

BREAKING THE CARBON ACCOUNTING LITERACY GAP THROUGH VOCATIONAL TEACHERS AS A SYSTEMIC LEVERAGE POINT IN THE GREEN ECONOMY TRANSITION

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Abstract

The global transition toward a green economy fundamentally transformed the landscape of the accounting profession, yet this transformation had not fully reached the vocational education system responsible for producing Indonesia's accounting workforce. This study showed that the carbon accounting literacy gap among vocational accounting teachers was not merely a matter of individual competency, but reflected a systemic failure that created a chain of ignorance from educators to students to the workers entering the labor market. Using a qualitative approach based on participatory observation of a training program involving 50 vocational accounting teachers from the Tangerang Accounting Teacher Association at Universitas Mercu Buana in April 2026, this study found that nearly all participants had never been exposed to carbon accounting concepts or greenwashing identification frameworks in any prior formal professional training. This finding confirmed that the existing gap was systemic rather than individual in nature. This study further showed that vocational teachers represented the most efficient leverage point for breaking this chain of ignorance, as the multiplier effect inherent to the teaching profession allowed a single training intervention to impact thousands of future workers. The implications of these findings pointed to the need for systemic reform in the professional development of vocational accounting teachers as a prerequisite, rather than a consequence, of Indonesia's successful green economy transition.

Keywords: Carbon Accounting, Greenwashing, Vocational Education, Sustainability Literacy, Green Economy

1. Introduction

The accounting profession is undergoing one of the most significant transformations in its history. For more than two centuries, accounting was built on one fundamental question: what is the economic value of a transaction? Today, global regulatory pressure has expanded that question to include: how many tons of carbon were produced by that transaction, and who is responsible for reporting it?

This shift is not merely a technical expansion. The establishment of IFRS S2 Climate-related Disclosures by the International Sustainability Standards Board in 2023 marked the moment when carbon reporting formally became part of international accounting standards, no longer a voluntary domain reserved for environmentally conscious companies. In Indonesia, OJK Regulation Number 51/POJK.03/2017 on Sustainable Finance had earlier mandated financial institutions to integrate sustainability dimensions into their reporting. Oktris et al. (2025) found that carbon disclosure quality directly influenced the sustainable financial performance of energy companies in Indonesia,

confirming that carbon accounting is no longer merely a regulatory obligation but a strategic variable in organizational management.

At the same time, greenwashing has grown as a direct consequence of market pressure pushing companies to appear sustainable without truly becoming sustainable. Delmas and Burbano (2011) defined greenwashing as the practice of organizations making environmental claims not supported by independently verifiable evidence. Driastuti et al. (2024) showed that the quality of ESG disclosure significantly influenced corporate financial performance, indicating that distinguishing substantive disclosure from rhetorical claims is a competency with real economic value. Without adequate literacy, accountants working in companies, public accounting firms, and financial institutions will be unable to perform the verification and reporting functions that are becoming increasingly critical.

Yet in the midst of this ongoing transformation, one element of the accounting ecosystem is moving far more slowly than all others: the vocational education system that produces the majority of Indonesia's accounting workforce. Vocational accounting teachers, who daily educate future accounting workers at the vocational level, face a paradoxical reality. On one side, the labor market that will absorb their graduates is already moving toward increasingly stringent carbon reporting obligations. On the other side, the curriculum and professional training programs available to vocational accounting teachers have not touched carbon accounting concepts at all.

This gap cannot be resolved by blaming individual teachers. It is a systemic failure occurring simultaneously at three levels. At the policy level, there is no mandate integrating sustainability literacy into national vocational accounting teacher competency standards. At the institutional level, teacher training and professional development programs organized by various parties have not included carbon accounting and greenwashing as relevant content. At the curriculum level, the applicable vocational accounting syllabus does not reflect the competency demands that already exist in the labor market. These three levels of failure mutually reinforce each other, creating a condition where teachers lack competency not because they are unwilling to learn, but because no system facilitates their learning.

The consequences of this systemic failure move through what this study terms the chain of ignorance. Teachers without carbon accounting literacy produce graduates without that competency. Those graduates then enter the labor market and fill accounting positions in companies that are increasingly required to accurately report their carbon emissions. The result is an accounting workforce unprepared to meet one of the most fundamental demands of the emerging green economy, a condition that ultimately weakens the overall quality of Indonesia's corporate sustainability reporting.

This study aims to fill the existing gap in the literature by doing two things simultaneously. First, it empirically documents the existence and depth of the carbon accounting literacy gap among vocational accounting teachers, using a training program involving 50 teachers from the Tangerang Accounting Teacher Association at Universitas Mercu Buana in April 2026 as the observational context. Second, it builds a theoretical argument about why vocational teachers are the most efficient leverage point to break the ongoing chain of ignorance, and what implications this argument has for teacher professional development policy in Indonesia. This study contributes to two scholarly conversations simultaneously: to the literature on workforce readiness in green economy transitions, and to the literature on the effectiveness of vocational teacher professional development as a mechanism for systemic change.

2. Theoretical Background

2.1 Accounting as an Emerging Professional Obligation

Carbon accounting evolved from a voluntary practice adopted only by companies with high environmental commitment into a professional obligation with legal and financial consequences. Rankin et al. (2011) defined carbon accounting as the systematic process of measuring, recording, and reporting greenhouse gas emissions generated by organizational activities, covering the entire value chain from direct operations to indirect impacts in the broader business ecosystem. The primary operational framework used globally is the GHG Protocol developed by the World Resources Institute and the World Business Council for Sustainable Development (2004), which classifies emissions into three scopes. Scope 1 covers direct emissions from sources owned or controlled by the organization. Scope 2 covers indirect emissions from purchased energy consumption. Scope 3 covers all other indirect emissions occurring in the organizational value chain, both upstream and downstream. The establishment of IFRS S2 Climate-related Disclosures in 2023 marked a turning point: for the first time, carbon reporting was placed within a binding international accounting standard rather than a voluntary guidance framework. Oktris et al. (2025) found that carbon tax and disclosure quality significantly drove sustainable financial performance in energy firms, affirming that carbon accounting competency is a strategic investment in human capital quality, not merely a compliance burden.

2.2 Greenwashing as a Systemic Problem

Greenwashing does not emerge from a vacuum. It is a nearly inevitable byproduct of two simultaneous conditions: high market pressure toward a sustainability image and an institutionally immature carbon reporting system. Delmas and Burbano (2011) defined greenwashing as the practice of organizations combining poor environmental performance with positive environmental communication, deliberately creating a gap between reality and representation. TerraChoice (2010) identified seven greenwashing typologies most commonly found in corporate practice: the sin of the hidden trade-off, where companies highlight one positive environmental aspect while concealing a larger negative impact elsewhere; the sin of no proof, referring to environmental claims without independently verifiable evidence; the sin of vagueness, covering the use of overly general terms with no agreed standard; the sin of false labels, involving the use of symbols resembling independent certifications but self-created by the company; the sin of irrelevance, where claims are true but not meaningful in the context of overall impact; the sin of lesser of two evils, presenting a product better than competitors in one environmental dimension while the product category itself is inherently harmful; and the sin of fibbing, which involves claims that are entirely factually false. Driastuti et al. (2024) showed that markets are capable of distinguishing substantive ESG disclosure from rhetorical claims, but this capability presupposes a level of literacy that must be deliberately built through education, not assumed to emerge automatically.

2.3 Carbon Accounting Literacy Gap as Systemic Risk

Human capital theory developed by Becker (1964) positioned workforce knowledge and competency as a form of capital invested in individuals that generates economic returns for both the individual and the economy as a whole. When a competency gap occurs at sufficient scale and concerns a competency increasingly demanded by the

market, it transforms from an individual problem into a systemic risk. Acemoglu et al. (2012) defined systemic risk as a condition where failure in one element of a system threatens the integrity and function of the system as a whole. The carbon accounting literacy gap among vocational teachers meets this criterion because it operates through a reproductive mechanism: each cohort of teachers without this competency produces a cohort of graduates without it, who then fill positions in Indonesia's corporate accounting system with inadequate preparation. Geels (2011) further showed through sustainability transition theory that transitions toward sustainable systems require simultaneous change at the levels of technology, institutions, and social practices. Regulations such as IFRS S2 and POJK 51/2017 address only the first level. The third level, changes in accounting professional practice, will not occur without deliberate intervention in the education system that shapes those practices.

2.4 Vocational Teachers as a Leverage Point

The concept of leverage point in complex systems analysis was first comprehensively articulated by Meadows (2008), who defined it as a place in a system where a small change can produce large changes in everything. Vocational teachers meet all the criteria for this definition within the system of sustainability literacy development for Indonesia's workforce. Darling-Hammond et al. (2017) affirmed that teacher quality is the single most influential factor in determining the quality of student learning, surpassing factors such as class size, curriculum, and technology availability. If teacher quality is the primary determinant of learning quality, then investment in teacher competency development generates returns that far exceed investment in other educational elements. Biesta et al. (2015) added a critical dimension through the concept of teacher agency: teachers are not passive knowledge transmitters but active agents who interpret, adapt, and transform knowledge according to the specific context of their classrooms and communities. When a vocational teacher gains carbon accounting literacy, they do not merely add one new topic to their teaching repertoire but develop the capacity to integrate a sustainability perspective into their entire accounting teaching narrative, producing knowledge transfer that is far more meaningful and lasting than direct training without pedagogical mediation.

2.5 Teacher Professional Development as a Mechanism for Systemic Change

Teacher Professional Development that is effective differs fundamentally from conventional training models. Darling-Hammond et al. (2017) identified seven characteristics of TPD proven to produce sustained changes in teaching practice: content focus, active learning, collaboration support, modeling of effective practice, coaching and expert support, feedback and reflection, and adequate duration. The Participatory Action Learning approach developed by Revans (1982) addresses most of these characteristics by placing participants as active agents of learning who not only receive new knowledge but also use it to solve real problems they face in their daily work. In the context of vocational teachers, this means learning about carbon accounting does not stop at conceptual understanding but continues directly to designing ways to teach the concept to students, which is the real problem teachers face every day. Nugroho et al. (2025) showed that collaboration between universities and teacher communities in a co-creation framework produces more applicable outcomes and more sustainable impact than one-directional training models, precisely because of the ownership effect: when teachers are

involved in developing teaching materials, they feel ownership over those materials and are more motivated to implement them consistently.

3. Methods

3.1 Research Design

This study employed a qualitative approach with an instrumental case study design. The qualitative approach was selected because the research objective was not to statistically measure the magnitude of change, but to develop a deep understanding of the carbon accounting literacy gap among vocational teachers and the mechanisms through which that gap is formed and can be addressed. Stake (1995) explained that instrumental case study is appropriate when a specific case is studied not for its own intrinsic value, but because it provides a window for understanding a broader issue. In this study, the training program conducted at Universitas Mercu Buana served as the instrumental case, while the broader issue was the systemic sustainability literacy gap in Indonesia's vocational accounting education. The instrumental case study design enables the researcher to explore the phenomenon in its natural context, capturing the richness and complexity of the training experience and its implications for vocational accounting education.

3.2 Scope and Object of Research

The study was conducted in the context of the Carbon Accounting and Greenwashing Literacy Training for Vocational Accounting Teachers program, held on 24 April 2026 at Universitas Mercu Buana, Jakarta. This program was part of the International Collaborative Community Service scheme of Universitas Mercu Buana for the 2025/2026 academic year, in partnership with Universiti Sains Malaysia through Dr. Afzal Izzaz Zahari. The training program served as the instrumental case for examining the broader issue of sustainability literacy gaps in Indonesia's vocational accounting education system. Participants consisted of 50 vocational accounting teachers from the Tangerang Accounting Teacher Association (MGMP Akuntansi Tangerang). Participants were selected purposively based on two criteria: they were active educators teaching accounting subjects at the vocational high school level, and they were members of an organized professional teacher community. The MGMP community was selected as the research context for two reasons. First, MGMP represents a professional teacher network with organic knowledge dissemination potential that extends beyond individuals present at the training. Second, MGMP members are teachers actively engaged in professional development, making findings from this context more relevant to the population of vocational teachers receptive to change. The purposive sampling approach ensures that the selected participants possess the characteristics necessary to adequately address the research objectives, particularly regarding their role as vocational accounting educators and their engagement with professional development activities.

3.3 Data Collection Techniques

Data were collected through two complementary methods: participatory observation and documentation. Participatory observation was conducted by the research team, who simultaneously served as program facilitators. This dual position, referred to in qualitative research tradition as participant observer, enabled deeper observation of dynamics occurring during the training process compared to external observation (Creswell, 2014). Observation focused on three aspects: participant responses to the material presented,

particularly moments where connections between new concepts and existing teaching experience appeared to form; questions and comments that emerged spontaneously during discussion sessions, reflecting participants' initial level of understanding and the direction of their curiosity; and the co-creation dynamics of the teaching module in the final session, indicating the extent to which participants were able to integrate new knowledge into their own pedagogical frameworks. Documentation included field notes written by research team members during and immediately after each session, as well as documentation of the co-creation process and outputs produced by participants. The combination of observation and documentation enables data source triangulation, enhancing the credibility and trustworthiness of the findings.

3.4 Data Analysis Techniques

Data were analyzed using thematic analysis as developed by Braun and Clarke (2006), following six systematic stages. The first stage, familiarization, involved repeated reading of field notes and documentation to gain comprehensive understanding of the data. The second stage, generating initial codes, involved systematically coding data units relevant to the research questions, capturing both explicit statements and implicit meanings. The third stage, searching for themes, involved organizing codes into potential themes with attention to relationships between codes, themes, and research questions. The fourth stage, reviewing themes, ensured internal cohesion and clear differentiation between themes. The fifth stage, defining and naming themes, captured the essence of each theme and its contribution to the research questions. The sixth stage, producing the report, involved writing an analytic narrative connecting themes to the research questions and theoretical framework. Throughout the process, the research team engaged in reflexive discussions to ensure interpretations remained grounded in the data. Three main themes emerged: the depth and extent of the carbon accounting literacy gap among participants, the mechanism of connection formation between new knowledge and existing teaching practice, and the conditions that facilitated or hindered the integration of new knowledge into teaching plans.

To ensure the trustworthiness of the findings, this study employed data source triangulation by combining participatory observation and documentation to verify the consistency of findings. Field notes were produced by more than one research team member, enabling perspective comparison and minimizing single-observer bias. This approach ensured that the findings were not merely the subjective interpretation of a single researcher but were corroborated through multiple lenses. The use of thick description in field notes and documentation also contributed to the transferability of findings, enabling readers to assess the applicability of the results to their own contexts. The research team maintained a reflective journal throughout the data collection and analysis process, documenting methodological decisions, emerging interpretations, and reflexive insights.

Two limitations of the analytical approach must be acknowledged explicitly. First, the implementation of the training program in a combined format alongside all PkM groups at Universitas Mercu Buana limited the researchers' ability to conduct quantitative measurement of knowledge change through controlled pre-post test instruments, making the findings descriptive-interpretive in nature rather than strong causal evidence. Second, participants came from one MGMP community in one region, so generalization of findings to the broader population of vocational accounting teachers should be approached with caution. The findings are best understood as transferable insights

requiring confirmation through further research with broader scope, rather than statistical generalizations. Despite these limitations, the systematic application of thematic analysis, combined with robust triangulation strategies, provides a credible foundation for the study's conclusions and recommendations.

4. Results and Discussion

4.1 The Carbon Accounting Literacy Gap as a Systemic Failure

The most fundamental finding of this study was empirical confirmation that the carbon accounting literacy gap among vocational accounting teachers is not an exception but a condition found uniformly across the entire participant group. At the opening of the first session, facilitators mapped participants' initial understanding through open questions about their familiarity with core carbon accounting concepts. The results showed that nearly all participants had never encountered basic carbon accounting terminology in any formal professional training context before. Terms such as Scope 1, Scope 2, Scope 3, GHG Protocol, and carbon footprint, which constitute standard terminology in international carbon reporting frameworks, were unfamiliar to the majority of participants. Similarly, IFRS S2 as the latest climate reporting standard established by ISSB in 2023 had never been heard of by most participants, despite this standard directly affecting the competencies needed by the graduates they educate.

More significant than mere unfamiliarity with terminology was the unfamiliarity with the relevance of the topic itself. Before the program began, most participants were unaware that carbon accounting was a competency their graduates would need in the labor market in the near future. This condition reflects what this study terms a layered gap: not only not knowing the content, but also not knowing that they need to know it. Broadwell (1969) described this condition as unconscious incompetence, the stage where a person is unaware of the gap between the competency they possess and the competency they need. This layered gap is far more difficult to close than a mere technical knowledge gap, because it does not generate intrinsic motivation to seek information or training independently. Without active and structured external intervention, this gap will not close on its own.

It is important to note that the participants in this study were active members of the MGMP professional community, by definition teachers with above-average engagement in professional development activities. If even the most professionally engaged teachers had never been exposed to carbon accounting, it is very likely that a similar or even deeper gap exists among the broader population of vocational accounting teachers who are not active in MGMP communities. This reinforces the characterization of the gap as a systemic failure rather than an individual shortcoming. The finding is consistent with Geels (2011), who showed that systemic transitions require deliberate intervention at the level of social practices, not merely regulatory mandates. Indonesia's current regulatory framework through IFRS S2 and POJK 51/2017 has addressed the technical and institutional dimensions of the transition, but the social practice dimension, specifically the professional practices of accountants and accounting educators, remains largely unaddressed.

4.2 From New Knowledge to Classroom Practice

The second finding concerns the process by which participants formed connections between newly acquired carbon accounting knowledge and the teaching frameworks and experience they already possessed. Observation showed that connections formed most

quickly when carbon accounting material was presented through comparison with conventional accounting concepts already familiar to participants. When Scope 1 was explained as analogous to direct costs in cost accounting, participants demonstrated faster comprehension compared to when the same concept was explained without reference to existing knowledge. This is consistent with the principle of meaningful learning developed by Ausubel (1968), which states that new knowledge is most effectively absorbed when it can be linked to the learner's existing knowledge structure.

The most significant moment in this connection-forming process occurred during the carbon footprint measurement simulation using a spreadsheet-based calculator in the second session. When participants practiced classifying and quantifying emissions through the PT Sinar Nusantara Logistik case study, several participants spontaneously began discussing how similar exercises could be designed for vocational students using simpler examples more relevant to their local context. The spontaneous emergence of pedagogical discussion in the middle of a technical session was an important indicator that active knowledge internalization was occurring. Participants were no longer positioning themselves merely as learners receiving material, but as teachers already thinking about how to transfer that material to their students. This observation is consistent with Biesta et al. (2015) on teacher agency: when teachers encounter new knowledge that resonates with their professional identity, they instinctively begin translating it into pedagogical terms rather than simply storing it as inert information.

A similar process was observed during the greenwashing session, particularly when participants analyzed real corporate sustainability reports using the seven-typology framework. Several participants began connecting greenwashing analysis skills with subjects they already taught, specifically financial statement analysis and accounting professional ethics. This connection is significant because it shows that greenwashing literacy does not need to be positioned as entirely new curriculum content, but can be integrated as a critical extension of existing material. For teachers operating within already dense curriculum constraints, this integration strategy is far more realistic to implement than introducing an entirely new subject.

4.3 Factors Supporting and Hinder Training Effectiveness

The third finding concerns the specific conditions observed to facilitate or hinder the effectiveness of the training in building carbon accounting literacy among participants. Understanding these conditions carries practical implications for the design of similar programs in the future.

The first supporting factor was the use of Indonesian context examples and case studies. Participants showed higher engagement when examples came from Indonesian companies or regulations compared to international contexts more distant from their everyday experience. This finding has direct implications for training program design: developing contextually relevant Indonesian company case studies is not merely a more engaging pedagogical choice, but a condition that substantively affects the depth of understanding participants can achieve.

The second supporting factor was a learning structure that moved explicitly from conceptual to practical. Participants who followed the progression from understanding Scope concepts in Session 1 to measurement practice in Session 2 demonstrated better ability to discuss pedagogical implications of the material. This confirms that in professional training for technically new topics, conceptual scaffolding is a prerequisite

for meaningful practical learning, not merely an introduction that can be shortened for time efficiency.

The third supporting factor, and arguably the most important from the perspective of impact sustainability, was active participant involvement in the teaching module co-creation process in the final session. Observation showed that the process of designing their own teaching modules compelled participants to consolidate their understanding of all previously received material, since designing effective learning requires deeper understanding than merely receiving information. Furthermore, modules designed by participants themselves carry far higher implementation rates than externally provided modules, because they are already adapted to each teacher's specific school context, student characteristics, and teaching approach. This finding supports Nugroho et al. (2025), who demonstrated that co-creation approaches between universities and teacher communities produce more sustainable impact precisely because of the ownership effect they generate.

The primary inhibiting factor observed was the combined format of implementation alongside all PkM groups at Universitas Mercu Buana. This format, while logistically efficient, limited the depth of discussion achievable because time available for each group was more constrained. This condition was also the reason why quantitative measurement of knowledge change through pre-post test instruments could not be conducted in this study. Table 1 summarizes the supporting and inhibiting factors identified through the thematic analysis.

Table 1. Supporting and Inhibiting Factors of Training Effectiveness

Factor	Type	Description
Use of Indonesian context case studies	Supporting	Increased participant engagement and depth of understanding
Conceptual to practical learning progression	Supporting	Enabled meaningful integration of technical concepts
Teaching module co-creation	Supporting	Deepened knowledge consolidation and increased implementation likelihood
Combined multi-group implementation format	Inhibiting	Limited discussion depth and prevented pre-post-test measurement

Source: Observational data analysis (2026)

The broader implication of these findings relates directly to the theoretical argument established in the Theoretical Background. If the carbon accounting literacy gap is systemic rather than individual, then closing it requires interventions that are themselves systemic in reach. A single training program reaching 50 teachers is a proof of concept, not a solution at scale. However, the findings demonstrate that when the right conditions are present, specifically contextual material, scaffolded learning progression, and co-creation involvement, the leverage point mechanism articulated by Meadows (2008) can be activated: investment in teacher competency cascades outward through the multiplier effect of the teaching profession, reaching not only the 50 teachers present but potentially the thousands of students they will educate throughout the remainder of their careers.

The relationship between carbon accounting literacy and greenwashing detection deserves particular attention in this discussion. Findings from the greenwashing session showed that participants' ability to identify greenwashing typologies was directly dependent on their prior understanding of what a comprehensive carbon report should contain. Without knowing what should be reported under a complete Scope 1-2-3 framework, participants had no reference point for judging whether a company's

environmental claim was adequately supported by data or not. This confirms the theoretical argument that greenwashing literacy is applied carbon accounting literacy: the former cannot be meaningfully built without the latter as its foundation. This has important implications for curriculum design in vocational accounting education, suggesting that carbon accounting and greenwashing literacy should be taught as an integrated unit rather than as separate topics.

5. Conclusion

This study proved that the carbon accounting literacy gap among vocational accounting teachers in Indonesia is systemic and uniform, reflecting not individual weakness but a structural failure of the professional development system to respond to rapidly changing labor market demands. Vocational teachers represent the most efficient intervention point for breaking this chain of ignorance, as the multiplier effect inherent to the teaching profession allows a single training investment to cascade through thousands of future workers. As long as this gap remains unaddressed, greenwashing practices will continue to find room to grow and Indonesia's corporate sustainability reporting will remain constrained by a workforce that was never equipped to support it.

Further research with broader participant coverage and more structured measurement instruments is needed to strengthen these findings quantitatively. The integration of carbon accounting literacy into national vocational teacher competency standards must become a policy priority that cannot be delayed, given that carbon reporting regulations at the corporate level are already in force while the educational foundation supporting them has not yet been repaired.

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