit, People, and Planet. Thus, the findings of this study will explicitly bridge the gap in the literature review to integrate the concepts of Green Entrepreneurship and Design Thinking as an innovative strategy. This can happen because Design Thinking involves students in coastal conservation. Therefore, this study is expected to provide a theoretical contribution by proving that Design Thinking can be used as a catalyst, as well as providing practical implications for the development of a more innovative and relevant curriculum in line with current environmental challenges and the Sustainable Development Agenda.

2. Theoretical Framework

2.1 Entrepreneurship

Entrepreneurship is the creation of a new business and the bearing of the associated risk in order to exploit market opportunities for profit. It involves the identification, appraisal, and exploitation of opportunities, the acquisition of resources, and the design of a new venture or business model (Diandra & Azmy, 2020). A broader perspective emphasizes the development and validation of ideas, including opportunity recognition, resource mobilization, and implementation of innovative solutions (Prince et al., 2021).

In general, entrepreneurship encompasses the activities of creating and managing new businesses with the aim of generating profits (Ratten, 2023). Thus, entrepreneurship can be defined as the process of creating something new by taking risks and allocating time and effort to obtain financial and psychological rewards. Entrepreneurship is not only about starting a business, but also about innovative, proactive thinking to solve problems. This concept is a fundamental concept that encompasses various forms of entrepreneurship, including social entrepreneurship and green entrepreneurship (Belz and Binder, 2015). Entrepreneurship is also considered a mechanism for transforming ideas into valuable actions, both economically and socially (Zahra & Wright, 2016).

2.2 Green Entrepreneurship

Green entrepreneurship represents a strategic pathway for generating economic value while simultaneously delivering environmental benefits. Rather than being a passing trend, it functions as a business model in which sustainability principles are embedded across all stages—from idea generation to operational processes. In this context, green entrepreneurship can be described as an entrepreneurial approach that prioritizes not only financial gains but also the incorporation of environmental and social considerations into business practices (Allen & Malin, 2008).

Green entrepreneurship can be described as a process involving the identification, assessment, and utilization of business opportunities aimed at producing environmentally friendly goods and services. Its objective is to achieve economic profitability while simultaneously delivering social and environmental value (Haldar, 2019b). Individuals engaged in this field commonly referred to as green entrepreneurs or ecopreneurs are regarded as change agents who play a pivotal role in accelerating the shift toward a sustainable economy (Hermala et al., 2025).

The idea of green entrepreneurship is rooted in the Triple Bottom Line (TBL) framework, which evaluates business performance through three interconnected dimensions: profit, people, and planet (Belz & Binder, 2017). Accordingly, green entrepreneurship encompasses three core dimensions:

a. Economic dimension – Generating sustainable added value and financial profit that can be reinvested to advance environmental and social goals.
b. Social dimension – Creating beneficial outcomes for communities, such as enhancing the livelihoods of coastal populations through employment opportunities and the promotion of sustainable products.
c. Environmental dimension – Prioritizing innovations aimed at minimizing environmental harm, which includes efficient resource utilization, effective waste management, and the preservation of ecosystems, such as mangrove forests.

Green entrepreneurship functions as a catalyst for change, fostering the shift toward a sustainable economy through innovations rooted in environmental considerations. This approach underscores the significance of optimizing resource use, minimizing adverse ecological impacts, and engaging local communities as active contributors in addressing environmental challenges (Haldar, 2019b). It also reflects a strong dedication to long-term sustainability principles, encompassing ecosystem awareness and the systematic safeguarding of the natural environment (Haldar, 2019a).

In addition, green entrepreneurship encompasses several essential dimensions, including eco-friendly innovation, conservation consciousness, community empowerment, and a focus on long-term value creation (Burge et al., 2014). These dimensions are particularly significant when applied to the development of mangrove-based ecotourism, which seeks to protect the environment while generating economic benefits and providing educational opportunities for the community. When combined with ecotourism a tourism model grounded in environmental responsibility this approach promotes the safeguarding of natural ecosystems and fosters active participation from local residents in tourism-related initiatives. Through the application of green entrepreneurship principles, mangrove conservation-oriented ecotourism can deliver ecological, social, and economic value in a sustainable and integrated manner (Basyuni et al., 2018).

2.3 Youth Involvement in Green Entrepreneurship

The youth plays a crucial role as agents of social and environmental change (Anwar et al., 2020). As the most adaptive demographic group to innovation, youth possess significant potential to bring about positive change. The results of research conducted by Dougherty and Clarke (2017) show that between 15 and 25 years of age adolescents and emerging adults possess traits of successful innovators. They are collaborative, creative, observant, curious, willing to experiment, willing to challenge the status quo, risk-takers, action oriented, and visionary. Also, when young people are meaningfully engaged, society is more likely to find solutions needed to tackle social, environmental, and economic challenges.

The youth's role is inseparable from the practice of green entrepreneurship. Youth can adopt green entrepreneurial values and practices in an effort to create positive social and ecological impacts (Soomro et al., 2020). The youth also holds a strategic role in mangrove conservation through education, direct action, ecotourism development, and the transmission of local knowledge. Their active involvement has been shown to enhance the effectiveness of conservation efforts and strengthen the future sustainability of mangrove ecosystems (Syamsuri et al., 2021).

The role of the youth in green entrepreneurship is crucial for building their capacity to become innovative business practitioners (Anghel & Anghel, 2022). In the context of conservation, youth with green entrepreneurship intentions do not just passively participate in environmental preservation activities. Instead, they begin to design business models or social interventions with the goal of creating economic value without sacrificing long-term environmental sustainability.

Previous studies have shown that a natural resource conservation approach involving the youth is effective (Anwar et al., 2020). This approach is deemed capable of creating a long-term impact because it instills a sense of ownership, responsibility, and emotional involvement among the youth toward the environment they are preserving. Therefore, involving the younger generation in developing green entrepreneurship within conservation projects, such as those for mangroves, is an innovative strategy that not only enhances conservation effectiveness but also fosters the emergence of sustainable, youth-led business models.

The transition from environmental awareness among young people to concrete entrepreneurial action requires an innovative approach. Therefore, traditional approaches alone are considered insufficient, necessitating a framework that not only teaches the principles of green entrepreneurship but also trains empathy, creative thinking, and the ability to solve complex problems involving society and the environment. Design Thinking emerges as an innovative approach needed to foster a transformative spirit of Green Entrepreneurship among young people and make it a conceptual bridge.

2.4 Design Thinking

Design thinking (DT) is an established process used in organizations, which aims to solve problems and promote innovation (Brown, 2008). By its creative and intuitive nature, design thinking can be distinguished from other processes, which are purely analytical (Mansoori & Lackéus, 2020). Design thinking is an innovative, human-centered methodology for solving complex problems. This method focuses not only on the final product but also on the creative and collaborative process (Qi et al., 2025). Rosch, Nicolas, Tiberius, and Kraus (2023) propose a consolidated definition for design thinking as an iterative innovation and problem-solving process, which is based on specific principles (such as a focus on user needs, multidisciplinarity, etc.) and uses specific methods (such as creative thinking, visualization, experimentation, etc.).

Design Thinking consists of five activities that are not always linear but are iterative. These stages enable an individual or a team to explore problems, create solutions, and validate them (Bender-Salazar, 2023).

a) Empathize: This stage aims to gain a deep understanding of users' needs, feelings, and motivations.
b) Define: Based on the insights from the Empathize stage, this stage formulates the core problem to be solved. A precise problem statement is key to creating a relevant solution.
c) Ideate: Brainstorming techniques are used in this stage to explore creative ideas for various possible solutions.
d) Prototype: The stage of transforming ideas into a form that can be seen, touched, and tested. Prototypes do not have to be perfect, but they must be representative in order to convey ideas and gather feedback.
e) Test: At this stage, it is possible to test the prototype with real users to gather feedback. The aim is to learn, refine, and repeat the process if necessary.

Design Thinking is a relevant method for the development of green entrepreneurship, particularly for enhancing youth participation. It can encourage entrepreneurs to not only focus on the environment but also on human needs and behavior (Bender-Salazar, 2023). As a result, Design Thinking can create solutions that are more easily accepted and adopted by users (Bender-Salazar, 2023).

Design Thinking also facilitates the creation of business models that are not only environmentally friendly but also innovative and economically sustainable. The Empathize stage allows youth to understand environmental problems in-depth, not just through data but through direct, first-hand experience. The Ideate and Prototype processes enable the exploration of new ideas that may not have been previously considered, encouraging them to think creatively beyond conventional solutions. This allows them to ensure their ideas can be realized and their effectiveness tested in later stages.

Therefore, by providing a structured framework, Design Thinking can be an effective tool for attracting youth participation. This interactive and solution-oriented methodology is more engaging and relevant for them, which in turn can foster a green entrepreneurial spirit. Moreover, Design Thinking can shift the mindset of youth from being problem-centric to solution-centric, and from passive to proactive.

The Design Thinking process functions as a systematic framework for instilling sustainable thinking (TBL) in the context of green entrepreneurship, and this begins from the very start of idea development. The stages in Design Thinking force youth (students) to identify not only market and customer problems but also social (*People*) and environmental (*Planet*) problems that exist in conservation areas. This encourages them to think of business ideas that are balanced, capable of generating profit while mitigating environmental impacts and empowering local communities. Ultimately, all stages of Design Thinking can be used to visualize these sustainable business ideas and ensure that the proposed solutions are integrated with criteria in economic, social, and ecological aspects. Thus, Design Thinking is not just a tool for innovation, but a mechanism for internalizing the values of Green Entrepreneurship among the younger generation.

3. Methods

3.1 Research Type

This study uses an exploratory qualitative approach with case studies. This type of research was chosen to enable in-depth exploration of a complex phenomenon, namely how the Design Thinking process triggers and shapes green entrepreneurship intentions among students. A qualitative approach is highly relevant for analyzing cognitive processes, mindset shifts, and the quality of business ideas generated, which are difficult to measure using a quantitative approach. Design Thinking (DT) was utilized in this study as a medium for exploring problem discovery, problem-solving, and the development of a solution idea. The specific stages of Design Thinking employed were Empathize, Define, Ideate, and Prototype. The Test stage was intentionally omitted because the research's objective was not to gather user feedback, but rather to reach the stage where participants could visually and physically articulate their ideas. The achievement of this Prototype stage is considered an adequate indication of green entrepreneurial intent, enabling researchers to analyze the sustainability quality of the solutions formulated by participants.

3.2 Participants and Research Location

This research was conducted in May 2025. The object of this study is to examine the intent to practice green entrepreneurship through the creation of problem-based business ideas. The subjects of this study are ten business administration students who have completed entrepreneurship classes, with a gender proportion of six females and four males in their third and fourth year. The selection of students from business administration is relevant because they already have a basic knowledge of business, making the implementation of green entrepreneurship more contextual. Further, the participants need to complete the entrepreneurship course prior joining the research. They also have not exposed by the design thinking at first as qualified participants. All participants underwent these four Design Thinking stages directly at the Gunung Anyar mangrove ecotourism site in Surabaya, providing them with a form of immersion into the challenges of mangrove conservation.

This location was chosen because it is part of the East Coast of Surabaya (*Pamurbaya*), which serves as both a conservation area and an ecotourism destination. The unique conditions of this location provide both sources of problems (degradation and operational challenges for ecotourism) and sources of inspiration and assets (natural beauty and local potential) that are essential. Therefore, this location can serve as an ideal living lab for participants to implement the *Design Thinking* stages, particularly *Empathize* and *Define*, in identifying realistic and contextual green business opportunities.

3.3 Data Collection

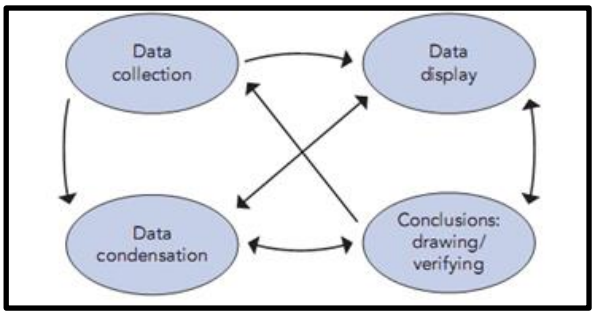
Data collection was conducted through data triangulation to ensure the validity and reliability of the findings. The data obtained throughout the study consisted of researcher observations (in the form of notes), participant reflections at each stage, and artifacts from the Design Thinking process. The researcher was directly involved in all Design Thinking activities, from the Empathize stage (approximately 60 minutes), Define stage (approximately 40 minutes), Ideate stage (approximately 40 minutes), and Prototype stage (approximately 30 minutes). Field notes were created to document student interactions, the brainstorming process, and the development of their ideas. Artifact data was obtained from the Prototype stage, which included business idea reports created by the students and used as presentation materials. An analysis of these artifacts was conducted to determine the extent to which sustainability aspects were integrated into the ideas the students produced.

3.4 Data Analysis and Findings Validity

Qualitative data consisting of field observation notes, participant reflection notes, and artifact results (prototype reports) were analyzed using Miles, Huberman, and Saldana (2014). Data analysis model that is used in this research is Interactive Models by Miles, Huberman, and Saldana consists of 4 phases i.e. data collection, data display, data condensation, and conclusion that is presented in this following figure:

Thematic analysis is used to conduct an in-depth interpretation. This analysis is used to:

1. Identify key themes that emerge from qualitative data during the process (e.g., empathy for nature, changes in mindset, interdisciplinary collaboration).
2. Connecting the emerging themes with the resulting artifacts (prototype ideas) and the Green Entrepreneurship (TBL) theoretical framework. This analysis ensures that empirical findings, such as product features in prototypes, can be systematically linked to the TBL dimensions *(Profit, People, Planet)* driven by the stages.



Source: Miles, Huberman, and Saldana (2013)

Figure 1. Interactive Model

Thus, data is not only described but also interpreted to generate meaningful patterns related to effectiveness as a catalyst for green entrepreneurship. The validity and reliability of the findings in this qualitative study were ensured through two main techniques:

1. *Data Triangulation*: Data were collected and cross-checked from various sources, namely: a) Participant observation and reflection notes (cognitive and behavioral processes), b) Researcher field notes, and c) Artifact results (prototype reports). The use of these three different data sources ensures that the findings are not based on a single perspective.
2. *Inter-Researcher Clarification*: To validate the qualitative findings, we conducted repeated discussions and clarifications among researchers. This process serves as an independent verification to ensure that the themes emerging from the Thematic Analysis (such as shifts in mindset and manifestations of TBL) are accurate and that data interpretations are consistent, thereby reducing single researcher bias.

4. Results and Discussion

4.1 Empathize

In the Empathize stage, participants were given 60 minutes to conduct direct observations at the Gunung Anyar mangrove ecotourism in Surabaya. The researcher provided a location map and instructed participants to make observations. Participants were free to engage in any activity, including trying out the available recreational facilities and trying food or drinks at the Culinary Center.

The research findings from this stage consisted of reflection notes written by the participants. Some participants focused on the natural and tranquil condition of the mangroves,

like one participant implied:

“We walked around the mangroves with friends to learn about the types of plants and some animals as well as their habitats” (P2)

This statement has similarity with P3, P4 that consecutively stated:

“I observed several information boards about plants and animals and saw several opportunities for development.”

“Observing the surrounding environments”

While others concentrated on tourism activities and attractions such as the aviary, information boards, the Marina Tower, and the souvenir shop (b) implied through (P5):

"Chatting with friends, laughing together while walking, then coming across an aviary and seeing what was inside, it turned out there were not many birds inside, climbing the Marina tower and taking photos, then going to a souvenir shop and buying *sinom* herbal drink.

In parallel with their observations, participants were also encouraged to inventory their findings. All these activities were conducted in groups to ensure that the problems identified would become a collectively agreed-upon consensus. During this stage, participants began to identify several problems, including trash accumulation, a lack of visitor education on waste disposal, damaged jogging tracks, and insufficient safe walking facilities for the elderly. (c) expressed by P2, P7 sequentially:

"Uneven paths and some broken wood make it a hazard for visitors"

"Some pavilions and access roads are damaged, particularly some of the wooden railings. This makes it uncomfortable for visitors to walking and relaxing. Unwary visitors could be injured by damaged facilities"

4.2 Define

After touring the Gunung Anyar mangrove ecotourism Surabaya, participants were invited to engage in a physical reflection using various mediums provided on-site for the research. In this stage, participants were asked to share their experiences from the observation and explain some of the issues they had found, such as uneven wooden footpaths, mixed-waste bins, and multiple path levels without clear markers. The participants, who also acted as visitors, expressed discomfort while navigating the footpaths. By consensus, three main problems were identified for resolution:

1. The limited expansion of the mangrove area.
2. The lack of waste sorting in the bins.
3. Footpaths that are not accessible for the elderly, children, and people with disabilities.

4.3 Ideate

Participants were encouraged to develop problem-based solutions for the issues identified in the Define stage. The solutions were directed toward sustainable business models that could be implemented at the Gunung Anyar mangrove ecotourism in Surabaya. The three previously identified problems were then addressed with solution ideas, including: expanding the mangrove area through participatory methods, implementing sorted waste bins that could be processed by the ecotourism site, and renovating the footpaths for better accessibility. All the ideation results were placed on a large blank paper and categorized using other mediums, such as sticky notes.

4.4 Prototype

The participants' ideas did not stop with a presentation on paper. In the **Prototype** stage, participants worked in groups to create prototypes in two, three, and even four-dimensional visual forms to realize the ideas they had proposed. They used several provided mediums, including plasticine, crayons, and LEGO, to resemble the original form of their ideas upon implementation.

The Design Thinking process was conducted up to the Prototype stage. The Test stage was intentionally omitted because the conditions at the research site were not conducive to its implementation. As a result, no data from the Test stage was obtained in this study.

Based on the researcher's observations and interviews, the development of a green entrepreneurial spirit among participants could be categorized into the following themes:

1. Increased environmental awareness: Participants became more sensitive to the environmental issues present in their surroundings.
2. Shift in mindset: Participants showed a change in their thinking, leading them to consider the social and environmental impacts of their actions.
3. Emergence of green entrepreneurial intent: Several participants expressed an intention to pursue sustainable business ventures, which was evidenced by the business ideas they developed and their final presentations.

Figure 1. Snapshot of prototype session

4.5 The Role of Design Thinking for Evoking Creativity & its Implications for Green Entrepreneurship

The sequential and iterative engagement through the Empathize, Define, Ideate, and Prototype stages collectively demonstrates a comprehensive and holistic development of a green entrepreneurial spirit. This process, which moves from a deep, empathetic understanding of problems to the conceptualization of tangible solutions, systematically cultivates increased environmental awareness, fosters a mindset geared toward sustainability, and directly leads to the emergence of concrete entrepreneurial intent. Ultimately, this highlights the profound transformative power of the Design Thinking methodology as a pedagogical framework for nurturing ecopreneurs.

The Empathize stage directly contributes to an increase in environmental and user awareness. The Define stage focuses and crystallizes this awareness into an actionable problem. The Ideate stage promotes creative and sustainable solutions, fostering a solution-centric mindset. The Prototype stage, by making ideas tangible, consolidates entrepreneurial intent and a sense of ownership. This demonstrates that the Design Thinking framework is not merely a disconnected series of steps, but a coherent and progressive journey that systematically builds the cognitive and motivational foundations necessary for green entrepreneurship.

The fact that these comprehensive results were observed even without the **Test** stage demonstrates that the Design Thinking process was still able to cultivate a holistic green entrepreneurial spirit. The Prototype stage served as a crucial internal validation step,

consolidating abstract ideas into tangible forms. This process significantly contributed to the observed emergence of green entrepreneurial intent by boosting participants' confidence in the feasibility of their solutions and fostering a deep sense of ownership, which is a crucial psychological precursor to entrepreneurial action. This suggests that the act of building or representing their ideas, even without external validation, served as a powerful exercise in internal commitment building. It transformed a conceptual solution into a 'real' possibility in the minds of the creators, which is a strong motivator for entrepreneurial pursuit and cultivates a sense of agency and confidence in their capacity to implement change.

4.5.1 Systematic Cultivation of Creativity and Innovation

Design Thinking is iterative in nature, consisting of four stages, are Empathize-Define-Ideate-Prototype, which systematically encourage and improve more creative problem-solving skills. The Empathize stage emphasis on direct experience and deep observation is crucial, as it moves participants beyond a superficial understanding, paving the way for unconventional insights and creative problem framing. The Ideate stage's explicit encouragement to generate "various possible solutions without limitations," coupled with practical tools for categorization, directly fosters divergent thinking and the exploration of non-obvious solutions. The Prototype stage's requirement to translate abstract ideas into tangible forms actively pushes creative boundaries in visualization, materialization, and practical application, compelling participants to think concretely about their solutions.

Design thinking functions as a mechanism that can change experience-based cognitive perspectives because it goes through structured but flexible and repetitive stages. This goes beyond simple problem-solving instruction; it fundamentally alters how individuals perceive problems and their own agency in creating solutions, specifically guiding them toward human-centered and sustainable innovation. This profound cognitive reframing is essential for nurturing a new generation of green entrepreneurs who are proactive, empathetic, and impactful.

4.5.2 The Foundation for Human-Centered Solutions

A deep analysis of how the fundamental emphasis on user needs and direct experience in the Empathize and Define stages serves as a foundation for developing truly human-centered solutions. Empirical evidence from participants' problem identification, which was directly related to user discomfort (e.g., uneven paths) and the critical need for accessibility for vulnerable groups (the elderly, children, and people with disabilities), strongly indicates the profound human-centered orientation cultivated by the Design Thinking process. This empirically validates the theoretical statement that Design Thinking "can encourage entrepreneurs to focus not only on the environment but also on human needs and behavior."

4.5.3 A Transformative Shift from Problem-Centric to Solution-Centric Thinking

A detailed discussion is presented on how the structured progression through the Design Thinking stages fundamentally "shifts the mindset of youth from problem-centric to solution-centric, and from passive to proactive." The "mindset shift" observed among participants, which led them to consider the social and environmental impacts of their actions, serves as compelling empirical evidence for this profound theoretical claim. This shift is crucial for fostering an entrepreneurial disposition. The theoretical framework explicitly states that Design Thinking "can shift the mindset of youth from problem-centric to solution-centric, and from passive to proactive." The empirical research observed a clear "mindset shift" among participants that is not a superficial change but a profound cognitive

reorientation. The Empathize stage compels participants to actively seek out problems from a user's perspective, moving beyond passive observation. The Define stage forces them to precisely articulate the problem, cultivating analytical rigor. The Ideate stage encourages divergent and innovative thinking, breaking conventional mindsets. The Prototype stage, by making ideas tangible, consolidates entrepreneurial intent and a sense of ownership. This sustained and iterative engagement fundamentally reshapes how individuals approach challenges, making them inherently more creative, empathetic, and proactive in identifying and solving problems. These are core attributes of successful entrepreneurs, particularly in the green sector.

4.5.4 Business Ideas as a Concrete Manifestation of Green Entrepreneurship

The business ideas generated by the students show significant potential to create major social and environmental impacts, making them a tangible embodiment of Green Entrepreneurship. Each idea is inherently aligned with the Triple Bottom Line (TBL) principle—Profit, People, and Planet—which is the foundation of green entrepreneurship.

a) Expansion of the mangrove area through participatory methods: This idea directly addresses the "Planet" aspect by promoting the restoration and conservation of the vital mangrove ecosystem. The emphasis on "participatory methods" strongly integrates the "People" aspect of the TBL, empowering the local community through active involvement in conservation efforts and potentially creating new job opportunities or livelihoods. From a "Profit" perspective, an expanded and well-managed mangrove area can enhance the ecotourism site's appeal, attracting more visitors and generating sustainable revenue for the site and its community. This mechanism has echoed by how community shall be strengthened in order to protect the conservation site (Sukarmen et al., 2023)
b) Implementation of sorted waste bins that can be processed by the ecotourism site: This solution directly addresses the "Planet" problem of trash accumulation and a lack of waste sorting. By processing waste on-site, this idea has the potential to reduce landfill waste and even create value from it (e.g., compost, recycling). It also has a strong "People" dimension by educating visitors about waste sorting and promoting responsible behavior. The "Profit" aspect can be realized through reduced waste disposal costs, the potential sale of recycled materials, or even the development of new products from waste. . This separated bin shall be enjoyed a technology supporting to help visitors' understandings on the urge of waste behavioral (Rosenlund et al., 2025)
c) Renovation of footpaths for better accessibility: This idea is fundamentally centered on the "People" aspect of the TBL, addressing the accessibility issues identified for the elderly, children, and people with disabilities. By increasing inclusivity, the ecotourism site becomes more welcoming and accessible to a wider segment of visitors, thereby enhancing social welfare and the overall visitor experience. While it may seem less directly related to the environment, well-designed footpaths can also reduce visitor impact on the fragile ecosystem. From a "Profit" perspective, increased accessibility can attract more visitors, extend the duration of visits, and improve satisfaction, all of which can contribute to increased revenue. Once its accessibility would be enhanced into open and better opportunity for all type of visitors to explore, it possibly towards visitors satisfaction (Groulx et al., 2021)

Table 1. Design Thinking Stages, Identified Problems, and Green Business Solutions

Design Thinking	Activity	Identified Issues	Green Business Solutions	Results Observed (Prototype Stage)

Stage				
Empathize	60-minute direct observation at Gunung Anyar mangrove ecotourism; Freedom to engage in activities (recreation, culinary); Group observation; Reflection notes and inventory of findings	Accumulation of rubbish; Lack of visitor education on rubbish disposal; Damaged jogging trails; Inadequate walking facilities for the elderly	N/A	N/A
Define	Physical reflection and sharing of experiences; Articulation of problems encountered (uneven paths, mixed waste bins, unmarked path levels); Group consensus	Limited expansion of mangrove areas; Lack of waste sorting in rubbish bins; Pedestrian paths are not accessible (elderly, children, people with disabilities)	N/A	N/A
Ideate	Problem-based solution development; Guidance for sustainable business models; Recording ideas on large sheets of paper and categorising them with sticky notes	N/A	Expansion of mangrove areas through participatory methods; Implementation of sorted waste bins that can be processed at ecotourism sites; Renovation of footpaths for better accessibility	N/A
Prototype	Creation of 2D, 3D, and 4D visual prototypes in groups; use of plasticine, crayons, and LEGO to resemble the original idea	N/A	N/A	Increased environmental awareness; Shift in mindset (considering social/environmental impacts); Emergence of green entrepreneurship intentions

Source: Research results, 2025

Collectively, these ideas go beyond mere environmental improvements; they are integrated business models that demonstrate a deep understanding of how environmental and social challenges can be transformed into sustainable economic opportunities. This proves that green entrepreneurship plays a role as an agent of change because it not only pursues profit but also actively promotes the transition to a more sustainable and inclusive economy. The solutions generated by the students are inherently holistic, addressing interconnected problems in a way that creates multiple benefits across environmental, social, and economic dimensions. These ideas focus not on a single aspect of a problem, but rather on creating mutually reinforcing value.

5. Conclusion

This study confirms the effectiveness of Design Thinking as a robust and systematic framework for fostering green entrepreneurship intentions and capabilities among students. Key findings show that the Design Thinking process, which focuses on deep empathy and creative problem solving, successfully builds a transformative cognitive foundation for participants. Specifically, each stage of Design Thinking (from Empathize to Prototype) cumulatively guides participants to formulate business ideas that explicitly reflect the principles of the Triple Bottom Line (TBL), namely the balance between Profit Generation, Social Empowerment (People), and Environmental Preservation (Planet). Thus, this study concludes that it is an effective catalyst for integrating human-centered design thinking with sustainability values that are important for the future of coastal conservation and the green economy.

Although this study provides significant insights into the effectiveness of Design Thinking in green entrepreneurship, it has several limitations that must be acknowledged and can serve as a basis for future research. The main limitations include:

1. Participant Limitations: The research sample was limited to 10 students from the Business Administration Study Program at one university. This group of participants potentially had a stronger prior knowledge base about business and environmental issues, which may not represent the youth population in general. This limits the generalizability of the findings.
2. Methodological Limitations: This study relied entirely on exploratory qualitative methods and deliberately omitted the Test stage from the framework. While reasonable, this means that the findings only reflect the intentions and quality of business ideas without market validation or empirical testing.

Suggestions for Future Research: Future research is recommended to use a mixed-method approach, for example, by including pre-tests and post-tests to measure changes in green entrepreneurship attitudes quantitatively. Additionally, replicating this study across various green industry sectors (e.g., sustainable agriculture or renewable energy) and with a more heterogeneous sample would provide a broader understanding of the potential for sustainable entrepreneurship.

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