Al-Kharaj: Journal of Islamic Economic and Business
Volume 7 (4), 2025
P-ISSN: 2686-262X; E-ISSN: 2685-9300

The Application of Environmental Management Accounting in Developing Sustainable Business Plans among Entrepreneurial Students of Politeknik Negeri Medan

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Keywords:
Environmental Management Accounting, Sustainable Business Plan, Entrepreneurship, Vocational Competence, Case Study.

Abstract

This study aims to (1) identify the level of understanding of entrepreneurial students at Politeknik Negeri Medan regarding the principles of Environmental Management Accounting (EMA), (2) analyze the extent to which their business plans substantively reflect environmental aspects, and (3) formulate a conceptual model for implementing EMA as a foundation for sustainable entrepreneurship development.

Method: *This research adopts a descriptive qualitative approach through a case study design. Primary data were obtained from in-depth interviews with relevant participants and content analysis of the business plans they developed. The analysis focuses on exploring students' perceptions, the challenges they encounter, and the environmental cost management components embedded in their planning.*

Results: *The findings reveal a contradiction between the students' strong commitment to ethics and sustainability and their limited technical competence in applying EMA to business planning contexts. Environmental aspects in their business documents are largely expressed qualitatively (such as environmentally friendly pledges) and have not yet integrated detailed calculations of environmental costs and eco-efficiency potential. This condition constrains the development of accountable business planning.*

Implications: *These results highlight the critical need to revise the vocational education curriculum. Institutions should introduce practical EMA modules emphasizing environmental cost measurement so that Polmed graduates can design business plans that are not only ethical but also strategic and measurable from an accounting perspective.*

INTRODUCTION

The world is currently facing a global environmental crisis triggered by economic activities that disregard sustainability (Wulandari, Mayako, et al., 2025). The linear economic model long practiced—take–make–dispose—has resulted in increased waste, carbon emissions, and massive exploitation of natural resources. In response to this situation, the concepts of the green economy and circular economy have emerged, aiming to integrate sustainability principles into all economic activities. These approaches have been formally reinforced by global agendas such as the Sustainable Development Goals (SDGs) 2030 and the Paris Agreement, which target a transition toward a low-carbon economy and resource efficiency (United Nations, 2023).

As part of the global community, Indonesia has committed to achieving Net Zero Emissions (NZE) by 2060 or earlier, as outlined in the *Long-Term Strategy for Low Carbon and Climate*

Resilience 2050 (LTS-LCCR 2050). This commitment drives the transformation of the national economic system toward greater sustainability—including within the education sector, particularly vocational education, which is responsible for producing job-ready graduates. Vocational education is expected to respond to the needs of businesses and industries (DUDI) by equipping learners with green competencies, such as energy efficiency, waste management, and environmental accountability.

Vocational education emphasizes mastery of applied skills to prepare learners for employment or entrepreneurship (Mayako & Wulandari, 2025). It plays a strategic role in producing a workforce aligned with industry needs while also being adaptive to global economic transformation (Ibrahim et al., 2025). Moreover, it is expected to nurture environmentally conscious young entrepreneurs. Therefore, integrating sustainability principles and environmental literacy into vocational education is a crucial step in preparing high-quality human resources for the green economy era.

Pratiwi et al. (2023) found that most student business plans do not yet include environmental cost accounting or sustainability strategies. This aligns with the findings of Handayani & Yusuf (2023), who explain that Environmental Management Accounting (EMA) is still treated as a supplementary topic and has not been fully integrated into entrepreneurship or business modules within vocational curricula.

Given the long-term benefits of EMA for both companies and their surrounding environments, it is concerning that its implementation and understanding remain limited within the education sector, particularly in higher education. Therefore, this study seeks to investigate this issue within a specific context—vocational students enrolled in the entrepreneurship program at Politeknik Negeri Medan—a subject rarely explored in existing literature on EMA implementation. This research adopts an integrative approach by linking environmental accounting with student business planning, through mapping students' understanding and analyzing the content of their business plan documents—two domains that have traditionally been treated separately in academic discussions. Furthermore, the study aims to develop a conceptual model for the application of EMA in preparing vocational students' business plans as an educational instrument to promote sustainable entrepreneurship.

METHODS

This study employs a descriptive qualitative approach to illustrate the application of Environmental Management Accounting (EMA) in developing sustainable business plans among students of Politeknik Negeri Medan. The research subjects consist of 250 active students who have participated in campus entrepreneurship programs—such as the *Program Mahasiswa Wirausaha (PMW)*—or have taken entrepreneurship courses and developed business plans. Data were collected through questionnaires, semi-structured interviews, and field observations of business plan documents from the PMW programs of 2023, 2024, and 2025, in order to obtain a factual depiction of how environmental aspects are integrated into business planning. The research instruments were developed based on the theoretical framework of Environmental Management Accounting (Burritt & Schaltegger, 2000; IFAC, 2005) and the Triple Bottom Line concept (Elkington, 1997), and were validated by experts in accounting and entrepreneurship. Data analysis was conducted using a descriptive qualitative method, encompassing the stages of data reduction, presentation, and conclusion drawing, supported by methodological and source triangulation to ensure data validity. All procedures were carried out systematically and ethically, allowing the

research results to be replicable and to serve as a foundation for developing a conceptual model of EMA implementation within sustainable vocational entrepreneurship education.

RESULTS AND DISCUSSION

Table 1 presents a summary of respondents' demographic data based on gender and participation in the entrepreneurship course.

Table 1. Demographic Profile and Entrepreneurial Background of Respondents

Variable	Category	Percentage (%)
Gender	Male	63.6%
	Female	36.4%
Participation in Entrepreneurship Course	Yes	80.8%
	No	19.2%
Experience in Developing a Business Plan	Yes	68.3%
	No	31.7%

The demographic data show that the majority of respondents are male (63.6%) and that almost all of them (80.8%) have taken an Entrepreneurship course. In addition, most respondents (68.3%) already have experience in developing a business plan. This profile indicates that the respondents possess an adequate entrepreneurial knowledge base to assess questions related to the integration of environmental aspects into business planning. Respondents were asked to evaluate several statements regarding their basic knowledge and perceptions of environmental issues and the benefits of Environmental Management Accounting (EMA) using a 5-point Likert Scale (1 = Strongly Disagree, 5 = Strongly Agree).

Table 2 presents the results of the Basic Understanding Assessment of EMA. The findings reveal a contrast between general environmental awareness and technical knowledge of EMA. Respondents demonstrated strong awareness of the environmental impacts of business activities ($\mu = 3.70$) and the role of environmental management in cost efficiency ($\mu = 3.70$). However, for the specific statement regarding familiarity with the term *Environmental Management Accounting* (P1), the mean score was only $\mu = 3.01$, with the highest mode being *Neutral* (39.0%). This suggests that while ethical and managerial awareness of environmental issues is well established, recognition of EMA as a formal accounting framework remains relatively low

Table 2. Results of Basic Understanding Assessment of EMA

No.	Key Statement	μ	σ	Mode (%)	Tendency
P1	I have heard of the term *Environmental Management Accounting (EMA).*	3.01	1.15	Neutral (39.0%)	Neutral
P2	I understand that business activities can cause environmental impacts.	3.70	0.99	Agree (33.3%)	Agree
P3	I realize the importance of measuring energy, water, and raw material usage.	3.75	1.05	Agree (37.3%)	Agree
P4	I am aware that waste or residual raw materials are part of environmental costs.	3.61	1.10	Agree (39.3%)	Agree
P5	I understand that environmental management can improve business cost efficiency.	3.70	1.07	Agree (36.9%)	Agree

Table 3 illustrates respondents' willingness and efforts to integrate manageable environmental aspects into their business planning. Respondents demonstrated strong commitment and intention to incorporate environmental principles into their business plans. Mean scores above 3.85 across all items indicate a strong *Agreement* tendency, particularly in seeking environmentally friendly solutions (T4: $\mu = 3.89$) and recognizing the importance of energy efficiency (T3: $\mu = 3.96$). The highest level of agreement lies in the market-economic aspect, where the majority of respondents (*Mode*: 42.2% *Strongly Agree*) believe that environmentally friendly businesses are preferred by consumers (T5: $\mu = 3.90$). This reflects a strong *market-driven motivation* in adopting environmental practices.

Table 3. Results of Environmental Principle Implementation Measurement in Business Plans

No.	Key Statement	μ	σ	Mode (%)	Tendency
T1	In preparing a business plan, I have considered ways to reduce business waste.	3.63	1.22	Agree (41.0%)	Agree
T2	I include ideas for using environmentally friendly raw materials in my business plan.	3.67	1.18	Agree (38.0%)	Agree
T3	I realize the importance of energy efficiency (electricity, water) in business operations.	3.96	1.06	Strongly Agree (40.5%)	High Agreement
T4	I seek solutions to ensure my business activities do not harm the surrounding environment.	3.89	1.11	Strongly Agree (36.8%)	High Agreement
T5	I believe that environmentally friendly businesses are preferred by consumers.	4.11	1.03	Strongly Agree (42.2%)	High Agreement

The research findings on the sustainable business (S) theme indicate that students demonstrate a positive understanding of sustainability principles, with an average score of 3.94 (*High Agreement*). The highest score was observed in statement S5, concerning students' interest

in developing businesses that support the Sustainable Development Goals (SDGs) (μ = 4.08; σ = 0.97; mode = 5; 40.2%), followed by S4, which reflects the belief that sustainable businesses enhance reputation and competitiveness (μ = 4.00; σ = 1.01; mode = 5; 39.5%). Meanwhile, understanding of the interconnection among economic, social, and environmental aspects (S1) and consideration of social impact (S3) also scored high, with μ = 3.88 and μ = 3.92, respectively. These findings affirm that students of Politeknik Negeri Medan possess a strong awareness of the importance of integrating sustainability into business development, although further reinforcement is needed in practical application through project-based learning and real-world case studies within the context of student entrepreneurship.

Table 4. Results of Sustainability Principle Assessment

No.	Key Statement	μ	σ	Mode (%)	Tendency
S1	I understand that sustainable businesses must consider economic, social, and environmental aspects.	3.88	1.08	Agree (4) (39.2%)	Agree
S2	I include long-term plans that balance profitability and environmental preservation.	3.81	1.05	Agree (4) (36.5%)	Agree
S3	I consider the social impact (on employees/community) in business planning.	3.92	1.02	Agree (4) (37.8%)	Agree
S4	I believe that sustainable businesses can enhance image and competitiveness.	4.00	1.01	Strongly Agree (5) (39.5%)	High Agreement
S5	I am interested in developing businesses that support the Sustainable Development Goals (SDGs).	4.08	0.97	Strongly Agree (5) (40.2%)	High Agreement

The research findings on the green business learning and curriculum (K) theme reveal that students have a high level of awareness and interest in integrating environmental principles into vocational education, with an overall mean score of 3.96 (*High Agreement*). The highest score was recorded in statement K5, reflecting students' willingness to learn more about integrating environmental aspects into business plans (μ = 4.23; σ = 0.94; mode = 5; 45.7%), followed by K4, which emphasizes the importance of incorporating green business material into the Polmed curriculum (μ = 4.20; σ = 0.98; mode = 5; 44.5%). Furthermore, interest in Environmental Management Accounting (EMA) courses (K3) was also high (μ = 4.01; 42.0% *Strongly Agree*), while understanding of green business concepts (K1) and lecturers' attention to sustainability issues (K2) were categorized as *Agree*. Overall, these findings affirm that students support the strengthening of sustainability-oriented curricula at Politeknik Negeri Medan as part of efforts to nurture environmentally conscious vocational entrepreneurs.

Table 5. Results of Academic and Curriculum Support Assessment

No.	Key Statement	μ	σ	Mode (%)	Tendency
K1	I have received explanations or materials about Green Business/Environmentally Friendly Business.	3.60	1.21	Agree (4) (37.5%)	Agree
K2	My lecturer has mentioned the importance of sustainability in entrepreneurship.	3.78	1.09	Agree (4) (39.1%)	Agree
K3	I am interested in taking a specific course/training on Environmental Management Accounting (EMA).	4.01	1.02	Strongly Agree (5) (42.0%)	High Agreement
K4	Polmed needs to include Green Business material in its curriculum.	4.20	0.98	Strongly Agree (5) (44.5%)	High Agreement
K5	I am willing to learn more about integrating environmental aspects into a business plan.	4.23	0.94	Strongly Agree (5) (45.7%)	Strongly Agree

Table 6. Results of Students' Perception and Readiness Assessment

No.	Key Statement	μ	σ	Mode (%)	Tendency
O1	I believe it is important for students to understand the relationship between business and the environment.	4.09	1.00	Agree (5) (41.6%)	High Agreement
O2	I am ready to apply environmentally friendly principles in my future business.	4.02	0.99	Agree (4) (40.8%)	High Agreement
O3	I believe that implementing EMA can help plan efficient and sustainable businesses.	4.10	1.03	Strongly Agree (5) (42.2%)	High Agreement
O4	I believe that future entrepreneurs must contribute to environmental preservation.	4.18	0.94	Strongly Agree (5) (43.0%)	High Agreement
O5	I want to become a young entrepreneur who cares about the environment.	4.24	0.93	Strongly Agree (5) (44.5%)	High Agreement

The findings on the students' perception and readiness (O) theme reveal a very high level of awareness and commitment toward applying environmentally friendly principles in entrepreneurship, with an overall mean score of 4.13 (*High Agreement*). The highest score was obtained for O5, which reflects students' aspiration to become young entrepreneurs who care about the environment (μ = 4.24; σ = 0.93; mode = 5; 44.5%), followed by O4, which emphasizes the belief that future entrepreneurs must contribute to environmental preservation (μ = 4.18; σ = 0.94; mode = 5; 43.0%). Furthermore, understanding of the relationship between business and

the environment (O1) and readiness to apply environmental principles in future business endeavors (O2) also scored highly, with μ = 4.09 and μ = 4.02, respectively, while the statement on the role of EMA in business planning (O3) recorded μ = 4.10. These results confirm that Politeknik Negeri Medan students demonstrate strong readiness and commitment to becoming vocational entrepreneurs oriented toward sustainability and environmental responsibility.

As complementary empirical evidence, the analysis of interviews and open-ended responses at the end of the questionnaire provides a descriptive overview of the strategic steps that Politeknik Negeri Medan (Polmed) should undertake to enhance students' understanding of Environmental Management Accounting (EMA). Based on the qualitative findings, respondents' suggestions can be categorized into three main themes: (1) Practical Implementation and Field Application; (2) Curriculum Integration, and (3) Contextual Case Studies and Environmental Approaches.

Based on direct interviews with students of Politeknik Negeri Medan (Polmed), it was found that most students acknowledged that the entrepreneurship courses at Polmed had provided a solid foundational understanding, yet they had not explicitly addressed the topics of *green business* or *Environmental Management Accounting (EMA)*. One student stated:

> *"We often create business plans in entrepreneurship classes, but they have never been specifically directed toward environmentally friendly aspects. It would be more interesting if there were projects focusing on sustainable businesses."*

This finding aligns with the quantitative results presented in Table 2, which indicate that students' understanding of EMA concepts remains limited (μ = 3.01; Neutral 39.0%), although their awareness of the environmental impacts of business activities is relatively high (μ = 3.70). This suggests a gap between students' technical knowledge of EMA and their general ecological awareness. In follow-up interviews, students emphasized the importance of practical experience to better understand the application of environmental principles in business planning. As one respondent remarked:

> *"If it's just theory, we tend to forget quickly. But if there's a practical session or a visit to a company that applies green accounting, we'll understand and remember it better."*

Quantitative results in Table 3 support this view, showing that the average scores for all items measuring the application of environmental principles in business plans exceeded 3.8, indicating a "High Agreement" tendency. Statements concerning energy efficiency (μ = 3.96) and the belief that environmentally friendly businesses are preferred by consumers (μ = 4.11; 42.2%) confirm that students are *market-driven* in adopting environmentally friendly practices. Students also demonstrated positive understanding of sustainability principles, as shown in Table 4. They agreed that sustainable businesses can enhance reputation and competitiveness (μ = 4.00) and expressed strong interest in developing ventures that support the *Sustainable Development Goals (SDGs)* (μ = 4.08). One respondent commented:

> *"Nowadays, consumers tend to trust businesses that care about the environment. So, it's important for us to learn how to build a business that's not just profitable but also responsible."*

From an educational and curriculum perspective, students consistently expressed a strong interest in learning topics related to green business and EMA. Interview results revealed that many students hoped for the inclusion of dedicated courses or cross-department projects focusing on environmental issues. This is reinforced by Table 5, where the statement on willingness to learn more about integrating environmental aspects into business plans (K5) received the highest score (μ = 4.23; 45.7%). One student even suggested:

"If it can't yet become a dedicated course, at least lecturers could mention green accounting in assignments or entrepreneurship projects, so we can get an idea of how accounting can help protect the environment."

Finally, interview results on students' personal readiness to apply environmentally friendly principles indicated a strong level of commitment. Students felt that they should be part of the movement toward sustainable entrepreneurship. This is reflected in Table 6, with an overall mean score of $\mu = 4.13$ (High Agreement). The highest statement was the desire to become a young entrepreneur who cares about the environment ($\mu = 4.24$; 44.5%). Several students emphasized:

"We want to prove that vocational graduates can also be pioneers of green businesses."
"The business of the future must be sustainable, and we're ready to start applying it now."

Overall, the interviews and quantitative data indicate that Politeknik Negeri Medan students demonstrate high levels of environmental awareness, commitment, and readiness to integrate environmental principles into entrepreneurial practice. Although conceptual understanding of Environmental Management Accounting still requires strengthening, students' enthusiasm reveals strong potential for developing sustainability-oriented vocational curricula and learning in the future.

Document analysis of the Entrepreneurship Student Program (Program Mahasiswa Wirausaha / PMW) guidelines and proposals at Politeknik Negeri Medan also reveals gradual progress in integrating environmental and sustainability aspects over time. In the 2023 PMW Guidelines, no explicit indicators emphasizing environmental aspects or *green entrepreneurship* were found in the student proposal format. However, interviews with the socialization committee identified several student proposals that mentioned sustainability and green product concepts, particularly in relation to innovation using environmentally friendly raw materials. One of the 2023 PMW presenters stated that product innovation should be directed toward the concept of "socially impactful and environmentally friendly business."

By 2024, the PMW proposal format still followed the previous guidelines, but there was a noticeable increase in the number of proposals focusing on environmentally conscious products—especially those emphasizing raw material efficiency and simple waste management. This suggests a growing student awareness of sustainability principles, even though such aspects were not yet formally mandated in the proposal writing guide.

A significant change occurred in the 2025 PMW Implementation Guidelines, where one of the eight priority themes explicitly included "Environmentally Friendly Business and Circular Economy." This theme marked the institution's commitment to promoting entrepreneurship based on sustainability and resource efficiency. Although the term *Environmental Management Accounting (EMA)* was not mentioned directly, the essence of the theme reflects EMA principles in terms of cost efficiency and production impact management. These findings indicate that Polmed's PMW policy direction has evolved from a product-based entrepreneurship model toward a more structured and measurable form of eco-entrepreneurship. This transition aligns with the focus of the present study, which underscores the importance of incorporating Environmental Management Accounting (EMA) into students' business plan development as part of a sustainable vocational education framework.

The findings of this study highlight a knowledge–practice paradox among Polmed students. On one hand, respondents exhibited a high level of environmental ethical awareness, consistently agreeing on the importance of resource measurement, recognizing waste as an environmental cost, and believing that *green businesses* are preferred by consumers. This awareness

reflects the success of general entrepreneurship and ethics courses in instilling sustainability-oriented business values (Wulandari, Mawaddah, et al., 2025). Students also showed strong proactivity in preventing environmental damage. On the other hand, specific knowledge of Environmental Management Accounting remains neutral, indicating that EMA as a technical discipline for measuring and reporting environmental costs has not been optimally conveyed. This suggests a gap between students' general awareness and the technical competencies required to implement *green business* principles in an accountable manner.

Students viewed EMA as a strategic tool that bridges ethical awareness with efficient and sustainable business practices—consistent with the *sustainability* concept that enhances reputation and competitiveness. Qualitative feedback from students highlighted a key solution to address this gap: a transition from theoretical knowledge to practical competence. Their requests to include EMA courses and apply real-world case studies confirm the need for curriculum reinforcement. Such reinforcement should focus on technical training (e.g., calculating environmental costs from waste or energy consumption), enabling students to internalize EMA not merely as a compliance mechanism but as a management instrument for cost efficiency and long-term sustainable planning. Consequently, Polmed can empower its students to progress from merely aspiring to run environmentally friendly businesses to possessing the capability to design and manage accountable green enterprises.

DISCUSSION

The findings of this study reveal a significant paradox between students' high ethical awareness of environmental issues (market-driven motivation) and their low technical competence in implementing Environmental Management Accounting (EMA) within business plans. This result not only reinforces previous studies but also specifically maps the urgent need for the integration of Environmental Accounting into vocational higher education curricula.

The Gap Between Environmental Awareness and EMA Technical Competence

The high level of students' environmental ethical awareness (for instance, μ=4.11 regarding consumer preference for eco-friendly businesses) reflects the success of ethics and sustainability education. However, the low level of formal familiarity with EMA (μ=3.01) reveals a significant gap. This phenomenon aligns with the findings of Azis, Widiawati, & Nur (2020), who reported that although many companies are aware of the need to manage environmental impacts, they "have not formally implemented Environmental Management Accounting (EMA)," indicating a disconnect between environmental practices and their formal accounting frameworks. This gap is further supported by Samirah et al. (2025), whose study of MSMEs highlighted the issue of low green accounting adoption "due to a lack of understanding and supporting regulations." Other studies, however, have demonstrated a positive relationship: "The results show that environmental literacy has a positive and significant influence on the implementation of green accounting," suggesting that the primary challenge lies in the provision of adequate knowledge.

The Urgency of Integrating Environmental Accounting into Vocational Curricula

The technical competency gap identified in this study—particularly the inability to internalize environmental costs—necessitates a curriculum-level solution. The results showing that students strongly agree Polmed should add Green Business content (μ=4.20) and are willing to learn more about integrating environmental aspects into business planning (μ=4.23) reinforce

recommendations from accounting education research. Burhany et al. (2024), who examined educators' perspectives on integrating Environmental Accounting in higher education, found that the most effective approach is embedding it within relevant courses. Their study specifies the most critical topics to include: "environmental policy, environmental impact assessment, accounting for waste, pollution, and disposal, accounting for recycling, packaging and containers, as well as environmental expenditures and commitments." At a broader level, Julita et al. (2025) emphasize that "higher education plays a strategic role in shaping sustainable entrepreneurial practices aligned with the Sustainable Development Goals (SDGs)." These findings underline the need for institutions such as Polmed to embrace Education for Sustainability, producing graduates who are not only ethically aware but also competent in Entrepreneurship for Sustainability.

EMA/Environmental Accounting as a Strategic Approach to Business Planning

The observed relationship between EMA and efficient business planning (μ=4.10) is consistent with and supported by recent literature that positions Environmental Accounting as a strategic tool for competitiveness rather than mere compliance. Adelia & Sisdianto (2025), in their study on sustainable business planning, found that "the implementation of environmental accounting not only helps companies comply with environmental regulations but also enhances their reputation and global competitiveness." This indicates that Environmental Accounting (which encompasses EMA) serves as a key mechanism for transforming ethical responsibility into competitive advantage. In the manufacturing context, Manap et al. (2024) similarly reported that most companies "have adopted environmental management accounting systems as part of their sustainability strategies," showing that EMA is a necessary management practice for business sustainability (Ndruru et al., 2025; Yunita et al., 2025). These findings reinforce the expectation of students in this study that EMA should be integrated into business planning, as it is an essential component of modern business strategy.

CONCLUSION

This study concludes that there exists a significant disparity between the high level of environmental ethical awareness among entrepreneurship students at Politeknik Negeri Medan (Polmed) and their relatively low technical understanding of Environmental Management Accounting (EMA). Although students demonstrate a strong commitment to sustainable business practices—consistent with the findings of Azis, Widiawati, and Nur (2020), which suggest that awareness often precedes implementation—the environmental aspects within their business plans remain largely qualitative and do not yet reflect the monetary integration of costs and eco-efficiency potential offered by EMA. Therefore, this study recommends the development of a conceptual EMA model that underscores the urgency of strengthening literacy and integrating environmental accounting topics specifically into vocational entrepreneurship curricula. Supported by the perspectives of accounting educators (Burhany et al., 2024), this integration serves as a crucial foundation for transforming ethical intentions into measurable competitive advantages within sustainable business planning.

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