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Research paper

Uncovering the Difficulties of Gen Z Teachers in Managing Green Learning in Vocational Education: A Case Study in Indonesia

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ABSTRACT

Background: The shift in demand for a workforce suited to the green economy has shifted the responsibility of vocational education toward producing graduates ready to contribute to the development of green jobs and industries. However, teachers of Generation Z face serious challenges in effectively managing green learning despite this need. This study aims to investigate the practices, challenges, and determinants of adopting green learning management by Generation Z teachers in vocational education in Indonesia

Method: This study was qualitative in nature and employed a multi-case study design. The research subjects were 12 Generation Z teachers from 4 vocational schools with the Adiwiyata program that has been implemented for at least 4 years. Data collection was done through semi-structured interviews, field observations, and document analysis. Data were analyzed using qualitative thematic analysis based on Miles and Huberman's concept, which involved open, axial, and selective coding.

Result: Green learning is implemented through learning orientation, contextual and project-based models, and multi-stakeholder roles. However, conceptual constraints, a lack of professional development, and inflexible curriculum structures limit its implementation. Also, its management is greatly influenced by individual, institutional, and work-demand factors. This indicates a gap between the theory of sustainability and classroom practice and the need for systemic alignment.

Conclusion: With that in mind, to achieve green learning effectiveness, vocational education needs integrated curriculum reform, improved teacher capacity, and collaborative governance to support sustainable vocational education.



INTRODUCTION

The global shift toward sustainable development has been a major driver of change in vocational education, making it an important area for developing a workforce that can support green industries (Pavlova, 2019). Some demands come from global agreements, such as the Sustainable Development Goals (SDGs), as well as from national and regional policies promoting ecologically sustainable production and consumption (León-Gómez et al., 2021; Low et al., 2020). This case emphasizes that vocational education institutions are no longer tasked solely with transmitting technical skills to students (Chinedu et al., 2018). They are also expected to promote green skills, environmental awareness, and sustainable working practices (Maclean et al., 2018). The increasing demand for green employment, jobs that contribute to maintaining or improving environmental quality, has increased the need for graduates with professional skills and ecological literacy (Handayani et al., 2020a; Sutiman et al., 2022). Therefore, the inclusion of green learning into vocational curriculum has become an urgent issue. Green learning is an educational approach that integrates environmental values, sustainable methods, and eco-friendly skills into the teaching-learning process (Kaliappan & Hamid, 2021; Putri et al., 2025). It contains theoretical knowledge and practical applications, such as resource efficiency, waste reduction, and environmentally sound decision-making (Fitriyanto et al., 2021). Teacher is the most important education elements in implementing teaching and learning (Guo et al., 2020), and the successful implementation of green learning largely depends on them. Teachers are required to translate theoretical sustainability formula into meaningful teaching and learning aligned with the world of work, student life, and career (Kuo & Madni, 2023; Wang et al., 2020). Hence, their capacities to develop, deliver, and evaluate green learning are essential to assessing the effectiveness of vocational education in addressing global sustainability issues.

However, the implementation of green learning in vocational education is inconsistent in practice, especially in developing countries such as Indonesia, despite its strategic importance. A major problem is educators' preparedness and competence to integrate and implement sustainability concepts into their teaching (Lamichhane, 2016; Mets et al., 2021). Over the past several years, the demographic makeup of vocational educators has dramatically changed as more Generation Z teachers have entered the profession. Gen Z educators, as digital natives, show an ease with technology, flexibility with digital technologies, and a desire for creative learning environments. In principle, these characteristics should help integrate green learning, especially when combined with digital learning platforms and project-based approaches (Szymkowiak et al., 2021). However, new evidence points to a paradox. Actually, Gen Z teachers show high digital competencies, but they face problems of pedagogical management, especially in the integration of disciplines and in the implementation of value-based instruction, for example, green learning (Iskandar et al., 2021). Some studies admitted that more than 70% of Gen Z vocational teachers in developing countries lack awareness, literacy, and even responsibility to teach environmentally friendly practices (Mutohhari et al., 2025; Wahyuni & Mutohhari, 2024). Critical levels of active engagement reveal deeper issues than technical skills alone, including conceptual understanding, strategies, institutional support, and professional identity. Moreover, another study has revealed that many Gen Z

teachers do not have a clear understanding of green learning implementation, especially in vocational education (Walker et al., 2021).

This current problem raises serious doubts about vocational education's ability to train students for green jobs in the long run. Teachers are the main engine of the learning process; if they do not effectively implement green learning, students will graduate without the competencies to match the changing demands of the labor market. This gap may result in a technically competent but environmentally unprepared workforce that may impede a country's achievement of sustainable development (Erişen & Bavlı, 2024; Kaliappan & Hamid, 2021). Moreover, the gap between policy expectations and classroom reality may widen, resulting in inefficient implementation of green education initiatives (Browning & Rigolon, 2019). This issue also highlights a major gap in the theory literature. There is extensive research on green skills, sustainability education, and vocational training, but little research focuses on the specific challenges that Gen Z teachers face as a distinct group (Cole & Altenburger, 2019). Most of the current research generalises about teacher competencies without considering generational differences, which may influence teaching practices, beliefs, and adaptability. Furthermore, past research is generally more concerned with the outcomes of green learning than with the processes and issues of implementing it (Maisaroh et al., 2023). Hence, there is a lack of greater awareness of the barriers that hinder teachers, especially Gen Z teachers, from effectively managing green learning. This gap needs to be addressed not only to improve teaching practices but also to inform teacher-training programs, policy interventions, and institutional strategies to improve green vocational education (Karpudewan & Kulandaisamy, 2018; Li & Eilks, 2021).

For these reasons, there is a strong need for empirical research that systematically examines the challenges Gen Z teachers have in managing green learning in vocational education settings. Such research should seek to reveal both the explicit and implicit challenges, including cognitive, pedagogical, institutional, and contextual factors that influence teaching practices. Besides that, this study also aims to develop the existing literature by providing insights into the intersection of generational characteristics and sustainability education. This area is under-explored in the current literature. Thus, this study aims to identify the difficulties faced by Gen Z teachers in managing green learning in vocational education in Indonesia. The contribution of this study is to provide empirically grounded evidence and a conceptual framework to inform policy, practice, and future research on green vocational education and teacher development. This study addresses three research questions:

- RQ1 : How are Generation Z teachers implementing green learning in vocational education?
- RQ2 : What are the obstacles faced by Generation Z teachers in managing green learning in vocational education?
- RQ3 : What factors influence Generation Z teachers in managing green learning in vocational education?

METHODS

Research Design

This study employed a qualitative method with a multi-case study design to explore the problems faced by Generation Z educators in implementing green learning in vocational education in depth. A qualitative case study is especially appropriate for research that seeks an in-depth understanding of complex phenomena in their real-life context, particularly when the phenomenon and context are not easily separated (Yin, 2018). This study explores the phenomena of the teachers' struggles in managing green learning. This study is embedded in the educational, institutional, and socio-cultural context of vocational schools; thus, it calls for qualitative inquiry. Additionally, the multi-case approach allows the researcher to examine the similarities and differences between various situations and thus enhance the robustness and external validity of the findings by analytical generalization rather than statistical generalization (Cresswell, 2009). Each case represents a unique vocational school context with Gen Z educators, enabling cross-case analysis to identify common trends, specific challenges, and contextual factors. This design is scientifically valid since it provides more comprehensive empirical evidence and a deep understanding of the implementation of green learning, the challenges faced, and the variables affecting these processes in different institutional contexts.

Participant

The participants were selected from four vocational education institutions in Indonesia that have been implementing the Adiwiyata school program, a national green school program, for at least four years. These institutions were purposely considered as they provided information-rich settings where green learning had been systematically embedded in school practices and allowed for a comprehensive investigation of Generation Z teachers' experiences in diverse vocational environments (Albertz & Pilz, 2025). Following qualitative case study principles, a purposive technique was used to identify information-rich participants who could provide detailed insights into the phenomenon under investigation. The participants of this study were twelve Generation Z teachers (born between 1997 and 2012) who were purposively selected. All participants had been practicing green learning in their classrooms for at least two years and thus had practical experience that enabled them to critically reflect on the challenges of managing sustainability-oriented learning. This was developed to ensure that the participants had experience of experiential knowledge relevant to the research objectives. The number of informants was determined by the depth of information obtained across cases, rather than statistical representativeness. Data collection continued until thematic saturation was reached. No substantial new themes emerged from the subsequent interviews, indicating that the data collected was sufficient to answer the research questions. To capture variation within the Generation Z cohort, participants were born in different years (i.e., 1998, 1999, and 2000). They were also drawn from four vocational disciplines: automotive engineering, mechanical engineering, fashion engineering, and culinary arts, which we deliberately selected for their strong links to green industry transformation and sustainable production systems. The wide variation across VET fields improved the cross-case comparison and the transferability of the findings.

Data Collection Procedure

Data were collected through semi-structured interviews, observations, and document analysis from August to November 2025. These techniques are designed to obtain a complete picture of the way Generation Z teachers manage green learning in vocational education. The data collection instruments were developed based on recent literature on green learning, green skills, sustainable education, and vocational pedagogy, and were refined through preliminary insights and discussions with vocational teachers. All interview protocols were reviewed and approved by the institutional ethics committee of Jakarta State University (UNJ) with Ethics Number: 1309/UN39.14/PT.01.05/VII/2025. Each informant was informed in writing and verbally about the purpose of the research, procedures, confidentiality of information, and voluntary participation before data collection. All participants provided informed consent. Interviews were done face-to-face in Central Java and Special Region of Yogyakarta, while in other places interviews were done online using Zoom and WhatsApp. Interviews lasted from 60 to 135 minutes.

In-depth interviews were conducted using a theme-based protocol informed by relevant literature and aligned with the research objectives. The interview guide comprised three main domains: (1) implementation of green learning in vocational education, (2) challenges faced by Gen Z teachers in managing green learning, and (3) internal and external factors influencing the implementation of green learning. In addition to the interview data, non-participant observations were also conducted in each institution for one to two days, with each session of three to five hours on classroom practices, integration of environmental values, and application of green skills in learning activities. All cases were observed using a structured observation sheet to ensure consistency. The document analysis was carried out on lesson plans, teaching modules, and school policy documents on the Adiwiyata program. All instruments (e.g., interview protocols, observation sheets, and document checklists) were systematically aligned to the research questions to ensure coherence, depth, and methodological rigour through the triangulation of data sources and methods. Data collection continued until thematic saturation was reached, as evidenced by pattern repetition and lack of new substantive insights across cases, supporting that the 12 informants offered sufficient depth to allow for robust qualitative analysis.

Data Analysis Procedure

The data were analyzed with an inductive thematic analysis to develop a holistic understanding of the difficulties experienced by Generation Z teachers in managing green learning in vocational education. Thematic analysis was chosen as it enables systematic identification, organization, and interpretation of patterns in qualitative data, and is flexible to capture complex and context-bound phenomena. The analysis was carried out in iterative phases. Initially, open coding was used to identify significant statements, key concepts, and initial categories from interview transcripts, observation notes, and documents (Miles et al., 2014). Then, axial coding was used to find the relationships between categories, and selective coding was used to integrate and refine the core themes corresponding to the research focus: (1) the implementation of green learning practices, (2) the obstacles faced, and (3) the influencing factors. The analysis was done simultaneously with data collection so that constant comparison across cases could be made and to facilitate identification of emerging patterns.

We systematically managed qualitative data using coding matrices and thematic mapping to improve organization and transparency of analysis.

The trustworthiness of the analysis was ensured through four criteria: credibility, transferability, dependability, and confirmability. Credibility is maintained through triangulation of data sources from interviews, observations, and documents, and cross-case comparison among the four institutions (Guba, 1981). Member checking was also conducted by confirming key interpretations with selected informants. Transferability was addressed by providing detailed descriptions of the research context and participants. Dependability and confirmability were ensured through an audit trail that documented the entire analytical process and through reflective discussions to minimize researcher bias. This rigorous analytical process ensures that the findings accurately reflect the lived experiences of Generation Z teachers and provide a valid basis for theoretical and practical contributions in green vocational education.

RESULTS AND DISCUSSION

RESULTS

Green Learning Implementation

The initial finding of the research indicates that the application of green learning to Generation Z teachers in vocational education is grouped into three interconnected sub-themes, namely Learning Orientation, Learning Patterns and Models, and Roles and Responsibilities, as shown in Figure 1. This set of sub-themes together is proof of how green learning is not a pedagogical add-on but a systemic pedagogical transformation that includes environmental values, contextual practices, and multi-stakeholder collaboration. At the most basic level, teachers connect learning to competencies driven by sustainability and reflective of the needs of the green industry. This orientation is embodied in specific learning patterns and models emphasizing contextualization, problem-solving, and project-based involvement. It also helps that the roles and responsibilities of teachers, schools, regulatory bodies and industry partners are clearly defined to strengthen implementation. Such interaction creates a lively ecology of green learning as a total educational practice. Importantly, the findings further suggest that Generation Z teachers are displaying emerging adaptive strategies to infuse environmental perspectives into vocational learning despite a range of limitations. The theme emphasizes that successful implementation requires not only pedagogic adjustment but also structural and collaborative alignment of education and industrial systems.

The first sub-theme is Learning Orientation, which highlights the manner in which the teachers frame green learning in three main dimensions: green work culture, problem-solving based on specific sciences, and environmental project development. These orientations affect students' attitudes, skills and behaviors toward sustainability. Teachers stress that environmentally responsible work habits should be developed as part of vocational competence. Furthermore, in particular vocational fields, the scientific problem-solving approach is applied to solve real environmental problems. Environmental projects also provide tangible opportunities to apply green principles in real-life scenarios. The results suggest that the learning orientation plays a significant role in the integration of sustainability into vocational education.

Green learning is not only about imparting knowledge, but also about forming students' habits. I always stress the importance of practicing efficiently and not practicing with waste. "Students must understand that every action taken in the workshop has environmental consequences that must be accounted for in a responsible way." (Teacher 1)

"I use technical subjects to discuss environmental issues in my class. For example, students look at emissions or waste from machines and come up with solutions." This approach helps them think scientifically and understand their responsibility toward environmental sustainability in their future work. (Teacher 4)

"I encourage students to come up with environmental projects in their major. They develop products or solutions to minimize environmental impact. Thus, they learn not only technical skills but also awareness and creativity to solve environmental problems in real context." (Teacher 11)

"Students are required to come up with projects to address environmental problems in their area of expertise. Like cutting food waste in manufacturing or recycling in fashion. These projects make learning more relevant and directly linked to sustainability challenges." (Teacher 6)

The second sub-theme is Learning patterns and models that show that green learning is implemented through contextual, problem-based and project-based learning. They enable students to take an active part in real-world environmental issues. Contextual learning connects theory to environmental issues in real-world vocational contexts. Problem-based learning encourages critical thinking and collaborative problem-solving, while project-based learning allows students to develop practical solutions aligned with green industry practices. The patterns imply a move away from traditional instruction to more experience-based, student-centered approaches to learning.

"I always try to relate the lesson to real environmental problems in the workplace. For example, how automotive workshops handle waste." It helps students to see that what they are learning in class can be directly applied to real industry situations. (Teacher 7)

Students are more engaged in contextual learning as they can see the relevance of what they are learning. "I relate environmental impact to their daily practices in school workshops, so they can implement improvements immediately." (Teacher 10)

"I dare students to learn through problem-based learning on real cases like pollution reduction or efficiency improvement. Groups of students analyze and suggest solutions." Their skills in technical and environmental problem-solving are improved with this technique. (Teacher 1)

The third sub-theme, Roles and Responsibilities, highlights the collaborative ecosystem that enables the enactment of green learning. Teachers as learning managers design, facilitate, and assess green learning processes. Schools as policy makers: institutional rules and

curriculum integration of sustainability. Environmental agencies are the regulators that provide guidance and set standards, and green industries are the partners that ensure they match with real-world practices. Together, these roles provide a supportive environment for sustainable vocational education.

“As a teacher, my job is not to teach, but manage the whole learning process. I design activities that embed environmental values and that students apply consistently in practice. This demands careful planning and ongoing assessment.” (Teacher 6)

“I am a learning manager, guiding learners to comprehend and practice sustainability. “All learning activities must have a clear environmental purpose and must contribute to the acquisition of green competencies.” (Teacher 9)

“Policies and programs support green learning in schools. We incorporate sustainability into the educational program and provide facilities that support environmentally friendly practices. Green learning needs institutional support for effective implementation.” (Teacher 12)

The implementation of green learning among Generation Z teachers in vocational education is characterized by a consistent combination of learning orientation, pedagogical models, and stakeholder roles. Learning orientation lays down the basic values and competencies. Learning patterns and models implement the basic principles through contextual, problem-based, and project-based approaches. The roles and responsibilities of teachers, schools, regulatory bodies, and industry partners also create a supportive ecosystem that sustains the implementation process. The interrelatedness of these sub-themes offers a holistic framework in which green learning is not only taught but lived as a systemic and collaborative undertaking. The finding indicates the significance of the congruence of pedagogy, institutional policy, and external partnerships to achieve effective green learning and position vocational education as a strategic platform to develop environmentally responsible human resources.

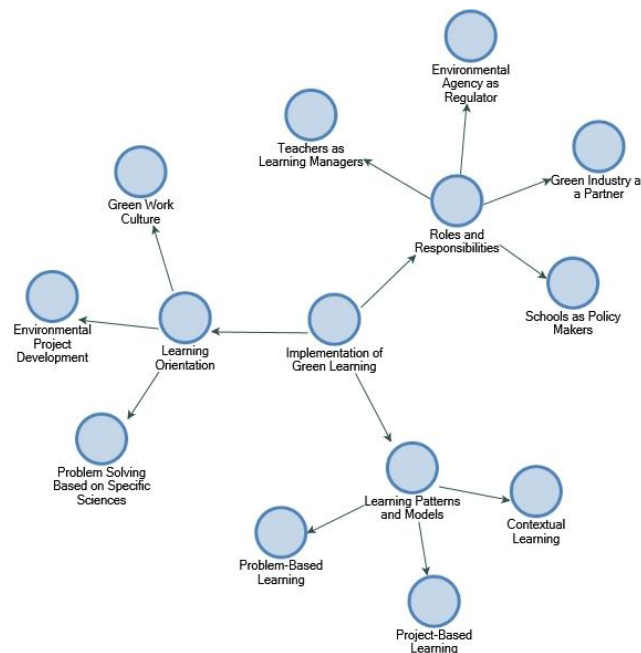


Figure 1. Green Learning Implementation

Green Learning Obstacles

The second set of results indicates that the challenges experienced by Generation Z teachers in implementing green learning in vocational education consist of three sub-themes: Conceptual Limitations, Lack of Adequate Career Development Opportunities, and Unflexible Curriculum Structures, as illustrated in Figure 2. These barriers are not only about individual teachers but also about systemic and institutional barriers for effective integration of green learning. However, in practice, the vagueness of the frameworks and the disconnection between sustainability goals and learning outcomes are likely to present challenges for teachers. They lack access to training and resources for developing green competencies at the professional level. Moreover, the implementation is hindered by structural constraints of the curriculum that limit flexibility and innovation in teaching practices. The results point to the multi-dimensional and interconnected character of the challenges and to the need for holistic interventions that address pedagogical, institutional, and policy aspects. Of significance, the findings also bring to the fore that although Generation Z teachers are digitally literate and adaptive, they continue to encounter formidable barriers to engaging in interdisciplinary and value-based learning such as green learning. Thus, mere technological know-how is insufficient to ensure sustainability of complexity in sustainability education.

The first sub-theme, Conceptual Limitations, highlights three main challenges, namely the absence of adequate constructs for green learning, lack of synchronization of learning outcomes, and absence of support from Adiwiyata regulations. Often there is no clear conceptual framework on which teachers could base the integration of environmental values into vocational subjects, thus leading to fragmented implementation. Moreover, the learning outcomes of green competencies are not necessarily in line with the aims of the curriculum, thus resulting in ambiguity in instructional design. Adiwiyata program also provides a

comprehensive policy-based framework but is often seen as being without operational guidance or application at the classroom level.

“I think the idea of green learning is just too abstract for me a lot of the time. There are no clear guidelines on how to concretely integrate it in vocational subjects. I understand it differently every time, so I am not consistent in the implementation, and I am less effective in achieving the sustainability goals.” (Teacher 4)

“Green learning is not well defined in our curriculum. They want us to do it, but there is no clear structure, there is no clear model. This makes it difficult for teachers to design lessons that are both environmentally meaningful and technically relevant.” (Teacher 11).

“The learning outcomes for the green competencies are not directly related to our subject objectives. Sometimes I have difficulty fitting them into the educational program. This results in confusion as to what to emphasize in teaching and how to evaluate students’ performance.” (Teacher 3)

“Often there is a disconnect between the expectations in green learning and what is actually in the curriculum. The asynchrony makes it difficult to do green learning effectively because we have to juggle multiple, not fully aligned, expectations.” (Teacher 7)

“Adiwiyata program gives general guidelines, but it does not provide detailed instructions on how to implement it in the classroom. Teachers have to interpret the policy themselves, and this leads to variation in practice and sometimes ineffective integration of environmental values.” (Teacher 5)

“Good initiative but the support we are getting still limited. The rules are more about what goes on in school than what goes on in the classroom. This makes translating policy into real teaching strategies a challenge for teachers.” (Teacher 2)

The second sub-theme, Poor Professional Development Opportunities, highlights two main challenges: the lack of facilities for green skills development and the low level of green career literacy. Teachers referred to the lack of access to training programs, workshops, or resources specific to green competencies in vocational education. This limitation is reflected in their design and implementation of successful green learning activities. Additionally, many teachers lack enough knowledge about green career pathways to effectively guide students interested in green career paths.

“There are very few training opportunities in vocational education that focus on green skills. Most professional development programs still focus on technical skills without integration of sustainability. It is difficult for us to adjust our teaching practices according to green industry norms.” (Teacher 8)

“We need more facilities and programs to hone our green competencies. Without the right training, we rely on our own knowledge, which may not always be correct or up to date with what is happening in industry in terms of environmental practices.” (Teacher 9)

“I know my knowledge of green careers is limited. I don’t always know how to tell students about opportunities in green industries. This impacts the way I coach them in preparing for future jobs that require environmental awareness and sustainability skills.” (Teacher 7)

“Students ask me a lot about green jobs, but I don’t have enough information to answer them fully. This shows that we as teachers need to be exposed to green career pathways more so we can support our students better.” (Teacher 1)

Rigid Curriculum Frameworks The third sub-theme, Rigid Curriculum Structures, highlights two main constraints: overloaded curriculum content and standardized assessment systems. “Teachers said the current curriculum is already packed and there is not much room to add in other elements like green learning. Standardized assessment systems, however, tend to focus on cognitive rather than practical and values-based competencies, and thus are not well suited to measuring green learning effectively.

“The curriculum is already pretty full, and we do have a lot of topics to cover in a short amount of time. It is even more difficult with the addition of the green learning components. “Sometimes we have to choose between core content and sustainability aspects, because of time,” she said. (Teacher 11)

“There is little flexibility in the curriculum. We have to follow a fixed framework, and this limits our ability to innovate and to incorporate green learning in a relevant way. This rigidity is a huge obstacle to implementing sustainability in teaching.” (Teacher 6)

“If we are talking about system evaluation, it is actually largely uniform and oriented toward theoretical knowledge. It does not sufficiently reflect the students’ capacity to implement green practices. It is difficult to evaluate the effectiveness of green learning in a holistic way.” (Teacher 1)

“Outdated assessment methods still dominate and overemphasize test scores. Green learning requires different kinds of assessment, such as projects and practical work, but the existing system does not always cater for these.” (Teacher 4)

In the end, the difficulties of green learning management according to Generation Z teachers' perspectives stem from the interconnected conceptual, professional, and structural challenges. Teachers’ conceptualizations of concepts constrain their capacity to understand and align green learning with curriculum goals. Limited professional development also limits the ability of teachers to effectively implement sustainability-oriented teaching. At the same time, rigidity in curriculum structures hampers flexibility and innovation, and makes it difficult to integrate green learning into existing educational structures. The findings recommend that overcoming these barriers requires a comprehensive strategy that includes curriculum reform,

targeted professional development, and more explicit conceptual frameworks for green learning. These interacting barriers show that a system change is needed to support teachers to deliver meaningful and sustainable vocational education that meets the needs of the green industry.

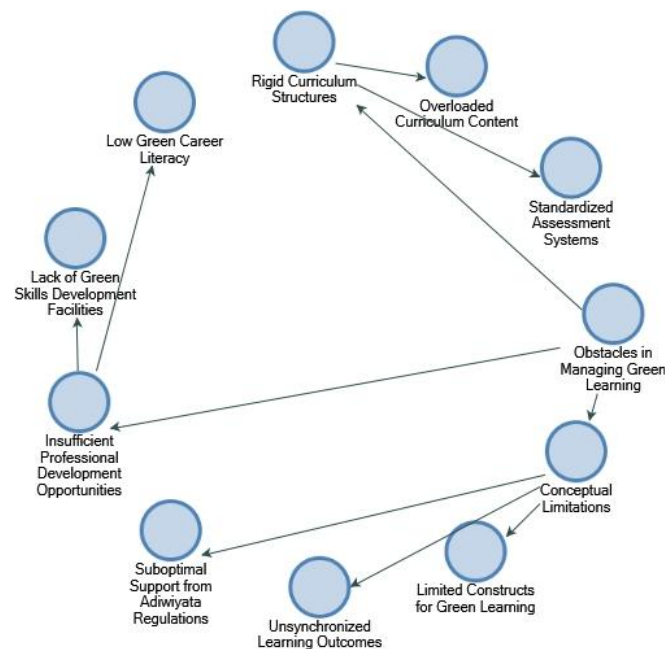


Figure 2. Green Learning Obstacles

Green Learning Factor

The findings showed that the management of green learning of Generation Z teachers in vocational education is influenced by three related sub-themes, namely Individual Factors, Institutional Factors and Work Demand Factors as shown in Figure 3. Together, these components determine what teachers observe, do, and maintain in their classrooms in terms of green learning practices. At an individual level, the teacher's beliefs, knowledge, and motivation influence their willingness to implement sustainability-oriented approaches. Implementation consistency and quality are dependent upon the existing supportive culture, leadership, and professional development initiatives at the institutional level. However, the external demand factors, including labour market expectations and social pressures, further strengthen or restrict teachers' engagement with green learning. The results suggest the significance of teacher competence in enabling green learning management, which is the outcome of a dynamic interaction between individual dispositions, organizational settings, and external pressures. The complexity implies that there is a need for a multi-level approach to strengthen green learning practices in vocational education.

The first sub-theme, Individual Factors, reveals three important determinants: environmental beliefs and values, green literacy, and green motivation. Teachers with firm environmental values are more likely to integrate sustainability into their teaching regularly. The teachers' green literacy affects their capacity to transfer environmental concepts into vocational settings. Moreover, intrinsic motivation also affects the willingness of teachers to innovate and continue green learning despite existing constraints.

"I believe that environmental responsibility should be part of every vocational skill. This conviction is the reason I always embed sustainability in my teaching. Even with the limitations, I always try to make every learning activity environmentally friendly." (Teacher 4)

A lot of how I teach is driven by my own values about the environment. "I believe that it is my responsibility to prepare students not only to be skilled workers, but also to be environmentally conscious individuals who can contribute positively to sustainable development." (Teacher 9)

"I'm still learning about green ideas. It is sometimes hard for me to relate environmental issues to specific vocational content. The results indicate that the implementation of green learning in a meaningful way requires improving green literacy for teachers." (Teacher 1)

"I understand that I don't know everything about sustainability yet. I need more resources and learning to gain a deeper understanding so that I can integrate green concepts into my teaching practices." (Teacher 8)

"Being aware of environmental issues, I am motivated to create green learning. I want my students to be ready for the future, where sustainability will be an important aspect in all industries. This inspires me to improve my teaching more and more." (Teacher 5)

"It's challenging at times, but I keep motivated because I see the importance of green skills for students' future careers. This motivation encourages me to keep experimenting with different teaching methods that include environmental values." (Teacher 6)

The next sub-theme on Institutional Factors explores the impact of institutional culture, leadership support, and training program initiatives. A sustainable school climate inspires teachers to regularly implement green learning. Leadership support is also important to provide direction, resources, and policy support. Moreover, the importance of structured training programs in improving teachers' skills and self-assurance in teaching green learning is emphasized.

"We have sustainability built into our school culture. This helps me to implement green learning because I am shared with the understanding of teachers and students. The school environment promotes environmentally friendly behavior in daily life." (Teacher 2)

"A strong institutional culture helps us to apply green learning consistently. Once sustainability is a shared value, it is not an individual effort, but a collective commitment in the school." (Teacher 1)

School leadership support is very important. "We are more confident in delivering green learning when the principal gives us clear directions and resources. It's hard to keep doing these things without that support," he said. (Teacher 6)

"Our school leaders are very keen that we include sustainability in our teaching. They offer opportunities and support that inspire us to innovate and improve our green learning practices." (Teacher 12)

Training programs are important to better understand green learning. "When we go to workshops or training, we learn new things and get practical strategies that we can take back and use in the classroom." (Teacher 10)

"I think there needs to be more structured training initiatives. With the right training, teachers can develop the skills and confidence to deliver green learning well and consistently." (Teacher 4)

The third sub-theme, Work Demand Factors, shows two major influences, namely clarity of career path and public pressure. The growing interest in green jobs and sustainable methods in industry forces teachers to align their teaching with these expectations. At the same time, public awareness and social pressure on environmental issues also affect the importance of teachers' green learning.

"The increasing demand for green jobs makes me realize we need to prepare students differently. I try to teach to the needs of the industry, so students are ready for careers that require sustainability competencies." (Teacher 12)

"Once we know the career pathways linked to green industries, it's easier to embed relevant skills in our teaching. This gives us clarity to create learning activities that are in alignment with jobs of the future." (Teacher 9)

"Public awareness of environmental issues is increasing, and schools are coming under pressure to respond. As teachers we have a responsibility to ensure our teaching is in line with these societal standards, and that it contributes to sustainability." (Teacher 2)

"Public pressure also has an effect on how we teach. Schools are expected by parents and communities to produce environmentally responsible graduates. It's really encouraging us to take green learning more seriously into our practices," she said. (Teacher 10)

Overall, the management of green learning among Generation Z teachers is affected by the complex interaction between individual, institutional, and work demand factors. Teachers' personal beliefs, knowledge, and motivation impact their willingness and commitment, and institutional culture, leadership, and training provide the support system. In addition, the external pressure of the needs of industry and social expectations is a factor in the importance of green learning in vocational education. These interrelated factors show that the success of green learning management is determined by the level of consistency and the level of internal

and external support for teachers. This integrated view provides an overall understanding of how green learning can be effectively sustained and developed within the framework of vocational education.

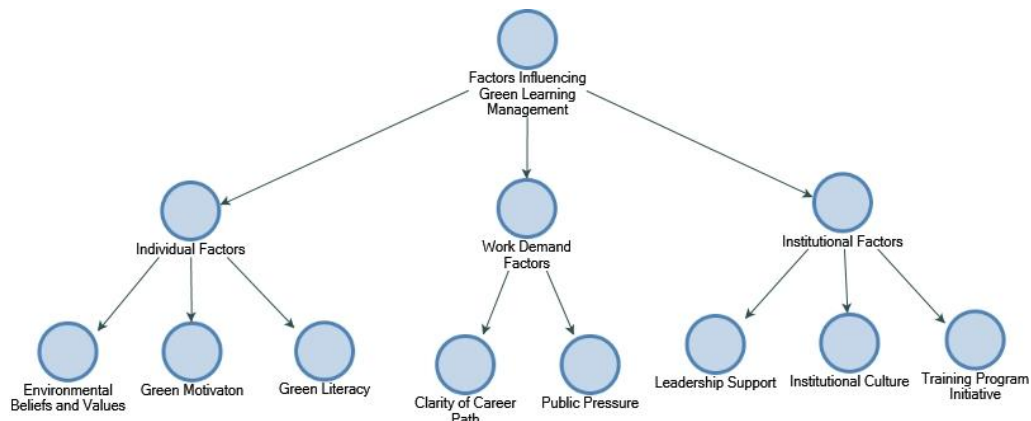


Figure 3. Green Learning Factors

DISCUSSION

This study reveals an inherent tension between the normative assumptions underpinning the integration of sustainability into vocational education and the realities faced by Generation Z teachers. A possible interpretation of such tension can be found in Vocational Education for Sustainable Development and Green Human Resources Management, which underline education as a tool for transformation, aligning workforce skills with the demands from the world of work (Iqbal et al., 2020). On the other side, the results highlight that the translation of sustainability ideals into teaching practice is still uneven and structurally constrained. General education is based on a holistic, interdisciplinary, and value-based learning approach, whereas vocational education systems, particularly in developing countries, still refer to competency-based and productivity-oriented paradigms. Furthermore, some particular studies have shown that integrating environmentally friendly aspects into vocational curricula can grow readiness and adaptability towards green jobs (Kaliappan & Hamid, 2021; Putri et al., 2025). But critics contend that such integration is mostly symbolic, superficial, and does not change actual workplace behavior (Asnawi & Djatmiko, 2016). The urgency of this study in this context is to show how generational change in the teaching workforce does not automatically close structural and conceptual gaps. Instead, it calls for a reconceptualization of green learning as an embedded socio-pedagogical system that demands alignment of epistemological frames, institutional policies and industry expectations.

The results can be further explained by a developed theoretical perspective that is informed by constructivist and situated learning theories that emphasize contextualized, experiential, and socially mediated learning processes (Dewey, 2001; Pavlova, 2009). These frameworks are theoretically consistent with implementation patterns identified in this study, such as contextual, problem-based, and project-based learning. The challenges that teachers face, however, point to a key limitation: the absence of a clear instructional design that connects sustainability concepts to vocational specificity. The gap indicates that pedagogical models are hard to integrate into teaching practice due to a lack of conceptual clarity and professional

preparation (Chen et al., 2020; Marques et al., 2020). Others point to the risk that these methods could lead to superficial engagement with sustainability issues because of the lack of scaffolding and teacher expertise (Cole & Altenburger, 2019; Rusyani et al., 2021). The findings of this study lend credence to the latter concern that pedagogical innovation alone is not sufficient without a strong conceptual basis and institutional support. These findings thus imply the need for a more structured instructional framework that embeds green competencies into vocational learning outcomes and is not dependent on individual teacher interpretation. For example, the framework would provide clear guidelines for the integration of technical skills and environmental values and would ensure that sustainability is not only contextualized but systematically integrated in the learning process.

Organizational theory and institutional isomorphism are useful for a critical analysis of the impact of the institutional and external factors identified in this study, as they explain how regulatory, normative, and cultural pressures influence organizational practices. The sustainability of green learning is in a multi-level governance structure with schools acting as policy makers, environmental agencies as regulators, and industries as partners. But the findings also show variation in the way these actors engage, particularly in the case of policy implementation. This aligns with recent research demonstrating that policy frameworks such as *Adiwiyata*, though offering symbolic legitimacy, tend to have weak implementation mechanisms and a disconnect from classroom realities, thereby constraining their practical impact (Wibowo et al., 2023). Opportunities and challenges exist in the partnership role of industry. However, industry collaboration can increase relevance and authenticity, but it has the potential for conflicts of interest in which the focus is on productivity and efficiency instead of sustainability values (Handayani et al., 2020b). This duality is a reflection of the ongoing debates in the literature of vocational education around economic and environmental goals. These results have important implications. They argue that policy support alone is not enough for effective green learning, and that there is also a need for coherent governance structures that enable collaboration, accountability and continuous stakeholder feedback. This could mean rethinking vocational institutions as middlemen between environmental policy and industrial practice, embedding sustainability into education and the economy in the future.

Finally, the interaction of factors at the individual, institutional and work-demand levels highlight the complexity of managing green learning as a dynamic and adaptive process. From the perspective of behavioral and self-determination theories, teachers' motivation, beliefs and competencies are key drivers of instructional change. However, the findings suggest that these individual factors are heavily influenced by external factors, such as rigid curricula and lack of professional development opportunities. This interaction provides a valuable insight: sustainable educational change cannot simply rest on individual agency but must be enabled by systemic factors. This argument is reinforced by recent studies that show that teacher motivation can be significantly enhanced when it is supported by organizational culture, leadership, and relevant training (Qasim et al., 2023; Raisian et al., 2022). In contrast, lack of systemic support can bring about resistance, burnout or superficial implementation of innovations (Ercantan & Eyupoglu, 2022). Thus, the future of green learning in vocational education depends on the development of an integrated ecosystem, consistent with the teacher

capacity, institutional structures, and labor market demands. This implies that curriculum reform needs to include flexible, interdisciplinary approaches and targeted professional development programs on green competencies and career pathways in practice. The present study adds a theoretical argument to the nascent literature on sustainability education by highlighting the need for multi-level integration and systemic alignment. Ultimately, the findings call for a shift from ad hoc and reactive approaches to a more strategic and sustainable model of green learning that can respond to the changing needs of education and industry.

CONCLUSION

The study concludes that the green learning practices of Generation Z teachers in vocational education are determined by an interconnected system of pedagogical orientation, teaching practices and multi-stakeholder roles, but are hindered by considerable conceptual, professional and structural obstacles. Teachers practice adaptive practices within the framework of contextual, problem-based, and project-based learning. However, inconsistent conceptual frameworks, lack of professional development, and unflexible curricula hamper their best implementation. Importantly, the findings reveal that green learning is a fragmented pedagogical project and not an institutionalized system in line with sustainability goals. In theory, the study points to the need to bridge the gap between grand theories geared toward sustainability and their practical application in vocational settings. In practice, it highlights the need for curriculum reform, targeted training of teachers and better co-operation between schools, industry and regulatory bodies. The study contributes to the literature by providing a multi-level analytical framework that considers individual, institutional and external factors affecting green learning management, particularly within the under-researched context of Generation Z teachers. However, the design of the investigation and the relatively small number of informants limit the generalizability of the findings. Further research should be extended to a broader context and use a mixed-methods approach to further validate and refine the proposed framework.

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