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Cultivating Green Entrepreneurs: A Project-Based Learning Module to Foster Environmental Awareness and Entrepreneurship in Primary Schools

Christina Wahyu Cahyani[1,*], Agung Hartoyo[1], Asriah Nurdini Mardiyyaningsih[1], Christiyanti Aprinastuti[2], Dona Fitriawan[3], Stevanus Widuri Nursusanto[4], & Ricka Tesi Muskania[5]

[1]Department of Magister of Elementary School Teacher Education, Tanjungpura University, Indonesia
[2]Department of Geometry, Faculty of Science and Technology, University of Debrecen, Hungary
[3]Department of Mathematics Education, Tanjungpura University, Indonesia
[4]Department of Technical and Vocational Education Study Program, Graduate School, Yogyakarta State University, Indonesia
[5]Department of Elementary Education, Tanjungpura University, Indonesia

*Corresponding email: christinawahyucahyani@gmail.com

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Abstract: Cultivating Green Entrepreneurs: A Project-Based Learning Module to Foster Environmental Awareness and Entrepreneurship in Primary School. Objectives: This research and development aimed to develop a valid, practical, and effective project module product for teaching entrepreneurship and raising environmental awareness, which is crucial for grade V students. This study investigated how a project-based learning module can foster environmental awareness and entrepreneurship character among fifth-grade students. **Methods:** This study was implemented at Toho State Elementary School, a rural school in West Kalimantan, Indonesia, facing environmental and economic sustainability challenges. This study used the Research and Development (R&D) method by adopting the ADDIE model. The module was to involve students in project activities that combine environmental care with opportunities to earn a living, in line with the local wisdom of the *Dayak* tribe in Toho. The module was validated by six experts in media, module design, and materials before field testing and implementation with teachers and students at SD Negeri 10 Toho. Participants included students, teachers, and expert validators involved in module testing. Environmental and entrepreneurship character were assessed using observation rubrics and pre–posttest. The practicality aspect of this module was measured through a survey of teachers and students; meanwhile, the effectiveness was assessed using Effect Size. **Findings:** Data were collected through tests, questionnaires, and interviews. The study found that the project module was feasible based on the expertise assessment. From the fifth graders' classroom teacher's perspective, the module had met 87.5 of % items of practicality and was seen as handy and easy to implement (practical). The findings indicate that the module is a valid and practical tool for integrating sustainability values into primary education. The effectiveness of the implementation of the project module shows that the N-Gain score reaches 55.27% indicating a moderate effect according to Hake's criteria. C**onclusion:** The project module is suitable for teaching environmental awareness and entrepreneurship to fifth graders, as it has been validated and practical, though it still needs adjustments to improve its effectiveness.

Keywords: project module, environmental care, entrepreneurship, sustainable lifestyle.

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INTRODUCTION

The integration of character education, particularly environmental awareness and entrepreneurship, remains a significant challenge within contemporary educational frameworks, necessitating innovative pedagogical approaches (Floris & Pillitu, 2019; Mejía et al., 2022; Zupan et al., 2018). National policies, such as Presidential Regulation No. 11 of 2022 in Indonesia, articulate clear priorities for achieving the Sustainable Development Goals (SDGs) by 2030, aligning with the 2020-2024 National Medium-Term Development Plan (RPJMN) and emphasizing environmental education from an early age (Dagli et al., 2025; Monte & Reis, 2024). While national curricula, such as the Project to Strengthen the Pancasila Student Profile (P5), aim to cultivate holistic student profiles, their effective implementation often falters due to a disconnect between generic educational resources and specific local contexts (Hartoyo, 2022; Priyadi, 2023; Syahrial et al., 2022). This gap is particularly evident in rural schools like SD Negeri 10 Toho, where, despite having promising undeveloped land and external community support, projects often remain administrative rather than transformative, failing to deeply embed environmental and entrepreneurial values (Comino et al., 2025; Morris et al., 2024; Pepin & St-Jean, 2019). Students frequently exhibit low environmental consciousness, and the potential of school grounds as a living laboratory for practical learning remains largely untapped, reinforcing a reliance on standardized, non-contextual modules (Cañín-Vargas et al., 2025; Saputri et al., 2025; Sinitkul et al., 2018).

The existing literature highlights a theoretical gap concerning the integration of entrepreneurship and environmental education (Burian et al., 2008; Moreira & Marques, 2025). While many studies advocate their combination, a persistent debate centers on the inherent conflict between the profit-driven motives often associated with entrepreneurship and the core principles of environmental sustainability (Floris & Pillitu, 2019; Pepin & St-Jean, 2019; Zupan et al., 2018). Some researchers argue that the two can be integrated through concepts such as green or social entrepreneurship, in which profit-making aligns with ecological awareness and ethical responsibility (Dagli et al., 2025; Jäggle et al., 2024). Others, however, caution that without clear value-based guidance, entrepreneurship programs risk reinforcing consumerism rather than sustainability (I*lkgz*, 2025; Miller, 2025; Zupan et al., 2018). This tension underscores the need for educational models that demonstrate how to harmoniously blend entrepreneurial skills with a profound sense of environmental responsibility, ensuring students develop an ethical approach to resource management and value creation (Slamet et al., 2025; Wardani et al., 2025). Previous studies show that project-based learning (PjBL) has been successfully used to build either entrepreneurship skills (Floris & Pillitu, 2019; Pepin & St-Jean, 2019) or promote environmental awareness (Mardiyyaningsih, 2024; Nugroho et al., 2023); however, these two domains are often treated separately, leaving a gap in how schools can help students see that economic creativity and environmental care can go hand in hand.

To address this challenge, a generic or purely theoretical module is insufficient; a specific pedagogical intervention is necessary (Le et al., 2023; Morris et al., 2024). Cognitive development theories justify why Project-Based Learning (PjBL) is the most appropriate strategy (Baser et al., 2017; Jia et al., 2025). According to Piaget's theory, elementary students (ages 10-12) are in the concrete operational stage, learning most effectively through direct experiences and manipulating tangible objects-something passive textbooks cannot facilitate (Matthews et al., 2022; Shah et al., 2025). Furthermore, Vygotsky's theory emphasizes the importance of

social interaction and scaffolding in learning (Gong, 2025; Salsabila & Muqowim, 2024). Therefore, PjBL is identified as the ideal framework because it inherently provides both: (a) tangible, hands-on tasks that align with concrete learning needs (Piaget), and (b) a structure for collaborative group work and guided learning (Vygotsky) (Jia et al., 2025; Matthews et al., 2022). This module is designed not just for students to know about the environment but for them to do something creative and collaborative about it. Theoretically, this module works by aligning PjBL with the needs of students at the concrete operational stage through hands-on activities, which are then systematically designed to bridge the "knowing-feeling-acting" gap (Lickona, 1991), transforming understanding into observable actions (moral action) (Septikasari & Frasandy, 2018; Yusuf & Fajari, 2025).

Based on this analysis, this research aims to answer the following question: to what extent is the developed project-based learning module valid, practical, and effective in fostering environmental awareness and entrepreneurship among fifth-grade students at SD Negeri 10 Toho? The study specifically aims to: (1) describe and analyze the validity of the module's media, design, and material aspects; (2) describe and analyze the practicality of the module's implementation; and (3) measure the effectiveness of the module in enhancing students' environmental awareness and entrepreneurship character (Mailool et al., 2025a; Monte & Reis, 2024). The novelty of this research lies in developing a comprehensive project module that uses the school's local environment, directly integrates environmental care with entrepreneurship concepts based on local wisdom, and is specifically designed for fifth graders, a combination not extensively found in previous studies (Burian et al., 2008; Morris et al., 2024). This module is expected to provide a concrete solution to address the challenges of character and environmental education in a rural context, in line with the vision of the Pancasila Student Profile and the SDGs (Asiati & Hasanah, 2022; Dagli et al., 2025).

■ METHOD

Research Design

This study employed a Research and Development (R&D) approach that followed the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) (Jia et al., 2025; Mailool et al., 2025b). The purpose of this approach was to systematically design, produce, and test the quality of a project-based learning module. This research is described as an R&D design with an embedded mixed-method approach.

Both quantitative and qualitative data were collected throughout the ADDIE stages. Quantitative data from questionnaires and tests were primarily used to measure validity, practicality, and effectiveness. In contrast, qualitative data from interviews, observations, and open-ended feedback were used to explain and enrich the quantitative results at each stage, providing a comprehensive evaluation of the module's quality and implementation (Baser et al., 2017; Le et al., 2023).

The module implementation procedure took place over five sessions: one pretest, three lessons, and one posttest, with each session lasting 70 minutes. The teacher acted as a facilitator to guide student activities (Gong, 2025; Jia et al., 2025).

Research Context and Participants

The research was conducted at SD Negeri 10 Toho, a public elementary school located in Mempawah Regency, West Kalimantan, Indonesia. This site was selected deliberately because it followed a preliminary analysis of the needs of the teaching staff and students, which identified a deficiency in relevant, project-based

learning resources associated with the *Merdeka* curriculum and a desire among the teaching staff to promote student participation in environmental and character education. The study lasted nine months, from September 2024 to May 2025.

This study used purposive sampling to ensure that the research setting and participants were closely aligned with the study's objectives. SD Negeri 10 Toho in West Kalimantan was chosen because the school had already implemented environmentally based learning through the Borneo Education for Sustainability Training program by the *Teach4Future* community and had introduced small entrepreneurship projects as part of the *Merdeka* Curriculum. These experiences made the school an ideal place to test a learning module that integrates environmental awareness with entrepreneurial values. In addition, six experts were invited to validate the developed module. They included two university lecturers specializing in environmental and character education, two experts in instructional design and educational technology, and two experienced elementary school teachers who had previously applied project-based learning in their classrooms. All validators had at least a Master's degree in Education (one held a Doctorate) and more than five years of relevant experience, ensuring that the module was reviewed by competent professionals from both academic and practical perspectives.

Data Collection and Instruments

Data were collected systematically throughout the five stages of the ADDIE model using a suite of validated instruments (Asrori, 2014). Analysis Stage: Initial data were gathered using: (a) a Needs-Analysis: Questionnaire administered to students, which used closed-ended questions to identify their current use of learning resources, interest in project-based activities, and need for more engaging materials; and (b) a Semi-Structured Interview with the fifth-grade teacher to gain in-depth information on current teaching practices, challenges in implementing projects, student environmental awareness, and specific needs for a new module. Development Stage (Validation): A Module Feasibility Questionnaire was used to collect data from the six expert validators. The instrument employed a 4-point Likert-type scale (1 = strongly disagree, 4 = strongly agree) and a percentage-based scoring system to interpret results. The validity questionnaire was completed by six expert validators and covered three dimensions: (1) content relevance, which assessed the accuracy and alignment of the material with learning objectives and character indicators; (2) language and presentation, which evaluated clarity, consistency, and readability; and (3) design and media, which examined layout, attractiveness, and usability. The practicality questionnaire was administered to teachers and students and focused on three aspects: (1) ease of use, (2) clarity of instructions and learning steps, and (3) time efficiency during implementation. Meanwhile, the effectiveness questionnaire and accompanying observation sheet were used during classroom trials to measure (1) students' engagement and participation, (2) improvement in environmental awareness, and (3) development of entrepreneurial attitudes. Quantitative results were supported by qualitative feedback from open-ended responses and teacher interviews, providing a more comprehensive understanding of the module's quality. The questionnaire also included open-ended fields for qualitative suggestions for improvement. Implementation Stage (Practicality): A Module Practicality Questionnaire was administered to both the teacher and the students. This instrument used a percentage-based rating system to measure the module's ease of use, clarity of instructions, student engagement, and perceived usefulness in the learning process. It was administered after

the small-scale trial (15 students) and the full implementation (22 students). Evaluation Stage (Effectiveness): A Character Assessment Test was administered as a pre-test before the intervention and a post-test after its completion. Questions included multiple-choice scenarios and situational judgment tasks.

The environmental care character in this study was limited to three indicators: beautifying the classroom and school with plants, participating in maintaining the school garden, and participating in maintaining environmental cleanliness. Entrepreneurship. The entrepreneurial character in this study was limited to five indicators: self-confidence, creativity, cooperation, leadership, and the courage to start.

Data collection utilized several instruments to ensure a holistic evaluation of the module's impact on students and its overall quality. Interview Guidelines: Semi-structured interviews were conducted with the fifth-grade teacher to gather qualitative data on challenges in project learning, module development, and the characteristics of preferred learning resources (Damayanti & Ari Nugrahanta, 2023; Priyadi, 2023; Syahrial et al., 2022). Expert Validation Instruments: Likert-scale questionnaires (1-4 scale) were used for media, design, and material experts, each with 10-15 items, to assess the module's quality, readability, completeness, layout, and content accuracy (Mailool et al., 2025b). A separate validation was performed for the summative assessment questions (pre-test/post-test) by experts to ensure alignment with indicators and content validity (Wulan et al., 2026).Practicality Questionnaires: Likert-scale questionnaires (1-5 scale) were administered to both students (8 items) and teachers (8 items) after implementation to assess ease of use, usefulness, attractiveness, and efficiency of the module, reflecting the practical usability of educational resources (Anggraini et al., 2022). Summative Assessment (Pre-test and Post-test): Eight multiple-choice questions, developed based on three indicators of environmental awareness (beautifying classrooms/schools with plants, participating in garden maintenance, maintaining environmental cleanliness) and five indicators of entrepreneurship character (self-confidence, creativity, teamwork, leadership, courage to initiate), were administered before and after module implementation (Cañón-Vargas et al., 2025; Floris & Pillitu, 2019; Pepin & St-Jean, 2019). These questions were validated and found to be reliable using *IBM SPSS Statistics version 27*. The choice of indicators for environmental awareness and entrepreneurship was aligned with Lickona's (1991) components of character: moral knowing (understanding), moral feeling (attitudes), and moral action (behavior, providing a comprehensive framework for assessment (Lickona, 1991; Septikasari & Frasandy, 2018; Yusuf & Fajari, 2025). The question format is self-assessment, with choices assigned different scores. The validator completes a validation sheet with scores and suggestions.

Table 1. Instrument list table

Instrument Type	Objective	Final Item Count	Scale Used	Results
Media Validation Sheet	To find out the validity of the media	10	Likert scale 1-4	96.25 %
Module Design Validation Sheet	To determine the validity of the module design	15	Likert scale 1-4	94.16 %
Material Validation Sheet	To find out the validity of the material	15	Likert scale 1-4	98.3 %

Pretest and posttest question sheets	To find out the pretest and posttest scores	8 questions	Validity and Reliability using SPSS version 27	The 8 test items show $p < 0.05$, indicating that the eight summative questions are valid. The results of the reliability test show that the eight questions declared valid had an Alpha Cronbach value > 0.60, indicating that the questions used as pretest and posttest were quite reliable and suitable for use.
Student Practicality Questionnaire	To determine the module's practicality for students.	8 statements	Likert scale 1-5	82.3 %
Teacher Practicality Questionnaire	To determine the level of practicality of the module for teachers.	8 statements	Likert scale 1-5	78.9 %

Data Analysis Procedures

The data were analyzed using a combination of descriptive and inferential statistical techniques for quantitative data, and thematic analysis for qualitative data. Quantitative Data Analysis: Likert-scale and percentage-based questionnaire were analyzed descriptively. For the feasibility questionnaire, the average score from the six validators was calculated for each aspect and overall. These scores were then categorized using a predefined conversion scale (e.g., 3.26-4.00 = Excellent). For the practicality questionnaires, percentage scores were calculated and categorized (e.g., 81%-100% = Very Practical). The pre-test and post-test results were evaluated using SPSS version 27. Before conducting inferential testing, a Shapiro-Wilk test was used to assess the data's normality. This test demonstrated that the data were normally distributed, which justified the use of parametric statistics. A paired-samples t-test was then conducted to determine whether the average difference between the pre-test and post-test was significant, with an alpha level of 0.05 used to define the test. Finally, the Normalized Gain (N-Gain) score was calculated using the formula <g>= (Post-test Score"Pre-test Score) / (Max Score"Pre-test Score) to measure the increase in learning effectiveness, categorized as high (g>0.7), moderate (0.3-0.7), or low (g<0.3). Qualitative data from the teacher interview and open-ended suggestions from the expert and practicality questionnaires were analyzed thematically.

■ RESULT AND DISCUSSION

Analysis Stage

Based on student questionnaires, 100% of students did not use the project module developed by their teachers. Students had also never used the project module, which aims to foster environmental stewardship and entrepreneurship. An interview with the principal of Toho 10 Public Elementary School on Monday, April 1, 2024, showed that children's environmental awareness remains low. When they see trash, they still have to be instructed to pick it up and put it in the trash. Project activities that

foster environmental stewardship and entrepreneurship began to emerge with the *Teach4Future* grant program, but there were no teacher-developed modules for these activities.

The questionnaire and interviews revealed a lack of specific, relevant, and tailored teaching materials tailored to the needs and environmental conditions of Toho 10 Public Elementary School. Environmental stewardship has not been properly internalized; opportunities to foster creativity, innovation, and economic independence from an early age are missed, and program initiatives and sustainability remain dependent on external parties. The school lacks a self-sufficient system and tools (modules) to sustain project activities.

Based on the student needs questionnaire, it showed that students do not use project modules that focus on building environmental and entrepreneurship character, so it was concluded that students need a project module that can do just that. The questionnaire results were backed up by an interview with the fifth-grade teacher. The teacher had never used a project module that fosters environmental and entrepreneurship character; they only used teaching materials like books provided by the school. Those materials did not fit the school's situation and did not really focus on developing students' character for environmental care and entrepreneurship. So, the teacher really needs a project module that can foster environmental and entrepreneurship character.

The findings of this Research and Development (R&D) study are presented in accordance with the ADDIE model's sequential stages, detailing the module's analysis, design, development, implementation, and evaluation (Mailool et al., 2025a; Mailool et al., 2025b). This section will also discuss these results in the context of relevant theoretical frameworks and previous research concerning educational resource development and character formation (Lickona, 1991; Syahrial et al., 2022).

Needs Analysis and Module Development. The *Analyze* phase revealed a significant gap between the ideal project implementation and the actual practice at SD Negeri 10 Toho, mirroring challenges identified in broader educational contexts (Hartoyo, 2022; Priyadi, 2023). A needs analysis questionnaire administered to 22 fifth-grade students yielded an average score of 0.12 (on a 0-1 scale), categorized as "very poor," indicating that teachers were not optimally fostering environmental awareness and entrepreneurial character (Floris & Pillitu, 2019; Petkou et al., 2025). Students expressed a clear need for modules that were easy to use, interesting, relevant to daily life, and rich in illustrations and pictures, aligning with calls for more engaging and accessible learning materials (Anggraini et al., 2022). These quantitative findings were corroborated by interviews with the fifth-grade teacher, who highlighted the reliance on generic online or textbook materials, a lack of comprehensive knowledge regarding project-based learning steps, and time constraints for module development (Damayanti & Ari Nugrahanta, 2023; Priyadi, 2023). This initial analysis underscored the urgency of a contextual and engaging project-based learning module to enhance project implementation at the school (Syahrial et al., 2022; Yusuf & Fajari, 2025). The absence of tailored resources and the teachers' limited experience in developing such materials created a clear rationale for the "Healthy Farm" module (Mailool et al., 2025b).

The *Design* phase focused on creating a blueprint for the "Healthy Farm" module, which included a cover, expert reviewer pages, project description, foreword, table of contents, objectives, sub-element development, and project flow, following standard module design principles (Mailool et al., 2025a). The core content featured 16 activities, student activity sheets, teacher feedback guidelines, observation sheets, and summative evaluation questions aligned with three

environmental awareness indicators and five entrepreneurship character indicators (Cañón-Vargas et al., 2025; Floris & Pillitu, 2019; Lickona, 1991). The design emphasized rich visuals, simple language, active sentences, and child-friendly terminology, drawing on references from the Teach4Future community, Green Educator Course at Greenschool Bali, and Kemendikbudristek project guidelines (Hartoyo, 2022). The module's visual design incorporated green hues and Dayak cultural motifs, symbolizing environmental harmony and local wisdom (Mardiyyaningsih, 2024; Syahrial et al., 2022).

In the *Develop* phase, the module underwent refinement and expert validation, a crucial step in ensuring the quality of educational materials (Mailool et al., 2025b). Six validators: two media experts, two design experts, and two material experts evaluated the prototype. The average validation scores were consistently high: 96.25% for media aspects, 94.16% for module design, and 98.3% for material content. These percentages placed the module in the "very good" category with a "very valid" recommendation, indicating that no major revisions were needed and that it was deemed suitable as teaching material (Mailool et al., 2025a). Minor revisions, such as enhancing cover illustrations, standardizing font sizes, improving layout consistency, and adding explicit teacher feedback guidelines, were incorporated based on expert suggestions to optimize visual appeal and instructional clarity further (Anggraini et al., 2022). Furthermore, a set of 24 summative questions was developed based on the specified character indicators and then tested with 42 students from other schools (Floris & Pillitu, 2019; Lickona, 1991). Eight valid and reliable multiple-choice questions ($p < 0.05$ and Cronbach's Alpha > 0.60) were selected for the pre-test and post-test, thereby ensuring the quality of the assessment instrument (Wulan et al., 2026).

Module Practicality and Implementation. The *Implement* phase involved deploying the validated "Healthy Farm" module with 22 fifth-grade students at SD Negeri 10 Toho over five days, providing a real-world context for learning (Hartoyo, 2022). The implementation began with a pre-test, followed by three days of project activities (*Piknik Teduh*, *Mindful Mandalas*, and managing harvested plants), and concluded with a post-test and a sharing session that integrated both assessment and experiential learning (Cañón-Vargas et al., 2025). Teacher and student practicality questionnaires were administered to assess the module's usability, an important aspect of successful educational interventions (Anggraini et al., 2022).

The practicality assessment yielded positive results, indicating the module's ease of use and appeal (Mailool et al., 2025b). In the small-scale trial with 15 children at SD Negeri 03 Toho, the practicality rate was 82.3%, categorized as "practical". In the main implementation with 22 students at SD Negeri 10 Toho, the practicality rate was 78.9%, placing it in the "practical" category. Students' feedback highlighted their enjoyment of the module's engaging material, the ease of understanding due to simple language, and the relevance of activities such as vegetable gardening and harvesting (Anggraini et al., 2022). They found the varied images, colors, and embedded material links particularly appealing and helpful for learning (Mailool et al., 2025a). Teachers, specifically five educators from SD Negeri 03 Toho and SD Negeri 10 Toho, reported an 87.5% practicality rate, categorizing the module as "very practical" (Damayanti et al., 2023). Teachers appreciated the module's clarity, ease of use, relevance to daily life, and its efficiency in facilitating learning, affirming its applicability in the classroom (Priyadi, 2023; Syahrial et al., 2022). These findings align with prior research emphasizing that practical, engaging, and relevant learning materials are crucial for effective pedagogical implementation and student engagement (Septikasari & Frasandy, 2018).

Module Effectiveness in Fostering Character. The *Evaluate* phase focused on assessing the module's effectiveness in enhancing environmental awareness and entrepreneurship character, a core objective of the project curriculum (Hartoyo, 2022; Lickona, 1991). Pre-test and post-test scores were used for this analysis. The mean pre-test score was 2.97, which significantly increased to 3.56 in the post-test (on a 1-4 scale). A paired-samples t-test confirmed that the increase was statistically significant, with $t(21) = 7.286$ and $p = 0.000$ ($p < 0.05$), indicating a significant difference between pre-test and post-test scores after using the module. This supports the hypothesis that the "Healthy Farm" module positively influenced students' character development, aligning with entrepreneurial and environmental goals (Floris & Pillitu, 2019; Petkou et al., 2025).

Further analysis using Cohen's *d* to estimate the intervention's effect size yielded a value of 1.553. This falls into the "Very Large Effect" category according to standard interpretations of Cohen's d (where d e" 0.8 indicates a very large effect), underscoring the practical significance of the module's impact on student character. Additionally, the N-Gain score, which measures normalized learning gain, was calculated at 0.5527 (55.27%). Consistent with Hake's criteria for N-Gain, this value is categorized as a "medium effect" (0.3 d" g < 0.7), signifying a substantial improvement in students' character attributes. This medium effect, coupled with the very large Cohen's *d*, collectively demonstrates the module's robust effectiveness in fostering environmental awareness and entrepreneurship character in the target student group (Pepin & St-Jean, 2019; Zupan et al., 2018).

The discussion of the module's impact aligns with both the problem context and theoretical frameworks (Morris et al., 2024; Syahrial et al., 2022). The observed enthusiasm of students during activities like "*Piknik Teduh*" (observing trees) and "*Mindful Mandalas*" (creating art from natural materials) highlights the module's success in engaging students with their environment (Cañín-Vargas et al., 2025; Comino et al., 2025; Petkou et al., 2025). This direct interaction with nature strengthens environmental awareness and fosters an appreciation for environmental protection (Mardiyyaningsih, 2024; Nugroho et al., 2023). Group discussions during plant management activities further developed communication, teamwork, and leadership, reinforcing key entrepreneurial competencies (Floris & Pillitu, 2019; Pepin & St-Jean, 2019).

The module's design is strongly rooted in established cognitive and sociocultural theories of learning (Salsabila & Muqowim, 2024). Activities that involve manipulating concrete objects and engaging in practical tasks, such as planting and harvesting, align with Jean Piaget's theory of concrete operational thought, where children at this age learn most effectively through direct, tangible experiences (Shah et al., 2025). The visual elements and step-by-step instructions in the module further facilitate this concrete learning, making abstract concepts more accessible and promoting engagement (Anggraini et al., 2022). Moreover, the collaborative nature of the project activities, where students work in groups, discuss ideas, and receive guidance from facilitators, strongly reflects Lev Vygotsky's sociocultural theory, particularly the concepts of social interaction and the Zone of Proximal Development (ZPD) (Salsabila & Muqowim, 2024; Syahrial et al., 2022). Scaffolding, evident in the initial guidance for "*Mindful Mandalas*" and in ongoing facilitator support, enabled students to complete tasks beyond their individual capabilities, promoting cognitive growth through social mediation (Priyadi, 2023). This is supported by the high average score for the "teamwork" indicator (3.59), which aligns with the principles of active learning. The increase in pre-test and post-test scores (from 2.97 to 3.56) provides empirical evidence that these active, experience-

based learning processes, contrary to John Locke's *tabula rasa view, in which* knowledge is passively imprinted, empower children to construct and elaborate on their existing knowledge frameworks actively.

Furthermore, the module effectively fosters 21st-century skills, particularly the 4 Cs: creative thinking, critical thinking and problem-solving, communication, and collaboration (Septikasari & Frasandy, 2018; Wulan et al., 2026). The "creativity" indicator, with a mean post-test score of 3.32, was evident in students' project outcomes and their ability to express themselves through reflections, demonstrating innovative thinking (Floris & Pillitu, 2019). Activities like "Piknik Teduh" (score 3.68 for beautifying school) and "*Mindful Mandalas*" (score 3.59 for garden maintenance) directly engaged students in environmental care, developing a practical understanding of ecological responsibility (Cañón-Vargas et al., 2025; Petkou et al., 2025; Saputri et al., 2025; Wardani et al., 2025). Concurrently, the collaborative plant management tasks strengthened teamwork (score 3.59), leadership (score 3.77), and initiative (score 3.50), reflecting a holistic development of entrepreneurial character (Pepin & St-Jean, 2019; Zupan et al., 2018). The explicit categorization of environmental awareness and entrepreneurship indicators into Lickona's (1991) moral knowing, moral feeling, and moral action (understanding self, acting well, and behaving positively) demonstrates a comprehensive approach to character development, covering cognitive, affective, and psychomotor domains (Lickona, 1991; Yusuf & Fajari, 2025).This holistic development ensures that students not only understand environmental and entrepreneurial concepts but also internalize these values and translate them into positive actions, contributing to sustainable lifestyles (Iþýkgöz, 2025; Miller, 2025a; Slamet et al., 2025).

Design Stage

The module's content was adapted from the Ministry of Education, Culture, Research, and Technology's project development guide. This sustainable lifestyle project module also comes with activity sheets and evaluation questions. The module was developed by considering the chosen theme, project description, goals, sub-element development, project stage flow, activities, activity sheets, feedback guidelines, and teacher reflections. The module contains 16 activities, each with a title, objective, time, tools/materials, preparation, and implementation steps. The module also includes links to easily accessible materials to help students better understand the lesson accurately based on existing facts. At the end of the module, there is an observation sheet, evaluation questions, an answer key, a bibliography, and a glossary.

Figure 1. Phase of designing the project module

In the design stage, the research was focused on creating the project module to foster environmental and entrepreneurship character. Some activities in this stage included: a) designing the concept of the project module, which contains the structure and content with various activities, b) designing the project module, which includes links to materials used as learning resources, and c) design validation, which involved experts as validators for the module design, as well as testing the module on fifth-grade students. The sustainable lifestyle project module was designed, developed, and then validated by six experts. A

feasibility test was conducted to determine the module's validity percentage. The module's validity was assessed using a questionnaire. Based on the validity test, several notes for improvement were provided to perfect the module. The average results from th validators are available in Table 2.

Table 2. Product validation results summary

No	Validity	Score	Qualification	Recommendation
1	Media Validity	3.85	Very Good	No revision required
2	Module Design Validity	3.77	Very Good	No revision required
3	Material Validity	3.93	Very Good	No revision required
Total mean score		**3.85**	Very Good	No revision required

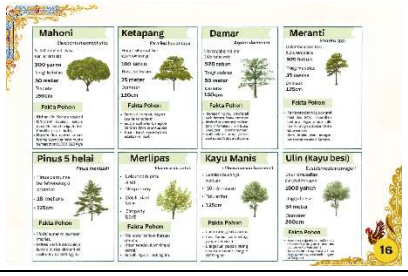
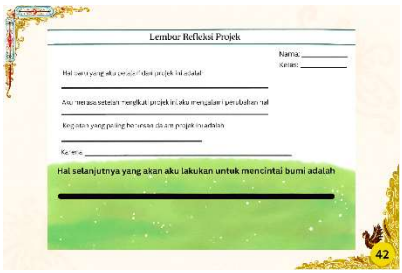
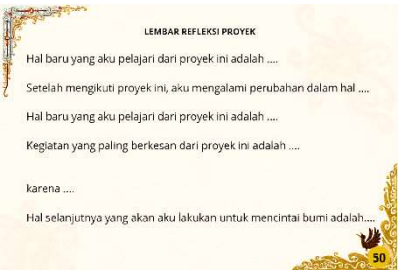
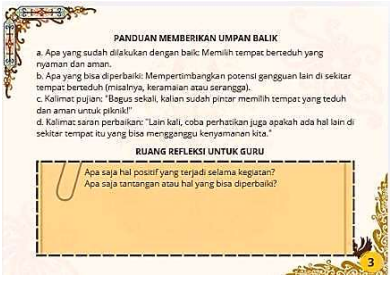
Based on the data in Table 2, the media potential score was 3.85; the module design potential was 3.77; and the material potential was 3.93. The average overall feasibility rating was 3.85; this category included "very feasible." This is in agreement with a research study by Wiwik Okta Susilawati (2023) titled "Development of a Project Module (Project to strengthen the students' profile of Pancasila) in the second phase of entrepreneurship. Specifically, the entrepreneurship-themed project module they created was demonstrated to be legitimate and practical; it addressed the lack of a project guide and teachers' lack of comprehension in elementary schools (Susilawati et al., 2023).

Development Stage

Even though these studies have made significant progress, there remains a dearth of projects that explicitly integrate the idea of a sustainable lifestyle, with a focus on both environmental care and entrepreneurship. For students at the practical application stage, this project should make sustainable use of the medium of entrepreneurship and environmental care. The lack of modules specifically designed for the requirements and circumstances of rural schools, as well as the enormous amount of land available at schools that could be used for direct learning to raise health and environmental awareness, makes this disparity noteworthy. The module's practicality in a small-scale experiment with 15 students was 82.3%, placing it in the "practical" category. In the implementation stage with 22 students, the practicality level was 78.9%, placing it in the "practical" category. For the teacher, the practicality percentage was 87.5%, which is considered "very practical."

Table 3. Revised Project Module outcomes incorporating validator feedback

Validator Suggestions	Before Revision	After Revision
The illustration on the cover should also display elements that reflect the module theme.		

A media expert suggested reconsidering the cover design to make it more attractive and better convey the module's title and contents.	 
The module design expert validator suggested revising attachments, such as worksheets and reflection pages, to address inconsistencies in layout, font, and font color.	 
The resolution of the illustrations on the worksheets needs to be increased to ensure image sharpness.	 
The spacing between text and illustrations is inconsistent. Design standards for all attachments are needed to ensure uniformity and professionalism.	 
The subject-matter expert validator suggested including a brief guide for teachers on how to provide constructive feedback, particularly for each observation activity.	 

Implementation Stage

A Shapiro-Wilk test showed a normal data distribution for the pre-test, with $W(22) = 0.951$ and $p = 0.336$ ($p > 0.05$), and for the post-test, with $W(22) = 0.965$ and $p = 0.600$ ($p > 0.05$). Neither value was significant. The null hypothesis was not rejected. This means both sets of data were normally distributed. Therefore, the normality condition was met. The statistical test used was parametric: a paired-samples t-test.

The implementation of the sustainable lifestyle project module took place at SD Negeri 10 Toho. The module was given to 22 fifth-grade students. Figure 2 is the distribution of pretest-posttest scores for each student using a scatter plot. The evaluation stage of the project module involved assessing its effectiveness in fostering environmental care and entrepreneurial character.

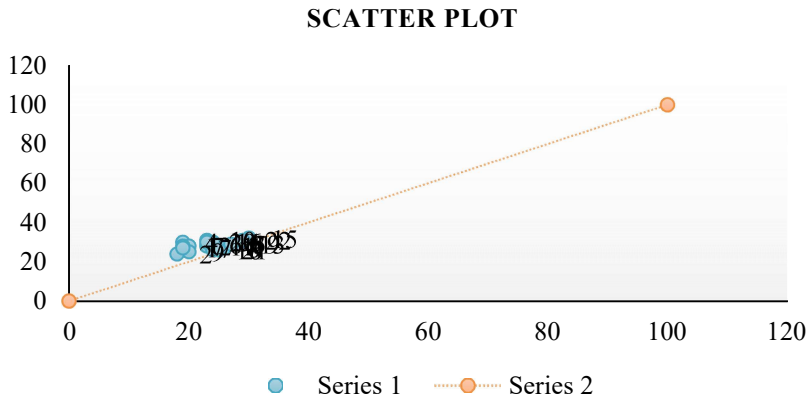


Figure 2. The distribution of pretest-posttest scores for each student is shown using a scatter plot

Table 4. The results of the paired samples t-test

					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Posttest-Pretest	4.68182	3.01404	.64259	3.34547	6.01817	7.286	21	.000

The results of the paired samples t-test in Table 4 show $t(21) = 7.286$, and the difference was significant, $p = 0.000$ ($p < 0.05$). The null hypothesis (H0) was rejected. This means that using the project module affected the students' environmental and entrepreneurial character. In N-Gain testing, the basic concept is to determine the effectiveness of the method or treatment implementation. The N-Gain Score test is conducted by subtracting the posttest score from the pretest score. The steps are: 1) inputting the pretest and posttest data into *SPSS*, 2) performing the N-Gain test calculations, and 3) interpreting the results.

Table 5. Interpretation of hake effect sizes

No	Effect Sizes	Interpretation
1	d > 0.7	High
2	0.3 – 0.7	Moderate
3	d < 0.3	Low

The N-Gain Score analysis aimed to determine the level of effectiveness of the project module on character. The N-Gain Score results are shown in Table 6. The N-Gain score was 0.5527. According to the effectiveness criteria table, this value falls into the "Moderate" category.

Table 6. Criteria and percentage of effectiveness of score improvement

Test	Mean	Score Range	N-Gain Score	Qualification
Pretest	2.97	1-4	0.5527	Moderate
Posttest	3.56			

The results of this study demonstrate that the developed project module on sustainable lifestyles is a high-quality, viable, and impactful educational tool. The following discussion interprets these findings by situating them within relevant theoretical frameworks and the existing literature, and by exploring the mechanisms behind the module's success and its broader implications for character education in Indonesia.

Evaluation Stage

The module's "exceptional" rating for feasibility (an overall score of 3.85 out of 4.00), determined by a panel of experts including media, design, and content producers, substantiates the robust and diverse nature of the construction. This high degree of validation demonstrates that the module meets stringent standards for content authenticity, pedagogical relevance, and user-friendliness. This quality is crucial to the successful teaching of complex concepts, as effective teaching materials are associated with greater student motivation and deeper understanding. The high ratings across all three categories of validation material, design, and media suggested a comprehensive quality that addressed the needs of both the learner and the educator.

The practicality assessments, which were from "practical" (78.9%) to "very practical" (87.5%), demonstrated that the module is effective in a real-world classroom environment. Students and the teacher found the language simple to understand, the activities entertaining, and the content pertinent to their daily lives. The inclusion of engaging drawings and relevant examples from the students' immediate surroundings was considered paramount for attracting their attention and inspiring them to question. The consistently high practicality ratings indicate that the module is not merely a theoretical concept but also a practical tool that can be easily incorporated into the regular school schedule.

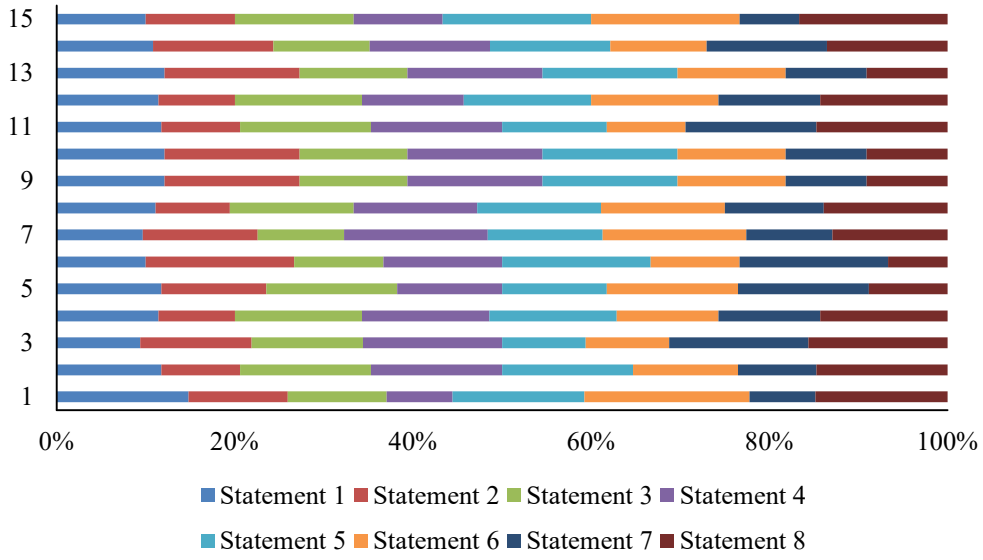


Figure 3. Student practicality questionnaire data

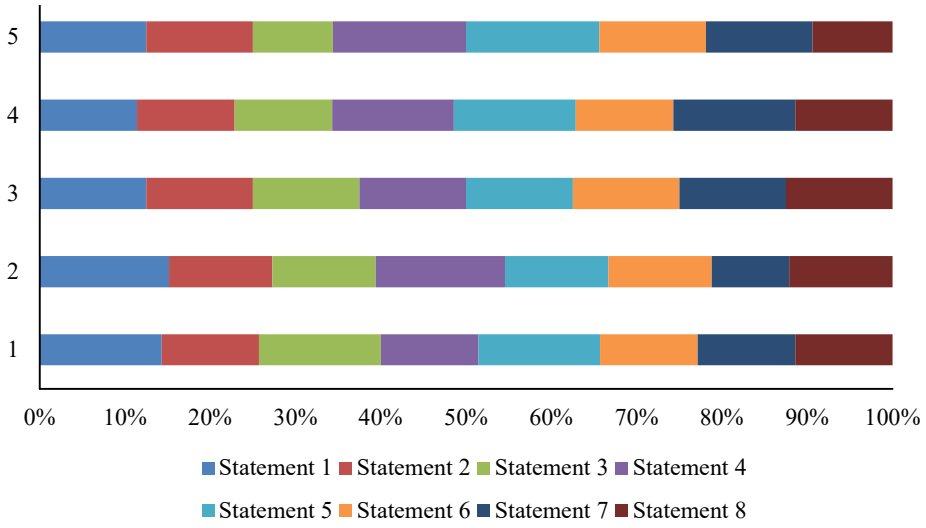


Figure 4. Teacher practicality questionnaire data

Deconstructing Effectiveness: A Constructivist and Character-Based Analysis

Students were supposed to participate in the creation of knowledge actively, rather than simply consume it (Salsabila & Muqowim, 2024, p. 819). This is entirely in line with Piaget's theory of operative concreteness, which holds that direct interactions with the physical world are the most effective way for children aged 10 to 12 to learn. Activities like planting seeds, maintaining a garden, and creating practical products from natural resources were part of the process, providing the concrete, physical experiences necessary for learning to occur at this developmental stage.

According to Vygotsky, the module's focus on group projects also produced a potent sociocultural learning environment (Wardani et al., 2025). Students were able to work together to address difficult problems beyond their individual capabilities, such as business planning and problem-solving, by creating a Zone of Proximal Development (ZPD) through group work. Essential scaffolding was provided by the teacher and more experienced peers, who helped the groups navigate challenges and set an example of higher-order thinking.

The claim of character cultivation is further substantiated when analyzed through Thomas Lickona's (1991) tripartite model of character, which consists of moral knowing, moral feeling, and moral action (Lickona, 1991, p. 53). The module systematically addressed all three components. Moral Knowing: Students developed a cognitive understanding of why environmental care is important and what constitutes an ethical, sustainable business. They learned the principles of sustainability. Moral Feeling: Through the hands-on process of nurturing plants and seeing the direct impact of their actions on their school environment, students cultivated a sense of empathy, responsibility, and care for the natural world. Moral Action: This was the module's cornerstone. Students engaged in concrete, observable behaviors that translated knowledge and feeling into habit. Activities such as beautifying the classroom with plants, maintaining the schoolyard garden, and collaborating to run their business venture were all forms of moral action. This framework provides a structured, theoretical validation for the observed character growth.

The involvement of children in creating projects using everyday concrete objects demonstrates that the project module aligns with Jean Piaget's concrete operational stage of cognitive development. The activities in the

project module provide a concrete illustration of the process of fostering environmental awareness and entrepreneurial character. The images in the module include objects found around students.

Vygotsky emphasized that social interaction is key to cognitive development. This is reflected in the use of group project modules, which allow students to actively learn from their peers, rather than simply receiving direction from the teacher. The concept of the Zone of Proximal Development (ZPD) is evident when students are encouraged to complete projects independently but can seek assistance from a facilitator when facing difficulties. This demonstrates the gap between what can be accomplished independently and what can be achieved with assistance. The facilitator's assistance is a form of scaffolding. A specific example is in creating mindful mandalas, where students are given initial support to continue and complete the task independently. The key to the ZPD is scaffolding, which helps children reach the upper limit of their ZPD (Wardani et al., 2023, p. 10). Scaffolding is evident in the creation of mindful mandalas. Children are given initial assistance with basic shapes and drawings, which they then create independently. Based on validation results, the cooperation indicator achieved an average score of 3.59. Vygotsky's theory explains that, in this study, environmental and social influences influence children's cognitive development.

According to Lickona (in Damariswara, 2021, p. 2), the character components of moral knowing, moral feeling, and moral action are evident in the characteristics of environmental care and entrepreneurship. The grouping of these indicators reflects the overall character of environmental care and entrepreneurship. Three indicators are used: beautifying the classroom and school with plants, participating in maintaining the school garden, and participating in environmental cleanliness activities. The researchers selected five indicators of entrepreneurial character: self-confidence, creativity, cooperation, leadership, and the courage to initiate. Beautifying the classroom and school with plants, helping to maintain the school garden, participating in cleanliness activities, and working together are all positive behaviors. Self-confidence and creativity are also part of self-awareness. Leadership and the courage to initiate are also part of being kind.

Developing an Entrepreneurship Attitude: Going Beyond Conventional Business Schooling

By presenting a strategy that encourages an entrepreneurial attitude rather than simply imparting technical business skills, this study advances the emerging field of entrepreneurship education. Because they emphasize finance, marketing, and operations, traditional entrepreneurship curricula have frequently been criticized for mimicking a "mini-MBA" approach (Blass, 2018).The success of this approach was validated by qualitative data from implementation-phase interviews. Students reported that they not only became more environmentally aware but also actively utilized it to supplement their income. Children can devise various ways to utilize the garden to benefit their lives. This is evident in their group work results. On the other hand, this module aligns with a more contemporary pedagogy that emphasizes the development of the entrepreneur's individual abilities, including action orientation, risk tolerance, and resilience (Blass, 2018, p. 1). One of the main goals of EE in basic education is to develop what are commonly referred to as transversal abilities, which are soft skills like communication, leadership, teamwork, and creativity that are highly sought after in the twenty-first century (Simón & Vivaldo, 2022).These talents were developed directly through business planning, team role negotiation, and product presentations. The Skills of Disruptive Innovators (SDI) framework, which defines associating, questioning, observing, experimenting, and

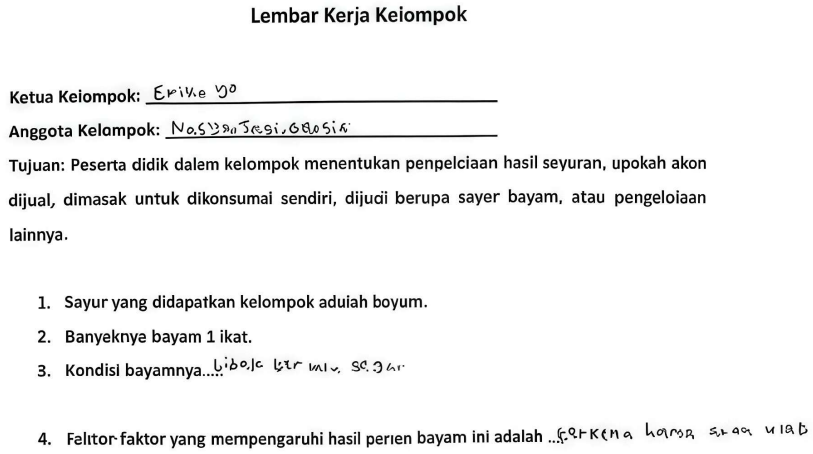
networking as essential entrepreneurship activities, is consistent with the observed development of these skills (Ratnaya et al., 2022)

Students' Entrepreneurship Potential (EP), which encompasses traits like proactive innovativeness, management and social skills, and calculated risk-taking, was enhanced by their participation in this process (Ephrem & Murimbika, 2024).The module offered a genuine yet secure environment for practicing these skills. The research's uniqueness is especially evident in its successful combination of two qualities rarely found together in elementary school curricula: environmental concern and entrepreneurship.

Culturally-Relevant Intervention: Realizing the Pancasila Student Profile

A crucial aspect of this module's success is its deep resonance with the Indonesian national educational context. The project's outcomes map directly onto the core dimensions of the Pancasila Student Profile, demonstrating that the module is an effective tool for implementing the *Merdeka* Curriculum (Asiati & Hasanah, 2022).Mutual Cooperation (*Gotong Royong*): This was the most evident dimension, practiced daily through the collaborative teamwork required to plan, produce, and sell the products (Kartini & Winahyu, 2019).The dimensions of cooperation, particularly the collaborative element, were confirmed through interviews. One child stated, "I gained better insight into plants, how to utilize the garden, and how to collaborate with others." Creativity: This was demonstrated in the innovative product designs, the use of environm ental materials, and the problem-solving required to overcome business challenges (Rahayu et al., 2022). Independence: Students took ownership of their projects, managing their own time, resources, and decision-making processes with minimal direct instruction (Kartini & Winahyu, 2019, p. 467). Faith, Piety to God Almighty, and Noble Character: This dimension was fostered through the theme of environmental care, framed as stewardship and a moral responsibility to protect creation. The act of creating a social business to benefit the community also reflects a noble character (Ngatono et al., 2024).Critical Reasoning: Students had to analyze costs, set prices, and evaluate the success of their business strategies, requiring them to think critically about cause and effect (Rahayu et al., 2022, p. 6).

This clear alignment demonstrates that the module is a culturally sensitive intervention rather than a generic, imported model. It offers a compelling illustration of how national character education's lofty, abstract objectives can be transformed into practical, interesting, and successful teaching exercises.



Lembar Kerja Kelompok

Ketua Kelompok: Erive yo

Anggota Kelompok: Nasyanasi, Gabsia

Tujuan: Peserta didik dalam kelompok menentukan penpelciaan hasil seyuran, upokah akon dijual, dimasak untuk dikonsumai sendiri, dijudi berupa sayer bayam, atau pengeloiaan lainnya.

1. Sayur yang didapatkan kelompok aduiah boyum.
2. Banyeknye bayam 1 ikat.
3. Kondisi bayamnya....bibaje ter mlv. segar
4. Felitor-faktor yang mempengaruhi hasil periен bayam ini adalah ..karena hama atau ulat

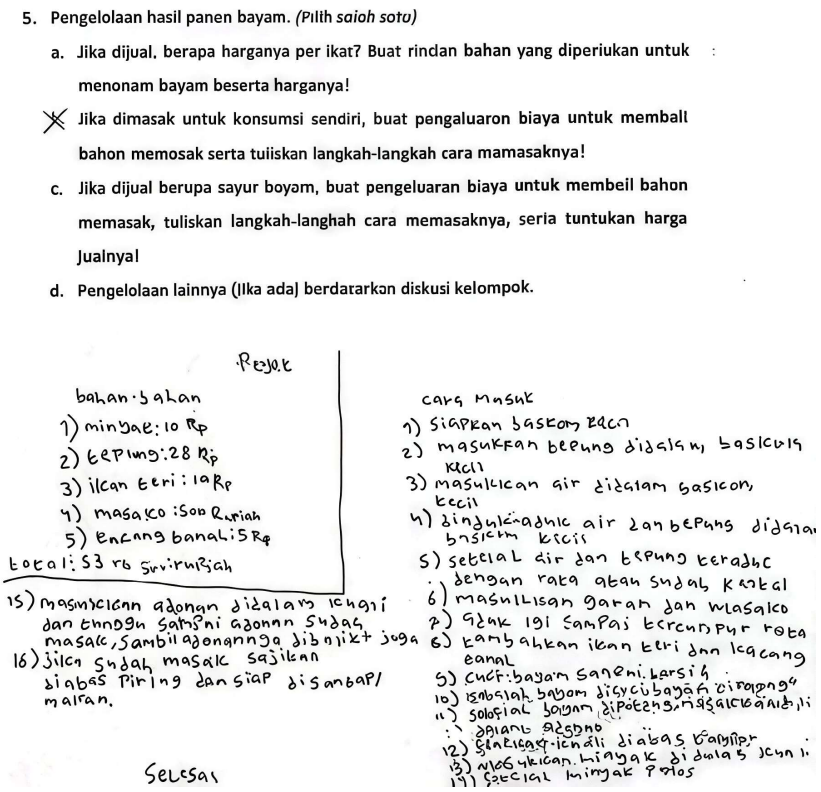


Figure 5. Group worksheet related to plans for utilizing garden produce

■ CONCLUSION

Theoretically, this study makes several important contributions. First, the findings provide empirical validation of Lickona's (1991) model of character education in the context of project-based learning (PjBL). Our findings indicate that PjBL focused on hands-on experiences (such as "Piknik Teduh" and "Mindful Mandalas") serves as a powerful bridge between moral knowledge (understanding the importance of the environment) and moral feelings (developing an appreciation for nature), which then translate into moral actions (caring for plants and school). Thus, this study implies that PjBL is a highly suitable pedagogy for bridging the "knowing-feeling-doing" gap that often presents a challenge in character education. The implication is that character should not be viewed merely as a positive "side effect" of PjBL but can be explicitly designed as a primary outcome target on par with academic achievement. The success of integrating local wisdom (Dayak motifs) and context (agriculture) also contributes to PjBL instructional design theory by showing that culturally sensitive approaches can strengthen learning relevance and impact (Moreira & Marques, 2025; Morris et al., 2024). This research successfully conceived, implemented, and evaluated a project-based learning module. The investigation suggests the module was well-regarded by professionals. In addition, this module is easy to use and practical, making it effective for teachers and students. Significant evidence of the beneficial effects is provided by the improvement in pre-test to post-test scores ($p<0.001$), a significant effect, and an N-Gain of 55.27 percent, which falls in the moderate category. The module's efficacy is attributed to its constructivist, experiential design, which supports a synergistic integration of environmental, entrepreneurship, and national education aligned with the developmental needs of elementary students. By translating the abstract

goals of the Pancasila Student Profile into practical applications, this module serves as a validated, beneficial resource for educators seeking to implement the *Merdeka* curriculum.

This study has limitations, including: 1) The research subjects were only one class with 22 students as respondents. This uncovered problems that were less in-depth and did not fully reflect the conditions or needs in other schools. In addition, the research process was limited to students at SD Negeri 10 Toho, so the results of this study are not generalizable to a wider population. 2) This study was limited to the project module on the theme of sustainable lifestyle and entrepreneurship for phase C of the elementary school level, the dimensions of faith, devotion to God Almighty, and the dimension of cooperation. 3) The test of the effectiveness of the implementation of the project module in fostering environmental care and entrepreneurial character is still limited to a small sample using the pre-experimental method of the one-group pretest-posttest design. 4) Activities in implementation are still limited to the introduction and action stages. Activities in the contextualization, reflection, and follow-up stages have not been implemented. 5) This project module is limited to the themes of sustainable lifestyle and entrepreneurship, and only focuses on developing environmental and entrepreneurial characters. In addition, this research was only conducted in grade 5. 6) This project module for developing environmental and entrepreneurial characters was only created using one application, namely Canva. 7) The material in this project module requires the use of an internet connection to access it. So, this is an obstacle for areas without internet access. Future studies could expand the scope by involving schools from different regions and educational levels to examine how the module performs across diverse settings. Further research could expand the scope by involving schools from diverse regions and educational levels. Additionally, researchers could explore the long-term impacts on student behavior and adapt the module into digital or community-based formats to further enhance collaboration and ecological responsibility (Jäggle et al., 2024; Matthews et al., 2022).

■ ACKNOWLEDGMENTS

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