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Greening Vocational Teacher Pedagogy Through AI Prompting: An Impact Study

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Abstrak

Studi berbasis masyarakat ini melaporkan program dua tahap bagi guru TVET dalam mengintergasikan desain kurikulum berorientasi *green skills* dengan pelatihan *prompting* kecerdasan buatan (AI) yang etis. Studi ini mengukur perubahan kompetensi AI dan pemahaman *green skills*, serta menguji keterkaitannya dengan kualitas rencana pembelajaran yang dinilai menggunakan rubrik portofolio berbasis *Framework GREEN* dengan desain one-group pretest–posttest (N=56). Hasil menunjukkan adanya peningkatan kompetensi AI dan pemahaman green skills yang signifikan secara statistik. Ditemukan adanya hubungan positif antara pemahaman *green skills* dan kualitas portofolio, sementara hubungan antara kompetensi AI dan kualitas portofolio tidak signifikan. Temuan ini mengindikasikan bahwa pemetaan konseptual *green skills* yang jelas merupakan penggerak utama kualitas desain pembelajaran, sedangkan AI berperan terutama sebagai alat pendukung setelah skema tersebut tertanam. Implikasi program mencakup prioritas pada contoh-contoh dan alat pemetaan *green skills*, panduan *prompting* AI yang terstruktur, serta penambahan siklus pendampingan iteratif untuk mengubah kemarhiran pemanfaatan AI dalam memproduksi produk instruksional yang lebih berkualitas.

Kata kunci: ekonomi hijau; *green skills*; *green TVET*; kecerdasan buatan; *TVET*

Abstract

This community-based study reported a two-part professional development program for TVET teachers to integrate green-skills–oriented curriculum design with ethical AI prompting for lesson plan development. Using a one-group pretest–posttest design (N=56), we measured changes in AI competency and understanding of green skills and examined associations between post-training competencies and the quality of lesson plans produced with a GREEN Framework-aligned rubric. Teachers showed a statistically significant improvement in AI competency and green skills understanding. Results indicated a positive association between green skills understanding and portfolio quality, while the association with AI competency was not significant. We interpret these findings to mean that clear conceptual mapping of green skills is the proximate driver of design quality, and that AI serves primarily as an enabler once such schema is in place. Program implications include prioritizing green-skills exemplars and mapping tools, developing structured AI prompting *guides, expanding rubric headroom to mitigate ceiling effects, and adding iterative coaching cycles to convert AI fluency into higher-quality instructional products.*

Keywords: *artificial intelligence; green economy; green skills; green TVET; TVET*

INTRODUCTION

Technical and Vocational Education and Training (TVET) is increasingly expected to equip graduates with green skills that encompass environmental awareness, innovation, communication, adaptability, and responsible waste management, thereby linking routine classroom tasks connect to authentic sustainability problems and practices (Albertz & Pilz, 2025; ILO, 2021; Handayani et al., 2020). In the Indonesian context, vocational education is strategically positioned to develop a workforce for green industry transitions that emphasize resource efficiency and reduced environmental impact (Handayani et al., 2020; Persson-Thunqvist et al., 2023; Pavlova, 2016). This is alligned with the RPJMN 2025–2029 target to reduce greenhouse-gas emission intensity on the pathway to Net Zero Emission by 62.7%, which in turn requires systematic human-capital development in green skills (Republic of Indonesia, 2025). Globally, it is also consistent with the UNESCO-UNEVOC 2022–2029 priorities that underscore green skills as a pillar for inclusive and sustainable economies (UNESCO, 2022a; UNESCO, 2022b).

Despite this policy momentum, empirical evidence in West Java indicates that TVET learners' green skills remain low, both in perceived levels and in assessed performance. Prior studies report low perceived green skills among Vocational High School (SMK/VHS) students, and a larger survey of 500 students across eight district education offices in West Java, Indonesia, similarly found low actual mastery. The challenge is particularly salient in districts such as Bandung Regency, which faces high exposure to flooding and landslides while also hosting a large concentration of medium–large industries (Statistics Indonesia, 2024a; Statistics Indonesia, 2024b). These conditions make VHS schools important loci for accelerating classroom-level integration of green skills.

A central constraint is limited classroom integration of sustainability contexts, often traceable to teachers' insufficient conceptual grasp of green skills and the absence of practical guides or modules for embedding sustainability into vocational instruction (Pavlova, 2016; Handayani et al., 2020; Zhang et al., 2012; Pompeii et al., 2019; Haloho et al., 2023). Consequently, activities tend to remain topic-based rather than design-driven (e.g., mapping green-skills domains to outcomes, structuring deep-learning tasks, and specifying authentic assessments). At the same time, artificial intelligence (AI) particularly generative AI offers an opportunity to streamline lesson-design workflows (objectives, activities, materials, rubrics) if teachers can craft effective prompts, verify outputs, and apply ethical safeguards (Aggarwal, 2023; Atwell et al., 2020; Sumardi et al., 2024). However, adoption in West Java SMKs remains limited, with most exposure confined to demonstrations or ad-hoc uses rather than guided, pedagogically integrated practice (Gunawan et al., 2021; Darmawan et al., 2024; Hajar et al., 2023).

Existing initiatives frequently emphasize awareness sessions or lists of "green topics," but fewer programs co-create lesson plans with teachers, provide a rubric that makes green-skills alignment explicit, and evaluate both learning gains and the quality of the teaching products that result. Moreover, AI is often framed as a general tool rather than operationalized through guided prompting workflows that teachers can directly adopt in their subject areas. There is a practical need for a community-based program that (i) equips teachers with a clear schema for embedding green skills, (ii) builds responsible AI-prompting competence, and (iii) tests whether these capacities translate into higher-quality lesson plans.

This study reports the results of a Community-Based Research (CBR) program with TVET teachers in West Java, Indonesia. The intervention comprised two parts: (1) a matriculation sequence covering (a) the role of AI in education and ethical use, (b) green-skills-oriented curriculum design, and (c) waste-management contexts for learning; and (2) hands-on co-creation of lesson plans using a GREEN-aligned rubric, followed by guided AI prompting (ChatGPT) to draft, refine, and verify lesson components. The program culminated in a curated portfolio of lesson plans oriented to authentic sustainability problems.

Accordingly, this study examines: (1) the influence of training on teachers' AI competency; (2) the influence of training on teachers' understanding of green skills; and (3) the influence of AI competence and green skills understanding on the quality of the lesson plans produced. By combining an explicit green-skills rubric, ethical prompting workflows, and product-based evaluation, this work offers practical evidence on how community-embedded training can move teachers from awareness to implemented designs, informing school-level professional development, district programs, and community-service initiatives that aim to scale AI-enabled, sustainability-focused pedagogy in TVET.

METHOD

Design and Setting

This Community-Based Research (CBR) facilitates the co-creation of green skills-oriented teaching modules through AI prompting (ChatGPT-5 Free). A one-group pretest–posttest evaluation design was used to assess the improvement of teachers' AI competency and green skills understanding. The normality test (Shapiro–Wilk) determined the analysis: paired t-test and Cohen's d (normal data) or Wilcoxon signed-rank and effect size r (non-normal data). The quality of the module was assessed using GREEN Framework-based rubric and analyzed for correlation (Spearman ρ) with posttest scores.

Participant

The integration of green skills into vocational education is urgently needed, especially in Bandung Regency, West Java, Indonesia, which faces environmental issues and has high potential for skilled labor absorption. One of the vocational schools with a good graduate absorption rate in Bandung Regency is SMKN 5 Pangalengan, as evidenced by data from a tracer study showing 39.15% of vocational school graduate absorption in 2024. This program involved 56 TVET teachers (out of 77 invitees) from SMKN 5 Pangalengan who completed all assessments and finished the output. Participants represented both applied vocational and general-subject tracks, with varied years of service (Table 1).

Tabel 1. Participant demography

Demography	(n)	Percentage
Gender		
Male	28	50.00%
Fermale	28	50.00%
Teacher Category		
General Subject Teacher	26	46.40%
Applied Vocational Teacher	30	53.60%
Teacher Employment Status		
Government Contract Teacher	37	66.1%
Temporary Teacher	11	19.6%
Permanent Government Teacher	8	14.3%
Length of Teaching Service		
< 5 years	7	12.50%
5–10 years	20	35.70%
11–20 years	24	42.90%
> 20 years	5	8.90%

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Intervention

The program began with a pretest, followed by a series of workshops covering AI ethics and applications, green skills enrichment, prompting practice and module development, and peer review/curation. The series concluded with a post-test. This series was designed to ensure increased knowledge and skills in learning design oriented toward achieving green skills. Figure 1 displays a brief flowchart of the intervention.

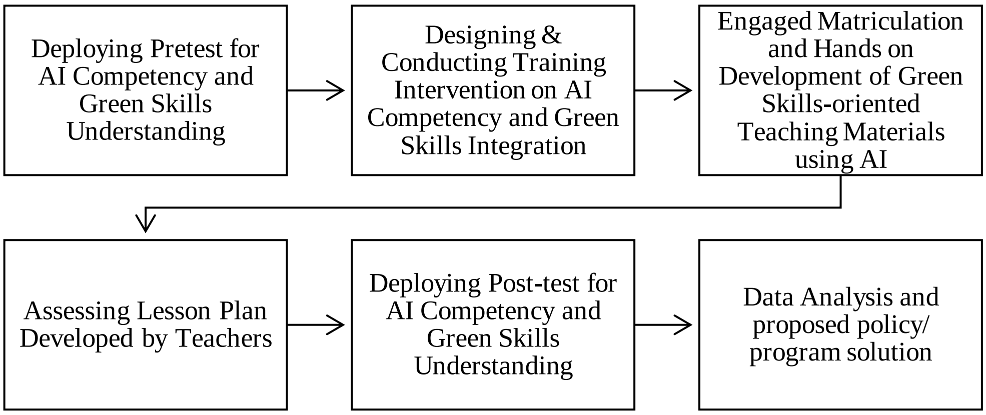

Figure 1. CBR intervention procedure.

Building on the intervention flow depicted in Figure 1, the learning activities were organized into two phases: the matriculation phase and the hands-on phase. The matriculation phase covered: (1) the role of AI in education; (2) a green skills-oriented curriculum; and (3) a waste management-based learning context. The hands-on practice phase included co-creation of lesson plans linking AI and green skills, deep learning, authentic assessment, and digital media, followed by AI prompting practice. Each session produced measurable artifacts. Table 2 details the topic, objectives, key activities, duration, and outputs of each session.

Table 2. Matriculation and hands-on topic

Phase	Topic & Core Content	Learning Objectives	Key Activities	Duration	Outputs / Artifacts
Matriculation	The Role of AI in Education — AI concepts & use-cases in TVET; opportunities–risks; teacher role shift; "high-tech & high-touch"; academic integrity & ethical AI use	explain basic AI concepts; identify classroom opportunities/risks; articulate ethical guidelines for AI-supported teaching	lecture + Q&A; short case discussion on AI ethics	1.5h	Worksheet: initial ideas for AI integration (by subject)
	Green-Skills-Oriented Curriculum — definition & domains (awareness, innovation, communication, adaptability, waste management); mapping to LOs; deep-learning tasks; authentic assessment	map green-skills domains to course/lesson outcomes; design deep-learning activities and authentic assessments	lecture + Q&A; demo of a green-skills curriculum worksheet	1.5h	Completed green-skills curriculum worksheet (LOs ↔ GS ↔ activities ↔ assessment)
	Waste-Management Contexts for Learning — local waste issues &	connect environmental/ waste contexts	lecture + Q&A; case work to	1.5h	List of project/conte

Phase	Topic & Core Content	Learning Objectives	Key Activities	Duration	Outputs / Artifacts
	solutions (compost, eco-enzyme, biogas, up-cycling, waste bank, urban farming); embedding projects in lesson plans	to lesson objectives, project tasks, and rubrics across subjects	generate cross-subject project ideas		xt ideas per subject area
Hands-on Practice	Co-creation of Green-Skills Lesson Plans	produce a lesson plan/RPP that (i) links Los and green skills, (ii) includes deep-learning activities, (iii) uses authentic assessment, (iv) integrates digital media	group work using worksheets; draft → peer review → revision	1.5h	Draft lesson plan/RPP + scoring rubric (GREEN-aligned)
	AI Prompting with ChatGPT for Lesson-Plan Development based on Framwork GREEN	craft and iterate prompts to generate/ refine lesson components (LOs, activities, materials, rubrics); document verification and ethical citation of AI outputs	live demo; paired/cluster practice; maintain a prompt log; human verification of AI outputs	1.5h	Prompt log; revised lesson plan; supporting AI-assisted materials (text/infographic)

Instrument and Measurement

The research instrument consists of three components: (a) Teacher's AI Competence; (b) Green Skills Understanding; and (c) Learning Plan Quality. Adapted from the UNESCO AI Competency Framework for Teachers which includes the domains of Ethics of AI, Basic Implementation of AI, AI in Pedagogy, and AI for Personal Development with a 4-level competency assessment (UNESCO, 2024). Green skills understanding refers to the Handayani et al. (2020) instrument that captures the domains of environmental awareness, waste management/resource efficiency, innovation & problem solving, and communication-collaboration; Likert responses 1–5 and normalized 0–100. (c) Lesson plan quality is assessed using a portfolio rubric based on the GREEN Framework (Ramadhan, 2025) which assesses linking learning objectives to green skills, depth of learning, authenticity of context/project, completeness of authentic assessment & portfolio evidence, as well as media/AI integration and ethical use; scores are reported on a 0–100 scale.

Data Analysis

Based on our research aim, this study focused on answering the following hypotheses:

H1 The training produces a significant improvement in teachers' AI competency.

H2 The training produces a significant improvement in teachers' green-skills understanding (pretest vs. posttest).

H3 Post-training teachers' AI competency score is positively associated with green-skills-oriented lesson-plan quality.

H4 Post-training teachers' green-skills understanding score is positively associated with lesson-plan quality.

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The training effect was measured through hypothesis testing adjusted for the characteristics of the data distribution. Normally distributed data were analyzed using a parametric paired t-test with Cohen's d effect size (interpretation: 0.2 is small; 0.5 is medium; 0.8 is large) (Equation 1). Meanwhile, non-normally distributed data were analyzed using the nonparametric Wilcoxon signed-rank test with an effect size of r (interpretation: 0.1 is small; 0.3 is medium; 0.5 is large) (Equation 2). All analyses were performed at a significance level of α = 0.05 (two-tailed) using IBM SPSS Statistics version 26.0.0.0. The data normality test is shown in Table 3 while the Cohen's d test was calculated using Equation 1 or Equation 2.

$$d_z = \frac{\bar{D}}{SD_z} \quad \text{...(Equation 1)}$$

d_z : cohen's d effect
$\bar{D}$: average difference
SD_z : standard deviation of the difference between pairs.

$$r = \frac{|Z|}{\sqrt{N}} \quad \text{...(Equation 2)}$$

r : effect r
|Z| : wilcoxon z Score
N : number of paired

Table 3. Normality test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Pretest AI Competency	.070	56	.200*	.987	56	.807
Posttest AI Competency	.116	56	.060	.979	56	.453
Pretest Green Skills	.241	56	.000	.798	56	.000
Posttest Green Skills	.500	56	.000	.175	56	.000
LessonPlanQuality	.310	56	.000	.721	56	.000

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 3 showed only the pre-test and post-test data of AI competency are normally distributed, while the pre-test and post-test data of green skills and the quality scores of the developed green skills-oriented lesson plans are not normally distributed. The Influence measurement is carried out as follows: H1 is answered with a paired t-test + Cohen's d (Include Formula) (0.2 small; 0.5 medium; 0.8 large). H2 is answered with Wilcoxon signed rank + effect size r (0.1 small; 0.3 medium; 0.5 large). Furthermore, H3 and H4 are answered by conducting a Spearman ρ test (post-AI & post-GS vs lesson plan quality scores). If there is a correlation, it will be continued with a linear regression test.

RESULTS AND DISCUSSION

Results

Vocational teacher training in transforming green skills-oriented teaching materials with AI prompting

The program was delivered as a lecture-based workshop at SMKN 5 Pangalengan and followed a clear sequence of pretest, matriculation, hands-on practice, lesson-plan curation/peer review, and post-test (Figure 2). The matriculation sessions emphasized the role of AI and ethical use, green-skills-oriented curriculum design, and waste-management contexts for learning. This was followed by co-creation of lesson plans/modules through AI prompting, formulating and iterating prompts, verifying and citing AI outputs, culminating in peer review-based curation. Of the 77 invited teachers, 56 completed the full program. Process artifacts were documented through working files, including an AI-integration worksheet, a GREEN Framework matrix (learning outcomes aligned with green-skills domains), peer-review-revised lesson plan drafts, prompt logs with verification notes, and a portfolio rubric. In total, 56 curated lesson plans achieved a high average quality score (88/100), demonstrating explicit learning objective to green-skills alignment, deep-learning tasks, authentic assessment, local sustainability contexts, and statements of AI ethics and verification, evidence of a shift from mere awareness to implementable instructional designs.

Figure 2. Implementation of interventions in the form of lecture-based matriculation and hands-on workshops on greening vocational teacher pedagogy through AI based green skills-oriented lesson plan

To assess program effectiveness, we analyzed three components in an integrated manner: (i) changes in knowledge/skills via pretest–posttest comparisons for AI competency and green-skills understanding; (ii) product quality via rubric-based scoring of the green-skills-oriented lesson plans produced by participants; and (iii) posttraining linkages by examining associations between posttest scores (AI and green skills) and lesson-plan quality.

The influence of training on teachers' AI competency

This study examined pre- and post-test distributions and summary statistics for teachers' AI competency. The descriptive results indicate an upward shift in central tendency from a pretest mean of 63.16 to a posttest mean of 71.00, accompanied by a slight reduction in dispersion (SD from 14.84 to 13.62) (Table 4.)

Table 4 Descriptive Results on Teacher's AI Competence

			Statistic	Std. Error
Pretest AI Competency	Mean		63.1607	1.98317
	95% Confidence Interval for Mean	Lower Bound	59.1863	
		Upper Bound	67.1351	
	5% Trimmed Mean		62.8651	
	Median		63.0000	
	Variance		220.246	
	Std. Deviation		14.84070	

	Minimum		31.00	
	Maximum		100.00	
	Range		69.00	
	Interquartile Range		23.50	
	Skewness		.210	.319
	Kurtosis		-.332	.628
Posttest AI Competency	Mean		71.0000	1.81963
	95% Confidence Interval for Mean	Lower Bound	67.3534	
		Upper Bound	74.6466	
	5% Trimmed Mean		70.8968	
	Median		73.5000	
	Variance		185.418	
	Std. Deviation		13.61683	
	Minimum		42.00	
	Maximum		100.00	
	Range		58.00	
	Interquartile Range		18.50	
	Skewness		-.072	.319
	Kurtosis		-.310	.628

Table 4 shows skewness and kurtosis values are small in magnitude, consistent with approximately normal distributions in both waves, and suggests that a parametric comparison of paired means is appropriate. Given the approximate normality and the paired design, H1 was tested with a paired *t*-test (Table 5).

Table 5. Paired t-test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pretest AI Competency - Posttest AI Competency	7.83929	13.44453	1.79660	-11.43976	-4.23882	-4.363	55	.000

Table 5 showed the two-tailed significance value ($p<.05$) indicates a statistically significant difference between teachers' pretest and post-test AI competency scores following the training. Therefore, H1 is supported indicating a significant improvement in teachers' AI competency after the training. To quantify the magnitude of this improvement, we computed Cohen's d (Equation 1). The resulting dz = 0.58 reflects a moderate-to-large training effect on AI competency.

The influence of training on teachers' understanding of green skills

This study inspected distributional characteristics of teachers' green-skills understanding score. The descriptive indicators suggest an overall upward shift, but with heterogeneity across participants, warranting a ranks-based test (Table 6).

Table 6. Descriptive Results on Teacher Green Skills Understanding

			Statistic	Std. Error
Pretest Green Skills	Mean		8.1786	.09904
	95% Confidence Interval for Mean	Lower Bound	7.9801	
		Upper Bound	8.3771	
	5% Trimmed Mean		8.1984	
	Median		8.0000	
	Variance		.549	

	Std. Deviation		.74118	
	Minimum		7.00	
	Maximum		9.00	
	Range		2.00	
	Interquartile Range		1.00	
	Skewness		-.301	.319
	Kurtosis		-1.101	.628
Posttest Green Skills	Mean		10.4286	1.27051
	95% Confidence Interval for Mean	Lower Bound	7.8824	
		Upper Bound	12.9747	
	5% Trimmed Mean		9.2738	
	Median		9.0000	
	Variance		90.395	
	Std. Deviation		9.50762	
	Minimum		6.00	
	Maximum		80.00	
	Range		74.00	
	Interquartile Range		1.00	
	Skewness		7.381	.319
	Kurtosis		54.971	.628

Table 6 and Table 3 showed that the posttest values were markedly non-normal (high skew/kurtosis), thus this study summarized central tendency with medians rising from 8.0 (pretest) to 9.0 (posttest) and proceeded with a nonparametric paired comparison Wilcoxon rank.

Table 7. Wilcoxon Signed Ranks

		N	Mean Rank	Sum of Ranks
Posttest Green Skills - Pretest Green Skills	Negative Ranks	3[a]	18.17	54.50
	Positive Ranks	36[b]	20.15	725.50
	Ties	17[c]		
	Total	56		

a. Posttest Green Skills < Pretest Green Skills

b. Posttest Green Skills > Pretest Green Skills

c. Posttest Green Skills = Pretest Green Skills

Table 7 showed Wilcoxon signed-ranks table, positive ranks (n=36) outnumber negative ranks (n=3), with ties (n=17), indicating that most teachers improved while a minority showed no change or slight declines. Table 8 shows the results for Wilcoxon test statistics of teachers' green skills understanding.

Table 8. Wilcoxon Statistics Test for Green Skills Pre-test and Post-test

	Posttest Green Skills - Pretest Green Skills
Z	-4.778[b]
Asymp. Sig. (2-tailed)	.000
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

Table 8 showed Wilcoxon signed-ranks results, the two-tailed asymptotic significance ($p < .05$). Therefore, H2 is supported, indicating a significant improvement in teachers' understanding of green skills after the training. To quantify the magnitude, we computed the effect size r using Equation 2 and obtained $r = 0.64$, indicating a large effect. These findings suggest that the training produced a substantial positive improvement in teachers' green-skills understanding.

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The influence of AI competence and teachers' understanding of Green Skills on the quality of the lesson plans developed

To characterize the products generated after training, we first summarize the lesson-plan quality score distribution (Table 9). Scores are high and tightly clustered (M = 88.32; SD = 2.41; median = 90; range = 80–90; IQR = 2), with negative skew and elevated kurtosis—patterns consistent with restricted variance/ceiling effects.

Table 9. Descriptive Analysis of Lesson Plan Quality Score

			Statistic	Std. Error
LessonPlanQuality	Mean		88.3214	.32244
	95% Confidence Interval for Mean	Lower Bound	87.6753	
		Upper Bound	88.9676	
	5% Trimmed Mean		88.5833	
	Median		90.0000	
	Variance		5.822	
	Std. Deviation		2.41290	
	Minimum		80.00	
	Maximum		90.00	
	Range		10.00	
	Interquartile Range		2.00	
	Skewness		-1.528	.319
	Kurtosis		1.794	.628

Overall, most teachers successfully produced green-skills–oriented lesson plans guided by the GREEN Framework. To examine whether post training AI competency and post training green-skills understanding are associated with lesson-plan quality, this study analysed their relationships. Because quality scores were non-normal and compressed at the upper end, we employed Spearman's rank correlation (Table 10)

Table 10. Spearman's ρ Ranks Correlation Test

			Posttest AI Competency	Posttest Green Skills	LessonPlan Quality
Spearman's ρ	Posttest AI Competency	Correlation Coefficient	1.000	-.094	.105
		Sig. (2-tailed)	.	.492	.440
		N	56	56	56
	Posttest Green Skills	Correlation Coefficient	-.094	1.000	.271*
		Sig. (2-tailed)	.492	.	.044
		N	56	56	56
	LessonPlanQuality	Correlation Coefficient	.105	.271*	1.000
		Sig. (2-tailed)	.440	.044	.
		N	56	56	56

*. Correlation is significant at the 0.05 level (2-tailed).

The correlation results show a small but significant positive association between post-training green-skills understanding and lesson-plan quality (ρ=.271, p=.044), while the association between post-training AI competency and quality is not significant (ρ=.105, p=.440). Accordingly, H3 is not supported, whereas H4 is supported. Substantively, this suggests that clear green-skills mapping is the more proximate driver of rubric-rated quality, with AI competence functioning as an enabler once that schema is in place. Methodologically, the ceiling-limited spread of portfolio scores likely attenuated detectable correlations, future evaluations should broaden rubric headroom (advanced criteria) and consider robust/quantile models or moderation tests to probe whether AI competence amplifies the green-skills quality linkage.

Discussion

This study revealed the influence of the training on teachers's AI competency and teachers' green skills understanding (H1-H2), as well as examined the correlation between their performance with the quality of the GREEN-aligned lesson plans they produced (H3-H4). The pretest-posttest analyses show significant improvements in teachers' AI competency and green-skills understanding, supporting H1 and H2. Correlational analyses show that post-training green-skills understanding is positively associated with green-skills-oriented lesson-plan quality, supporting H4, whereas post-training AI competency is not significantly associated with lesson-plan quality; therefore, H3 is not supported. The evidence is consistent with all intended proximal outcomes AI competency increased with a moderate-to-large effect, green-skills understanding increased with a large effect, and post-training green-skills understanding (but not AI competency) showed a positive association with portfolio quality. These results indicate that the program moved teachers beyond awareness to implemented, rubric-aligned designs, which is central to TVET's mandate to embed sustainability in everyday instruction (e.g., curriculum mapping, deep-learning tasks, authentic assessment). The pattern also coheres with contemporary TVET and green-skills literature that emphasizes structured alignment between outcomes, tasks, and assessment as the key driver of instructional quality (Pavlova, 2016; Handayani et al., 2020; ILO, 2021; UNESCO-UNEVOC, 2022).

The increase in AI competency scores indicates that the combination of concept exposure, ethical demonstrations, and structured prompting practices effectively built teachers' initial fluency in utilizing AI. Theoretically, this is consistent with the idea of scaffolded practice guided practice on relevant tasks (prompt formulation–iteration, verification, citation) accelerates the formation of procedural knowledge (Saks et al., 2021). However, the AI competency domains measured were relatively broad (conceptual understanding, pedagogical integration, assessment, ethics/privacy, security), so the short duration of the intervention likely resulted in gains "scattered" across multiple aspects rather than a large spike in one aspect. In other words, this training was effective as a "starting dose" for AI literacy, but conversion to advanced proficiency typically requires repeated cycles of application–feedback–revision. Therefore, a much more relevant guide is needed for teachers to design lesson plans using AI (Liu et al., 2024).

The significant effect on green skills understanding shows that the strategy of integrating LO mapping to green skills domains with authentic contexts (e.g., waste management, energy efficiency) and deep learning tasks strengthens teachers' conceptual schemes. From the perspective of situated cognition and constructive alignment, the presentation of contextual examples, the LO to Green Skills matrix, and authentic assessments help teachers see the "red thread" between outcomes–activities–assessments. Teachers engaged more readily with concrete, context-rich exemplars than with abstract theory. This is in line with Trajkovski & Braun (2023) that worked examples reduced extraneous load, accelerated schema formation, and made transfer to their own subjects faster. Co-creation of lesson plans and peer review serve as elaboration and knowledge consolidation, so that understanding is not merely declarative but begins to be operational made it easily projected into learning designs.

The average lesson plan quality score with a narrow distribution indicates two things at once: (i) most participants were able to meet the basic criteria of the GREEN rubric (LO to GS linking, contextualization, deep learning tasks, authentic assessment, AI ethics), and (ii) a range restriction/ceiling effect occurred in the product assessment. Methodologically, this narrowing of the distribution is common in post-training assessments that use structured templates/worksheets, scaffolding facilitates the achievement of minimum standards but limits the scope for differentiation of advanced performance (Linds & Gee, 2023). The relatively homogeneous high scores may also be influenced by the immediate timing of the assessment (no repeat classroom testing), so that the emerging quality dimensions only reflect design readiness, not classroom robustness.

The positive correlation between post-training green skills understanding and lesson plan quality confirms the central role of a "green mindset" as a proximate driver of design quality (Kleinhans & Cattell, 2023). Within the framework of constructive alignment, teachers who are more familiar with mapping GS domains to objectives, activities, and assessment evidence tend to produce more coherent and meaningful designs. The scientific mechanism is simple, a strong conceptual schema reduces extraneous load during design, focusing cognitive resources on the selection of relevant activities, measurable sustainability indicators, and authentic assessment design (Lavrsen & Daalhuizen, 2024).

The lack of a significant correlation between post-training AI competency and lesson plan quality can be explained by three factors. First, construct misalignment, AI competency measures cover a broad spectrum (ethics, privacy, AI-assisted assessment) that do not all contribute directly to product rubric items. Without a sharp GS mapping, "fluent" AI output does not automatically translate into good design. Teachers need a structured, task-specific AI prompting guide aligned to green-skills design requirements. Second, transfer requires time and iteration. A single training session improves ideation/drafting efficiency, but it requires an enactment-feedback-revision cycle to impact rubric-assessed quality. A well-designed prompting guide can accelerate this transfer by standardizing revision prompts, verification steps, and reflection prompts that help teachers iterate beyond "first drafts.". The effects of AI on quality tend to only become apparent after repeated classroom practice. Third, statistical effects showed a very narrow distribution of portfolio scores (ceiling effect) mechanically minimizes any correlations, including with AI competency, making even small, tangible relationships difficult to detect. Despite this, AI has proven capable of helping improve the quality and content creation of teaching materials (Arcet, 2025). However, the integration of green skills still depends on teachers' mindsets about green skills. Therefore, it is necessary to select a more specific AI competency framework in prompting green skills-oriented learning.

Practical implications

These findings suggest an operational pathway for moving teachers from "green" awareness to a design ready for implementation: strengthen the green skills scheme first, then use AI as a force multiplier through prompting aligned with the rubric (objectives–context–deep learning tasks–assessment–verification). The practical benefit is the availability of a community service model that produces measurable and actionable artifacts (matrices, lesson plans, prompt logs). Results indicate that programs should not stop at "how to use AI," but should provide a structured prompting guide that is (i) task-specific (goal-setting prompts, context/authenticity prompts, deep-learning task prompts, assessment/rubric prompts, verification/citation prompts), (ii) explicitly linked to GREEN-aligned rubric items, and (iii) designed for iterative improvement.
Further program development needs to be expanded rubric and AI literacy skills to prevent ceiling effects (e.g., assessing structured cross-subject integration, industry/community networking, use of environmental impact data, and classroom M&E plans) and incorporate micro-coaching cycles to ensure AI fluency translates into quality products.

Limitation and Future Direction

The generalizability of the findings is limited by a single site and sample size, immediate post-training assessment, and indications of non-normality and narrow dispersion in outcomes. Future studies should replicate across schools/districts with a quasi-experimental design, add a delayed posttest (+6-8 weeks), employ multiple assessments (ICC), and, where possible, Rasch calibration for conceptual instruments. Analytically, robust/quantile regression can address non-normality, and moderation/mediation models can test mechanisms whether GREEN-aligned prompting competence (rather than broad AI competence) mediates or moderates the pathway from green-skills understanding to lesson-plan quality. This will clarify how prompting guidance converts conceptual understanding into implementable design quality and supports scale-up of AI-assisted, green-skills-oriented vocational pedagogy.

CONCLUSION

This community service program effectively shifted teachers from mere awareness to implemented learning design: AI competency increased moderately to significantly (d≈0.58) and understanding of green skills increased significantly, while the quality of lesson plan portfolios was high on average. However, the sharpness of green skills mapping was the most predictive of quality, emphasizing the principle of constructive alignment: concept first, tools second. The absence of a direct AI competence and lesson plan quality relationship can be explained by the ceiling effect of product assessment and the need for gradual transfer (enactment–feedback–revision) for prompting fluency to convert into design quality. Consequently, training needs to prioritize green skills schemes, link them to task-specific AI prompting, connect them to task-specific AI prompting guidance, expand the rubric headroom at the “advanced” level, and add coaching cycles for sustained impact. Practically, these findings provide an operational roadmap for schools and departments to strengthen green skills schemes, use AI as a force multiplier, and nurture improvements through iterative cycles until the quality of green learning is truly institutionalized.

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